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Promoting aerobic physical activity of adolescents aged 12 to 16 years old during after-school hours using mobile applications: a critical review

Fomento del trabajo cardiorrespiratorio en adolescentes de 12 a 16 años durante el horario extraescolar mediante aplicaciones móviles: una revisión crítica

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Abstract

The decrease in physical activity during adolescence, together with the increase in screen time, has led to the search for alternatives for maintaining an active lifestyle that provides physical and psychological benefits to this population. Thus, mobile phones, and more specifically mobile applications for physical activity, have acquired greater prominence in recent years. However, some aspects need to be considered when using mobile applications to obtain improvements in the level of activity that produce changes in the fitness and body composition of adolescents. First, the scope of use of the mobile apps (at school or out-of-school); second, the academic year or age of the subjects; third, gender; fourth, the volume of training completed with the mobile apps; and fifth, the mobile app selected to carry out the intervention. The practical applications of all of the above in terms of the use of mobile applications in adolescents are discussed, and conclusions are made with aspects that should be taken into consideration in future research.

Key words: Physical activity, adolescents, mobile apps, body composition, physical fitness.

Resumen

La disminución de la actividad física durante la adolescencia, unida al incremento del tiempo de pantalla, ha obligado a la búsqueda de alternativas para el mantenimiento de un estilo de vida activo que permita obtener beneficios físicos y psicológicos en esta población. Así, los teléfonos móviles, y más concretamente las aplicaciones móviles de actividad física, han adquirido un mayor protagonismo en los últimos años. Sin embargo, es necesario considerar algunos aspectos cuando se utilizan aplicaciones móviles para obtener mejoras en el nivel de actividad que produzcan cambios en la condición física y la composición corporal de los adolescentes. En primer lugar, el ámbito de utilización de las aplicaciones móviles (escolar o extraescolar); en segundo lugar, el curso académico o la edad de los sujetos; en tercer lugar, el género; en cuarto lugar, el volumen de entrenamiento completado con las aplicaciones móviles; y, en quinto lugar, la aplicación móvil seleccionada para llevar a cabo la intervención. Se discuten las aplicaciones prácticas de todo lo anterior en cuanto al uso de aplicaciones móviles en adolescentes, y se finaliza con los aspectos que deben tenerse en consideración en futuras investigaciones.

Palabras clave: Actividad física, adolescentes, aplicaciones móviles, composición corporal, condición física.

Introduction

The practice of physical activity is fundamental during adolescence, due to its capacity to treat and prevent different chronic diseases (Alvarez-Pitti et al., 2020). This makes it possible to reduce the healthcare costs derived from the treatment of these pathologies at this and later stages of life (Hall et al., 2021; Santos et al., 2023). Furthermore, it should be noted that adolescence is one of the fundamental stages for the establishment of healthy lifestyle habits, and in the case of physical activity, an active adolescent is more likely to become an active adult (Telama et al., 2005).

For all the above reasons, the practice of physical activity becomes a healthy habit, whose acquisition is fundamental during puberty (Mateo-Orcajada, González-Gálvez, et al., 2022). Active adolescents have a healthier body composition, physical condition and/or psychological state as compared to inactive adolescents (Mateo-Orcajada, González-Gálvez, et al., 2022). Despite the above, previous research has shown a drastic decrease in the practice of physical activity in this population, which has reached historical minimum values (Guthold et al., 2020). Thus, it has been observed that at most 29% of adolescents across Europe reach the minimum recommendations of the World Health Organization (WHO) to be considered active (Steene-Johannessen et al., 2020), including 60 minutes of moderate intensity cardiorespiratory work at least five days per week; or vigorous intensity cardiorespiratory work at least 3 days, at a rate of 20 minutes per day; or strength training at least 3 days per week (Chaput et al., 2020). Therefore, a large percentage of adolescents are currently considered inactive (80%) (van Sluijs et al., 2021). In addition, it should be mentioned that 37% spend more than three hours sitting outside the school environment, and are therefore considered sedentary (Pechtl et al., 2022).

This decrease in the practice of physical activity has had negative consequences on the health of adolescents, including a higher prevalence of chronic diseases during adolescence (Kallio et al., 2021), an increase in overweight and obesity rates at this stage and in the future, a decrease in physical fitness (Gualdi-Russo et al., 2020; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2022), and a higher rate of psychological affectations (Uddin et al., 2020).

For this reason, the promotion of physical activity in this population has become a critical necessity, even more so after the COVID-19 pandemic, in which physical activity was made impossible, at the same time that adolescent screen time increased (Bates et al., 2020; Castañeda-Babarro et al., 2020; Dubuc et al., 2021).

However, new technologies, and specifically mobile applications, have provided interesting possibilities for the promotion of healthy habits among adolescents, as they can be useful in promoting physical activity and the maintenance of an adequate diet (Kim & Seo, 2020; Villasana et al., 2020).

Use of physical activity mobile applications of adolescents aged twelve to sixteen years old

Among the electronic devices most used by the adolescent population, the cell phone stands out. Between the ages of 12 and 16, adolescents acquire their first mobile device on which they invest numerous hours a day. This is detrimental to their health, as their use is generally excessive in terms of duration (Hirsh-Yechezkel et al., 2019; Martinotti et al., 2011), and inadequate in terms of mobile applications used and websites visited, favoring unhealthy behaviors (Nikhita, 2015). However, mobile devices also present an opportunity, as shown by previous research that used mobile devices as a health promotion tool in adolescents, to educate them on the use of physical activity mobile applications (Vega-Ramírez et al., 2020), providing healthy alternatives to the most downloaded applications in this population, such as TikTok, Instagram, Facebook, WhatsApp or Twitter (Sarman & Tuncay, 2023).

However, the use of mobile physical activity applications has not shown the expected benefits in this population, and they are considered to be one of the least effective electronic media for increasing the physical activity practiced, as compared to wearables or interventions through webpages (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c). This is because mobile applications have not been shown to be effective in increasing the number of daily steps or moderate to vigorous intensity physical activity, making it impossible to achieve changes in body composition and physical fitness in this population (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c), questioning their validity as instruments for promoting physical activity.

Different areas of use of mobile applications with teenagers

One of the main aspects to be considered in the use of mobile applications with adolescents is the scope of their use. Previous research has provided two completely differentiated application settings, within the school (Zhu & Dragon, 2016) and outside of school field (Gil-Espinosa et al., 2020; Seah & Koh, 2021). Regarding the within the school setting, previous research has not shown significant improvements in the level of physical activity following the use of mobile apps during physical education class hours (Zhu & Dragon, 2016). This is perhaps because the mobile applications that are currently available on the market are not designed to be used within educational centers, finding limitations in their integration within physical education classes by teachers (Alonso-Fernández et al., 2022). In addition, these devices lack evaluation systems that facilitate their use by teachers in the subject of physical education, so they are not considered a simple and viable resource for use with adolescents.

As for the out-of-school setting, the results found have not allowed us to draw accurate conclusions on the

effectiveness of their use in this population. This is due to the fact that the research designs proposed have important limitations (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c), with the mobile applications being used in reduced time periods, such as weekends (Seah & Koh, 2021); and the small sample sizes (n < 150) (Gil-Espinosa et al., 2020) or that they include only a homogeneous sample in terms of gender (Seah & Koh, 2021), which makes it difficult to extrapolate the data to other populations. Based on these limitations, the results found in previous research show slight increases in the number of daily steps (Seah & Koh, 2021) and in the level of physical activity (Gil-Espinosa et al., 2020), with minimal improvements obtained with the extracurricular use of mobile applications.

In view of the limitations found with the use of mobile applications at school and in out-of-school settings individually, recent research has attempted to combine both settings to increase the benefits obtained (Mateo-Orcajada, Abenza-Cano, et al., 2023; Mateo-Orcajada et al., 2024; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a). Thus, the mobile applications have been used outside school hours by the adolescents, but the teachers were responsible for promoting and encouraging their use from the school setting, through the subject of physical education (Mateo-Orcajada, Abenza-Cano, et al., 2023), providing direct rewards as part of the grade of the subject to the adolescents who used these devices to increase their practice of physical activity. The results found were encouraging, as improvements were obtained in the level of physical activity, as well as in the body composition and physical condition of the adolescents. Thus, there was an increase in muscle mass and a decrease in fat mass in adolescents who used the mobile applications, as compared to those who did not use them (Mateo-Orcajada, Abenza-Cano, et al., 2023). Similarly, these adolescents showed improvements in abdominal muscle strength and endurance, greater jump height, and greater cardiorespiratory capacity, at the end of the intervention (Mateo-Orcajada et al., 2024; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

Despite the benefits obtained with mobile applications in out-of-school hours when their use was promoted from the subject of physical education, interventions with mobile applications have a relevant handicap, which is the lack of adherence of adolescents (He et al., 2021; van de Kop et al., 2019). Thus, previous research has shown that in the first two weeks of intervention, a high percentage of adolescents complied with the proposed training volume (Mateo-Orcajada et al., 2024). However, after the third week, adolescents stopped using the mobile applications (He et al., 2021), regardless of whether their use was rewarded in the physical education subject. Thus, few adolescents followed the proposed interventions in the long term (Mateo-Orcajada et al., 2024), so that the benefits obtained during the first weeks are lost as the weeks go by, and the interventions are not successful in changing the actual behavior of the adolescents.

Aspects to consider in the use of mobile applications with adolescents

To try to increase adherence and the success of interventions with mobile applications, scientific research carried out in recent years has established some criteria to be taken into consideration for the use of these devices with adolescents aged twelve to sixteen years.

Firstly, the age and academic year of the adolescents seems to be relevant, as adolescents in higher academic years (4th year of Compulsory Secondary Education) use mobile applications to a greater extent than adolescents in lower years (1st and 2nd year of Compulsory Secondary Education). This increase in the use of mobile applications is reflected in a greater decrease in fat mass and a greater increase in muscle mass in these adolescents (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

Secondly, the gender of adolescents seems to be a determinant factor, as adolescent girls use mobile applications to a greater extent than boys (Hirsh-Yechezkel et al., 2019). Given that boys tend to practice more physical activity than girls during adolescence, especially in the competitive arena (Mateo-Orcajada et al., 2021), mobile applications could be a very valid resource to increase physical activity in girls, a population that is sensitive to remaining inactive in these stages. Some of the benefits obtained with the use of these devices in girls would be the decrease in fat mass and increased performance in physical fitness tests (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

Thirdly, the volume of training completed is a key factor in the benefits found (Mateo-Orcajada et al., 2024). Even though most adolescents did not complete 100% of the target distance in the interventions with mobile apps, many of the participants completed a high percentage. Thus, previous research has shown that adolescents who complete a higher volume of training using mobile applications have greater benefits in the level of physical activity practiced, in abdominal strength and endurance, and in the decrease in fat percentage, regardless of gender (Mateo-Orcajada et al., 2024). However, this research has also shown that the volume of training completed may not be the only determining variable for obtaining benefits, and future research is needed to address the intensity and type of training performed.

And, fourthly, the mobile application used during the intervention (Mateo-Orcajada, Abenza-Cano, et al., 2023; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023b). Most previous scientific research has opted towards the use of mobile applications available on the market, which are useful for recording the physical activity performed. However, few studies have analyzed the differences in the benefits obtained with different mobile applications. In this regard, Mateo-Orcajada et al. (2023) found that mobile apps such as Strava, Pacer, MapMyWalk or Pokémon Go were useful for achieving changes in body composition

and physical fitness, but there were significant differences depending on the mobile app used by the adolescents. Moreover, within gamified mobile applications, as is the case of Pokémon Go, the benefits were different for adolescents depending on whether this application was used in an immersive or non-immersive manner, as the physical activity practiced was intermittent or continuous, respectively, which affected the increase in total physical activity practiced and the body composition of adolescents (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023b). This opens a wide range of possibilities regarding the ways in which mobile applications can be used with the adolescents.

Practical implications of the above and future perspectives of working with mobile applications and adolescents

To increase the chances of success with the use of mobile applications for the practice of physical activity with adolescents aged 12 to 16 years, these devices should be used by adolescents in the out-of-school setting, but accompanied by the promotion from the school setting by physical education teachers.

Furthermore, to use these devices with adolescents, it is necessary to take into consideration aspects such as academic year, gender, volume and intensity of the training performed, as well as the mobile applications selected, since these seem to be determining aspects with respect to the benefits obtained and the level of adherence to the program.

Despite the progress made in recent years in the use of mobile applications with adolescents, there are still pending issues for these devices to become a real complement to physical education classes that will increase the physical practice time of this population. Thus, some of the aspects that need to be solved would be: 1) that the mobile applications used are designed specifically for this purpose, being useful so that teachers can integrate them into the subject of physical education and use them during its evaluation phase; 2) that the mobile applications take into consideration the requirements and needs of adolescents, as this would facilitate greater adherence to the use of these devices; 3) that their use is established within the subject of physical education as homework, granting importance to mobile applications from the time adolescents begin the stage of Compulsory Secondary Education until they finish it; 4) to assess the possibility of combining the intervention with mobile physical activity applications with other devices such as wearables, as this could increase adherence and the effectiveness of the intervention; 5) not to only use mobile applications aimed at improving cardiorespiratory capacity, since adolescents who already practice aerobic physical activity, or those who do not show interest in this type of physical activity, will be more likely interested in this type of physical activity; and 6) that future research should analyze the sociocultural context of adolescents in the use of mobile applications, as this could be a determining factor in the effectiveness achieved. Thus, these interventions should not consider mobile applications as an individual and isolated resource that momentarily serves the adolescent to practice more physical activity, but rather that these devices should be integrated into their lifestyle and maintained over time. To this end, their use can be complementary to other interventions in which adolescents are already involved, or they can include their immediate environment (family and friends) so that they can be more easily maintained over time. In this way, not only will the adolescent be influenced, but a paradigm shift is pursued in which all the agents around the adolescent are educated about the importance of physical activity in this and later stages of life. From there on, the adolescent will be provided with a resource that allows him/her to be active throughout his/her life, not only during the educational stage where the use of mobile applications is mandatory and encouraged from the subject of physical education. In view of this, the main recommendation when carrying out interventions with electronic devices and adolescents is to take into consideration that the starting point is a minimum level of understanding of adolescents and their environment about the importance of physical activity for health, which requires a process of education and training in which these devices are not thought of as an end for adolescents to be active, but rather as a means. To achieve this objective, interventions should not only focus on adolescents increasing their physical activity for the duration of the program, regardless of whether they return to baseline levels when it ends, as this will not succeed in establishing this healthy habit. Instead, these programs should go further and provide adolescents with a tool that allows them to practice physical activity when school physical education class is no longer compulsory, making mobile applications a useful resource for the adolescent population that can be used early on for the quantification and planning of their training.

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Fomento del trabajo cardiorrespiratorio en adolescentes de 12 a 16 años durante el horario extraescolar mediante aplicaciones móviles: una revisión crítica

Promoting aerobic physical activity in adolescents aged 12 to 16 years old during after-school hours using mobile applications: a critical review

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Resumen

La disminución de la actividad física durante la adolescencia, unida al incremento del tiempo de pantalla, ha obligado a la búsqueda de alternativas para el mantenimiento de un estilo de vida activo que permita obtener beneficios físicos y psicológicos en esta población. Así, los teléfonos móviles, y más concretamente las aplicaciones móviles de actividad física, han adquirido un mayor protagonismo en los últimos años. Sin embargo, es necesario considerar algunos aspectos cuando se utilizan aplicaciones móviles para obtener mejoras en el nivel de actividad que produzcan cambios en la condición física y la composición corporal de los adolescentes. En primer lugar, el ámbito de utilización de las aplicaciones móviles (escolar o extraescolar); en segundo lugar, el curso académico o la edad de los sujetos; en tercer lugar, el género; en cuarto lugar, el volumen de entrenamiento completado con las aplicaciones móviles; y, en quinto lugar, la aplicación móvil seleccionada para llevar a cabo la intervención. Se discuten las aplicaciones prácticas de todo lo anterior en cuanto al uso de aplicaciones móviles en adolescentes, y se finaliza con los aspectos que deben tenerse en consideración en futuras investigaciones.

Palabras clave: Actividad física, adolescentes, aplicaciones móviles, composición corporal, condición física.

Abstract

The decrease in physical activity during adolescence, together with the increase in screen time, has led to the search for alternatives for maintaining an active lifestyle that allows physical and psychological benefits to be obtained in this population. Thus, mobile phones, and more specifically mobile applications for physical activity, have acquired greater prominence in recent years. However, some aspects need to be considered when using mobile applications to obtain improvements in the level of activity that produce changes in the fitness and body composition of adolescents. First, the scope of use of the mobile apps (school or out-of-school); second, the academic year or age of the subjects; third, gender; fourth, the volume of training completed with the mobile apps; and fifth, the mobile app selected to carry out the intervention. The practical applications of all of the above in terms of the use of mobile applications in adolescents are discussed and conclude with aspects that should be taken into consideration in future research.

Key words: Physical activity, adolescents, mobile apps, body composition, physical fitness.

Introducción

La práctica de actividad física es fundamental durante la adolescencia debido a la capacidad que presenta para tratar y prevenir diferentes enfermedades crónicas (Alvarez-Pitti et al., 2020). Esto posibilita la disminución del coste sanitario derivado al tratamiento de estas patologías durante esta y posteriores etapas de la vida (Hall et al., 2021; Santos et al., 2023). Además, cabe destacar que la adolescencia es una de las etapas fundamentales para el establecimiento de hábitos de vida saludables, y en el caso de la actividad física un adolescente activo tiene mayor probabilidad de convertirse en un adulto activo (Telama et al., 2005).

Por todo lo anterior, la práctica de actividad física se convierte en un hábito saludable cuya adquisición es fundamental durante la pubertad (Mateo-Orcajada, González-Gálvez, et al., 2022). Los adolescentes activos presentan una composición corporal, condición física y/o estado psicológico más saludable en comparación con los inactivos (Mateo-Orcajada, González-Gálvez, et al., 2022). A pesar de todo, investigaciones previas han mostrado una disminución drástica de la práctica de actividad física de esta población, alcanzando valores mínimos históricos (Guthold et al., 2020). Así, se ha observado que como máximo un 29% de los adolescentes de toda Europa alcanzan las recomendaciones mínimas de la Organización Mundial de la Salud (OMS) para ser considerados como activos (Steene-Johannessen et al., 2020), incluyendo estos 60 minutos de trabajo cardiorrespiratorio de intensidad moderada al menos cinco días por semana; o trabajo cardiorrespiratorio de intensidad vigorosa al menos 3 días, a razón de 20 minutos por día; o de fuerza al menos 3 días a la semana (Chaput et al., 2020). Por tanto, actualmente un gran porcentaje de los adolescentes son considerados como inactivos (80%) (van Sluijs et al., 2021). Además, hay que añadir que un 37% pasa más de tres horas sentado fuera del ámbito escolar, siendo considerados además como sedentarios (Pechtl et al., 2022).

Esta disminución de la práctica de actividad física ha producido consecuencias negativas sobre la salud de los adolescentes, entre las que destaca una mayor prevalencia de enfermedades crónicas durante la adolescencia (Kallio et al., 2021), un aumento de los índices de sobrepeso y obesidad en esta etapa y futuras, una disminución de la condición física (Gualdi-Russo et al., 2020; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2022), así como una mayor tasa de afectaciones psicológicas (Uddin et al., 2020).

Por este motivo, la promoción de la actividad física en esta población se ha convertido en una necesidad, más aún si cabe tras la pandemia de COVID-19 en la que se imposibilitó la práctica de actividad física y aumentó el tiempo de pantalla de los adolescentes (Bates et al., 2020; Castañeda-Babarro et al., 2020; Dubuc et al., 2021).

Sin embargo, las nuevas tecnologías y específicamente las aplicaciones móviles también son una posibilidad para la promoción de hábitos saludables entre los adolescentes, pudiendo ser útiles en la promoción de la actividad física y el mantenimiento de una adecuada alimentación (Kim & Seo, 2020; Villasana et al., 2020).

Uso de aplicaciones móviles de actividad física en adolescentes de doce a dieciséis años

Entre los dispositivos electrónicos más utilizados por la población adolescente destaca el teléfono móvil. Entre los 12 y 16 años los adolescentes adquieren su primer dispositivo móvil en el que invierten numerosas horas al día. Esto conlleva perjuicios para su salud debido a que generalmente su uso es excesivo en cuanto a duración (Hirsh-Yechezkel et al., 2019; Martinotti et al., 2011), e inadecuado en cuanto a las aplicaciones móviles utilizadas y los sitios web visitados, favoreciendo comportamientos poco saludables (Nikhita, 2015). Sin embargo, los dispositivos móviles también presentan una oportunidad, habiendo investigaciones previas que han tratado de utilizar los dispositivos móviles como instrumento de promoción de la salud en adolescentes, educando a estos para el uso de aplicaciones móviles de actividad física (Vega-Ramírez et al., 2020), aportando alternativas saludables a las aplicaciones más descargadas en esta población como son Tiktok, Instagram, Facebook, WhatsApp o Twitter (Sarman & Tuncay, 2023).

Sin embargo, el uso de aplicaciones móviles de actividad física no ha mostrado los beneficios esperados en esta población, llegando a ser consideradas como uno de los medios electrónicos menos eficaces para aumentar la actividad física practicada, en comparación con los wearables o las intervenciones mediante páginas web (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c). Esto se debe a que las aplicaciones móviles no han mostrado ser efectivas para incrementar el número de pasos diarios, ni la actividad física de intensidad moderada a vigorosa, imposibilitando la consecución de cambios en la composición corporal y la condición física de esta población (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c), cuestionándose su validez como instrumentos de promoción de la actividad física.

Diferentes ámbitos de uso de las aplicaciones móviles con adolescentes

Uno de los principales aspectos a tener en cuenta en el uso de las aplicaciones móviles en adolescentes es el ámbito de utilización de las mismas. Investigaciones previas han aportado dos ámbitos de aplicación totalmente diferenciados, el ámbito escolar (Zhu & Dragon, 2016) y el ámbito extraescolar (Gil-Espinosa et al., 2020; Seah & Koh, 2021). Respecto al ámbito escolar, las investigaciones previas no han mostrado mejoras significativas del nivel de actividad física tras el uso de aplicaciones móviles en las horas lectivas de educación física (Zhu & Dragon, 2016). Esto se debe probablemente a que las aplicaciones móviles disponibles actualmente en el mercado no están diseñadas para su uso dentro de los centros educativos, hallándose limitaciones

para su integración dentro de las clases de educación física por parte de los docentes (Alonso-Fernández et al., 2022). Además, estos dispositivos carecen de sistemas de evaluación que faciliten a los docentes su uso en la asignatura de educación física, por lo que no se consideran un recurso sencillo y viable de utilizar con los adolescentes.

En cuanto al ámbito extraescolar, los resultados hallados no han permitido extraer una conclusión certera sobre la efectividad de su uso en esta población. Esto se debe a que los diseños de investigación planteados cuentan con limitaciones importantes (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023c), siendo las aplicaciones móviles utilizadas en periodos de tiempo reducidos, como los fines de semana (Seah & Koh, 2021); y los tamaños muestrales pequeños (n < 150) (Gil-Espinosa et al., 2020) o que incluyen únicamente a una muestra homogénea en cuanto a género (Seah & Koh, 2021), lo que dificulta la extrapolación de los datos a otras poblaciones. En base a estas limitaciones, los resultados hallados en investigaciones previas muestran incrementos leves en el número de pasos diarios (Seah & Koh, 2021) y en el nivel de actividad física (Gil-Espinosa et al., 2020), siendo mínimas las mejoras obtenidas con el uso extraescolar de las aplicaciones móviles.

Atendiendo a las limitaciones halladas con el uso de las aplicaciones móviles en los ámbitos escolar y extraescolar de forma individual, investigaciones recientes han tratado de combinar ambos ámbitos de actuación para aumentar los beneficios obtenidos (Mateo-Orcajada, Abenza-Cano, et al., 2023; Mateo-Orcajada et al., 2024; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a). Así, las aplicaciones móviles fueron utilizadas en horario extraescolar por parte de los adolescentes, pero los docentes se encargaron de promocionar e incentivar su uso desde el ámbito escolar mediante la asignatura de educación física (Mateo-Orcajada, Abenza-Cano, et al., 2023), aportando recompensas directas en la calificación de la asignatura a los adolescentes que utilizaron estos dispositivos para incrementar su práctica de actividad física. Los resultados hallados fueron alentadores ya que se obtuvieron mejoras en el nivel de actividad física, así como en la composición corporal y la condición física de los adolescentes. Así, se produjo un aumento de la masa muscular y una disminución de la masa grasa en los adolescentes que utilizaban las aplicaciones móviles, en comparación con los que no las usaron (Mateo-Orcajada, Abenza-Cano, et al., 2023). Del mismo modo, estos adolescentes presentaron mejoras en la fuerza y resistencia de la musculatura abdominal, mayor altura de salto y mayor capacidad cardiorrespiratoria al finalizar la intervención (Mateo-Orcajada et al., 2024; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

A pesar de los beneficios obtenidos con las aplicaciones móviles en horario extraescolar cuando se promocionó su uso desde la asignatura de educación física, las intervenciones con aplicaciones móviles cuentan con un hándicap relevante, y es la falta de adherencia de los adolescentes (He et al., 2021; van de Kop et al., 2019). Así, investigaciones previas han mostrado que en las dos primeras semanas de intervención un porcentaje elevado de adolescentes cumple con el volumen de entrenamiento propuesto (Mateo-Orcajada et al., 2024). Sin embargo, a partir de la tercera semana, los adolescentes dejan de utilizar las aplicaciones móviles (He et al., 2021), independientemente de que su uso sea recompensado desde la asignatura de educación física. De este modo, son pocos los adolescentes que siguen a largo plazo las intervenciones planteadas (Mateo-Orcajada et al., 2024), por lo que los beneficios obtenidos durante las primeras semanas se pierden con el paso de las semanas y las intervenciones carecen de éxito en el cambio real de conductas de los adolescentes.

Aspectos a considerar en el uso de aplicaciones móviles con adolescentes

Para tratar de aumentar la adherencia y el éxito de las intervenciones con aplicaciones móviles, las investigaciones científicas llevadas a cabo en los últimos años han establecido algunos criterios que deben tenerse en consideración para la utilización de estos dispositivos en adolescentes de doce a dieciséis años.

En primer lugar, la edad y el curso académico de los adolescentes parece ser relevante ya que los adolescentes en los cursos académicos más altos (4º de Educación Secundaria Obligatoria) utilizan las aplicaciones móviles en mayor medida que los adolescentes de cursos más bajos (1º y 2º de Educación Secundaria Obligatoria). Este incremento en el uso de las aplicaciones móviles se ve reflejado en una mayor disminución de la masa grasa y un mayor incremento de la muscular de estos adolescentes (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

En segundo lugar, el género de los adolescentes parece ser determinante, ya que las chicas adolescentes utilizan las aplicaciones móviles en mayor medida que los chicos (Hirsh-Yechezkel et al., 2019). Dado que los chicos tienden a practicar mayor actividad física que las chicas durante la adolescencia, especialmente en el ámbito competitivo (Mateo-Orcajada et al., 2021), las aplicaciones móviles podrían ser un recurso muy válido para aumentar la actividad física de las chicas, población sensible a permanecer en inactividad en estas etapas. Algunos de los beneficios obtenidos con el uso de estos dispositivos en las chicas sería la disminución de la masa grasa y el aumento del rendimiento en las pruebas de condición física (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023a).

En tercer lugar, el volumen de entrenamiento completado es un factor clave en los beneficios encontrados (Mateo-Orcajada et al., 2024). A pesar de que en las intervenciones con aplicaciones móviles la mayor parte de los adolescentes no completan el 100% de la distancia planteada, muchos de los participantes cumplimentan un alto porcentaje. Así, investigaciones previas han mostrado que los adolescentes que cumplimentan un mayor volumen de

entrenamiento mediante las aplicaciones móviles presentan mayores beneficios en el nivel de actividad física practicado, en la fuerza y resistencia abdominal y en la disminución del porcentaje de grasa, independientemente del género (Mateo-Orcajada et al., 2024). No obstante, estas investigaciones también han mostrado como el volumen de entrenamiento completado podría no ser la única variable determinante para obtener beneficios, siendo necesarias investigaciones futuras que atiendan a la intensidad y al tipo de entrenamiento realizado.

Y, en cuarto lugar, la aplicación móvil utilizada durante la intervención (Mateo-Orcajada, Abenza-Cano, et al., 2023; Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023b). La mayoría de las investigaciones científicas previas han optado por la utilización de aplicaciones móviles disponibles en el mercado, siendo estas útiles para el registro de la actividad física realizada. Sin embargo, son pocos los estudios que han analizado las diferencias en los beneficios obtenidos con diferentes aplicaciones móviles. A este respecto, Mateo-Orcajada et al. (2023) hallaron que aplicaciones móviles como Strava, Pacer, MapMyWalk o Pokémon Go eran útiles para conseguir cambios en la composición corporal y la condición física, pero había diferencias significativas en función de la aplicación móvil utilizada por los adolescentes. Además, dentro de las aplicaciones móviles gamificadas, como es el caso de Pokémon Go, los beneficios eran diferentes para los adolescentes según se utilizase esta aplicación de manera inmersiva o no inmersiva ya que la actividad física practicada era intermitente o continua, respectivamente, lo que afectaba al incremento de la actividad física total practicada y a la composición corporal de los adolescentes (Mateo-Orcajada, Vaquero-Cristóbal, et al., 2023b). Esto abre un amplio abanico de posibilidades en cuanto a las formas de uso de las aplicaciones móviles con la población adolescente.

Implicaciones prácticas de todo lo anterior y perspectivas futuras de trabajo con aplicaciones móviles en adolescentes

Para aumentar las posibilidades de éxito con el uso de aplicaciones móviles para la práctica de actividad física en adolescentes de 12 a 16 años, estos dispositivos deberían ser utilizados por los adolescentes en el ámbito extraescolar, pero acompañados de una promoción desde el ámbito escolar por parte de los docentes de la materia de educación física.

Además, para usar estos dispositivos en adolescentes es necesario tener en consideración aspectos como el año académico, el género, el volumen e intensidad del entrenamiento realizado, así como las aplicaciones móviles seleccionadas, ya que parecen ser aspectos determinantes en los beneficios obtenidos y la adherencia generada al programa.

A pesar de los avances conseguidos en los últimos años en la utilización de aplicaciones móviles en adolescentes, aún quedan asignaturas pendientes para que estos dispositivos se conviertan en un complemento real a las clases de educación física que permitan aumentar el tiempo de práctica física de esta población. Así, algunos de los aspectos que necesitan ser solventados serían: 1) que las aplicaciones móviles utilizadas estén diseñadas específicamente para este fin, siendo útiles para que los docentes las puedan integrar en la asignatura de educación física y puedan utilizarlas en la evaluación de la misma; 2) que las aplicaciones móviles tengan en consideración los requerimientos y necesidades de los adolescentes, ya que facilitaría una mayor adherencia al uso de estos dispositivos; 3) que su uso se instaure dentro de la asignatura de educación física como deberes de la misma, otorgando importancia a las aplicaciones móviles desde que los adolescentes comienzan la etapa de Educación Secundaria Obligatoria hasta que la finalizan; 4) valorar la posibilidad de combinar la intervención con aplicaciones móviles de actividad física con otros dispositivos como las wearables, ya que podría aumentar la adherencia y la efectividad de la intervención; 5) no utilizar únicamente aplicaciones móviles destinadas a la mejora de la capacidad cardiorrespiratoria puesto que los adolescentes que ya practiquen actividades físicas aeróbicas, o los que no muestren interés por esta modalidad de entrenamiento, no las utilizarán. Por tanto, será necesario incluir alternativas para el entrenamiento de fuerza, flexibilidad o movilidad para que cada adolescente pueda realizar el entrenamiento que mejor se adapte a sus necesidades; y 6) que las investigaciones futuras analicen el contexto sociocultural de los adolescentes en la utilización de las aplicaciones móviles, ya que podría ser determinante en la efectividad conseguida. Así, estas intervenciones no deben considerar a las aplicaciones móviles como un recurso individual y aislado que sirva de forma momentánea al adolescente para practicar más actividad física, sino que estos dispositivos deben ser integrados en su estilo de vida y mantenerse en el tiempo. Para ello, su uso puede ser complementario a otras intervenciones en las que los adolescentes ya estén implicados, o pueden incluir a su entorno más cercano (familia y amigos) para que sean mantenidas en el tiempo con mayor facilidad. De esta forma no solo se influye sobre el adolescente, sino que se persigue un cambio de paradigma en el que todos los agentes que rodean al mismo son educados sobre la importancia que presenta la actividad física en esta y posteriores etapas de la vida. A partir de ahí, se aporta al adolescente un recurso que le permita ser activo a lo largo de su vida, no solo durante la etapa educativa donde el uso de las aplicaciones móviles es obligatorio e incentivado desde la asignatura de educación física. Atendiendo a esto, la principal recomendación cuando se lleven a cabo intervenciones con dispositivos electrónicos en adolescentes es tener en consideración que se parte de un nivel de comprensión mínimo por parte de estos y de su entorno de la importancia que presenta la práctica de actividad física para la salud, siendo necesario un proceso de educación y formación en el que estos dispositivos no sean vistos como un fin para

que los adolescentes sean activos, sino como un medio. Para conseguir este objetivo, las intervenciones no deben focalizarse en que los adolescentes aumenten la actividad física mientras dura la misma, sin importar que vuelvan a los niveles basales cuando finaliza, ya que no se conseguirá instaurar este hábito saludable. Estos programas deben ir más allá y poner a disposición de los adolescentes una herramienta que les permita practicar actividad física cuando la educación física escolar deja de ser obligatoria, convirtiéndose las aplicaciones móviles en un recurso útil para la población adolescente que puede ser utilizado en un futuro próximo para la cuantificación y planificación de su entrenamiento.

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Drop sets effects on maximum dynamic strength, jumping ability and acceleration in female basketball players

Efectos del entrenamiento de series descendentes sobre fuerza máxima dinámica, salto y aceleración en jugadoras de baloncesto

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Abstract

The aim of this research was to quantify the effects of the inclusion of drop set training (DS) on maximum dynamic strength (1RM) in back squat, jump ability (CMJ) and speed (10 m) in female basketball players. For this purpose, 25 participants (22.59 ± 3.73 years) of two amateur teams were examined in three times: initial assessment (T0), after six weeks of traditional lower limbs strength training without DS (T1), and after an additional six weeks incorporating DS training (T2). Only the performance in the CMJ test was significantly influenced by the training program (p = .001; ηp^2 = .376). Post-hoc test identified statistical differences from 1RM: T0-T1 (p = .001), T0-T2 (p = .001) and T1-T2 (p = .001). Differences were also identified in CMJ between T0-T1 (p = .001) and T0-T2 (p = .001), and in 10 m between T0 and T2 (p = .05). These results suggest that, despite the supposed low efficacy of DS training compared to traditional training in improving performance in jumping and acceleration capacities, both can be complementary within a training program, as the effects produced are maintained.

Key words: Team sport, training, female, sport performance, drop sets.

Resumen

El objetivo de esta investigación fue analizar los efectos del entrenamiento de series descendentes (DS) en fuerza máxima dinámica (1RM) en media sentadilla, capacidad de salto (CMJ) y capacidad de aceleración (10 m) en jugadoras amateur de baloncesto. Veinticinco jugadoras (22.59 ± 3.73 años) de dos equipos fueron evaluadas en tres ocasiones, siendo T0 la evaluación inicial, T1 la evaluación después de trabajar la musculatura de la extremidad inferior durante seis semanas con entrenamiento clásico de fuerza sin DS, y T2 después de otras seis semanas incluyendo DS. Únicamente el rendimiento en CMJ estuvo influenciado significativamente por el programa de entrenamiento (p = .001; ηp^2 = .376). Se encontraron diferencias significativas en 1RM comparando los tres tiempos: T0-T1 (p = .001), T0 con T2 (p = .001) y T1-T2 (p = .001). También hubo diferencias en CMJ entre T0-T1 (p = .001) y T0-T2 (p = .001), mientras que en 10 m únicamente entre T0-T2 (p = .05). Estos resultados sugieren que, a pesar de una supuesta poca eficacia del entrenamiento con DS respecto al entrenamiento tradicional en la mejora del rendimiento en acciones de salto y aceleración, ambos pueden ser complementarios dentro de una planificación al mantenerse los efectos producidos.

Palabras clave: Deporte de equipo, entrenamiento, mujer, rendimiento deportivo, drop sets.

Introduction

The practice of a specific sport is characterized by specific conditional demands on athletes. In basketball, these demands are primarily related to the application of explosive strength, which influences other capacities as it enables agility with and without the ball and speed over short distances (Delextrat & Cohen, 2008; Montgomery et al., 2010), in addition to performance in technical actions inherent to the game (Alsasua et al., 2022; Izquierdo et al., 2021). In this context, the literature confirms that the application of strength is essential for proper athletic performance in basketball (Chaouachi et al., 2009). Improving strength leads to an enhancement in the ability to accelerate (Ben Abdelkrim et al., 2006) and jump (Delextrat & Cohen, 2008; San Román-Quintana et al., 2012), crucial actions for performance due to their influence during the game.

Strength training prescription involves manipulating the components of the load (volume, frequency, duration, intensity and density) to achieve the intended muscular adaptations (Kraemer & Ratamess, 2004). In fact, alternating the manipulation of these load components is recommended to avoid potential stagnation in muscular adaptations (Krzysztofik et al., 2019). In this regard, it has been speculated that manipulating training volume and relative effort (proximity to muscular failure) may have a positive impact on various training adaptations, such as muscle hypertrophy (Schoenfeld et al., 2019). This is precisely the basis for the training technique known as drop sets (DS).

DS training involves performing a set of an exercise with a specific load until momentary muscle failure. After reaching failure, the load is reduced (± 20%) and additional repetitions are performed until a new point of muscle failure is reached (Angleri et al., 2020; Krzysztofik et al., 2019). DS training increases time under tension and training density (work per unit of time) (Coleman et al., 2022; Schoenfeld & Grgic, 2018), promoting a greater accumulation of metabolites and cellular inflammation, thus favoring the growth of muscle cross-sectional area, i.e., muscle hypertrophy (Schoenfeld & Grgic, 2018; Schoenfeld et al., 2019).

The muscular adaptations of the lower extremities promoted by DS training have been underexplored in athletes. University students showed significant increases in dynamic one-repetition maximum (1RM) in leg press through this method by performing five sets with loads at 50% of 1RM compared to a traditional single-set configuration (Goto et al., 2004). However, in bodybuilders, no significant differences were observed between DS training (two sets with a 20% load reduction) and traditional training (three to five sets of six to twelve repetitions with a two-minute rest interval between sets), despite both types of training promoted significant increases in muscle strength and hypertrophy (Angleri et al., 2017). Raeder et al. (2016) compared the effects of various training types, including DS training, over six days in soccer and handball players. Their results did not show significant improvements in jump capacity, and the authors suggested the need for a multi-day adaptation period to produce the necessary gains. Only one study has analyzed the effects of DS training in basketball players (Drinkwater et al., 2007). After a six-week training period with different DS training types (G1: 12x3; G2: 4x6 G3: 8x3; all with a 60% 1RM load), there were no significant differences between groups in muscle hypertrophy or 1RM. With these precedents, there is a significant gap in the scientific literature regarding the effect of DS training on jump capacity and acceleration ability in sports in general, and in basketball in particular.

This research may provide new evidence regarding a type of strength training that has not been sufficiently analyzed in female basketball players and its potential effects on crucial capacities such as dynamic maximum strength, jumping, and acceleration (Mancha-Triguero et al., 2020). Therefore, the objective of this study was to analyze the effects of incorporating DS training on the dynamic maximum strength of the lower extremities, jumping ability, and acceleration capacity in amateur female basketball players. Based on the available literature, it can be hypothesized that DS training may not increase the magnitude of neuromuscular effects produced by traditional strength training, but it might help to maintain the effects achieved with it.

Methods

Sample

Twenty-five players (age: 22.59 ± 3.73 years; body mass: 66.37 ± 8.21 kg; height: 170.13 ± 10.44 cm; federated experience: 10.45 ± 3.00 years) from two amateur senior teams of the same club participated in this study. Both teams competed at national and regional levels, respectively.

The inclusion criteria for the participants were as follows: a) age between 18 and 30 years; b) minimum relative strength in deep squat with a barbell of 1.25 times body mass; c) at least 2 years of experience in strength training; d) no consumption of creatine supplements, anti-inflammatory drugs, anabolic androgenic steroids or other substances that could affect muscular adaptations during the training period and 4 weeks before the study; and e) adherence to the assigned strength program three days a week throughout the intervention period. Sixty-eight percent (17 players) were assessed during the follicular phase of the menstrual cycle in one of the three measurable assessments, and 40% (10 players) used oral contraceptives.

This research was approved by the ethics committee of the corresponding University (ULE-022-2021). All procedures were conducted in accordance with the Helsinki Declaration. All participants were informed about

the aim and procedures and signed an informed consent before voluntarily participating in the study.

Design

The present study has a quasi-experimental design, as there is no control group, and all participants underwent the same intervention. The intervention took place over 14 weeks, starting in the first week of the competitive period after all players had completed a five-week preseason. The training load for both teams was relatively identical during both the preparatory and competitive periods: three weekly training sessions plus four friendly matches during the preparatory period, and three weekly training sessions plus one official league match every weekend during the competitive period. Furthermore, the planning and design regarding the load of training tasks and exercises were the same and carried out by the same individual (in the role of a fitness coach) for both teams, along with supervision by the coaches.

During the competitive period, training sessions had a relatively similar design: activation and warm-up (15 min), tasks focused on improving conditioning aspects (30 min), technical-tactical tasks (45 min) and cool-down (10 min). Two days prior to the initial measurement (T0), a familiarization session was conducted to explain the protocol and technical standards for each test: 1RM in half squat, countermovement jump (CMJ), and 10-meter linear acceleration (10 m).

On measurement days (T0, T1, and T2), for obtaining the 1RM, a specific standardized warm-up was performed consisting of five half squats with a bar and light loads, and two submaximal repetitions in half squat with a bar and a high load selected by the players (Enes et al., 2021). The warm-up for measuring jump capacity and acceleration included 5 min of continuous running at 6 km/h, five repetitions of CMJ, and three repetitions of 10 m acceleration (Enes et al., 2021).

The order of the tests evaluated in each measurement was as follows: 1RM test in half squat with a bar (Tuesday) and, 48 hours later (Thursday), CMJ and 10-m test. This sequencing ensured a 48-hour recovery period after the last competitive match. After the initial evaluation (T0), the participants began a six-week traditional strength training program conducted twice a week (12 training sessions in total). Once this period was completed, the same tests as in the initial assessment were conducted in the following week to evaluate the effects of traditional training (T1). Subsequently, another six-week period with 12 sessions of the same strength training was initiated, but with the addition of DS. After this training period, the tests were repeated to assess the potential effects of including DS training (T2). The study timeline, with the measurement weeks and training periods, can be observed in Figure 1.

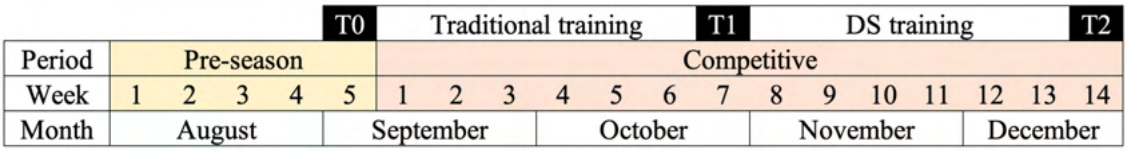

Figure 1. Timeline in the study design

Notes: T0, initial assessment; T1, traditional training assessment; T2, drop set (DS) training assessment.

The strength training programs were integrated at the beginning of the session, before the technical-tactical training, on Tuesdays and Thursdays of each week, at the same time. The warm-up consisted of running for 5 min at 6 km/h around the playing court and performing 2 sets of 8 and 3 repetitions of half squat with a bar with an estimated load of 10% and 60% of 1RM, respectively (Enes et al., 2021).

Both traditional strength training and DS training included the same contents and were performed in the same order. Both are shown in Table 1, which also includes the training loads applied in each of them (Enes et al., 2021; Schoenfeld et al., 2019).

Table 1. Exercises and training loads for both traditional and drop set (DS) training performed by the players during the study

Exercises	Training loads	
	Traditional training	Drop Sets Training
Deep barbell squat 45° Leg press Seated knee extension Stiff-legged deadlift Seated knee flexion	3 sets of 12 repetitions at 70% of 1RM (2 min of rest between sets)	3 sets of 6 repetitions at 75% of 1RM 3 sets of 10 repetitions at 55% of 1RM (20 seconds of intra-set rest and 2 min of rest between sets)

Dynamic one-repetition maximum (1RM)

The dynamic 1RM strength test began approximately 3 min after the warm-up. Each assessment was conducted at a cadence of 60 beats per minute (using a digital metronome), resulting in 2 s for both the eccentric and concentric phases, ensuring constant muscle tension throughout the exercise (Thiele et al., 2015). To obtain the 1RM value in a half squat, a previously used protocol was employed (Brown, 2007).

In a maximum of five attempts, with three minutes of rest between them, each player determined an approximate 85% load (3 repetitions) of their 1RM in the first attempt. In subsequent attempts, gradually small loads (2.27 – 9.09 kg) were applied until the player could not complete a repetition using proper technique through the full range of motion or could no longer maintain the cadence (60 beats per minute) of the metronome (Mackey et al., 2020). All players were provided with an elastic band to give kinesthetic feedback on achieving a knee angle of 90° (Conchola et al., 2015). The equipment used was a commercial adjustable Power Rack (RockSolid Fitness, Rutland, VT, USA) with a standard Olympic barbell (20.45 kg) located in a weightlifting room adjacent to the playing court. The recorded 1RM value was the weight lifted in the maximal repetition (kg).

Jump capacity

The players performed three repetitions of the CMJ, with 60 seconds of rest between each jump (Warr et al., 2020). A force platform (QuattroJump, Kistler 100 Instrument AG, Winterthur, Switzerland) located in the same weightlifting room where the 1RM test was conducted was used for measurement. The jump height (cm) was recorded, and the best result was utilized for statistical analysis.

Acceleration capacity

The players placed their front foot 0.5 m before the first timing gate. They were instructed to run as fast as possible through the timing gates (Witty Timing System, Microgate, Bolzano, Italy), located at the start and 10 meters away. The players performed three repetitions with 3 min of recovery between each repetition. The time taken to cover the established distance (s) was monitored, and the best result was used for statistical analysis. This test was conducted on the teams' training court.

Statistical analysis

The data are presented as means and standard deviations (*M* ± *SD*). The intraclass correlation coefficient (*ICC*) was used to measure the agreement between measurements in each physical performance test (Atkinson & Nevill, 1998). The *ICC* value was interpreted according to the following ranges: poor (< 0.5), moderate (0.5 - 0.75), good (0.75 - 0.9), and excellent (> 0.9) (Koo & Li, 2016). The coefficient of variation (*CV*) was calculated to assess the relative variability of the measurements. The Shapiro-Wilk test was applied to determine the normality of the data, and the Levene test was used to assess homogeneity of variance.

Subsequently, a two-way repeated measures analysis of variance (ANOVA) was conducted to analyze the effects of the traditional strength training program and the DS training program at different measurement points (T0-T1-T2). The Wilks' Lambda was calculated, and when the F value was significant, the Bonferroni test was performed to determine differences between measurement points and the effects of the training programs. The partial eta squared value (ηp^2) was calculated. Statistical analyses were carried out using SPSS for Windows, version 25.0 (SPSS Inc., Chicago, USA). The level of statistical significance was set at $p < .05$.

Results

Table 2 displays the descriptive data for 1RM, CMJ and 10 m performance at each of the three measurement time points (T0, T1, and T2), along with the *ICC* and *CV* for each physical performance test. The agreement between measurements in each physical performance test was moderate and the *CV* ranged from 2.7% (10 m) to 10.6% (1RM).

Table 2. Descriptive data, ICC, and CV for performance in 1RM, CMJ, and 10m at each of the three measurement time points (T0, T1 and T2)

	T0	T1	T2	*ICC*	*CV (%)*
	Mean ± SD	***Mean ± SD***	***Mean ± SD***		
1RM (kg)	70.440 ± 6.988	74.760 ± 7.247	78.960 ± 7.463	.669	10.6
CMJ (cm)	24.582 ± 1.618	26.316 ± 1.706	26.744 ± 1.673	.534	7.5
10m (s)	1.978 ± 0.064	1.959± 0.045	1.947 ± 0.041	.661	2.7

CMJ: Counter Movement Jump; *CV:* Coefficient of Variation; *SD:* Standard Deviation; *ICC:* Intraclass Correlation Coefficient; 1RM: 1 Repetition Maximum; 10 m: 10-Meter Linear Acceleration.

Table 3 presents the significant differences in1RM, CMJ and 10 m performance depending on the measurement time point (T0, T1, and T2) and the training program (traditional and DS). Only CMJ performance was significantly influenced by the training program (p =.001; ηp^2 = .376).

Table 3. Contrast test to determine differences in performance in 1RM, CMJ, and 10m based on the measurement time point (T0, T1 and T2) and the training program (traditional and drop sets)

	Effects	*RMS*	*F*	*p*	ηp²
1RM (kg)	Time	453.690	200.305	.001*	.807
	Time * Training Program	0.090	0.040	.843	.001
CMJ (cm)	Time	31.438	96.868	.001*	.669
	Time * Training Program	9.370	28.870	.001*	.376
10m (s)	Time	0.006	10.634	.002*	.181
	Time * Training Program	0.000	0.412	.524	.009

CMJ: Counter Movement Jump; *SD:* Standard Deviation; *F: F-value; RMS:* Root Mean Square; p: *p-value;* 1RM: 1 Repetition Maximum; 10 m: 10-Meter Linear Acceleration; *ηp2:* partial eta-squared. *: $p < .05$.

Specifically, the effects of the traditional strength training program on CMJ performance were higher compared to the effects promoted by the DS training program (Figure 2). Significant differences in 1RM were obtained after the entire strength training period (T0-T2, $p = .001$), after the traditional training period (T0-T1, $p = .001$) and after the DS training (T1-T2, $p = .001$). Significant differences in CMJ performance were obtained after the strength training period (T0-T2, $p = .001$) and after traditional training (T0-T1, $p = .001$), but not after DS training (T1-T2, $p = .118$). In 10 m performance, significant differences were only obtained after the strength training period (T0-T2, $p = .05$), while both traditional training and DS training showed no significant effects on performance (T0-T1, $p = .088$; T1-T2, $p = .069$).

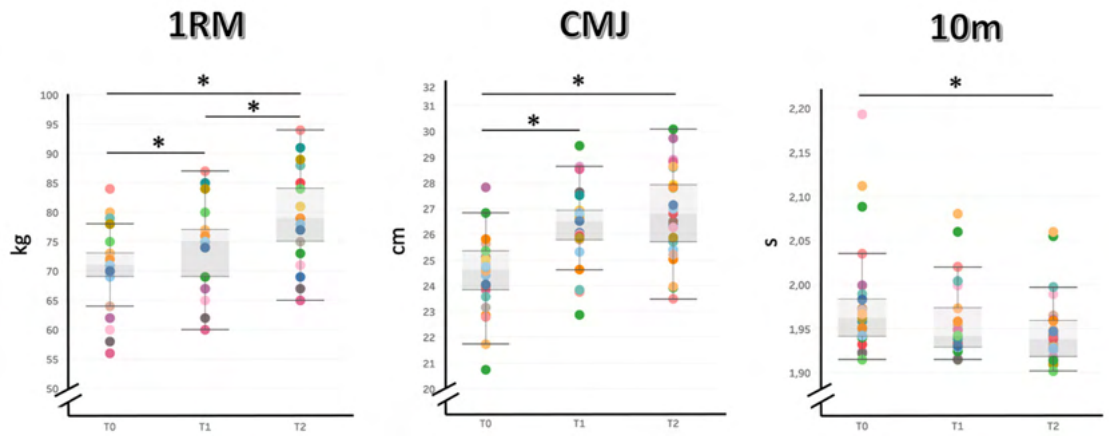

Figure 2. Comparison of performance in 1RM (one-repetition maximum), CMJ (counter-movement jump) and 10m (10-meter linear acceleration) between different measurement time points (T0, T1 and T2)

* Significant differences ($p < .05$). Box plots are displayed with medians, first and third quartiles, and outliers.

Discussion

The aim of this study was to analyze the effects of including DS training on dynamic maximal strength of the lower limb, acceleration capacity and jump performance in amateur female basketball players. The results show that both traditional training and DS training had a significant effect on the performance in 1RM in the half squat. However, the effects of both training programs on 1RM performance were similar. No differences were observed in CMJ and 10 m performance after DS training compared to traditional strength training. In fact, traditional strength training had significantly superior effects on CMJ performance compared to those obtained with DS training. These results confirm the initial hypothesis. Although CMJ performance was significantly influenced by the training program ($p = .001$; $\eta p^2 = .376$), the inclusion of DS training did not statistically increase the magnitude of neuromuscular effects produced by traditional strength training in CMJ and 10 m. However, it demonstrated that it could maintain the effects achieved with the DS program.

In the present study, 1RM increased significantly after completing both training programs, although the magnitude of the changes was similar, as no Time*Training Program interaction was found ($p = .843$; $\eta p^2 = .001$). These results support previous findings indicating that DS training does not have superior effects compared to traditional training in strength improvements. In this regard, Fink et al. (2018) demonstrated that a six-week DS training program promoted greater hypertrophy compared to a conventional strength training program, although the magnitude of strength gain was higher after conventional training than after the DS training program (traditional: 25.2 ± 17.5%,

ES = 1.34; *DS*: 16.1 ± 12.1%, *ES* = 0.88). This implies that, although hypertrophy is one of the factors explaining the increase in muscle strength (Folland & Williams, 2007), greater hypertrophy does not guarantee superior strength gains (Fink et al., 2018; González-Badillo et al., 2022). Moreover, there is not enough evidence regarding greater hypertrophy when performing strength training close to muscular failure compared to strength training performed without reaching muscular failure (Refalo et al., 2023). Therefore, based on the results of the present study and in accordance with previous research, it seems not advisable to apply DS training to improve the 1RM of amateur female basketball players, as similar results can be obtained with traditional strength training and lower volume (i.e., fewer sets and repetitions than with DS).

Basketball is characterized by the execution of various vertical movements, such as jump shots, dunks, rebounds and blocks (Gottlieb et al., 2014; Meckel & Gottlieb, 2009; Meckel et al., 2009). Therefore, basketball players need to apply force as quickly as possible to produce effective vertical movements that facilitate optimal performance (Delextrat & Cohen, 2008). The results of the present study show that CMJ performance significantly improved after traditional strength training, which had significantly greater effects compared to those obtained with DS training. Additionally, it was the only test significantly influenced by the training program (p = .001; ηp^2 = .376). It has been suggested that the potential transfer of strength training exercises to high-intensity sports actions is not only determined by the relative load used (% 1RM) but also by the degree of fatigue experienced during the sets, which is associated with the velocity loss during each set (Rodríguez-Rosell et al., 2020). In this regard, it has been shown that squat training with loads of 70-85% 1RM is less effective in inducing improvements in CMJ performance when a velocity loss of 40 – 45% is reached compared to 10 - 20% (Pareja-Blanco et al., 2017; Rodríguez-Rosell et al., 2020). Considering that reaching a velocity loss in each set of 40 – 45% in the squat exercise implies proximity to muscular failure (Rodríguez-Rosell et al., 2020), and that DS training involves performing additional repetitions until a new muscular failure (Angleri et al., 2020; Krzysztofik et al., 2019), it seems that the accumulated fatigue during DS training results in undesirable adaptations or negative interference in high-intensity actions such as jumps.

Basketball is also characterized by the execution of accelerations and changes of direction (Gottlieb et al., 2014). In fact, these accelerations and changes of direction performed by basketball players are based on horizontal movements (Meckel & Gottlieb, 2009; Meckel et al., 2009), so and adequate performance in this sport is partially determined by the ability to perform accelerations in the horizontal plane (Delextrat & Cohen, 2008). The results obtained in the present study indicate that strength training improves acceleration capacity in 10 m, a finding that has been demonstrated previously (Young et al., 2001). However, no differences were observed in 10 m performance after DS training compared to traditional strength training. Like in CMJ performance, the results obtained in the 10 m acceleration capacity may be influenced by the relative load used (% 1RM), but also by the fatigue experienced during the sets of both training programs (i.e., velocity loss), which is associated with the number of repetitions. In this sense, Rodríguez-Rosell et al. (2020) showed that a strength training performed until a 10% velocity loss during each set corresponds to completing less than half of the repetitions performed during a strength training reaching a 30% velocity loss during each set, with a greater increase in 20 m sprint performance (-1.5% vs. 0.4%). Considering that DS training increases the time under tension and training density (Coleman et al., 2022; Schoenfeld & Grgic, 2018), it seems not advisable to apply DS training when aiming for amateur basketball players to improve horizontal acceleration capacity, as similar results can be obtained with traditional strength training and lower volume (i.e., fewer sets and repetitions than with DS).

Despite the findings obtained for basketball training, this research also has certain limitations. Firstly, the 1RM value can change during the training process (González-Badillo et al., 2022), so the actual daily relative training load (% 1RM) of the participants in this study may have differed from the programmed or intended effort. Additionally, the current trend is to determine the 1RM based on the maximal intended velocity of the first repetition performed (González-Badillo et al., 2022), but in this study, dynamic maximum strength could not be evaluated in this way. Therefore, it would be interesting to replicate this study using velocity-based methods to monitor strength training and determine the 1RM value. Secondly, although the load in minutes during training sessions and the task design were similar in both teams, individual response to effort was not monitored, as could have been done through a rating of perceived exertion. Finally, the results may be influenced by the sample characteristics and may not be applicable to other athletes with different characteristics. Therefore, it would be advisable to replicate this study in male basketball players of similar competitive level (amateur) and in male and female players of higher level (professional, elite). A further associated research that could be interesting would be to implement DS training for a few weeks initially and then apply traditional training during another period. Lastly, it is essential to consider that the design of this study was quasi-experimental, so it is recommended to replicate the study using a larger sample size and including a control group.

Conclusions

The results show that both traditional strength training and DS training had a significant effect on 1RM performance. However, the effects of both training programs on 1RM performance were similar. Although performance in the CMJ test was significantly influenced by

the training program, no differences were observed in the 10 m performance after DS training compared to traditional strength training. In fact, traditional strength training had significantly superior effects on CMJ performance compared to those obtained with DS training. These results suggest that, despite the supposed lower efficacy of DS training compared to traditional strength training in improving jumping and acceleration performance in amateur female basketball players, both training methods can be complementary within a 14-week competitive period plan, maintaining the achieved effects.

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Efectos del entrenamiento de series descendentes sobre fuerza máxima dinámica, salto y aceleración en jugadoras de baloncesto

Drop sets effects on maximum dynamic strength, jumping ability and acceleration in female basketball players

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Resumen

El objetivo de esta investigación fue analizar los efectos del entrenamiento de series descendentes (DS) en fuerza máxima dinámica (1RM) en media sentadilla, capacidad de salto (CMJ) y capacidad de aceleración (10 m) en jugadoras amateur de baloncesto. Veinticinco jugadoras (22.59 ± 3.73 años) de dos equipos fueron evaluadas en tres ocasiones, siendo T0 la evaluación inicial, T1 la evaluación después de trabajar la musculatura de la extremidad inferior durante seis semanas con entrenamiento clásico de fuerza sin DS, y T2 después de otras seis semanas incluyendo DS. Únicamente el rendimiento en CMJ estuvo influenciado significativamente por el programa de entrenamiento (p = .001; ηp^2 = .376). Se encontraron diferencias significativas en 1RM comparando los tres tiempos: T0-T1 (p = .001), T0 con T2 (p = .001) y T1-T2 (p = .001). También hubo diferencias en CMJ entre T0-T1 (p = .001) y T0-T2 (p = .001), mientras que en 10 m únicamente entre T0-T2 (p = .05). Estos resultados sugieren que, a pesar de una supuesta poca eficacia del entrenamiento con DS respecto al entrenamiento tradicional en la mejora del rendimiento en acciones de salto y aceleración, ambos pueden ser complementarios dentro de una planificación al mantenerse los efectos producidos.

Palabras clave: Deporte de equipo, entrenamiento, mujer, rendimiento deportivo, drop sets.

Abstract

The aim of this research was to quantify the effects of the inclusion of drop set training (DS) on maximum dynamic strength (1RM) in back squat, jump ability (CMJ) and speed (10 m) in female basketball players. For this purpose, 25 participants (22.59 ± 3.73 years) of two amateur teams were examined in three times: initial assessment (T0), after six weeks of traditional lower limbs strength training without DS (T1), and after an additional six weeks incorporating DS training (T2). Only the performance in the CMJ test was significantly influenced by the training program (p = .001; ηp^2 = .376). Post-hoc test identified statistical differences from 1RM: T0-T1 (p = .001), T0-T2 (p = .001) and T1-T2 (p = .001). Differences were also identified in CMJ between T0-T1 (p = .001) and T0-T2 (p = .001), and in 10 m between T0 and T2 (p = .05). These results suggest that, despite the supposed low efficacy of DS training compared to traditional training in improving performance in jumping and acceleration capacities, both can be complementary within a training program, as the effects produced are maintained.

Key words: Team sport, training, female, sport performance, drop sets.

Introducción

La práctica de un deporte concreto solicita a los deportistas unas demandas condicionales específicas. En el baloncesto, estas demandas se basan principalmente en la aplicación de fuerza rápida, la cual influye en el resto de capacidades puesto que permite ser ágil con y sin balón, y veloz en distancias cortas (Delextrat & Cohen, 2008; Montgomery et al., 2010), además de en el rendimiento en acciones técnicas propias del juego (Alsasua et al., 2022; Izquierdo et al., 2021). En este sentido, la literatura confirma que la aplicación de fuerza es esencial para un adecuado rendimiento deportivo en baloncesto (Chaouachi et al., 2009). Su mejora conlleva un aumento del rendimiento en la capacidad de acelerar (Ben Abdelkrim et al., 2006) y de saltar (Delextrat & Cohen, 2008), determinantes en el rendimiento por su influencia en el juego.

La prescripción de entrenamientos de fuerza implica la manipulación de los componentes de la carga (volumen, frecuencia, duración, intensidad y densidad) para lograr las adaptaciones musculares pretendidas (Kraemer & Ratarmess, 2004). De hecho, se recomienda la alternancia en la manipulación de los componentes de la carga para evitar un posible estancamiento en las adaptaciones musculares (Krzysztofik et al., 2019). En este sentido, se ha especulado que manipular el volumen de entrenamiento y el esfuerzo relativo (proximidad al fallo muscular) puede tener un impacto positivo en diferentes adaptaciones al entrenamiento, como es el caso de la hipertrofia muscular (Schoenfeld et al., 2019). Precisamente en esto se basa el entrenamiento de series descendentes o drop sets (DS).

El entrenamiento de DS consiste en realizar una serie de un ejercicio con una carga determinada hasta el fallo muscular momentáneo. Después se reduce la carga (± 20%) y se realizan repeticiones adicionales hasta el nuevo fallo muscular (Angleri et al., 2020; Krzysztofik et al., 2019). El entrenamiento de DS aumenta el tiempo en el que el músculo está sometido a tensión y la densidad de entrenamiento (trabajo por unidad de tiempo) (Coleman et al., 2022; Schoenfeld & Grgic, 2018), estimulando una mayor acumulación de metabolitos e inflamación celular y favoreciendo el crecimiento de la sección transversal muscular, es decir, la hipertrofia muscular (Schoenfeld & Grgic, 2018; Schoenfeld et al., 2019).

Las adaptaciones musculares de la extremidad inferior promovidas por el entrenamiento de DS han sido poco analizadas en deportistas. Estudiantes universitarios mostraron aumentos significativos en una repetición máxima dinámica (1RM) en prensa de piernas a través de este método aplicando cinco series con cargas de 50% de 1RM en comparación con una configuración de serie tradicional (Goto et al., 2004). Sin embargo, en culturistas no se observaron diferencias significativas entre un entrenamiento con DS (dos series y una reducción del 20% en la carga) y un entrenamiento tradicional (tres a cinco series de seis a doce repeticiones con un intervalo de descanso de dos minutos entre series), a pesar de que ambos tipos de entrenamiento promovieron aumentos significativos en la fuerza muscular e hipertrofia (Angleri et al., 2017). Raeder et al. (2016) compararon los efectos de varios tipos de entrenamientos (incluido el entrenamiento de DS) durante seis días en jugadores de fútbol y balonmano. Sus resultados no mostraron mejoras significativas en la capacidad de salto, y los autores sugirieron la necesidad de incluir un periodo de adaptación de varios días para producir las ganancias necesarias. Únicamente un estudio ha analizado los efectos del entrenamiento DS en jugadores de baloncesto (Drinkwater et al., 2007). Tras un periodo de entrenamiento de seis semanas con diferentes tipos de entrenamiento de DS (G1: 12x3; G2: 4x6 G3: 8x3; todos con carga de 60% de 1RM), no hubo diferencias significativas entre los grupos en la hipertrofia muscular ni en 1RM. Con estos precedentes, existe un gran vacío en la literatura científica sobre el efecto del entrenamiento de DS en la capacidad de salto y en la capacidad de aceleración en el deporte en general, y en el baloncesto en particular.

La presente investigación puede mostrar nuevas evidencias acerca de un tipo de entrenamiento de fuerza que no ha sido suficientemente analizado con jugadoras de baloncesto y sus posibles efectos en capacidades tan importantes como la fuerza máxima dinámica, el salto y la aceleración (Mancha-Triguero et al., 2020). Por tanto, el objetivo de este estudio fue analizar los efectos de la inclusión del entrenamiento de DS en la fuerza máxima dinámica de la extremidad inferior, la capacidad de salto y la capacidad de aceleración en jugadoras amateur de baloncesto. Basándonos en la literatura disponible, se planteó la hipótesis de que la inclusión del entrenamiento de DS puede no aumentar la magnitud de los efectos neuromusculares que produce un entrenamiento de fuerza tradicional, pero quizá sí que pueda ayudar a mantener los efectos logrados con este.

Método

Participantes

Veinticinco jugadoras (edad: 22.59 ± 3.73 años; masa corporal: 66.37 ± 8.21 kg; altura: 170.13 ± 10.44 cm; experiencia federada: 10.45 ± 3.00 años) de dos equipos seniors amateur de un mismo club participaron en este estudio. Ambos equipos competían de forma federada a nivel nacional y autonómico, respectivamente.

Los criterios de inclusión de las participantes fueron: a) edad comprendida entre 18 y 30 años; b) fuerza relativa mínima en sentadilla profunda con barra de 1.25 x masa corporal; c) tener al menos dos años de experiencia en entrenamiento de fuerza; d) no consumir suplementos de creatina, antiinflamatorios, esteroides anabolizantes androgénicos u otras sustancias que pudieran tener efecto en las adaptaciones musculares durante el periodo de entrenamiento y cuatro semanas antes del estudio; y e) realizar el programa de fuerza asignado durante tres días a la semana en todo el periodo de intervención. El 68% (17 jugadoras) fueron evaluadas durante la fase folicular del ciclo menstrual en alguna de las tres mediciones evaluables, y el 40% (10 jugadoras) hizo uso de anticonceptivos orales.

Este estudio fue aprobado por el comité de ética de la Universidad correspondiente (ULE-022-2021). Todos los procedimientos se realizaron de acuerdo con la Declaración de Helsinki. Todas las participantes fueron informadas del objetivo y los procedimientos, y firmaron un consentimiento informado antes de la participación voluntaria en el estudio.

Diseño

El presente estudio tiene un diseño cuasiexperimental, en tanto que no hay grupo control y todas las participantes realizaron la misma intervención. La intervención se llevó a cabo durante 14 semanas, y se inició la primera semana del periodo competitivo, cuando todas las jugadoras habían realizado la pretemporada de cinco semanas de duración. La carga de ambos equipos tanto en el periodo preparatorio como durante el periodo competitivo fue la misma: tres entrenamientos semanales más cuatro partidos amistosos (periodo preparatorio), y tres entrenamientos semanales más un partido oficial de liga regular cada fin de semana en el periodo competitivo. Además, la planificación y el diseño en cuanto a la carga de las tareas y ejercicios de entrenamiento fue la misma y fue realizada por la misma persona (en labores de preparador físico) para ambos equipos, junto con la supervisión de los técnicos. De tal manera que, durante el periodo competitivo, las sesiones de entrenamiento tuvieron un diseño relativamente similar: activación y calentamiento (15 min), tareas orientadas a mejorar los aspectos condicionales (30 min), tareas técnico tácticas (45 min) y vuelta a la calma (10 min). Dos días anteriores a la medición inicial (T0) se realizó una sesión de familiarización para explicar el protocolo y los estándares técnicos de cada prueba: 1RM en media sentadilla, salto con contramovimiento (CMJ) y aceleración lineal de 10 m (10 m). En los días de medición (T0, T1 y T2), para la obtención del 1RM se realizó un calentamiento específico estandarizado compuesto por cinco medias sentadillas con barra y cargas bajas, y dos repeticiones submáximas en media sentadilla con barra y carga alta seleccionada por las jugadoras (Enes et al., 2021). El calentamiento para medir la capacidad de salto y la aceleración consistió en 5 min de carrera continua a 6 km/h, cinco repeticiones de CMJ y tres repeticiones de aceleración de 10 m (Enes et al., 2021).

El orden de las pruebas a evaluar en cada medición fue el siguiente: prueba de 1RM en media sentadilla con barra (martes) y pasadas 48 horas (jueves) pruebas CMJ y 10 m. De este modo se garantizaron 48 horas de recuperación tras el último partido de competición. Tras la evaluación inicial (T0), las participantes iniciaron un programa de entrenamiento de fuerza tradicional de seis semanas realizado dos veces por semana (12 sesiones de entrenamiento en total). Una vez completado este periodo, en la semana posterior se realizaron las mismas pruebas que en la evaluación inicial con el objetivo de evaluar los efectos del entrenamiento tradicional (T1). Tras ello se inició otro periodo de seis semanas y 12 sesiones del mismo entrenamiento de fuerza, pero añadiendo el DS. Tras ese periodo de entrenamiento se repitieron las pruebas con el fin de evaluar los posibles efectos de la inclusión del entrenamiento DS (T2). La cronología del estudio, con las semanas de medición y los periodos de entrenamiento, se puede observar en la Figura 1.

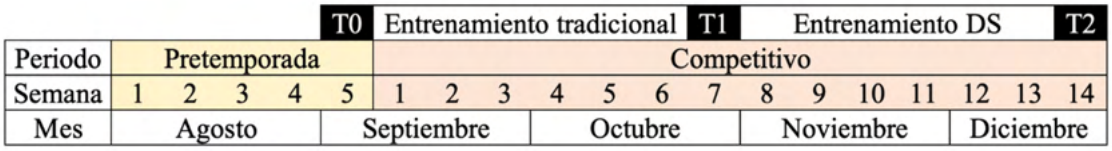

Figura 1. Cronología en el diseño del studio

Notas: T0, evaluación inicial; T1, evaluación del entrenamiento tradicional; T2, evaluación del entrenamiento con DS (drop sets).

Los programas de entrenamiento de fuerza se integraron en el inicio de la sesión, antes del entrenamiento técnico-táctico, los martes y jueves de cada semana y a la misma hora. El calentamiento consistió en correr 5 min a 6 km/h alrededor de la pista de juego y realizar 2 series de 8 y 3 repeticiones de media sentadilla con barra con una carga estimada de 10% y 60% de 1RM, respectivamente (Enes et al., 2021).

Tanto el entrenamiento de fuerza tradicional como el entrenamiento DS incluían los mismos contenidos y se realizaron en el mismo orden. Ambos se muestran en la Tabla 1 en la que se incluye también las cargas de entrenamiento aplicadas en cada uno de ellos (Enes et al., 2021; Schoenfeld et al., 2019).

Tabla 1. Ejercicios y cargas de entrenamiento de ambos entrenamientos (tradicional y drop sets) realizados por las jugadoras durante el periodo de estudio

Ejercicios	Cargas de entrenamiento	
	Entrenamiento tradicional	Entrenamiento Drop Sets
Sentadilla profunda con barra Prensa de piernas a 45° Extensión de rodilla sentado, Peso muerto con piernas rígidas Flexión de rodilla sentado	3 series de 12 repeticiones al 70% de 1RM (2 min de recuperación entre series)	3 series de 6 repeticiones al 75% de 1RM 3 series de 10 repeticiones al 55% de 1 RM (20 s de recuperación intra series y 2 min de recuperación entre series)

Fuerza máxima dinámica (1RM)

El test de 1RM comenzó aproximadamente 3 min después del calentamiento. Cada evaluación se realizó a una cadencia de 60 compases por minuto (usando un metrónomo digital), resultando en 2 s para las fases de contracción excéntrica y concéntrica, de tal modo que hubo una tensión muscular constante durante todo el ejercicio (Thiele et al., 2015). Para obtener el valor de 1RM en media sentadilla se utilizó un protocolo previamente utilizado (Brown, 2007). En cinco intentos como máximo, con tres minutos de descanso entre ellos, cada jugadora determinó en el primer intento una carga aproximada al 85% (3 repeticiones) de su 1RM, y en los sucesivos intentos se aplicaron cargas gradualmente pequeñas (2.27 – 9.09 kg) hasta que la jugadora no pudo completar una repetición utilizando la técnica adecuada a través del rango completo de movimiento o ya no pudo mantener la cadencia (60 b·min^{-1}) del metrónomo (Mackey et al., 2020). A todas las jugadoras se les colocó una banda elástica para proporcionarles una retroalimentación cinestésica de cuándo se logró un ángulo de rodilla de 90° (Conchola et al., 2015). El material empleado fue un Power Rack comercial ajustable (RockSolid Fitness, Rutland, VT, EE. UU.) con una barra olímpica estándar (20.45 kg) situado en una sala de musculación anexa a la pista de juego. El valor de 1RM registrado fue el peso movilizado en la repetición máxima (kg).

Capacidad de salto

Las jugadoras realizaron tres repeticiones de CMJ, con 60 s de descanso entre ellos (Warr et al., 2020). Para su medición se utilizó una plataforma de fuerza (QuattroJump, Kistler 100 Instrument AG, Winterthur, Switzerland) situada en la misma sala de musculación donde se realizó la prueba de 1RM. Se registró la altura de salto (cm) y el mejor resultado fue el que se empleó para el análisis estadístico.

Capacidad de aceleración

Las jugadoras colocaron el pie delantero 0.5 m antes de la primera puerta de cronometraje. Se indicó a las jugadoras que corrieran lo más rápido posible a través de las puertas de cronometraje (Witty Timing System, Microgate, Bolzano, Italia), ubicadas en la salida y a 10 m. Las jugadoras realizaron tres repeticiones con 3 min de recuperación entre cada repetición. Se monitorizó el tiempo en recorrer la distancia establecida (s), y el mejor resultado se empleó para el análisis estadístico. El lugar donde se llevó a cabo esta prueba fue en la pista de entrenamiento de los equipos.

Análisis estadístico

Los datos se presentan como medias y desviaciones estándar *(M ± DE)*. El coeficiente de correlación intraclase (*ICC*) se utilizó para medir la concordancia entre las mediciones realizadas en cada prueba de rendimiento físico (Atkinson & Nevill, 1998). El valor del *ICC* se interpretó de acuerdo a los siguientes rangos: escasa (< 0.5), moderada (0.5 - 0.75), buena (0.75 - 0.9) y excelente (> 0.9) (Koo & Li, 2016). El coeficiente de variación *(CV)* se calculó para la variabilidad relativa de las mediciones. Se aplicó la prueba de Shapiro-Wilk para determinar la normalidad de los datos, y la prueba de Levene para evaluar la homogeneidad de la varianza. Tras ello se realizó un análisis de varianza (ANOVA) de dos factores de medidas repetidas para analizar los efectos del programa de entrenamiento de fuerza tradicional y del programa de entrenamiento de DS en los diferentes momentos de medición (T0-T1-T2). Se calculó la Lambda de Wilks y, cuando el valor *F* resultó significativo, se realizó la prueba de Bonferroni para determinar las diferencias entre los momentos de medición y el efecto de los programas de entrenamiento. El valor eta cuadrado parcial (ηp^2) fue calculado. Los análisis estadísticos se realizaron con SPSS para Windows, versión 25.0 (SPSS Inc., Chicago, EEUU). El nivel de significación estadística se fijó en $p < .05$.

Resultados

La Tabla 2 muestra los datos descriptivos del rendimiento en 1RM, CMJ y 10 m en cada uno de los tres momentos de medición (T0, T1 y T2), y el *ICC* y el *CV* de cada una de las pruebas de rendimiento físico. La concordancia entre las mediciones realizadas en cada prueba de rendimiento físico fue moderada y el *CV* oscilo entre el 2.7% (10 m) y el 10.6% (1RM).

Tabla 2. Datos descriptivos, ICC y CV del rendimiento en 1RM, CMJ y 10m en cada uno de los tres momentos de medición (T0, T1 y T2)

	T0	T1	T2	ICC	CV (%)
	Media ± DE	***Media ± DE***	***Media ± DE***		
1RM (kg)	70.440 ± 6.988	74.760 ± 7.247	78.960 ± 7.463	.669	10.6
CMJ (cm)	24.582 ± 1.618	26.316 ± 1.706	26.744 ± 1.673	.534	7.5
10m (s)	1.978 ± 0.064	1.959± 0.045	1.947 ± 0.041	.661	2.7

CMJ: salto con contramovimiento; *CV:* coeficiente de variación; *DE:* desviación estándar; *ICC:* coeficiente de correlación intraclase; 1RM: 1 repetición máxima; 10 m: aceleración lineal de 10 m.

La Tabla 3 muestra las diferencias significativas en el rendimiento en 1RM, CMJ y 10 m en función del momento de medición (T0, T1 y T2) y el programa de entrenamiento (tradicional y DS). Únicamente el rendimiento en la prueba CMJ estuvo influenciado significativamente por el programa de entrenamiento ($p = .001$; $\eta p^2 = .376$).

Tabla 3. Prueba de contrastes para determinar diferencias en el rendimiento en 1RM, CMJ y 10m en función del momento de medición (T0, T1 y T2) y el programa de entrenamiento (tradicional y drop sets)

	Efectos	*RMS*	*F*	*p*	ηp²
1RM (kg)	Tiempo	453.690	200.305	.001*	.807
	Tiempo * Programa	0.090	0.040	.843	.001
CMJ (cm)	Tiempo	31.438	96.868	.001*	.669
	Tiempo * Programa	9.370	28.870	.001*	.376
10m (s)	Tiempo	0.006	10.634	.002*	.181
	Tiempo * Programa	0.000	0.412	.524	.009

CMJ: salto con contramovimiento; *DE:* desviación estándar; *F:* valor *F; RMS:* Media cuadrática; *p:* valor *p;* 1RM: 1 repetición máxima; 10 m: aceleración lineal de 10 m; *ηp2:* Eta cuadrado parcial. *: $p < .05$.

En concreto, los efectos del programa de entrenamiento de fuerza tradicional en el rendimiento en CMJ fueron superiores a los efectos promovidos por el programa de entrenamiento de DS (Figura 2). En 1RM se obtuvieron diferencias significativas tras todo el periodo de entrenamiento de fuerza (T0-T2, $p = .001$), tras el periodo de entrenamiento tradicional (T0-T1, $p = .001$), y tras el entrenamiento de DS (T1-T2, $p = .001$). En el rendimiento en CMJ se obtuvieron diferencias significativas tras el entrenamiento de fuerza (T0-T2, $p = .001$) y tras el entrenamiento tradicional (T0-T1, $p = .001$), pero no tras el entrenamiento de DS (T1-T2, $p = .118$). En el rendimiento en 10 m sólo se obtuvieron diferencias significativas tras el entrenamiento de fuerza (T0-T2, $p = .05$), ya que el entrenamiento tradicional y el entrenamiento de DS no tuvieron efectos significativos en el rendimiento (T0-T1, $p = .088$; T1-T2, $p = .069$).

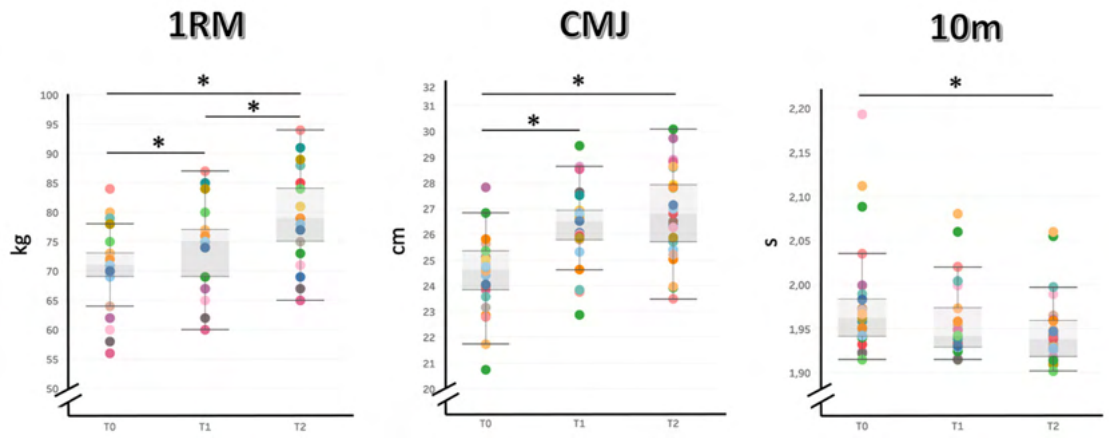

Figura 2. Comparación del rendimiento en 1RM (repetición máxima), CMJ (salto con contramovimiento) y, 10m (aceleración lineal de 10 m) entre los diferentes momentos de medición (T0, T1 y T2)

*Diferencias significativas ($p < .05$). Los diagramas de caja se muestran con medianas, primer y tercer cuantiles, y valores atípicos.

Discusión

El objetivo de este estudio fue analizar los efectos de la inclusión del entrenamiento de DS en la fuerza máxima dinámica de la extremidad inferior, la capacidad de aceleración y la capacidad de salto en jugadoras amateur de baloncesto. Los resultados muestran que tanto el entrenamiento tradicional como el entrenamiento de DS tuvieron un efecto significativo en el rendimiento en 1RM en media sentadilla. Sin embargo, los efectos de ambos programas de entrenamiento en el rendimiento en 1RM fueron similares. Tampoco se apreciaron diferencias en el rendimiento en CMJ y 10 m tras realizar el entrenamiento de DS respecto al entrenamiento de fuerza tradicional. De hecho, el entrenamiento de fuerza tradicional tuvo efectos significativamente superiores en el rendimiento en CMJ respecto a los obtenidos con el entrenamiento de DS. Estos resultados confirman la hipótesis inicial, puesto que, aunque el rendimiento en la prueba CMJ estuvo influenciado significativamente por el programa de entrenamiento ($p = .001$; $\eta p^2 = .376$), la inclusión del entrenamiento de DS no ha aumentado de forma estadísticamente significativa la magnitud de los efectos neuromusculares que produce un entrenamiento de fuerza tradicional en CMJ y 10 m, pero sí ha demostrado que puede mantener los efectos logrados con este último.

En el presente estudio, 1RM aumentó significativamente tras completar ambos programas de entrenamiento, aunque la magnitud de los cambios al completar ambos pro-

gramas de entrenamiento de fuerza fue similar, pues no se encontró interacción Tiempo*Programa (p = .843; ηp^2 = .001). Estos resultados apoyan los previamente publicados que indican que el entrenamiento con DS no tiene efectos superiores respecto al entrenamiento tradicional en el incremento de fuerza. En esta línea, Fink et. al. (2018) demostraron que un programa de entrenamiento de DS durante seis semanas generó mayor hipertrofia en comparación a un programa de entrenamiento convencional de fuerza, aunque la magnitud de la ganancia de fuerza fue superior tras el entrenamiento convencional que tras el programa de entrenamiento de DS (convencional: 25.2 ± 17.5%, *ES* = 1.34; *DS*: 16.1 ± 12.1%, *ES* = 0.88). Esto implica que, aunque la hipertrofia sea uno de los factores que explican el aumento de la fuerza muscular (Folland & Williams, 2007), una mayor hipertrofia no garantiza ganancias de fuerza superiores (Fink et al., 2018; González-Badillo et al., 2022). Además, no hay evidencias suficientes que muestren una mayor hipertrofia al realizar entrenamientos de fuerza próximos al fallo muscular respecto a entrenamientos de fuerza realizados sin alcanzar el fallo muscular (Refalo et al., 2023). Por ello, en base a los resultados del presente estudio, y de acuerdo con las investigaciones anteriores, no parece aconsejable aplicar el entrenamiento de DS para mejorar la 1RM de jugadoras amateur de baloncesto, en tanto que se pueden obtener los mismos resultados con un entrenamiento de fuerza tradicional y menor volumen (es decir, menor número de series y repeticiones que con DS).

El baloncesto se caracteriza por la realización de diferentes movimientos verticales, tales como tiros en suspensión, mates, rebotes, y tapones (Gottlieb et al., 2014; Meckel & Gottlieb, 2009; Meckel et al., 2009). Por ello, las jugadoras de baloncesto necesitan aplicar la fuerza lo más rápidamente posible para producir movimientos verticales efectivos que faciliten la obtención de un adecuado rendimiento (Delextrat & Cohen, 2008). Los resultados del presente estudio muestran que el rendimiento en CMJ mejoró significativamente tras el entrenamiento de fuerza tradicional, el cual tuvo efectos significativamente superiores respecto a los obtenidos con el entrenamiento de DS. Además, fue la única prueba en la que pudimos demostrar que el rendimiento estuvo influenciado significativamente por el programa de entrenamiento (p = .001; ηp^2 = .376). Estudios previos sugieren que el potencial de transferencia del entrenamiento con ejercicios de fuerza a las acciones deportivas de alta intensidad no sólo está determinado por la carga relativa utilizada (% 1RM), sino que está influido por el grado de fatiga experimentado durante las series, el cual se asocia a la pérdida de velocidad de ejecución de cada serie (Rodríguez-Rosell et al., 2020). En este sentido, se ha demostrado que el entrenamiento de sentadilla con cargas de 70 - 85% 1RM es menos efectivo a la hora de inducir mejoras en el rendimiento en CMJ cuando se alcanza una pérdida de velocidad del 40 – 45% en comparación al 10 - 20% (Pareja-Blanco et al., 2017; Rodríguez-Rosell et al., 2020). Teniendo en cuenta que alcanzar una pérdida de velocidad del 40 – 45% en el ejercicio de sentadilla implica una proximidad al fallo muscular (Rodríguez-Rosell et al., 2020), y que el entrenamiento de DS se basa en realizar repeticiones adicionales hasta un nuevo fallo muscular (Angleri et al., 2020; Krzysztofik et al., 2019), parece que la fatiga acumulada durante el entrenamiento de DS resulta en adaptaciones no deseadas o interferencias negativas en el rendimiento en acciones de alta intensidad como los saltos.

El baloncesto también se caracteriza por la realización de aceleraciones y cambios de dirección (Gottlieb et al., 2014). De hecho, estas aceleraciones y cambios de dirección que realizan los jugadores de baloncesto se basan en movimientos horizontales (Meckel & Gottlieb, 2009; Meckel et al., 2009), por lo que un buen rendimiento en este deporte está determinado, en parte, por la capacidad realizar aceleraciones en el plano horizontal (Delextrat & Cohen, 2008). Los resultados obtenidos en el presente estudio indican que el trabajo de fuerza mejora la capacidad de aceleración en 10 m, un hallazgo que ya ha sido demostrado anteriormente (Young et al., 2001). Sin embargo, no se apreciaron diferencias en el rendimiento en 10 m tras realizar el entrenamiento de DS respecto al entrenamiento de fuerza tradicional. Al igual que en el rendimiento en CMJ, los resultados obtenidos en la capacidad de aceleración en 10 m pueden estar influenciados por el porcentaje de 1RM pero, también, por la fatiga experimentada durante las series de ambos programas de entrenamiento (es decir, pérdida de velocidad de ejecución), la cual se asocia al número de repeticiones. En este sentido, Rodríguez-Rosell et al. (2020) mostraron que un entrenamiento de fuerza realizado hasta disminuir un 10% la velocidad de ejecución de cada serie implica realizar menos de la mitad de las repeticiones que un entrenamiento realizado hasta la disminución del 30 % de velocidad de ejecución y un mayor incremento en el rendimiento de sprint en 20 m (-1.5% vs. 0.4%). Teniendo en cuenta que el entrenamiento de DS aumenta el tiempo en el que el músculo está sometido a tensión y la densidad de entrenamiento (Coleman et al., 2022; Schoenfeld & Grgic, 2018), no parece aconsejable aplicar el entrenamiento de DS cuando se pretende que jugadoras amateur de baloncesto mejoren la capacidad de aceleración en el plano horizontal, en tanto que se pueden obtener los mismos resultados con un entrenamiento de fuerza tradicional y menor volumen (es decir, menor número de series y repeticiones que con DS).

A pesar de los hallazgos obtenidos para mundo del entrenamiento en el baloncesto, esta investigación también tiene ciertas limitaciones. En primer lugar, el valor de 1RM puede cambiar durante el proceso de entrenamiento (González-Badillo et al., 2022), por lo que la carga de entrenamiento aplicada diariamente en este estudio pudo diferir del esfuerzo programado o pretendido. Además, la tendencia actual es determinar la 1RM a partir de la velocidad de ejecución de la primera repetición ejecutada a la máxima velocidad posible (González-Badillo et al., 2022), pero en el presente estudio 1RM no se pudo evaluar de esta manera.

Por ello, sería interesante replicar este estudio utilizando la velocidad de ejecución para monitorizar el entrenamiento de fuerza y la evaluación del valor de 1RM. En segundo lugar, aunque se consideró la carga de minutos durante las sesiones de entrenamiento y el diseño de las tareas era similar en ambos equipos, no se monitorizo la respuesta individual al esfuerzo, como pudiese haber sido mediante una escala de esfuerzo percibida (RPE). Por último, los resultados pueden estar condicionados por las características de la muestra y no ser extensibles a otras deportistas de características diferentes. Por ello, sería conveniente replicar este estudio en jugadores masculinos de baloncesto de similar nivel competitivo (amateur) y en jugadores masculinos y femeninos de mayor nivel (profesionales, élite). Una nueva investigación asociada que podría ser interesante consistiría en plantear en primer lugar el entrenamiento DS durante unas semanas y, posteriormente, aplicar el entrenamiento tradicional durante otro periodo. Por último, es preciso tener en cuenta que el diseño de este estudio fue cuasiexperimental, por lo que se recomienda replicar el estudio utilizando una muestra de mayor tamaño y con un grupo control.

Conclusiones

Los resultados muestran que tanto el entrenamiento tradicional como el entrenamiento de DS tuvieron un efecto significativo en el rendimiento en 1RM. Sin embargo, los efectos de ambos programas de entrenamiento en el rendimiento en 1RM fueron similares. Aunque el rendimiento en la prueba CMJ estuvo influenciado significativamente por el programa de entrenamiento, tampoco se apreciaron diferencias en el rendimiento en 10 m tras realizar el entrenamiento de DS respecto al entrenamiento de fuerza tradicional. De hecho, el entrenamiento de fuerza tradicional tuvo efectos significativamente superiores en el rendimiento en CMJ respecto a los obtenidos con el entrenamiento de DS. Estos resultados sugieren que, a pesar de una supuesta poca eficacia del entrenamiento con DS respecto al entrenamiento de fuerza tradicional a la hora de mejorar el rendimiento en acciones de salto y aceleración en jugadoras amateur de baloncesto, ambos entrenamientos pueden ser complementarios dentro de una planificación de 14 semanas en periodo competitivo al mantenerse los efectos producidos.

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Gender equality in women's professional sport. Progress and pending challenges

Igualdad de género en el deporte profesional femenino. Avances y retos pendientes

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Abstract

Despite the progress made in terms of gender equality in all areas, there are still numerous difficulties and challenges that professional athletes continue to face. In this regard, is important to determine if there are effective legal tools to achieve this equality in real and effective terms. To do that, we analyze the legal framework of employment relationship of professional athletes, with special reference to male and female sports collective agreements and the new Sports Law of December 30, 2022. As main results we found that there have been clear advances in this area. of equality in the sporting field, but there are still challenges to conquer. An example of this is that the regulatory instruments that specifically regulate the collective rights of professional athletes depend on the gender of worker. An aspect only occurs in sports and is especially striking. Furthermore, they appear insufficient. Especially in some sports disciplines that do not even have a female collective agreement that regulates the content of the employment relationship according to their sporting singularities.

Key words: Women, professional sport, collective agreements, equality.

Resumen

A pesar de los avances producidos en materia de igualdad de género en todos los ámbitos, aún son numerosas las dificultades y desafíos a los que se siguen enfrentando las deportistas profesionales. Por ello, es clave determinar si existen herramientas jurídicas eficaces para la consecución de esta igualdad en términos reales y efectivos. En el presente estudio se analiza el marco jurídico regulador de la relación laboral de las deportistas profesionales, con especial referencia a los convenios colectivos deportivos masculinos y femeninos y la nueva Ley del deporte de 30 de diciembre de 2022. Los principales resultados muestran que se han producido claros avances en materia de igualdad en el ámbito deportivo, pero aún quedan retos por conquistar. Un ejemplo de ello es que los instrumentos normativos que específicamente regulan los derechos colectivos de las personas deportistas profesionales difieren según el género de la persona trabajadora. Aspecto que tan sólo se da en el deporte y que resulta especialmente llamativo. Además, se muestran insuficientes. Especialmente en algunas disciplinas deportivas que ni siquiera cuentan con un convenio colectivo femenino que regule el contenido de la relación laboral de acuerdo con sus singularidades deportivas.

Palabras clave: Mujeres, deporte profesional, convenios colectivos, igualdad.

Introduction

Sport serves as a reflection of both the progress that has been made in society in terms of gender, as well as the inequalities and the road still to be travelled towards real and effective equality. This is due to the fact that women's participation in professional sport is still marked by the inequality and discrimination that has traditionally existed in this field, where the design and implementation of legislation, policies and public funds were constructed from an eminently male perspective, in accordance with traditional educational models or social stereotypes and gender roles, which have given rise to imbalances and glass ceilings for women in society and in working and sporting life (Vázquez Gómez & Alfaro, 2020).

Women's professional sport has been subject to discriminatory practices related to segregation; the pay gap; under-representation in management positions within sports organisations - 40% on the Board of Directors for Sports Federations -, which have indirectly resulted in a lower presence of women's sport in the media and greater obstacles to accessing economic resources, women's professional leagues or sponsorships (Torres & Mirón, 2020); non-existence of women's professional leagues, according to sporting disciplines; or sexual harassment (Association for Women in Professional Sport & Thomson Reuters Foundation, 2020, p. 17). All of these circumstances place these female workers at a clear disadvantage compared to their male counterparts.

In addition to the above, another of the difficulties that professional sportswomen have traditionally faced has been the compatibility between the development of their sporting careers and motherhood. Both in terms of reconciling work and family life, as in other areas of work, as well as pregnancy itself and the physiological changes produced by it (Hinojosa-Alcalde et al., 2023). This is a particularly singular issue in the professional sports field, where the body and physical capacities play a central role in the professional career.

Thus, it is worth referring to practices such as the denial of calls for training sessions, training camps or championships to others who are not pregnant or do not have children, or the most serious of these, the anti-pregnancy clauses that some clubs, governed exclusively by economic and profitability parameters, have been including in employment contracts, penalising pregnancy with non-compensated dismissal. This, under the premise of considering that pregnancy implies a loss of physical conditions that translates into worse sporting performances and a temporary interruption of the sporting career (Conde, 2018, p. 180). In other words, the physiological changes associated with pregnancy are penalised more, even if they are of a temporary nature, than others such as a sports injury, which can keep athletes away from the field of play for similar periods of time and with no guarantee of full recovery.

The existence of these actions, which obviously reduce the possibilities of competition and professional promotion of these sportswomen, has meant that many of them have had to face the dilemma of having children or continuing with their sporting careers and delaying the option of becoming a mother until they finally retire. As an example of this scenario, mention the case of women's football, where in 2017 only 2% of players were mothers compared to 47% who said they would do so when they left football, citing the lack of childcare services as an important reason for this decision (Fifpro, 2019, p. 40). Likewise, the experiences suffered by sportswomen such as the athlete and Olympic medallist Allyson Felix, the sailing Olympian Blanca Manchón, or the tennis player Serena Williams, among others, who suffered discriminatory experiences due to the fact that they chose to exercise their right to motherhood, either as a result of a contract termination, a worsening of working conditions, or because the rankings they had at the time of motherhood were not respected in the tournaments (El País, 2019).

It is therefore a fact that women's professional sport has traditionally been characterised by the widespread use of unlawful practices that have increased the discriminatory factors linked to maternity in comparison with other professional fields. Practices that, of course, violate women's fundamental right to equality in the framework of the employment relationship. This is even though maternity is an asset that is widely protected by both legislation and jurisprudence.

Thanks to the visibility of this problem and the numerous demands that have been made in this regard by many elite sportswomen and sports organisations, this panorama is fortunately beginning to change. In fact, there are more and more cases that show that compatibility between a sporting career and motherhood is possible. Among others: Maider Isarri, an Osasuna player, trained until the end of her pregnancy and returned the following season after a period of readaptation after giving birth; Teresa Portela and Ona Carbonell had to face great difficulties and challenges in order to make their recent maternity compatible with the Olympic Games (Morgado, 2022; Hidalgo, 2020); or Ana Peleteiro, who after her recent maternity and a 15-month break has played the 2023 European Games (McAlister & Aragón, 2023).

Likewise, the various initiatives promoted by different institutions - both governmental and non-governmental - as well as scientific activity itself, have contributed to the greater involvement and visibility of women in professional sport in order to make this problem visible and contribute to the promotion of women's sport (Castro-García & López-Villar, 2022; González et al., 2022).

In this line, special mention should be made of the Brighton Declaration of 1994, organised by the British Sports Council, supported by the International Olympic Committee, and signed by various sports organisations from

82 countries - both governmental and non-governmental - which has become a reference treaty in support of a fairer and more equitable system of sport. Today it updates the Brighton plus Helsinki Declaration, with the cooperation of more than 800 delegations from almost 100 countries (IWG Women&Sport, 2014).

In the same sense, ORDER PRE/525/2005, of 7 March, adopting measures to promote equality between women and men, which in the field of sport, established actions such as the creation of a permanent unit within the Consejo Superior de Deportes (CSD) to develop the Women and Sport programme; the signing of an agreement between the Consejo Superior de Deportes and the Instituto de la Mujer to promote women's sport; or the assignment to the Consejo Superior de Deportes to apply the principle of parity in all campaigns or exhibitions for the promotion of sport (at. 6).

Thus, in 2009, the CSD presented the Manifesto for Equality and the participation of women in sport, which pointed out the need to introduce the principle of equal opportunities as a maxim of quality in the management of all those institutions or entities related to physical activity and sport, urging the collaboration of all Sports Federations (Consejo Superior de Deportes, 2009).

Along the same lines, Organic Law 3/2007, of 22 March, for effective equality between women and men - hereinafter referred to as LOI - which, among other provisions in favour of gender equality, establishes the obligation for women's sport to be promoted, with a real opening up of sporting disciplines to women, through the development of public sports programmes that incorporate the effective consideration of this principle of equality between women and men.

It is therefore necessary to carry out an analysis of the legal framework applicable to the labour relations of women athletes from a gender perspective, with the aim of making further progress in the debate and raising awareness of the importance of the gender perspective in the labour rights of professional sportspersons. All of this, with special reference to the evolution that has been taking place in this regard through collective bargaining in some sporting disciplines.

The new Law 39/2022, of 30 December, on sport, from a gender perspective

There are several novelties introduced by the new Law 39/2022, of 30 December, on sport, which repeals the old and obsolete previous law, from 1990, whose precepts needed to be updated in accordance with the socio-economic reality that has been taking place in the field of sport since then.

Focusing on the object of this work, it is worth mentioning that, in contrast to the absence of references to the principle of equality and prohibition of discrimination on grounds of sex in the previous law, this law expressly recognises the right of all sportspeople to equal treatment and opportunities in the practice of sport, without any discrimination on any of the grounds considered discriminatory, including sex (art. 22.1. a). Furthermore, Article 4 sets out a specific framework for the promotion of effective equality in sport that urges public administrations to carry out public policies that guarantee equality in access to and practice of physical activity and sport, including in positions of responsibility, with the aim of achieving a balance between men and women in management bodies. It also includes the need to promote equality in terms of visibility in sporting events, without sexual objectification or sexist stereotypes.

The aim is to promote effective equality through policies that prevent, identify and sanction situations of discrimination against women carried out by sports entities in labour, sporting, administrative or any other kind of relations. In this way, it establishes the obligation for professional federations and leagues to draw up an annual report on equality - to be submitted to the Higher Sports Council, the Women's Institute, the Council for the Elimination of Racial or Ethnic Discrimination, as well as to the sportspersons' commissions created within the respective federation, associations and sportspersons' unions - as well as to have a prevention and action protocol for situations of discrimination, abuse and sexual or gender-based harassment, among others.

With regard to professional sport, it also regulates the consideration as null and void of any contractual clause that allows or favours the unilateral termination of the contract due to pregnancy or maternity of sportswomen which, as has already been said, has traditionally been one of the reasons that has most hindered the promotion and professional development of sportswomen who decided to opt for maternity. In other words, this new law adapts to the new sporting context and introduces measures that are in line with those stipulated by other regulatory instruments that have been adapting their provisions in accordance with the social advances made in the field of equality - as will be explained throughout this work. This was undoubtedly more than necessary.

In this regard, as measures aimed at reducing the loss of rights of sportswomen who decide to opt for maternity, the maintenance of voting rights in general assemblies is also recognised, as well as their rights as top-level sportswomen once this period has elapsed. In addition, Spanish sports federations and professional leagues are obliged to draw up a specific plan for work-life balance and co-responsibility with specific protection measures in cases of maternity and breastfeeding.

Likewise, and as it could not be otherwise, a sanctioning regime is set up that is updated to the current reality of sport. Thus, a set of infringements and sanctions are determined, whose public authority can be exercised by the

Spanish sports federations and professional leagues within the scope of their competences, in the same way as the Administrative Court of Sport in very specific cases referring to the commission of infringements by the governing bodies of the sports federations and professional leagues. In addition, a preventive mechanism is set up to favour transparency and exemplarity in the management of sport, through the code of good conduct for managers (Title VII).

Specifically, in terms of equality, it is regulated that any unilateral decision by sports entities that implies direct or indirect discrimination with respect to sportspersons to whom they are linked by an employment relationship constitutes a very serious infringement (104.2 i) punishable according to the provisions of the Law on Infringements and Penalties in the Social Order (hereinafter LISOS).

Results

Legal framework of the employment relationship of sportspersons from a gender perspective. Special reference to collective bargaining

The starting point for the analysis of this employment relationship is the definition that Law 39/2022, of 30 December, on Sport itself makes of professional sportspersons, which includes those who voluntarily and habitually engage in sporting activity and are remunerated for it, whether or not they are subject to a special employment relationship as professional sportspersons. In other words, it includes both employed and self-employed persons.

However, this paper will focus on those who carry out this professional sporting activity within the framework of an employment relationship, according to the terms that will be developed along the following lines, whose governing regulation is the Royal Legislative Decree 2/2015, of 23 October, which approves the revised text of the Workers' Statute Law (Estatuto de los Trabajadores in Spanish) -hereinafter ET-.

In line with the above, it is necessary to consider the classification that the ET makes of this employment relationship of professional sportspersons (art. 2), whose consideration as a special relationship implies its regulation by means of a specific body of legislation, in accordance with the singularities of this field of work. Thus, the legal instrument of reference to be examined is Royal Decree 1006/1985, of 26 June 1985, which regulates the special employment relationship of professional sportspersons, with special reference to its scope of application.

In this regard, it should be noted that the purpose of this rule is to regulate the special employment relationships of professional sportspersons, defined as those who, by virtue of a regularly established relationship, voluntarily engage in the practice of sport on behalf of and within the scope of the organisation and management of a sports club or entity in exchange for remuneration (art. 1). In other words, it regulates those employment relationships that are established on a regular basis between the sportsperson and the sports club or entity, as well as between sportspersons and firms or with companies whose corporate purpose consists of organising sporting events, provided that they comply with the labour-related characteristics that define and delimit the scope of employment relationships (art. 1.1. ET). This, also bearing in mind that this includes all work and labour with a direct connection to and impact on the sporting results obtained. In other words, both sportspersons and those who form part of the technical staff -coach, physical trainer, physical trainer, injury rehabilitation, etc., who carry out their activity on a regular basis- are included within its scope of application (Aznar, 2019).

On the other hand, specific relationships such as those occurring in sports like golf, where a company organises an open and, by way of a claim and/or exhibition, invites a player to participate in exchange for a financial payment, but the relationship between the two ends at the end of the event, would be excluded. Likewise, relationships established between athletes and National Federations - whether national, provincial, regional, etc. - through the integration of teams - representations or selections - organised by them. Likewise, the so-called "compensated amateurs", who are those people who carry out a sporting activity but do not receive a salary, but rather compensation to cover the expenses derived from the practice (Mercader, 2016).

However, it should be noted that due to the numerous references that this Royal Decree makes to the ET and other generally applicable labour regulations, which are supplementary to the provisions of the Royal Decree (art. 21), the study of the legal regime regulating these professional relations from a gender perspective includes the study of other bodies of law such as collective agreements, where they exist, and the general rules on employment discrimination. This, bearing in mind that it is precisely in this question, that of referring to collective agreements, where part of the problems of inequality in professional sport are to be found. Given that in Spain we do not have many of them. This aspect will be developed in greater detail in the following pages.

In contrast, it should be noted that the provisions of these legal texts make little use of inclusive language as a legal formulation. Thus, instead of using, for example, the reference to "the special employment relationship of female sports workers", "female workers" or "leave of absence to care for children", the traditional masculine form is used to refer to both sexes (it is important to notice that in Spanish there are masculine and feminine forms for verbs, names and articles, and the laws mentioned are written in Spanish). In fact, only some provisions of the ET -such as those relating to the consideration of the nullity of the termination of the contract produced in the context

of circumstances associated with the birth and care of a child (art 55), among others-, which were modified by Royal Decree-Law 6/2019, of 1 March, on urgent measures to guarantee equal treatment and opportunities between women and men in employment and occupation, do so. In this sense, it would have been advisable for this text to have modified these provisions throughout the entire labour legislation, rather than only with respect to some of them.

Legal framework for gender equality in the workplace

The principle of gender equality and non-discrimination as a universal right is enshrined in various international and domestic legal provisions. As far as the domestic legal system is concerned, the Spanish Constitution of 1978 itself proclaims the principle of equality and non-discrimination on grounds of sex in Article 14, while establishing the obligation of the public authorities to promote the conditions for equality to be real and effective (Article 9.2.). This recognition is complemented by other specific provisions on gender equality such as the LOI of 2007, which establishes specific actions and positive actions to avoid situations of discrimination based on sex in all spheres of life (arts. 1-2).

This recognition implies the right of all persons to equal treatment and opportunities and the absence of any discrimination on grounds of gender. Or, to put it another way, it implies that equal cases are treated identically in their legal consequences, so that if there are differences there is sufficient justification in terms of reasonableness and proportionality, with the burden of proof falling on the person who assumes the defence of the same SSTC 126/1997, of 3 July -rec.661/96-, FJ 8; 3/2007, of 15 January). Likewise, discrimination can occur both directly and indirectly.

In this sense, the LOI defines direct discrimination on grounds of sex as "the situation in which a person is, has been or could be treated less favourably than another person in a comparable situation because of his or her sex" (art. 6.1.). Also, any scenario of gender-based harassment, understood as "any conduct conducted on the basis of sex with the purpose or effect of violating the dignity of a person and of creating an intimidating, degrading or offensive environment" (Art. 7), or "any unfavourable treatment of women related to pregnancy or maternity" (Art. 8). This is in line with case law, which states that the protection of the biological condition and health of the worker must be compatible with the preservation of her professional rights, so that the undervaluing or prejudice caused by pregnancy or subsequent maternity constitutes a case of direct discrimination on grounds of sex (STC 182/2005, 4 July -rec. 2447/2002-).

However, cases of discrimination are not limited to the above, but extend to those situations or provisions which, although apparently neutral, place persons of one sex at a particular disadvantage compared to persons of the other, unless such differentiation can be objectively justified by a legitimate aim and the means of achieving that aim are necessary and appropriate (Art. 6.2. LOI; (SSTJCE of 27 June 1990, Kowalska case; 9 February 1999, Seymour-Smith and Laura Pérez case; SSTC 145/1991, of 1 July -rec. 175/89-; 240/1999, of 20 December -rec. 2897/95-). This case could include the impact that certain labour rights or apparently neutral business decisions have on the employment of female workers, as is the case with the exercise of the right to conciliate work and family life. This is due to the fact that rights such as reduced working hours, leave of absence for childcare or other suspensions of the employment contract can have repercussions on aspects of the employment relationship such as professional promotion, salary or the amount of a future retirement pension (Maldonado, 2019).

Likewise, any adverse treatment or prejudice suffered by a person because of the presentation of a complaint, claim, denunciation, lawsuit, or appeal aimed at avoiding discrimination is considered discrimination on the grounds of gender (art. 9 LOI).

Finally, and regarding the legal consequences and guarantees for those who are subject to situations of gender discrimination, it should be noted that both the LOI (Art. 10) and, about the labour sphere, the ET (Arts. 17.1 and 55.5), establish the nullity of acts, clauses or business decisions that lead to direct or indirect discrimination on the grounds of gender. Thus, actions such as the dismissal of a worker who is pregnant or who exercises her rights to conciliation can be classified as fair or null and void, but never unfair, depending on their causality (STS (Social), 25 January 2013 -rec. 1144/2012- (Casas, 2017).

Collective agreements in women's professional sport

As mentioned above, the constant references made by the 1985 RD to other supplementary rules such as collective bargaining agreements are part of the problem of inequality in professional sport since, to date, Spain does not have many of them.

Specifically, at national level, only five sports can boast of having a collective agreement - basketball (IV Collective Agreement for professional basketball ACB, 3 March 2021), cycling (Collective Agreement for professional cycling, 17 March 2010), football (Collective Agreement for professional football, 23 November 2015), handball (IV Collective Agreement for professional handball, 11 January 2017) and futsal (Collective Agreement for futsal, 22 March 2017). Meanwhile, in other sports we can find collective agreements of clubs or entities for their sport discipline.

These state collective agreements, as in the case of ordinary employment relationships, regulate aspects relating to employment, economic conditions, working hours, rest periods, holidays and other special leave,

among others. However, it is fair to point out that insofar as these provisions apply to the professional relations between players and clubs or sports entities attached to the corresponding sports league depending on the discipline, we are faced with the problem that the employment relations are or are not regulated by these specific legal instruments depending on the existence or not of these leagues.

Well, if we consider the general non-existence of women's professional leagues and the fact that, if they do exist, these agreements do not include them in their scope of application, as they only include men's leagues, we find that in practice these regulatory provisions do not govern the employment relations of sportswomen. Even the basketball collective bargaining agreement expressly limits its personal scope of application to "players participating in professional men's basketball competitions" (Art. 4).

This exclusion has meant that in recent years sportswomen have been demanding their own collective bargaining agreements, which have been approved in the areas of basketball and football. Thus, women's sport, to date, has the Collective Agreement for the professional basketball activity of the Women's League organised by the Spanish Basketball Federation (agreement code no. 9916915), which was signed on 22 October 2007, and the Collective Agreement for women footballers who provide their services in the first division of women's football clubs (agreement code no. 99100245012020), which was signed on 31 July 2020.

Thus, until the negotiation of these women's collective agreements, the employment relationships of these sportswomen, who performed the same work activity as their male counterparts, were without a collective agreement to regulate numerous aspects relating to the employment relationship. The same scenario is currently found in the rest of women's sporting disciplines, which have no agreements. And even in these disciplines, depending on the level at which the sporting activity is carried out, as is the case with women's second division footballers.

Therefore, we are faced with the peculiarity that the legal instruments governing each sporting discipline are distinguished according to the gender of the worker. This only occurs in the field of sport, as in the rest of labour relations the delimitation of the personal scope of a collective agreement does not include any criteria linked to gender (UGT, 2015).

Discussion

A step towards equality or towards the perpetuation of inequality?

A comparison between the collective agreements for men and women in the sports disciplines that have such instruments for both sexes, i.e. basketball and first division football, highlights issues such as the different minimum annual remuneration set in each, or the different amounts of compensation in the event of death or absolute permanent incapacity at work, which is higher in the case of the men's agreements. Likewise, the different provisions on annual leave in the case of basketball, with 45 calendar days of annual leave in the case of men as opposed to 30 in the case of women. Special mention should be made of the guarantees that both agreements establish in terms of reconciling work and family life or pregnancy, since, as has been stated, there are numerous situations of gender discrimination in this area.

With regard to work-life balance, both women's agreements, unlike the men's, add a specific section dedicated to it. In the case of basketball, a commitment is established on the part of the club, entity or sports limited company to finance, even if only in part, the custody of children under 8 years of age or the costs generated by having to look after parents or relatives. In addition, it is stated that the possibility of part-time employment shall be facilitated (Art. 34). The football agreement, on the other hand, merely makes a generic reference to the fact that "both parties undertake to make their best efforts to adopt appropriate measures to reconcile the family and professional life of the football player" (Art. 39). A legal formula which, given its generic and unspecific content, subject to the understanding between both parties and "their best efforts", seems insufficient for the sake of legal certainty for the worker and could be improved.

Undoubtedly, the establishment of any measure that favours work-family reconciliation must be considered positive and represents a step forward from the perspective of decent work. However, it should also be noted that the fact that they are only referred to in the case of women and not men is a sign of the still sexist nature of gender roles, where it is taken for granted that women are the ones who take on all aspects of family care. It is for this reason that, apart from the fact that, as has been pointed out, any stipulation that facilitates this aspect is a step towards achieving greater quality of work, from a perspective that protects fundamental rights, equality would be achieved by establishing this type of measure in a regime of co-responsibility in the agreements of both genders.

Of course, the fact that collective agreements for men do not expressly refer to the reduction of working hours linked to reconciling work and family life does not mean that there is no such right, since everything not provided for in them is governed by the supplementary legislation, i.e. the Royal Decree of 1985, and failing that, the ET, which recognises it indistinctly for workers of both sexes (art. 37.6.). However, it cannot be ignored that any specific provision in a collective agreement which takes into account the peculiarities of each work activity, as opposed to the generic reference made in the ET for all professions regardless of their nature, translates into a greater possibility of reconciliation. In other words, in practice, this means that if two parents

involved in professional basketball, a man and a woman, have to decide who will opt for a reduction in working hours, even to the detriment of their professional career, it is more likely that it will be the woman who does so, as her collective agreement contains specific tools that favour this situation in accordance with the particularities of this professional sport.

On the other hand, and in this case with regard to pregnancy and other measures for the protection of women, it is worth mentioning that the football agreement is more protective than the basketball agreement. This is due to the fact that the former establishes mechanisms aimed at protecting cases of gender violence and harassment, such as: the adaptation of the timetable within the club's possibilities; financial aid; psychological support; or the inclusion of a harassment prevention protocol as an annex to the agreement itself. Likewise, with regard to the protection of sportswomen and maternity, it establishes that when pregnancy occurs during the last season of the contract, the sportswoman will be able to choose between renewing her contract for an additional season, under the same conditions as before, or not renewing it. This provision is close to the provisions of FIFA in order to protect the continuity of the professional career of the footballer and to avoid the existing problem of anti-pregnancy clauses.

It goes without saying that insofar as these employment relationships are also governed by the rest of the labour legislation that is not incompatible, the guarantees provided by the ET and equality legislation are applicable. Therefore, even if no specific provision is made in these agreements, any discriminatory act such as the establishment of anti-pregnancy clauses in the employment contract will be considered null and void (arts. 17.1. and 55.5. ET). In other words, the dismissal of a sportswoman whose only cause is pregnancy could be judicially declared null and void - through the ordinary procedure or the special procedure for the protection of fundamental rights (art. 177 to 184 Ley Reguladora de la Jurisdicción Social -LRJS-), which results in the cessation of the discriminatory act and possible compensation for the damages caused.

In addition to this, another means of protection available to the worker is the possibility of requesting the termination of the employment relationship with compensation, under the protection of the provisions of art. 50.1. a), designed to protect the worker against substantial changes in working conditions that undermine their dignity. There is also the possibility of resorting to administrative channels by means of a complaint to the Labour and Social Security Inspectorate.

Similarly, the application of labour legislation allows clubs that make use of discriminatory practices to be sanctioned for committing a very serious offence (art. 8.12. LISOS). Even in criminal proceedings, through Article 314 of the Criminal Code - Organic Law 10/1995, of 23 November, of the Criminal Code -, with a prison sentence of six months to two years or a fine of 12 to 24 months, if after a warning or administrative sanction the situation of equality is not restored and the economic damage caused is not repaired. Likewise, through article 512, which condemns those who, in the exercise of professional or business activities, deny a person a benefit to which they are entitled for discriminatory reasons, including gender, with a penalty of special disqualification from the exercise of a profession, trade, industry or commerce for one to four years.

Despite these systems of protection, the practical problem that arises in relation to the use of discriminatory practices is to be found in relation to their proof, because although an anti-pregnancy clause expressly provided for in the contract does not pose a problem in this aspect, it is different in the case where discrimination is produced by indirect acts such as the denigration of those sportswomen who exercise maternity compared to those who do not.

It is undeniable that the inclusion of these clauses in the women's football agreement - the basketball agreement makes no mention of them whatsoever - are completely new and essential in order to move towards effective equality for women in sport. However, it is also true that they seem insufficient, especially with regard to the protection of pregnancy. In fact, it is striking that the only mention of this is in the case of football and, moreover, with only a generic article that gives rise to numerous interpretative doubts as to the concreteness and scope of the protective measures. Accordingly, these are tools which, on the one hand, represent a great first step towards material equality in sport and, on the other hand, reflect the still existing inequalities between women and men in professional sport, whose employment relationship is governed by different normative instruments, with different content, exclusively as a consequence of the gender of one or the other. This is only the case in the field of sport.

Conclusions

Women's professional sport is growing steadily worldwide in terms of both participation and competitiveness. However, there is still a long way to go to achieve real and effective equality.

The new law on sport is a clear advance in terms of gender equality in sport compared to the previous law, which made no reference to this aspect. Although the labour regime described is somewhat generic, the fact that any violation of the principle of equality, whether directly or indirectly, is expressly defined as a very serious offence is a great step forward towards reducing and eliminating the abusive practices that professional sportswomen have traditionally suffered. It remains to be seen how effectively this is monitored and whether real sanctions will be imposed if such behaviour continues to occur.

However, an example of the challenges that are still pending in terms of equality in this area is the fact that we are faced with a scenario in which the regulatory

instruments that specifically regulate the collective rights of professional sportspersons differ according to the gender of the worker. This is an aspect that only occurs in sport and is undoubtedly particularly striking. Even more so, taking into account that in recent years, in line with the progress that has been made in terms of gender equality in society, the trend has been to eliminate any reference to gender in the regulation of a right in favour of an inclusive language formula. Moreover, it should be noted that these collective agreements are proving to be insufficient. Especially in some women's sports disciplines that do not even have these normative instruments or regulations such as the one approved by FIFA in 2021.

Raising awareness of this problem of discrimination has been and continues to be a fundamental tool for change, as it urges both the establishment of measures to promote and support professional women's sport and the use of the law as a vehicle for equality. For this reason, any initiative carried out in this sense becomes an instrument that contributes to the sustainability and growth of this field of sport and to the achievement of a fairer and more equitable society.

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Igualdad de género en el deporte profesional femenino. Avances y retos pendientes

Gender equality in women's professional sport. Progress and pending challenges

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Resumen

A pesar de los avances producidos en materia de igualdad de género en todos los ámbitos, aún son numerosas las dificultades y desafíos a los que se siguen enfrentando las deportistas profesionales. Por ello, es clave determinar si existen herramientas jurídicas eficaces para la consecución de esta igualdad en términos reales y efectivos. En el presente estudio se analiza el marco jurídico regulador de la relación laboral de las deportistas profesionales, con especial referencia a los convenios colectivos deportivos masculinos y femeninos y la nueva Ley del deporte de 30 de diciembre de 2022. Los principales resultados muestran que se han producido claros avances en materia de igualdad en el ámbito deportivo, pero aún quedan retos por conquistar. Un ejemplo de ello es que los instrumentos normativos que específicamente regulan los derechos colectivos de las personas deportistas profesionales difieren según el género de la persona trabajadora. Aspecto que tan sólo se da en el deporte y que resulta especialmente llamativo. Además, se muestran insuficientes. Especialmente en algunas disciplinas deportivas que ni siquiera cuentan con un convenio colectivo femenino que regule el contenido de la relación laboral de acuerdo con sus singularidades deportivas.

Palabras clave: Mujeres, deporte profesional, convenios colectivos, igualdad.

Abstract

Despite the progress made in terms of gender equality in all areas, there are still numerous difficulties and challenges that professional athletes continue to face. In this regard, is important to determine if there are effective legal tools to achieve this equality in real and effective terms. To do that, we analyze the legal framework of employment relationship of professional athletes, with special reference to male and female sports collective agreements and the new Sports Law of December 30, 2022. As main results we found that there have been clear advances in this area. of equality in the sporting field, but there are still challenges to conquer. An example of this is that the regulatory instruments that specifically regulate the collective rights of professional athletes depend on the gender of worker. An aspect only occurs in sports and is especially striking. Furthermore, they appear insufficient. Especially in some sports disciplines that do not even have a female collective agreement that regulates the content of the employment relationship according to their sporting singularities.

Key words: Women, professional sport, collective agreements, equality.

Introducción

El deporte sirve de reflejo tanto de los avances que en la sociedad se vienen produciendo en materia de género, como de las desigualdades y el camino que aún queda por recorrer en aras de una igualdad real y efectiva. Ello, debido a que la participación de la mujer en el deporte profesional aún a día de hoy sigue marcada por la desigualdad y discriminación que tradicionalmente ha existido en este ámbito, donde el diseño e implementación de legislación, políticas y fondos públicos fueron construidos desde una perspectiva eminentemente masculina, de acuerdo con los tradicionales modelos educativos o los estereotipos sociales y roles de género, que han venido dando lugar a desequilibrios y techos de cristal para la mujer en la sociedad y en la vida laboral y deportiva (Vázquez Gómez & Alfaro, 2020).

El deporte profesional femenino ha venido siendo objeto de prácticas discriminatorias relacionadas con la segregación; la brecha retributiva; la infrarrepresentación en cargos directivos dentro de las organizaciones deportivas –un 40% en la Junta Directiva para las Federaciones Deportivas-, que indirectamente se han traducido en una menor presencia del deporte femenino en los medios de comunicación y mayores obstáculos para el acceso a recursos económicos, ligas profesionales femeninas o patrocinios (Torres & Mirón, 2020); inexistencia de ligas profesionales femeninas, según disciplinas deportivas; o el acoso sexual (Asociación para Mujeres en el Deporte Profesional y Fundación Thomson Reuters, 2020, p. 17). Circunstancias todas ellas que sitúan a estas trabajadoras en una clara posición de desventaja con respecto a sus homólogos masculinos.

Junto a lo anterior, otra de las dificultades a la que tradicionalmente se han venido enfrentando las deportistas profesionales ha sido la relativa a la compatibilización entre el desarrollo de la carrera deportiva y la maternidad. Tanto en lo concerniente a cuestiones de conciliación laboral y familiar, al igual que en otros ámbitos laborales, como al propio embarazo y los cambios fisiológicos producidos por el mismo (Hinojosa-Alcalde et al., 2023). Cuestión ésta de especial singularidad en el ámbito deportivo profesional, dónde el cuerpo y las capacidades físicas juegan un papel central en la carrera profesional.

Así, cabe hacer referencia a prácticas como el ninguneo con relación a llamamientos a entrenamientos, concentraciones o campeonatos sobre otras que no están embarazadas o no tienen hijos/as, o la más grave de ellas, las cláusulas antiembarazo que algunos clubs, regidos exclusivamente bajo parámetros economicistas y de rentabilidad, han venido incluyendo en los contratos de trabajo, penalizando el embarazo con el despido no indemnizado. Esto, bajo la premisa de considerar que el embarazo implica una pérdida de las condiciones físicas que se traduce en peores marcas deportivas y en una interrupción temporal de la carrera deportiva (Conde, 2018, p. 180). Es decir, se penalizan más los cambios fisiológicos asociados al embarazo, aun siendo de naturaleza temporal, que otros como una lesión deportiva, que puede apartar a las deportistas del terreno de juego durante tiempos similares y sin garantías de recuperación completa.

La existencia de estas actuaciones, que obviamente merman las posibilidades de competición y promoción profesional de estas deportistas, ha ocasionado que muchas de ellas hayan tenido que enfrentarse a la disyuntiva entre ejercer la maternidad o continuar con la carrera deportiva y retrasar la opción de ser madre hasta la retirada definitiva. Como ejemplo de este panorama, mencionar el caso del fútbol femenino, donde en el año 2017 tan sólo el 2% de las jugadoras eran madres frente al 47% que dijo que lo harían cuando dejaran el fútbol, alegando como razón importante de esta decisión la falta de servicios de cuidado de menores (Fifpro, 2019, p. 40). Igualmente, las experiencias padecidas por deportistas como la atleta y medallista olímpica Allyson Felix, la olímpica de vela Blanca Manchón, o la tenista Serena Williams, entre otras, que sufrieron experiencias discriminatorias por el hecho de haber optado por ejercer su derecho a la maternidad, bien como consecuencia de una rescisión del contrato, de un empeoramiento de las condiciones de trabajo, o de no haberse respetado en los torneos los rankings que tenían al momento de la maternidad (El País, 2019).

Luego, es un hecho que el deporte profesional femenino tradicionalmente se ha protagonizado por el uso generalizado de prácticas contrarias a derecho que han incrementado los factores discriminatorios vinculados a la maternidad con respecto a otros ámbitos profesionales. Prácticas que, por supuesto, vulneran el derecho fundamental a la igualdad de la mujer en el marco de la relación laboral. Esto a pesar de que la maternidad es un bien ampliamente protegido tanto por la legislación como por la doctrina jurisprudencial.

Gracias a la visibilización de esta problemática y a las numerosas reivindicaciones que en este sentido se han venido haciendo por parte de numerosas deportistas de élite y organizaciones deportivas, este panorama afortunadamente está comenzando a cambiar. De hecho, cada vez son más los casos que muestran que la compatibilidad entre carrera deportiva y maternidad son posibles. A saber, entre otras: la deportista Maider Isarri, jugadora del Osasuna, estuvo entrenando hasta el final del embarazo y se reincorporó en la temporada siguiente tras un periodo de readaptación al dar a luz; Teresa Portela y Ona Carbonell tuvieron que enfrentarse a grandes dificultades y retos para compatibilizar su reciente maternidad con los JJOO (Hidalgo, 2020; Morgado, 2022); o Ana Peleteiro, que tras su reciente maternidad y un paréntesis de 15 meses ha jugado los juegos europeos de 2023 (McAlister y Aragón, 2023).

Igualmente, han contribuido a la mayor intervención y visibilidad de la mujer en el deporte profesional las diversas iniciativas impulsadas, tanto desde distintas institu-

ciones -tanto gubernamentales como no gubernamentales- como de la propia actividad científica, para visibilizar esta problemática y contribuir a la promoción del deporte femenino (Castro-García & López-Villar, 2022; González et al., 2022).

En esta línea, especial mención merece la Declaración de Brighton de 1994, organizada por el Consejo de Deportes Británico, apoyada por el Comité Olímpico Internacional, y suscrita por diversas organizaciones deportivas de 82 países -tanto gubernamentales como no gubernamentales-, que se ha convertido en un tratado de referencia en el apoyo hacia un sistema de deporte más justo y equitativo. Hoy día actualizada a la Declaración de Brighton más Helsinki, con la cooperación de más de 800 delegaciones de casi 100 países (IWG Women&Sport, 2014).

En el mismo sentido, la ORDEN PRE/525/2005, de 7 de marzo, por la que se adoptan medidas para favorecer la igualdad entre mujeres y hombres, que en lo que respecta al ámbito deportivo, estableció acciones como la creación de una unidad con carácter permanente dentro del Consejo Superior de Deportes (CSD) para desarrollar el programa Mujer y Deporte; la firma de un convenio entre el Consejo Superior de Deportes y el Instituto de la Mujer para promover el deporte femenino; o la encomienda al Consejo Superior de Deportes de aplicar el principio de paridad en todas las campañas o exposiciones para el fomento del deporte (art. 6).

De esta manera, el CSD ya en el año 2009 presentó el Manifiesto por la Igualdad y la participación de la mujer en el deporte, con el que se apuntaba la necesidad de introducir el principio de igualdad de oportunidades como una máxima de calidad en la gestión de todas aquellas instituciones o entidades relacionadas con la actividad física y el deporte, instando a la colaboración de todas las Federaciones Deportivas (Consejo Superior de Deportes, 2009).

Asimismo, la Ley Orgánica 3/2007, de 22 de marzo, para la igualdad efectiva entre mujeres y hombres -de ahora en adelante LOI- que, entre otras previsiones en pro de la igualdad de género a las que más adelante se hará mayor mención, establece la obligatoriedad de que el deporte femenino sea promovido, con una apertura real de las disciplinas deportivas a las mujeres, mediante el desarrollo de programas públicos de deporte que incorporen la efectiva consideración de este principio de igualdad entre mujeres y hombres.

Así las cosas, resulta preciso realizar un análisis del marco jurídico aplicable a las relaciones laborales de la mujer deportista desde una perspectiva de género, con el objetivo de seguir avanzando en el debate y visibilización de la importancia de la perspectiva de género en los derechos laborales de las personas deportistas profesionales. Todo ello, con especial referencia a la evolución que en este sentido se viene produciendo a través de la negociación colectiva en algunas disciplinas deportivas.

La nueva Ley 39/2022, de 30 de diciembre, del Deporte desde una perspectiva de género

Son diversas las novedades introducidas por la nueva Ley 39/2022, de 30 diciembre, del deporte, que deroga la antigua y obsoleta ley precedente, del año 1990, cuyos preceptos precisaban ser actualizados conforme a la realidad socioeconómica que desde entonces se ha venido produciendo en el ámbito deportivo.

Centrándonos en el objeto de este trabajo, cabe hacer mención a que, frente a la ausencia de referencias al principio de igualdad y prohibición de discriminación por razón de sexo de la norma precedente, esta ley expresamente reconoce el derecho a todas las personas deportistas a la igualdad de trato y oportunidades en la práctica deportiva, sin discriminación alguna por cualquiera de las causas consideradas discriminatorias, entre las que se incluye el sexo (art. 22.1. a). Además, en su artículo 4 configura un marco específico de promoción de la igualdad efectiva en el deporte que insta a las Administraciones Públicas a llevar a cabo políticas públicas que garanticen la igualdad en el acceso y práctica de la actividad física y el deporte, incluso en los puestos de responsabilidad, con el objetivo de que exista un equilibrio entre la presencia masculina y femenina en los órganos directivos. También se recoge la necesidad de impulsar la igualdad en términos de visibilidad en los eventos deportivos, sin que pueda existir cosificación sexual o estereotipos sexistas.

Se pretende promocionar la igualdad efectiva mediante políticas que prevengan, identifiquen y sancionen las situaciones de discriminación hacia las mujeres llevadas a cabo por las entidades deportivas en las relaciones laborales, deportivas, administrativas o de cualquier clase. De esta manera, se establece la obligatoriedad de que las federaciones y ligas profesionales realicen un informe anual en materia de igualdad -será elevado al Consejo Superior de Deportes, Instituto de las Mujeres, Consejo para la Eliminación de la Discriminación Racial o Étnica, así como a las comisiones de deportistas creadas en el seno de la respectiva federación, asociaciones y sindicatos de deportistas-, así como de que cuenten con un protocolo de prevención y actuación para situaciones de discriminación, abusos y acoso sexual o por razón de sexo, entre otras.

Con respecto al deporte profesional, se regula además la consideración de nulidad de pleno derecho de cualquier cláusula contractual que permita o favorezca la rescisión unilateral del contrato por razón de embarazo o maternidad de las deportistas que, como ya se ha dicho, tradicionalmente ha venido siendo uno de los motivos que más ha obstaculizado la promoción y desarrollo profesional de las deportistas que decidían optar por la maternidad. Es decir, esta nueva ley se adapta al nuevo contexto deportivo e introduce medidas que se encuentran en línea con las estipuladas por otros instrumentos normativos que han ido adaptando sus disposiciones conforme a los avances sociales producidos en materia de igualdad -tal y como se

expondrá a lo largo de este trabajo-. Algo que sin duda era más que necesario.

En este orden de cosas, como medidas que pretenden reducir la merma de derechos de las deportistas que deciden optar por la maternidad, se reconocen también el mantenimiento del voto en las asambleas generales, así como los derechos como deportistas de alto nivel una vez transcurrido este periodo. Además, las federaciones deportivas españolas y las ligas profesionales quedan obligadas a elaborar un plan específico de conciliación y corresponsabilidad con medidas concretas de protección en los casos de maternidad y lactancia.

Igualmente, y como no puede ser de otro modo, se configura un régimen sancionador actualizado a la realidad actual del deporte. Así, se determinan un conjunto de infracciones y sanciones, cuya potestad pública pueden ejercer las federaciones deportivas españolas y las ligas profesionales en el ámbito de sus competencias, de la misma manera que el Tribunal Administrativo del Deporte en supuestos muy concretos referidos a la comisión de infracciones por los órganos directivos de las federaciones deportivas y las ligas profesionales. Además, se configura un mecanismo preventivo para favorecer la transparencia y ejemplaridad en la gestión del deporte, a través del código de buena conducta para las personas dirigentes (título VII).

Concretamente, en materia de igualdad se regula que cualquier decisión unilateral de las entidades deportivas que impliquen discriminaciones directas o indirectas respecto de las personas deportistas con las que estén vinculadas por una relación laboral, constituye una infracción de carácter muy grave (104.2. i) sancionable según lo previsto por la Ley de Infracciones y Sanciones en el Orden Social -de ahora en adelante LISOS-.

Resultados

Marco jurídico de la relación laboral de las personas deportistas desde una perspectiva de género. Especial referencia a la negociación colectiva

El punto de inicio del análisis de esta relación laboral se sitúa en la definición que la propia Ley 39/2022, de 30 de diciembre, del Deporte realiza de las personas deportistas profesionales, que incluye a quienes se dediquen voluntaria y habitualmente a la actividad deportiva y sean remunerados por ello, estén o no sujetos a una relación laboral especial de deportista profesional. Es decir, incluye tanto a quienes realizan la actividad por cuenta ajena como propia.

Si bien, este trabajo se dedicará a quienes realizan esta actividad deportiva profesional en el marco de una relación laboral, según los términos que se desarrollarán a lo largo de las siguientes líneas, cuya norma rectora es el Real Decreto Legislativo 2/2015, de 23 de octubre, por el que se aprueba el texto refundido de la Ley del Estatuto de los Trabajadores -de ahora en adelante ET-.

En línea con lo anterior, es preciso atender a la catalogación que el ET realiza de esta relación laboral de las personas deportistas profesionales (art. 2), cuya consideración como relación de carácter especial implica su regulación mediante un cuerpo normativo específico, de acuerdo con las singularidades de este ámbito de trabajo. De esta manera, el instrumento jurídico de referencia a examinar es el Real Decreto 1006/1985, de 26 de junio, por el que se regula la relación laboral especial de los deportistas profesionales, sobre el que cabe hacer especial mención a su ámbito de aplicación.

Sobre este aspecto, hay que señalar que esta norma tiene por objeto la regulación de las relaciones especiales de trabajo de las personas deportistas profesionales, definidas como aquellas que, en virtud de una relación establecida con carácter regular, se dediquen voluntariamente a la práctica del deporte por cuenta y dentro del ámbito de organización y dirección de un club o entidad deportiva a cambio de una retribución (art. 1). Es decir, regula aquellas relaciones laborales que de forma regular se establezcan entre la persona deportista y el club o entidad deportiva, así como entre deportistas y firmas o con empresas cuyo objeto social consista en la organización de espectáculos deportivos, siempre y cuando se cumplan con las notas de laboralidad que definen y delimitan el ámbito de las relaciones laborales (art. 1.1. ET). Esto, teniendo además presente que en este sentido se incluye a todo trabajo y labor con conexión directa e incidencia en los resultados deportivos obtenidos. Es decir, se encuentran dentro de su ámbito de aplicación tanto las personas deportistas como aquellas que forman parte del cuerpo técnico -entrenador/a, preparador/a físico/a, readaptador/a de lesiones, etc, que realicen su actividad con carácter regular (Aznar, 2019).

Por el contrario, las relaciones puntuales como las acaecidas en deportes como el golf, donde una empresa organiza un open y, a modo de reclamo y/o exhibición, invita a un jugador/a a participar a cambio de una percepción económica, pero la relación entre ambos finaliza al término del evento, quedarían excluidas. Igualmente, las relaciones establecidas entre deportistas y Federaciones Nacionales -tanto nacionales, como provinciales, regionales, etc.- a través de la integración de equipos -representaciones o selecciones- organizados por éstas. Asimismo, los denominados como "amateurs compensados", que son aquellas personas que realizan una actividad deportiva pero no perciben un salario, sino una compensación para cubrir los gastos derivados de la práctica (Mercader, 2016).

Sin embargo, es preciso advertir que debido a las numerosas remisiones que este Real Decreto realiza al ET y demás normas laborales de general aplicación, que rigen con carácter supletorio a lo no dispuesto en el RD (art. 21), el estudio del régimen jurídico regulador de estas relaciones profesionales desde una perspectiva de género incluye el estudio de otros cuerpos normativos como los convenios colectivos, en el caso de que los haya, y los normas generales en materia de discriminación laboral. Ello, teniendo en

cuenta que es precisamente en aquella cuestión, la de la remisión a los convenios colectivos, donde se encuentran parte de las problemáticas de desigualdad en el deporte profesional, toda vez que en España no disponemos de un gran número de ellos. Aspecto que se desarrollará de una manera más amplia a lo largo de las siguientes páginas.

Por otro lado, es necesario hacer mención a que las disposiciones de estos textos normativos apenas utilizan el lenguaje inclusivo como fórmula jurídica configuradora. Así, en lugar de utilizarse, por ejemplo, la referencia a "la relación laboral de carácter especial de las deportistas trabajadoras", "las personas trabajadoras" o "la excedencia por cuidado de hijos/as", tal y como se viene haciendo en este trabajo, se hace uso de la tradicional forma masculina para hacer referencia a ambos sexos. De hecho, tan sólo algunas previsiones del ET -como las relativas a la consideración de nulidad de la extinción del contrato producida en un contexto de circunstancias asociadas al nacimiento y cuidado de menor (art 55), entre otras-, que fueron modificadas por el Real Decreto-ley 6/2019, de 1 de marzo, de medidas urgentes para garantía de la igualdad de trato y de oportunidades entre mujeres y hombres en el empleo y la ocupación, lo hacen. Hubiese sido conveniente en este sentido, que este texto hubiese modificado tales previsiones a lo largo de todo el articulado de la normativa laboral en lugar de hacerlo tan sólo con respecto a algunas.

Marco jurídico en materia de igualdad de género en el ámbito laboral

Son diversas las disposiciones normativas tanto internacionales como del ordenamiento jurídico interno que consagran el principio de igualdad y no discriminación de género como un derecho de alcance universal. En lo que respecta al ordenamiento jurídico interno, la propia Constitución Española de 1978 proclama el principio a la igualdad y no discriminación por razón de sexo en su artículo 14, al tiempo que estable la obligatoriedad de los poderes públicos de promover las condiciones para que la igualdad sea real y efectiva (art. 9.2.). Reconocimiento que se ve complementado mediante otras disposiciones específicas en materia de igualdad de género como la LOI de 2007, que establece acciones concretas y acciones positivas para evitar situaciones de discriminación por razón de sexo en todas las esferas de la vida (arts. 1-2).

Este reconocimiento implica el derecho de todas las personas a la igualdad de trato y oportunidades y a la ausencia de toda discriminación por razón de género. O, dicho de otro modo, conlleva que los supuestos de hecho iguales sean tratados idénticamente en sus consecuencias jurídicas, de suerte que si existen diferencias haya una suficiente justificación en términos de razonabilidad y proporcionalidad, recayendo la carga de la prueba sobre quien asume la defensa de la misma SSTC 126/1997, de 3 de julio –rec.661/96-, FJ 8; 3/2007, de 15 de enero). Asimismo, que la discriminación puede producirse tanto de forma directa como indirecta.

En este sentido, la LOI define como discriminación directa por razón de sexo "la situación en que se encuentra una persona que sea, haya sido o pudiera ser tratada, en atención a su sexo, de manera menos favorable que otra en situación comparable" (art. 6.1.). También, todo escenario de acoso por razón de género, entendido este como "cualquier comportamiento realizado en función del sexo de una persona, con el propósito o el efecto de atentar contra su dignidad y de crear un entorno intimidatorio, degradante u ofensivo" (art. 7), o "todo trato desfavorable a las mujeres relacionado con el embarazo o la maternidad" (art. 8). Ello, en consonancia con lo dispuesto por la jurisprudencia, que dictamina que la protección de la condición biológica y de la salud de la trabajadora ha de ser compatible con la conservación de sus derechos profesionales, de suerte que la minusvaloración o el perjuicio causado por el embarazo o la sucesiva maternidad constituyen un supuesto de discriminación directa por razón de sexo (STC 182/2005, de 4 de julio –rec. 2447/2002-).

No obstante, los casos de discriminación no se limitan a lo anterior, sino que se extienden a aquellas situaciones o disposiciones que, aunque aparentemente puedan resultar neutras, pongan a personas de un sexo en desventaja particular con respecto a personas del otro, salvo que dicha diferenciación pueda justificarse objetivamente en atención a una finalidad legítima y que los medios para alcanzarla sean necesarios y adecuados (art. 6.2. LOI); (SSTJCE de 27 de junio de 1990, asunto Kowalska; 9 de febrero de 1999, asunto Seymour-Smith y Laura Pérez; SSTC 145/1991, de 1 de julio –rec. 175/89-; 240/1999, de 20 de diciembre -rec. 2897/95-). Supuesto este, en el que cabría incluir el impacto que determinados derechos laborales o decisiones empresariales aparentemente neutras producen sobre el empleo de las trabajadoras, tal y como ocurre con el ejercicio de los derechos de conciliación laboral y familiar. Esto, debido a que derechos como la reducción de jornada, las excedencias por cuidado de hijos/as, u otras suspensiones del contrato de trabajo pueden repercutir sobre aspectos de la relación laboral como la promoción profesional, el salario, o la cuantía de una futura pensión de jubilación (Maldonado, 2019).

De la misma manera, se considera discriminación por razón de género cualquier trato adverso o perjuicio que sufra una persona como consecuencia de la presentación de queja, reclamación, denuncia, demanda o recurso destinadas a evitar su discriminación (art. 9 LOI).

Por último, y en cuanto a las consecuencias jurídicas y garantías para aquellas personas que sean objeto de situaciones de discriminación de género, señalar que tanto la LOI (art. 10) como, en lo que respecta al ámbito laboral, el ET (arts. 17.1 y 55.5), establecen la nulidad de los actos, cláusulas, o decisiones empresariales que ocasionen supuestos de discriminación por razón de género, tanto directa como indirecta. Así, actuaciones como el despido de la trabajadora que está embarazada o ejerce sus derechos de conciliación puede ser calificado procedente o nulo,

pero nunca improcedente, según su causalidad (STS (Social), de 25 de enero de 2013 -rec. 1144/2012- (Casas, 2017).

Convenios colectivos del deporte profesional femenino

Como se ha dicho, las constantes remisiones que el RD de 1985 realiza a otras normas supletorias como los convenios colectivos constituye parte de las problemáticas de desigualdad en el deporte profesional ya que, hasta la fecha, en España no se disponen de muchos de ellos.

Concretamente, a nivel estatal, tan sólo cinco deportes pueden presumir de tener un convenio colectivo -baloncesto (IV Convenio colectivo de baloncesto profesional ACB, 3 de marzo de 2021), ciclismo (Convenio colectivo para la actividad del ciclismo profesional, 17 de marzo de 2010), fútbol (Convenio colectivo para la actividad de fútbol profesional, 23 de noviembre de 2015), balonmano (IV Convenio colectivo de balonmano profesional, 11 de enero de 2017) y fútbol sala (Convenio colectivo de fútbol sala, 22 de marzo de 2017)-. Mientras, en otros deportes podemos encontrar convenios colectivos de clubs o entidades para su disciplina deportiva.

Estos convenios colectivos estatales, al igual que ocurre en las relaciones laborales de carácter común, regulan aspectos relativos a la contratación, las condiciones económicas, la jornada de trabajo, o los descansos, vacaciones u otros permisos especiales, entre otros. Sin embargo, es de justicia señalar que en la medida en que estas disposiciones se aplican a las relaciones profesionales entre jugadores y clubes o entidades deportivas adscritos a la liga deportiva correspondiente según la disciplina, nos encontramos ante la problemática de que las relaciones laborales están o no reguladas mediante estos instrumentos jurídicos específicos en función de la existencia o no estas ligas.

Pues bien, si se tiene en consideración la generalizada inexistencia de Ligas Profesionales Femeninas y el hecho de que, en el caso de que las haya, estos convenios no las incluyen en su ámbito de aplicación, por incluir tan sólo ligas masculinas, nos encontramos con que en la práctica estas disposiciones normativas no rigen las relaciones laborales de las deportistas. Incluso el convenio colectivo de baloncesto delimita expresamente su ámbito de aplicación personal a "los jugadores que participen en las competiciones profesionales de baloncesto masculino" (art. 4).

Esta exclusión ha ocasionado que en los últimos años las deportistas hayan venido reivindicando la existencia de convenios colectivos propios, habiendo conseguido su aprobación en el ámbito del baloncesto y del fútbol. Así, el deporte femenino, a la fecha, cuenta con el Convenio colectivo para la actividad de baloncesto profesional de la Liga Femenina organizada por la Federación Española de Baloncesto (código de convenio núm. 9916915), que fue suscrito, con fecha 22 de octubre de 2007, y el Convenio Colectivo para las futbolistas que prestan sus servicios en clubes de la primera división femenina de fútbol (código de convenio núm. 99100245012020), que fue suscrito con fecha 31 de julio de 2020.

De esta forma, hasta la negociación de estos convenios colectivos femeninos las relaciones laborales de estas deportistas, que realizaban una misma actividad laboral que sus homólogos masculinos, se encontraban sin convenio colectivo para regular numerosos aspectos relativos a la relación laboral. Mismo escenario que en el que actualmente se encuentran el resto de disciplinas deportivas femeninas, que carecen de convenios. E incluso en estas mismas, según el nivel en el que se desarrolle la actividad deportiva, tal y como ocurre con las futbolistas de la segunda división femenina.

Luego, nos encontramos ante la peculiaridad de que los instrumentos jurídicos que rigen cada disciplina deportiva se distinguen en función del género de la persona trabajadora. Algo que tan sólo ocurre en el ámbito deportivo, pues en el resto de relaciones laborales la delimitación del ámbito personal de un convenio colectivo no incluye criterio alguno vinculado al género (UGT, 2015).

Discusión

¿Un paso hacia la igualdad o hacia la perpetuación de la desigualdad?

De la comparativa entre los convenios colectivos masculinos y femeninos de las disciplinas deportivas que cuentan con dichos instrumentos para ambos sexos, es decir, el baloncesto y fútbol de primera división, llaman la atención cuestiones como la diferente retribución mínima anual fijada en uno y otro o la distinta cuantía de las indemnizaciones previstas para los casos de muerte o incapacidad permanente absoluta de origen laboral, superior en el caso de los convenios masculinos. Asimismo, las distintas disposiciones previstas en materia de descanso anual en el caso del baloncesto, con cuarenta y cinco días naturales anuales de vacaciones en el caso masculino frente a los treinta del femenino. Especial mención merece lo relativo a las garantías que unos y otros convenios establecen en materia de conciliación laboral y familiar o embarazo, ya que como se ha manifestado, son objeto de numerosas situaciones de discriminación de género en este ámbito.

En cuanto a la conciliación, ambos convenios femeninos, a diferencia de los masculinos, añaden un apartado específico dedicado a ello. En el caso del baloncesto, se establece el compromiso por parte del club, entidad o sociedad anónima deportiva de financiar, aunque sea en parte, la custodia de menores de 8 años o los costes generados por tener que atender a progenitores o familiares. Además, se señala que se facilitará la posibilidad de contratación a tiempo parcial (art. 34). Por su parte, el convenio de fútbol se limita a hacer una genérica referencia a que "ambas partes se comprometen a desplegar sus mejores esfuerzos para adoptar medidas acordes para conciliar la vida familiar y profesional de la futbolista" (art. 39). Fórmula jurídica que, dado su genérico e inconcreto contenido, supeditada

al entendimiento entre ambas partes y a "sus mejores esfuerzos", parece insuficiente en aras de una seguridad jurídica para la trabajadora y resulta más que mejorable.

Sin duda, el establecimiento de toda medida que favorezca la conciliación laboral y familiar ha de considerarse como positiva y supone un avance desde la perspectiva de un trabajo decente. Ahora bien, también es preciso advertir que el hecho de que tan sólo se haga alusión a ellas en el caso femenino y no el masculino es una muestra del carácter todavía sexista del reparto de roles de género, donde se da por hecho que la mujer es quien asume todo lo relativo a estos cuidados familiares. Es por este motivo que al margen de que, como se ha señalado, toda estipulación que facilite este aspecto es un paso hacia la consecución de una mayor calidad laboral, desde una perspectiva protectora de los derechos fundamentales, la igualdad se conseguiría con el establecimiento de este tipo de medidas en un régimen de corresponsabilidad en los convenios de ambos géneros.

Por supuesto, el hecho de que en los convenios colectivos masculinos no se realice referencia expresa a la reducción de jornada vinculada a la conciliación laboral y familiar no implica que no se tenga tal derecho, pues todo lo no previsto en ellos se rige por la normativa supletoria, es decir, el Real Decreto de 1985, y en su defecto, el ET, que lo reconoce de manera indistinta a las personas trabajadoras de uno y otro sexo (art. 37.6.). No obstante, no es posible obviar que cualquier precepto específico previsto en un convenio colectivo que tenga presente las peculiaridades que envuelven a cada actividad laboral, frente a la genérica referencia realizada en el ET para todas las profesiones con independencia de su naturaleza, se traduce en una mayor posibilidad de conciliación. En otras palabras, en la práctica implica que si dos progenitores dedicados al baloncesto profesional, hombre y mujer, han de decidir quién opta por la reducción de la jornada, aún en detrimento de la carrera profesional, existen mayores probabilidades de que sea la mujer quien lo haga, por tener en su convenio colectivo herramientas concretas que favorecen esta situación de acuerdo con las particularidades de este deporte profesional.

En otro orden de cosas, y en este caso en lo que al embarazo y otras medidas de protección de la mujer se refiere, cabe hacer mención al mayor carácter garantista del convenio de fútbol con respecto al de baloncesto. Ello, debido a que en aquel se establecen mecanismos destinados a proteger los casos de violencia de género y acoso como: la adecuación del horario dentro de las posibilidades del club; ayuda económica; apoyo psicológico; o la inclusión de un protocolo de prevención del acoso como anexo al propio convenio. Asimismo, en cuanto a la protección de la mujer deportista y la maternidad establece que cuando el embarazo se produzca durante la última temporada de contrato, la deportista podrá optar entre la renovación del mismo por una temporada adicional, en las mismas condiciones que venía teniendo, o la no renovación. Previsión que se aproxima a lo dispuesto por la FIFA para proteger la continuidad de la carrera profesional de la futbolista y evitar la problemática existente en torno a cláusulas antiembarazo.

Ni que decir tiene que en la medida en que estas relaciones laborales se rigen también por el resto de la normativa laboral que no resulte incompatible, las garantías previstas por el ET y la legislación de igualdad resultan de aplicación. Luego, aunque en estos convenios no se establezca ninguna previsión específica acerca de ello, cualquier acto discriminatorio como el establecimiento de cláusulas antiembarazo en el contrato de trabajo se reputará nulo y sin efecto (arts. 17.1. y 55.5. ET). Es decir, el despido de una deportista cuya única causa es el embarazo cabría ser declarado judicialmente como nulo -a través del procedimiento ordinario o del especial para la tutela de los derechos fundamentales (art. 177 a 184 Ley Reguladora de la Jurisdicción Social – LRJS-), que se traduce en el cese del acto discriminatorio y una posible indemnización por los daños ocasionados.

Junto a esto, otra vía de protección con la que cuenta la trabajadora es la de solicitar la extinción indemnizada de la relación laboral, al amparo de lo dispuesto por el art. 50.1. a), contemplado para proteger a la persona trabajadora ante modificaciones sustanciales de las condiciones de trabajo que menoscaben su dignidad. Igualmente, existe la posibilidad de acudir a la vía administrativa a través de una denuncia ante la Inspección de Trabajo y Seguridad Social.

Del mismo modo, la aplicación de la normativa laboral permite que los clubs que hagan uso de prácticas discriminatorias sean sancionados por cometer una infracción de carácter muy grave (art. 8.12. LISOS). Incluso en vía penal, a través del artículo 314 del Código Penal -Ley Orgánica 10/1995, de 23 de noviembre, del Código Penal-, con una pena de prisión de seis meses a dos años o multa de 12 a 24 meses, si tras requerimiento o sanción administrativa no se restituye la situación de igualdad y se reparan los daños económicos producidos. Asimismo, mediante el artículo 512, que condena a quienes en el ejercicio de las actividades profesionales o empresariales denegaren a una persona una prestación a la que tenga derecho por razones discriminatorias, entre las que se incluye el género, con una pena de inhabilitación especial para el ejercicio de profesión, oficio, industria o comercio de uno a cuatro años.

Pese a estos sistemas de protección, el problema de tipo práctico que se produce en relación al uso de prácticas discriminatorias se encuentra en lo relativo a su probanza, pues si bien una cláusula antiembarazo expresamente prevista en el contrato no plantea problema en este aspecto, distinto es el supuesto en el que la discriminación se viene produciendo por actos indirectos como el ninguneo de aquellas deportistas que ejercen la maternidad con respeto a las que no.

Resulta innegable que la inclusión de estas cláusulas en el convenio femenino de fútbol –el de baloncesto no hace ningún tipo de alusión- son del todo novedosas y esenciales para avanzar hacia la igualdad efectiva de las mujeres

en el deporte. Sin embargo, también lo es el hecho de que parecen insuficientes, especialmente en lo relativo a la protección del embarazo. De hecho, llama la atención que la única mención a ello sea en el caso del fútbol y, además, con tan sólo un genérico artículo que da lugar a numerosas dudas interpretativas en cuanto a la concreción y alcance de las medidas protectoras. Según esto, se trata de herramientas que, por una parte, suponen un gran primer paso hacia la igualdad material en el deporte y, por otro, reflejan las todavía desigualdades entre mujeres y hombres en el ámbito deportivo profesional, cuya relación laboral se rige por instrumentos normativos distintos, con diferente contenido, exclusivamente como consecuencia del género de unos y otros. Aspecto que tan sólo ocurre en el ámbito deportivo.

Conclusiones

El deporte profesional femenino está registrando un constante crecimiento a nivel mundial tanto en los niveles de participación como de competitividad. Sin embargo, aún queda mucho por conquistar en aras de una igualdad real y efectiva.

La nueva ley del deporte supone un claro avance en materia de igualdad de género en el deporte con respecto a la norma precedente, que no hacía alusión alguna a este aspecto. Si bien en materia laboral el régimen descrito resulta un tanto genérico, el hecho de que se tipifique de manera expresa como infracción muy grave cualquier vulneración del principio de igualdad, tanto de manera directa o indirecta, constituye un gran avance hacia la reducción y eliminación de las prácticas abusivas que tradicionalmente han venido sufriendo las deportistas profesionales. Queda por ver el control efectivo que se hace de ello y la imposición de sanciones reales si estas conductas siguen produciéndose.

Ahora bien, un ejemplo de los retos que aún quedan pendientes en materia de igualdad en este ámbito, es el hecho de que nos encontramos ante un escenario en el que los instrumentos normativos que específicamente regulan los derechos colectivos de las personas deportistas profesionales difieren según el género de la persona trabajadora. Aspecto que tan sólo se da en el deporte y que, sin duda, resulta especialmente llamativo. Más aún, teniendo en cuenta que, en los últimos años, en consonancia con los progresos que en materia de igualdad de género se vienen produciendo en la sociedad, la tendencia viene siento la eliminación de cualquier referencia de género en la regulación de un derecho en pro de una fórmula de lenguaje inclusivo. Además, es preciso señalar que estos convenios colectivos se muestran insuficientes. Especialmente en algunas disciplinas deportivas femeninas que ni siquiera cuentan con estos instrumentos normativos o con un reglamento como el aprobado por la FIFA en el año 2021.

La visibilización de esta problemática de discriminación ha constituido y constituye una herramienta fundamental hacia el cambio, pues insta tanto al establecimiento de medidas de promoción y apoyo al deporte femenino profesional como a la utilización de la norma como vehículo hacia la igualdad. Es por ello, que toda iniciativa llevada a cabo en este sentido se convierte en un instrumento que contribuye a la sostenibilidad y crecimiento de este ámbito deportivo y a la consecución de una sociedad más justa y equitativa.

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Effects of a 10-week detraining period on gross motor skills in young tricking practitioners

Efectos de un período de desentrenamiento de 10 semanas sobre las habilidades motoras gruesas en jóvenes practicantes de tricking

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Abstract

Tricking has emerged as a martial arts sport that combines acrobatics, gymnastics, kicks and jumps to create multiple visually striking movements. The effects of a period of detraining in young tricking practitioners still unclear. The main objective of this study was to verify the effect of a 10-week detraining period on different motor skills in young tricking practitioners. A group of 17 children (age: 10.18 ± 0.98 years) tricking practitioners were analyzed in a pre-detraining period and a post-detraining period using agility test, vertical impulse test, horizontal impulse test and push-up test, sit-up test. The agility and sit-ups variables show significant differences of large effect (Δ = 6.82, p = .001, d = 2.80; Δ = -13.76, p = .003, d = 1.27) respectively. Vertical impulse and push-ups showed significant differences between training phases a moderate effect (Δ = -5.13, p =

Resumen

Tricking se ha convertido en un deporte de artes marciales que combina acrobacias, gimnasia, patadas y saltos para crear múltiples movimientos visualmente impactantes. En realidad, los efectos de un período de desentrenamiento en los jóvenes practicantes de trucos aún no están claros. El objetivo principal de este estudio fue verificar el efecto de un período de desentrenamiento de 10 semanas en diferentes habilidades motoras en jóvenes practicantes de trucos. Se analizó un grupo de 17 niños (edad: 10.18 ± 0.98 años) practicantes de trucos en un período previo al desentrenamiento y un período posterior al desentrenamiento mediante test de agilidad, test de impulso vertical, test de impulso horizontal y test de flexión de brazos, test de abdominales. Las variables agilidad y abdominales muestran diferencias significativas de gran efecto (Δ = 6.82, p = .001,

.007, *d* = .85; Δ = -8.37, *p* = .006, *d* = 1, 13). Results showed that agility and abdominal strength test sit ups were those that decreased to a greater extent in these subjects with a large effect, being the vertical jump as well as the push up, the motor tests that decreased moderately, while the horizontal jump did not vary significantly.

Key words: Extreme sports, youth, agility, strength, vertical jump.

d = 2.80; Δ = -13.76, *p* = .003, *d* = 1.27) respectivamente. El impulso vertical y las flexiones mostraron diferencias significativas entre las fases de entrenamiento con un efecto moderado (Δ = -5.13, *p* = .007, *d* = 0.85; Δ = -8.37, *p* = .006, *d* = 1.13). Los resultados mostraron que las pruebas de agilidad y fuerza abdominal fueron las que más disminuyeron en estos sujetos con gran efecto, siendo el salto vertical al igual que las flexiones, las pruebas motrices que disminuyeron moderadamente, mientras que el salto horizontal no varió. significativamente.

Palabras clave: Deportes extremos, jóvenes, agilidad, fuerza, salto vertical.

Introduction

Around the world there has been a growing interest among young people in extreme motor activities (i.e., parkour, gimbarr, crossfit, skateboarding, rollerblading, snowboarding) (Batuev & Robinson, 2018; Green et al., 2018; Stratford, 2015). In recent years, tricking has emerged as a martial arts sport that combines acrobatics, gymnastics, and various kicks and jumps to create an elaborate and visually stunning display of movement (Hnitetska et al., 2017). Tricking usually involves complex and dynamic movements, including aerials, backflips, kicks, corkscrews and other acrobatic maneuvers (Grassie, 2017; Witfeld et al., 2013). This sport incorporates a wide range of movements, in which the practitioner can choose and combine movements based on their preferences and aptitudes, allowing for creativity and personal expression (Rodrigo et al., 2023). Practitioners are encouraged to develop their unique style and incorporate personal creativity into their routines. There are no strict rules or prescribed sequences, allowing individuals to express themselves through the flow and composition of movements (Tamm et al., 2022). Therefore, it is common for gymnastics or other similar disciplines to be present during the training process (Knapik et al., 2015). Tricking is constantly evolving, with practitioners continually pushing the limits of what is possible, creating new combinations, moves and variations. The modality's technical actions are fundamentally based on various movement disciplines, especially disciplines such as Taekwondo, Wushu and Capoeira, as many of its fundamental kicks and techniques are derived from these martial arts (O'Connor et al., 2022). Due to the demanding typology, practitioners of this modality are required to present high levels of strength, agility and coordination, which must be constantly optimized during training and practice (Chatinyan & Avetisyan, 2022; Hnitetska et al., 2017). Additionally, the tricking training should include static and dynamic stretching routines to improve flexibility and range of motion, especially in the legs, hips, and back, which are crucial for executing kicks and acrobatics. Also, the trampoline training to practice aerial awareness, flips, and spins in a controlled environment, tumbling exercises (e.g., cartwheels, round-offs, handsprings) to develop acrobatic skills and air sense and plyometric exercises (e.g., box jumps, burpees) to enhance explosive power can also be used (Hadlow et al., 2018). However, as in other sports, periods of detraining may occur. Detraining periods are characterized as periods of time during which an individual decreases or completely stops physical training or exercise (Girardi et al., 2020; Izquierdo et al., 2007). Detraining can occur due to many reasons such as injury, illness, vacations, lookdown periods, end-of-season, changes in schedule or lifestyle (Ammar et al., 2021; Vandoni et al., 2021; Vassilis et al., 2019).

During a period of detraining, the body gradually loses some of the adaptations and gains gained from regular exercise and training (Branquinho et al., 2020; Ratel et al., 2012; Suarez-Arrones et al., 2019) Previous studies have reported that muscle strength, cardiovascular endurance and flexibility may decrease over time with reduced physical activity (Dasso, 2019; Guo et al., 2022; Nuzzo, 2021). Still, the length of the detraining period and the degree of fitness loss can vary depending on a number of factors, including the individual's initial fitness level, the type of exercise or training being performed, and the time since the last training session (Blasco-Lafarga et al., 2020; Psilander et al., 2019; Ribeiro et al., 2017).

Previous investigations have reported that young people tend to experience less decline in physical fitness during a detraining period compared to adults (Carter & Horvat, 2016; Chaouachi et al., 2019; Gavanda et al., 2020). This is due to the fact that young people have greater capacity for physical adaptation due to their higher levels of natural growth and development (Howard et al., 2019; Maughan & Little, 2017). This is particularly due to the windows of opportunity and the greater trainability for learning specific sports-based motor skills, especially when it comes to a multifaceted sport like tricking. Overall, young people seem to have an advantage when it comes to staying fit during periods of training or reduced activity. However, the detraining is also easier due to lack of experience and morpho-functional changes (Malm et al., 2019).

To the best of our knowledge, so far no study has investigated the effects of a period of detraining in young

tricking practitioners and therefore this issue still needs to be broadly clarified. The main aim of this study was to verify the effect of a 10-week detraining period on different motor skills in young Tricking practitioners. The study hypothesis is that there may be losses in physical fitness (i.e., upper and core strength, agility, vertical and horizontal impulse) as a result of a detraining period of this duration.

Method

Participants

A group of 17 children (Mean ± *SD* age: 10.18 ± 0.98 years old; Height: 138.54 ± 7.82 Kg; Weight: 34.74 ± 7.66 Kg) tricking practitioners volunteered to participate in the study. The sample calculation was performed using Software G*Power 3.1 according to a previous protocol (Kang, 2021). An priori analysis was performed that determined that 13 subjects would be needed for the study (Effect size *dz*: 0.7, **α** error probability: 0.05, power: 0.95). Additionally, four element was added to the sample as a matter of convenience as there were 17 volunteers to participate in the study. The inclusion criterion for the participants was to be tricking practitioners, be young and/or a child (i.e. 10 to 17 years old), practice federated tricking and have taken part in all the evaluation research stages, while no exclusion criteria was applied. Prior to the start of the study, all participants and the trainer were informed of the objectives and requirements of the study as well as known health risks and were informed that they could withdraw from the study at any time even after it had started. All guardians filled out an informed consent where they authorized the voluntary participation of their children in the study. All procedures followed guidelines of the Declaration of Helsinki for research in humans. The research was validated by the Scientific Board of the Higher Institute of Educational Sciences of the Douro (PMTF:2;24.9.2018).

Instruments

This descriptive study evaluated the variations in the agility test, vertical impulse, horizontal impulse, Push-ups and Sit-ups along 10 weeks of interruption of training in tricking practitioners. The tests were performed on different days to mitigate the potential effects of fatigue (Branquinho et al., 2021). The tests were performed in the following order, Day one: Agility Test and Vertical Impulse; Day two: Horizontal Thrust, Push-ups and Sit-ups.

In sit-ups assessment, the participant lies on their back with knees bent at a 90-degree angle and feet flat on the ground. The hands are placed behind the head or crossed over the chest. The number of correctly performed sit-ups within the set time or until failure is counted. In push-ups assessment the participant starts in a plank position with the body in a straight line from head to heels. Repeat the movement for a specific number of repetitions or until failure to maintain proper form. The number of correctly performed push-ups was counted (Ferraz et al., 2020).

To measure agility, the Agility T-Test was used according to a previously validated protocol (Munro & Herrington, 2011). Participants were instructed to remain behind the starting line with both supports on the ground until the start. The test consists of rapid accelerations between four cones that must be touched at the base and that are placed at different distances. The test must be carried out in the following order: i) sprint from cone one to cone two placed 9.14 m from the starting line; ii) lateral displacement for cone three placed 4.57 m to the left of cone two; iii) return to cone two; iv) lateral displacement for cone four placed 4.57 m from cone two; v) return to cone two; vi) finally they must run backwards as quickly as possible towards cone one. The time required to complete the test was used as a performance result and was evaluated with an electronic timing system (Microgate SARL, Bolzano, Italy)

To assess vertical jump, the participant begins by standing on a measuring device with feet shoulder-width apart (Granacher et al., 2011). After a countermovement squat, they explosively jump vertically, reaching as high as possible, and the highest point reached was recorded (Gavanda et al., 2020). Vertical Jump was recorded using a linear transducer (Celesco, Toronto, ON, Canada), connected to the BioPacMP100 data capture system (BioPac Systems, Inc.).

For the horizontal jump, the participant starts behind a marked line, performs a counter movement and then moves forward, jumping as much as possible. The distance from the starting line to the landing point was measured to determine the jump distance. The horizontal displacement of the jump was measured using a tape measure and straight ruler. Both assessments evaluate the power and explosiveness of an individual's lower body (Chaouachi et al., 2019; Fathi et al., 2019). All tests were carried out indoors, to eliminate the potential effect of environmental conditions.

Procedures

Five specific variables were analyzed with adaptations of previously used protocols: agility test (Hammami et al., 2018), vertical impulse test (Nogueira et al., 2020), horizontal impulse test (Nassau et al., 2006) and push-up test (Baumgartner et al., 2002), sit-up test (Diener et al., 1995). Participants were evaluated in two distinct phases: before the detraining period (i.e., pre-detraining period) and after the detraining period (i.e., post-detraining period). The values of each test were recorded for later analysis. The anthropometric variables of height and body mass were measured for each subject, on a leveled platform scale (Año Sayol, Barcelona, Spain), with precision of .001 m and 0.01 Kg, respectively (Marques et al., 2016).

Statistical analysis

The calculation of means, standard deviations with 95% confidence intervals (95% *CI*) was performed using standardized statistical methods. The normality of the

distribution was examined using the Shapiro-Wilk test (n < 30) and, depending on the condition of normality, parametric or non-parametric tests were adopted for analysis. To compare the variations between the two analyzed moments, a t-test and the corresponding non-parametric Wilcoxon test were used. The level of statistical significance found was p ≤ .05. Effect sizes (ES) were calculated based on Cohen's d and classified as: 0.2, trivial; 0.6, small; 1.2, large; and > 2.0, very large (Cohen, 2013; Hopkins, 2019). The percentage changes between baseline (pre) and post-term (post) assessment [(post-training - pre-training) / pre-training) x 100] were also calculated. IBM SPSS Statistics for Windows, Version 27.0 (Armonk, NY: IBM Corp.) was used for all statistical analyses. The data visualization was computed by GraphPad Prism (GraphPad Software, CA, USA).

Results

The results indicate that in the comparison between the pre-detraining and post-detraining evaluation moments, statistically significant differences with large effects are verified for agility (Δ = 6.82, p = .001, d = 2.80) and sit-ups (Δ = -13.76, p = .003, d = 1.27) variables (Table 1. ang Figure 1.).

Significant differences were found with a moderate effect for the vertical impulse (Δ = -5.13, p = .007, d = 0.85) and push-ups variables (Δ = -8.37, p = 0.006, d = 1.13) (Table 1. ang Figure 1.). On the other hand, no differences were found between the evaluations for the horizontal impulse variable (Δ = -2.48, p = 0.209, d = 0.78), although there seems to be a trend of negative effects that can be associated with the detraining period (Table 1. ang Figure 2.).

Table 1. Mean differences between the comparison between the Pre-Detraining Period and the Post-Detraining Period elit

VARIABLES	ANALYSED MOMENTS			INFERENCE		
	Pré-Detraining	Post-Detraining	Δ (%)	*p*	*d*	Qualitative
Agility Test (s)	13.19 ± 0.29	14.09 ± 0.35	6.82	.001***	2.80	Large
Vertical Impulse (cm)	25.88 ± 1.47	24.55 ± 1.62	-5.13	.007**	0.85	Moderate
Horizontal Impulse (cm)	149.17 ± 3.29	145.47 ± 5.76	-2.48	.209	0.78	Moderate
Push Ups (n)	30.94 ± 2.68	28.35 ± 1.82	-8.37	.006**	1.13	Moderate
Sit-Ups (n)	32.47 ± 3.80	28.00 ± 3.20	-13.76	.003**	1.27	Large

Table footer - Δ= Percentage Changes; *p*= p-value*; d=Cohens d;* ** indicates P < 0.01 and *** indicates P < .001.

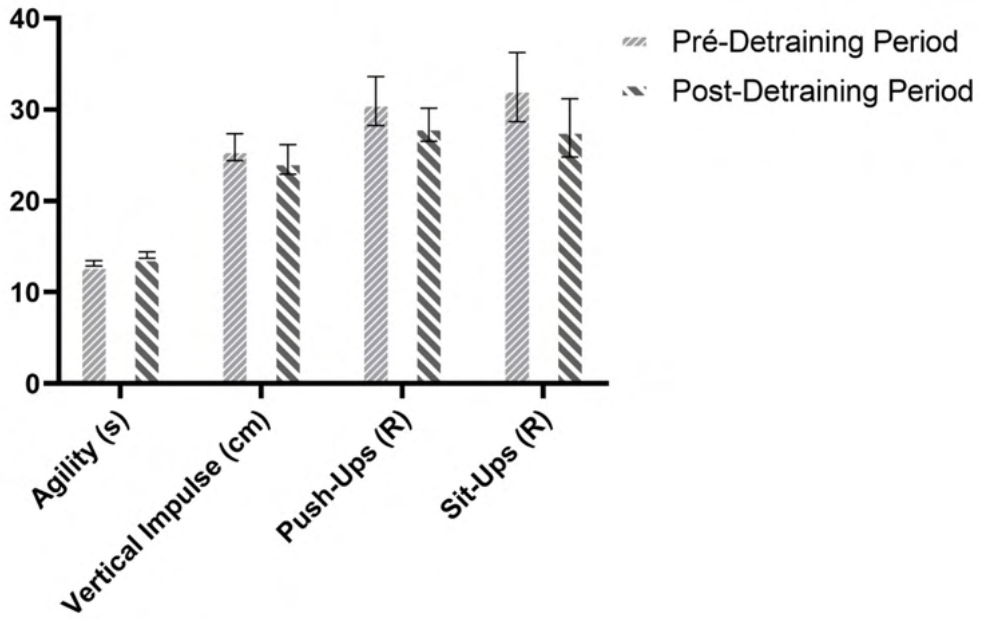

Figure 1. Mean differences between the comparison between the Pre-Detraining Period and the Post-Detraining Period for the variables that present significant differences (Agility, Vertical Impulse, Push-ups and Sit-ups)

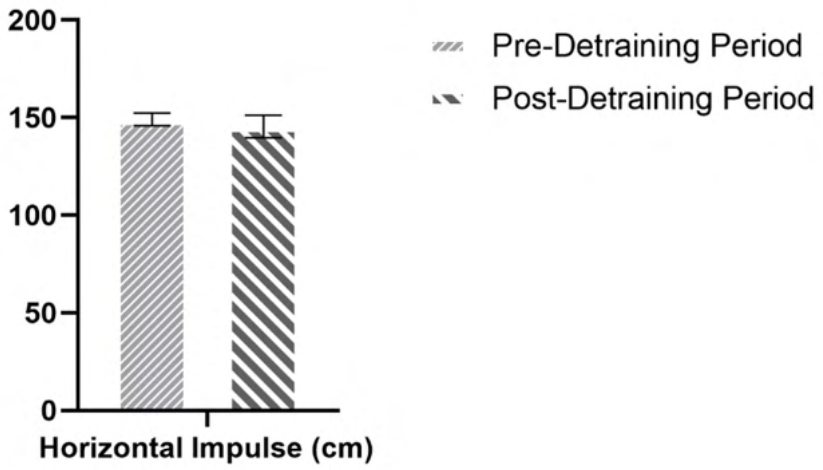

Figure 2. Mean differences between the comparison between the Pre-Detraining Period and the Post-Detraining Period for the variables that do not present significant differences (Horizontal Impulse)

Discussion

In this study we analyzed the detraining of motor skills in young tricking athletes over a 10-weeks period. It was found that agility and the abdominal strength test sit ups were those that decreased to a greater extent in these subjects with a large effect, being the vertical jump as well as the push up, the motor tests that decreased moderately, while the horizontal jump did not vary significantly.

As expected, most motor skills declined after a 10-week detraining period, as other authors have found (Carter & Horvat, 2016; Chaouachi et al., 2019; Gavanda et al., 2020). Even young subjects tend to show lower levels of detraining, due to factors such as adaptive capacity and their own development and growth (Howard et al., 2019; Maughan & Little, 2017). In any case, it must be considered that in relation to detraining, a wide variety of factors and circumstances can affect it.

There are even authors who claim that upper and lower body muscle strength can be maintained in children and adolescents for 12 weeks, in adolescents trained through a combined programs of resistance and aerobic endurance or exclusively through resistance (Santos et al., 2011) or even 16 weeks (Faigenbaum et al., 2013; Gavanda et al., 2020; Santos et al., 2011). While others speak of decreases at four weeks (Chaouachi et al., 2019; Fathi et al., 2019), seven weeks (Granacher et al., 2011) eight weeks (Faigenbaum et al., 2013) and 12 weeks (Ingle et al., 2006). In these studies, some motor skills decrease to a greater or lesser extent, or no significant changes are seen.

One of the problems of comparing detraining in children and adolescents may be that they are usually more active even if they are not practicing the sport in which they train, for example in physical education classes or other activities (Chaouachi et al., 2019; Santos et al., 2011), which could be a limitation of the study as in this case, where physical activity has not been controlled in these 10 weeks. Skills are maintained through regular practice, and detraining leads to reduced motor learning and skill retention. The proficiency in complex motor skills, techniques, and movement patterns deteriorates, affecting sports-specific skills. Indeed, movements requiring a full range of motion, agility, or flexibility may be compromised (Faigenbaum et al., 2013; Gavanda et al., 2020). The skills are maintained through regular practice, and detraining leads to reduced motor learning and skill retention (Howard et al., 2019; Maughan & Little, 2017).

Moving on to a more specific analysis of the gross motor skills, we find that not many studies have analyzed agility in motor performance tests compared to detraining (Fazelifar et al., 2013) found in obese children aged 11-13 years that agility decreased after four weeks. The greater decline in agility in our study could be associated with neural mismatch more typical of agility than muscle strength testing. It is possible that increases in corticospinal excitability, decreased corticomotor inhibition and reduced interhemispheric inhibition affecting motor neuron recruitment and frequency coding may disappear or partially return to basal functioning during a period of detraining in young people (Chaouachi et al., 2019). This could be associated with the fact that coordination in children is lower due to experience and dexterity than in adults (Behm et al., 2017). Detraining, also known as deconditioning, refers to the partial or complete loss of training-induced adaptations following a period of reduced or discontinued training. This can affect various motor skills and physiological parameters. The observed effects of detraining on different motor skills are primarily due to several interrelated physiological and neuromuscular mechanisms, such as muscle atrophy, neuromuscular adaptation, cardiorespiratory fitness decline, inefficiency and capacity of energy systems and loss of flexibility and

range of motion (Carter & Horvat, 2016). Also, the lack of training can lead to a reduction in motivation, confidence, and mental preparedness. Psychological factors can influence performance and affect decision-making, reaction time, and overall execution of motor skills.

On the other hand, in our studies, vertical jumping decreased moderately, but not horizontal jumping. This coincided with the results of Ingle et al. (2006), in 12-year-old boys, who found after 12 weeks of training and 12 weeks of detraining, a decrease in vertical jump but not in horizontal jump. Fathi et al. (2019) found small decreases in vertical jump using the Counter Movement Jump (CMJ) Test or the Squat Jump Test in adolescent volleyball players trained for 16 weeks. In the case of the study by Santos et al. (2011), no significant decrease was observed in either of the two jump tests in children aged 11 to 13 years after 12 weeks following the end of the resistance training to which the adolescents were subjected. On the other hand, in another study (Chaouachi et al., 2019), no effect of detraining on the CMJ was found in children aged 10 to 13 years after four weeks, as well as after seven weeks in adolescents aged 16 years on average after a physical education training program, (Granacher et al., 2011) or in professional handball players (Marques & González-Badillo, 2006). A possible explanation for these contradictory results with our study could be that this maintenance of performance in the CMJ test occurs because it is a coordinative movement that involves the whole body, to a greater extent than other isometric tests used in other studies and that the subjects were in a phase of motor learning improvement (Chaouachi et al., 2019). This contrasts with the previous approach (Behm et al., 2017), which argued for a decline in the agility test. The mechanisms responsible for the effect of detraining on anaerobic performance characteristics have not yet been elucidated, although in the case of dynamic strength performance, reduced motor unit activation and losses in motor coordination have been suggested (Van Praagh & Doré, 2002).

In relation to abdominal tests, Faigenbaum et al. (2013) found no decreases in the curl up test in seven-year-old children, trained in physical education classes in strength and after a detraining period of eight weeks, but in those who continued with their usual physical education classes. In the same study, a decrease in horizontal jumping was found. Fazelifar et al. (2013) found in obese children aged 11-13 years that abdominal strength measured by Crunch tests decreased less than agility.

To maintain standing long jump performance, it appears that children must repeatedly produce adequate levels of lower body power to effectively train this movement. It is also possible that participation in traditional physical education games and activities throughout the training and detraining period may have influenced these observations (Faigenbaum et al., 2013). Another possible explanation could be associated with agility and abdominal strength and to a lesser extent vertical jump and push-ups are motor skills specific to the tricking modality, so their detraining suffers a more significant decrease than for example horizontal jump, the more they are related to the training process that is carried out in the sport modality of Tricking. Mitigating the effects of detraining is crucial to maintaining and enhancing their skills and performance. Detraining can occur due to injuries, extended breaks, or other life circumstances (Faigenbaum et al., 2013). Encourage regular maintenance training with lower intensity training during breaks to maintain fundamental skills, strength, flexibility and conditioning. Integrate complementary activities such as gymnastics, martial arts, dance or parkour to maintain or improve flexibility, strength and coordination during periods of reduced trick training (Santos et al., 2011). Cross-training can help minimize losses in agility, balance and general fitness (Granacher et al., 2011).

Conclusions

Current research confirmed that detraining in young tricking practitioners has a large effect on agility and abdominal strength test sit ups, being the vertical jump as well as the push up, the motor tests that decreased moderately, while the horizontal jump did not vary significantly. Thus, the young tricking practitioners should develop a training program for strength, power, agility and coordination to ensure the appropriate development of motor skills, avoid detraining and ensure tricking performance.

Conflict of interest

Nothing to declare.

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Kinomichi, the therapeutic Aikido. A Systematic Review

Kinomichi, el Aikido terapéutico. Una revisión sistemática

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Abstract

Kinomichi is a movement art of Japanese origin based on the martial art of Aikido. It is based on the Japanese tradition known as Budo, which can be translated as a form of self-knowledge and personal development through martial practice. It was created by Aikido master Masamichi Noro (1935-2013) after a serious traffic accident in 1966. Noro adapted Aikido, minimised the physical demands and incorporated therapeutic exercises so that people with motor limitations could also practice it. Our aim is to analyse the therapeutic potential of Kinomichi by determining the Western therapies on which it is based. A systematic search of six databases was conducted using PRISMA (Preferred Reporting Items for Systematic Review and Meta- Analysis) guidelines. The search yielded 118 results, of which seven met the inclusion criteria (*n* = 7) and were found in the EBSCOHOST and Google Scholar databases. The Western therapeutic methods incorporated in the Kinomichi were the following (*n* = 9): Alexander Technique; Gindler Method; Ehrenfried Method; Kabat Method; Feldenkrais Method; Eutonia Method; Mézières Method; GDS-Godolieve Denys-Struyf Method and Antigymnastics Method. It justifies the need for quantitative experimental or quasi-experimental studies to verify the hypothetical benefits of Kinomichi as a therapeutic exercise.

Key words: Martial arts, neurorehabilitation, psycho-corporal techniques, somatic practices.

Resumen

El Kinomichi es un arte de movimiento de origen japonés basado en el arte marcial del Aikido. Se fundamenta en la tradición japonesa conocida como Budo, que puede traducirse como una forma de autoconocimiento y desarrollo personal a través de la práctica marcial. Fue creado por el maestro de Aikido Masamichi Noro (1935-2013) tras sufrir un grave accidente de tráfico en 1966. Noro adaptó el Aikido, minimizó las exigencias físicas e incorporó ejercicios terapéuticos para que también pudieran practicarlo personas con limitaciones motrices. Nuestro objetivo es analizar el potencial terapéutico del Kinomichi determinando las terapias occidentales sobre las que se sustenta. Se realizó una búsqueda sistemática en seis bases de datos siguiendo las directrices PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis). La búsqueda arrojó 118 resultados, de los cuales siete cumplían los criterios de inclusión (n = 7) hallados en las bases de datos EBSCOHOST y Google Scholar. Los métodos terapéuticos occidentales incorporados en el Kinomichi fueron los siguientes (n = 9): Técnica Alexander; Método Gindler; Método Ehrenfried; Método Kabat; Método Feldenkrais; Método Eutonia; Método Mézières; Método GDS-Godolieve Denys-Struyf y Método Antigimnasia. Se justifica la necesidad de estudios experimentales cuantitativos o cuasi-experimentales para verificar los hipotéticos beneficios del Kinomichi como ejercicio terapéutico.

Palabras clave: Artes marciales, neurorrehabilitación, técnicas psico-corporales, prácticas somáticas.

Introduction

Kinomichi is based on the Japanese tradition known as Budo, which can be translated as a form of self-knowledge and personal development through martial practice. The term Kinomichi in Japanese is divided into three words: way (= michi), from (= no) and energy (= ki). In addition, among many other definitions that characterise it, it is called art of life, art of peace, original way or Japanese energetic technique that favours ki (understood as vital energy) (Hevin, 2014a).

Noro was a prominent Aikido master who in 1961 was stationed in France as the official delegate for Europe and Africa of the Aikikai Foundation, the Japanese governing body responsible for the development and popularisation of the martial art of Aikido (Murcia, 1996a; Pozarnik, 1984). Noro was involved in a very serious car accident in 1966 (Pozarnik, 1984). The impact with another vehicle caused him to suffer a clinical picture of numerous fractures in the thorax, with a perforated lung and several days in a coma. In addition, Noro suffered paralysis of the left hand and loss of sensation in the left upper body (Hevin, 2014a). The after-effects of the accident were so severe that he was forced to considerably reduce his activities and the frequency of his training courses (Roumanoff, 1992a). As a consequence of the accident, Noro was hospitalised for almost four months. After his release from the hospital, Noro started to do recovery exercises through private training with the help of another Aikido master, Katsuaki Asai (Hevin, 2014a). In this way, the dojo, a space for the practice and teaching of Aikido, became Noro's place of rehabilitation. During this period, between 1966 and 1979, Noro adopted a more open stance towards Aikido and met with Western therapists. Gradually, Noro incorporated aspects of European therapies into the organisational system of Aikido practices (Murcia, 1996b). The recognition of Kinomichi as an art independent of Aikido was consummated after an interview of Noro with Aikido master Kisshomaru Ueshiba (son of Aikido founder Morihei Ueshiba) in 1979. The 1990s and the first decade of the 21st century saw the development and expansion of Kinomichi outside France, adopting modern features while maintaining the essence of the Japanese tradition (Paoli, 2019). Noro passed away in 2013 after a long illness leaving his unfinished legacy to four of his disciples: Lucien Forni, Hubert Thomas, Jean-Pierre Cortier and Christian Bleyer (Institute Française du Kinomichi, undated-a).

There are several scientific studies that analyse the therapeutic application of Aikido (Ben-Soussan et al., 2019; Cuellar Hidalgo et al., 2019; Delva-Tauiliili, 1995; Foster, 1997; Lothes et al., 2013; Szabolcs et al., 2019; Szabolcs et al., 2021; Weiss et al., 2017). This therapeutic application of Aikido is projected in three distinct areas: firstly in the psycho-emotional domain of the adolescent or young students (Ben-Soussan et al., 2019; Cuellar Hidalgo et al., 2019; Delva-Tauiliili, 1995; Foster, 1997; Lothes et al., 2013; Szabolcs et al., 2019; Szabolcs et al., 2021; Weiss et al., 2017); secondly, in the treatment of subjects with post-traumatic stress disorder (Weiss et al., 2017); and thirdly, in the therapeutic benefits of mindfulness during Aikido practice (Ben-Soussan et al., 2019; Cuellar Hidalgo et al., 2019; Lothes et al., 2013; Szabolcs et al., 2021; Szabolcs et al., 2019). The results of these studies do not show significant evidence for the use of Aikido as a therapeutic activity. In a way, studies on the therapeutic application of Aikido require further analysis from a cross-sectional and interdisciplinary perspective (Gómez-Lozano et al., 2023).

These results contrast with statements made by Lucien Forni in 2009, one of Noro's direct disciples. Forni argues that Kinomichi, as an evolution of Aikido, has therapeutic applications on a motor level thanks to its gentle stretching and extensive joint mobilisations. Conscious practice allows the body to relax and joint blockages to be eliminated, thus contributing to the improvement of physical and mental health. Its development has been carried out respecting the premises of Noro as well as its sporting, medical and pedagogical rules, in accordance with the French sporting code and ministerial guidelines governing Kinomichi practices (Hernadez, 2021).

Therefore, the aim of this study is to analyse the therapeutic potential of Kinomichi by determining the Western therapies on which it is based. To this end, a systematic review was carried out in academic and scientific databases and advanced search platforms, carrying out a descriptive statistical analysis of the Western therapies found in the review of the results found.

Method

Sources of information and search strategy

This systematic review was conducted following the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis (Page et al., 2020) statement from the start of the databases until 21 November 2023: Web of Science, PubMed, Scopus, Dialnet, EbscoHost and Google Scholar. For each of these databases, all possible combinations of the following search terms were used with the Boolean operator AND, namely: Kinomichi, Somatic Practices, Rehabilitation, Health or Therapies. The final combinations of these terms were: Kinomichi AND Somatic Practices; Kinomichi AND Rehabilitation, Kinomichi AND Health, Kinomichi AND Therapies. Due to the real need for the delimitation of the study objectives (Garnett et al., 2022), the search was supplemented through electronic repositories belonging to official Kinomichi Bodies (Institute Française du Kinomichi, undated-b; International Kishinryu Association, undated-a).

Eligibility criteria

Inclusion criteria (IC)

The following conditions were set for the studies: firstly they could be primary research sources of any kind (articles, book chapters, dissertations such as Master's theses or

Doctoral dissertations) published between the start of the databases and 30 November 2023 (IC1); the publication had to be specialised in the Art of Kinomichi (IC2); the writings could appear in any language, and would be translated into English where necessary, or in any language the authors considered (IC3); the full text had to be available (IC4); the study should also address a health issue of any kind in relation to the Kinomichi (IC5); and finally, an analysis of the theoretical and practical foundations of Western therapeutic methods incorporated into the construction of the Kinomichi should appear (IC6).

Exclusion criteria (EC)

In a first phase, given the contemporaneity of the term Kinomichi, officially recognised in 1979 (Pozarnik, 1984), there was no restriction as to the type of academic or scientific databases. Also, no date limitation or linguistic restriction was imposed on the search due to the specificity of our topic. In a second phase, after viewing the title, we excluded those studies that were informative or opinionated, without scientific methodological structure or contrastability criteria (EC1). In the third phase, when viewing the abstracts, Oriental Therapies or Philosophies were discarded, as they were not the object of our study (EC2). In the fourth phase, no EC were applied.

Study selection and data extraction process

Thus, the selection process was divided into 4 steps. First, all records retrieved from the databases were exported to Endnote Web, where duplicates were automatically removed. The next step was to merge all records into a single database. Next, two co-authors evaluated the titles and abstracts against the IC. Finally, the same co-authors reviewed the full text of the remaining records. At all stages, if there was disagreement between the two reviewers, a third reviewer made the final decision. The reference lists of all included studies were checked to ensure that no studies were omitted. The first author summarised the data from the included studies in a specially prepared Microsoft Word document. The following characteristics were extracted: author and year of publication, keywords, name records, type, founder and purpose of therapy. In addition, the therapists who had a direct relationship with Noro were recorded.

Study assessment of the risk of bias

The 'Quality Assessment Tool for Quantitative Studies' (Thomas et al., 2004) to assess the methodological quality of the included studies was not considered by the researchers. The tool consisted of six components: A) selection bias, (B) study design, (C) confounders, (D) blinding, (E) data collection methods, and (F) withdrawals, on a scale of 1 to 3, according to different questions related to each section. The Quality Assessment Tool dictionary (Thomas et al., 2004) was used to determine each score. Due to the qualitative, personal and experiential nature of the studies included, all values given for each of the components would have been scored with a value of 4, which means not applicable. For this reason, it was considered inappropriate to analyse the scale in relation to our results for all of its components.

Synthesis methods

To identify the study design, the classification proposed by Thompson and Panacek (2007) was applied. The studies were classified as: a) cross-sectional study, b) case-control study, c) before-and-after study (retrospective), d) historical controls (retrospective), e) surveys/questionnaires, f) case series and g) case report.

Certainty assessment

The 2009 Oxford Center for Evidence-Based Medicine Levels of Evidence scale was used to determine the level of evidence for the included studies (Centre for Evidence-Based Medicine, undated). Two co-authors rated the studies at level five (lowest level of evidence). In case of disagreement, a third investigator would have made the final decision.

Results

Evolution of the filtering of results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Following the application of the search term combinations, 118 results were obtained, of which 11 were duplicates of the assigned databases and were therefore eliminated. For the next steps, appropriate IC were used to select appropriate studies.

For the selection of titles, the search was restricted to any study of an experimental, trial, historical, review or conceptual approach nature that had contrasting primary reference sources and citations (IC1); for the selection of abstracts, the title was associated with the context of the Kinomichi study (IC2). According to these criteria and based on the first phase or section by title only, 20 studies were considered eligible.

During the abstract screening phase, no studies were excluded due to language unfeasibility or inaccessibility of the Full Text (IC3/IC4). Finally, 11 studies were discarded because the topic was not contextualised within the health field (IC5). In this phase, nine studies were selected according to these criteria. For the full text evaluation phase, the existence of an analysis of the foundations of Western Therapies or therapeutic practices that helped to construct the Kinomichi was verified (IC 6). After application of the IC, three studies were eligible for the systematic review (n = 3). All of them dealt with the type of Western Therapies that influenced Noro in the course of his Aikido practice both in the early stage from 1969 to 1979 and in later years. Of the three studies, being full-length books, we

selected only those chapters that met the IC6. The results obtained were seven book chapters (*n* = 7).

The PRISMA diagram outlines the process for focusing the field of study and the application of IC/EC to determine the relevant studies that determine the background of Western Therapies employed in the construction of the Kinomichi style (Figure 1).

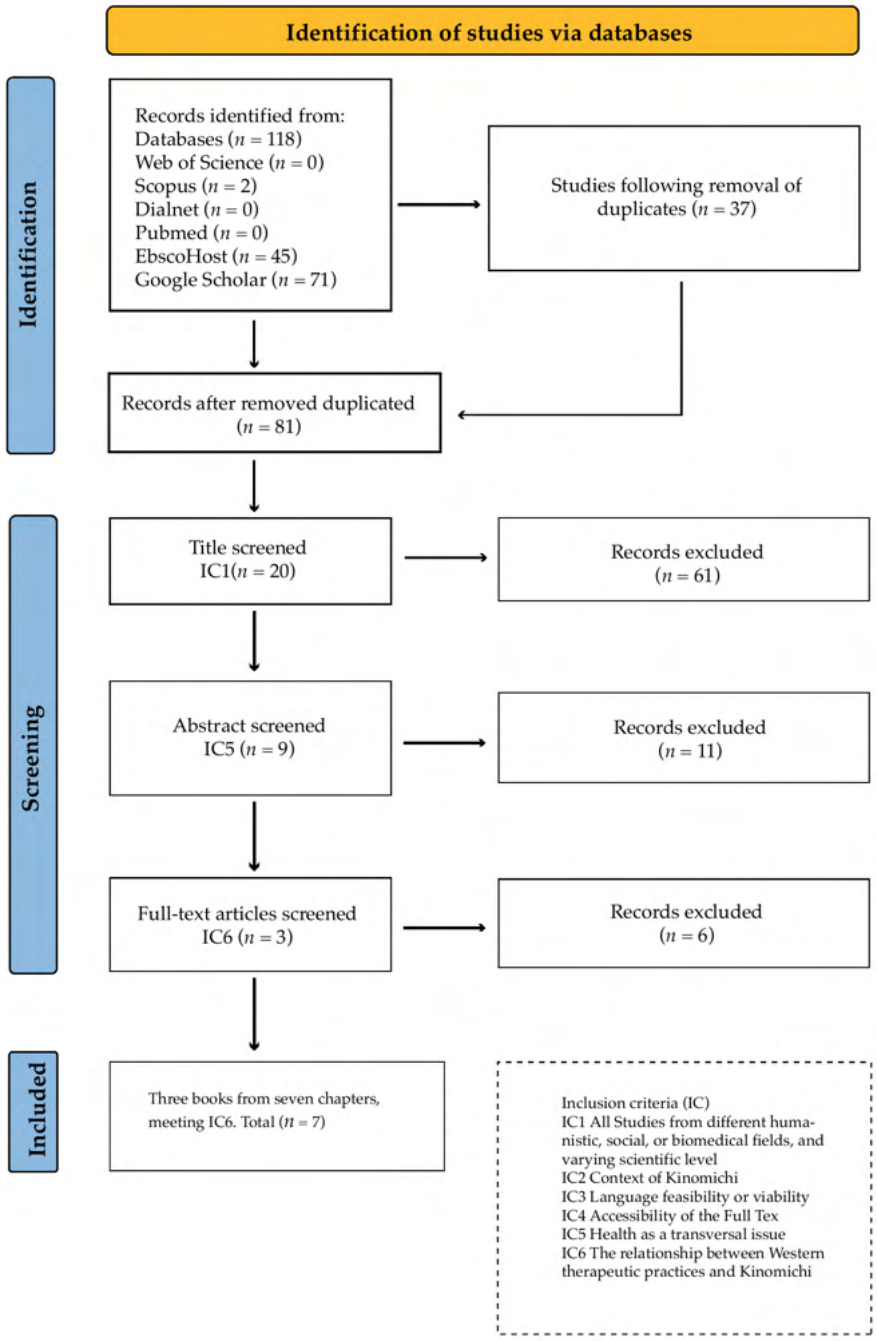

Figure 1. PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) flow diagram showing the selection process followed

Selection of studies

Figure 1 shows the extraction of a total of 118 studies, leaving 20 abstracts after removal of duplicates. Of these, nine were eligible for full text assessment after selection of the title and abstract. During the full text assessment, six records were excluded as they did not meet the eligibility criteria. Finally, after full text screening, three studies related to the concept of Somatic, psycho-bodily or rehabilitative therapies in the field of Kinomichi (Hevin, 2014b; Murcia, 1996c; Roumanoff, 1992b) were included in the systematic review. As these studies are complete books, with chapters on different Kinomichi subthemes, IC6 was applied for the second time. Finally, seven results were obtained (Hevin, 2014a, 2014c; Murcia, 1996d, 1996e, 1996f; Roumanoff, 1992a, 1992c).

Characteristics of the selected studies

The studies included in the results were published between 1992 and 2014 (Table 1). No study describes any sample of participants who had followed Kinomichi training programmes (*n* = 7). However, all studies describe some theoretical-practical foundation of Western Therapies through direct experiences with the founder of the Kinomichi style. Furthermore, the studies unfold the contextual framework of those Western Therapies whose original purpose is postural re-education or neurorehabilitation (Table 3). The included studies indirectly or directly associate the Western Therapies described as part of the pedagogical approach of the Kinomichi teaching programmes (*n* = 7) (Table 2 and 3). The bibliography in the framework of the results found is reduced to chapters found in specialised books (Table 1). The three authors are experts with direct experience and contemporaries of Master Noro. Raymond Murcia was Noro's collaborator and helped build the style (Murcia, 1996a). Bernard Hevin, who attended a lesson with Noro for the first time in 1967, after a period of injury due to a muscle tear caused by Karate practice (Hevin, 2014a). And finally, Daniel Roumanoff, a friend of Noro's, was one of the greatest experts on the union of Eastern and Western thought (Roumanoff, 1992d).

Table 1. Study authors and source of publication

Study	Authors (Year)	Book Title	Title of Chapter (C)/Section (S)	ISBN/ISSN	Language	Keywords (*)
1	Daniel Roumanoff (Roumanoff, 1992c)	The practice of Kinomichi with Master Noro	C-3. Les Découvertes du Débutant p.74-113	2-7413-0040.2	French	Permanent relaxation Natural body movement Tonic dialogue Bodily union Helical path Unlocking stretches Spiritual quest
2	Daniel Roumanoff (Roumanoff, 1992a)	The practice of Kinomichi with Master Noro	C-Annexes S-2. Kinomichi et Thérapies p.289-339	2-7413-0040.2	French	Vacuum Yin-yang Breathing together Heaven-Earth Energy work Psychomotor therapy Listening and welcoming attitude
3	Raymond Murcia (Murcia, 1996d)	Du mouvement à la création. Meeting with Masamichi Noro	C-4. Lès Étirements p.43-64	2-850076-806-5	French	Awareness of inner space. Spirals or spiroid movement Joint and muscle chains Globality Elongation without compensation 5 Chinese elements: earth, metal, water, wood and fire. Earth-to-sky connection
4	Raymond Murcia (Murcia, 1996e)	Du mouvement à la création. Meeting with Masamichi Noro	C-5. Le Contact p.65-82	2-850076-806-5	French	Harmonious encounter Psychological work Emotional tone Effective manual contact Intense tonic organisation and balancing activity Self-realisation
5	Raymond Murcia (Murcia, 1996f)	Du mouvement à la création. Meeting with Masamichi Noro	C-6.Terre-Ciel et Verticale p.83-93	2-850076-806-5	French	Earthworks Sky movements Fixed point Yang Yin Anti-gravity organisation Duality in unity
6	Bernard Hévin (Hevin, 2014a)	The chef-d'oeuvre of Master Masamichi Noro. A martial art without combat.	Première partie: Un peu d'Histoire p.15-68	979-10-242-0049-1	French	Dance form Silent perception A practice to refine the feeling. Gentle gymnastics The anti-martial-art Shin o kokoro (alignment of the mind with the heart)
7	Bernard Hévin (Hevin, 2014c)	The chef-d'oeuvre of Master Masamichi Noro. A martial art without combat.	Deuxième partie: Les Concepts Foundamentaux. p-69-110 S-Les étirements p. 95-103	979-10-242-0049-1	French	Energy release Hygiene of life Harmonic relationship Body and spirit Ki management Energy economics Psychic balance

* Keywords found for each of the results around the semantic field of the psychosomatic relationship in the Kinomichi.

Authors, publication sources and extraction of study variables

Table 1 lists the seven studies that develop theoretical-practical tests on the foundations of Western therapeutic practices used in Noro's incorporation of Aikido. These Therapies, mainly of European origin, are present from the beginning of the process of transformation of Aikido until the recognition of the Kinomichi in 1979. All these practices revolve around the teachings of their founder Noro (Hevin, 2014a, 2014c; Murcia, 1996e, 1996d, 1996f; Roumanoff, 1992a, 1992c).

Table 2 shows the records found for Western Therapies (*n* = 9). In the seven selected studies, Western Therapies are recorded with a total frequency of 30 occurrences in total (100%): Alexander Technique (10%); Gindler Method (6.66%); Ehrenfried Method (20%); Kabat Method (3.33%); Feldenkrais Method (10%); Eutonia Method (20%); Mézières Method (10%); GDS-Godolieve Denys-Struyf Method (6.66%) and Antigymnastics Method (10%). The Dürckheim Method (10%) should also be noted.

Table 2. Recorded Western therapies whose concepts, principles and strategies were incorporated into the development of the Kinomichi

N = 9	Western Therapies (Founders)	Authors (Year)							
		N = 30 (absolute frequency*)	Daniel Roumanoff (1992c)	Daniel Roumanoff (1992a)	Raymond Murcia (1996d)	Raymond Murcia (1996e)	Raymond Murcia (1996f)	Bernard Hévin (2014a)	Bernard Hévin (2014c)
1	Mézières Method: (Françoise Mézières)	3 (10%)	X		X		X		
2	Anti-gymnastics method (Thérèse Bertherat)	3 (10%)			X			X	X
3	Eutonia Method (Gerda Alexander)	6 (20%)	X	X	X	X	X		X
4	Gindler Method (Elsa Gindler)	2 (6.66%)		X				X	
5	Ehrenfried Method (Lily Ehrenfried)	6 (20%)	X	X	X		X	X	X
6	Kabat Method (Herman Kabat & Margaret Knott)	1 (3.33%)			X				
7	Feldenkrais Method (Moshe Feldenkrais)	3 (10%)	X		X				x
8	Alexander Technique (Friedrich Mathias Alexander)	3 (10%)	X		X		X		
9	GDS method (Godolieve Denys-Struyf)	2 (6.66%)			X		X		

* Absolute frequency of presence of Western Therapies found in each of the results.

Table 3 lists variables directly related to the founders, original fields of research, degree of therapeutic identification, purpose and direct relationship of therapists with the creation of the Kinomichi. In the original field of research, the training of the founders in Education, Psychology, Sports Medicine, Kinesiotherapy/ Physiotherapy and Osteopathy stands out. The terms found that identify the types of Therapies that influenced Noro were: Psychomotor Therapy; Somatic Therapy; Gentle, Sweet or Holistic Gymnastics; Neurohabilitative Therapy, Body Psychotherapy and Conscious Technique of self-observation.

Table 3. Western therapies, founders, types, purpose and direct practitioners with Masamichi Noro

	Western Therapy	Founder / Research field	References Authors	Type of Therapy Name	Degree of Identification (*)	Purpose	Therapists/ Practitioners directly with Masamichi Noro in the Dojo from the focus of each Therapy
1	Mézières Method Stretching technique through the concept 'Muscle Chains'.	Françoise Mézières (Hanoi 1909- Paris 1991) Physiotherapy / applied kinesiotherapy	Raymond Murcia (Murcia, 1996d) (Murcia, 1996f)	Psycho-Motor Therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 3 2 5 4 2	To become aware of muscular tensions, to promote states of relaxation and to discover the body's energetic pathways for healing.	Gisèle de Noiret & Marie-Thérèse Foix (French Physiotherapists of the Mezierist School)
2	Godelieve Denys-Struyf Method (GDS) Stretching technique through the concept of 'Articulo-muscular chains'.	Godelieve Denys-Struyf (Belgian Congo 1931-Malines 2009) Physiotherapy/ kinesiotherapy and applied osteopathy	Raymond Murcia (Murcia, 1996d) (Murcia, 1996f)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 1 2 5 5 2	Preventing, maintaining and treating psycho-corporal imbalances	Gisèle de Noiret & Marie-Thérèse Foix (Godelieve Denys-Struyf direct disciple of Françoise Mézières 1972-1973)
3	Ehrenfried Method	Dr Lily Ehrenfried (Wroclaw, 1896 - Paris, 1994), Sports medicine	Daniel Roumanoff (Roumanoff, 1992c) (Roumanoff, 1992a) Raymond Murcia (Murcia, 1996d) (Murcia, 1996f) Bernard Hévin (Hévin, 2014a) (Hévin, 2014c)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 1 5 1 5 5	Promote greater body awareness and spontaneous movement to achieve a holistic balance of the human being and posture.	Dr Lily Ehrenfried Françoise Paumard
4	Anti-gymnastics Method by Thérèse Bertherat	Thérèse Bertherat (Lyon 1931- 2014) Physiotherapy/ kinesiotherapy	Raymond Murcia (Murcia, 1996d) Bernard Hévin (Hévin, 2014a) (Hévin, 2014c)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 4 5 1 5 5	To assist in the holistic restoration of bodily function, emphasising the importance of coordination and interconnection of all parts of the body.	Gisèle de Noiret & Marie-Thérèse Foix Thérèse Bertherat
5	Gindler Method Psycotherapy Body	Elsa Gindler (Berlin 1885 - Berlin 1961) Physical Education	Daniel Roumanoff (Roumanoff, 1992a) Bernard Hévin (Hévin, 2014a)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	3 5 5 1 5 4	Promote body awareness, sensitivity to improve health and prevent psychosomatic imbalances.	Dr Lily Ehrenfried was a direct disciple of Elsa Gindler. Ehrenfried Method is influenced by Elsa Gindler.

6	Eutonia Method	Gerda Alexander (Wuppertal1908-1994) Education and psycho-corporal therapy	Daniel Roumanoff (Roumanoff, 1992c) (Roumanoff, 1992a) Raymond Murcia (Murcia, 1996d) (Murcia, 1996e) (Murcia, 1996f) Bernard Hévin (Hévin, 2014c)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	1 5 2 5 5 5	Body awareness to regulate muscle tension among other central nervous system functions to improve neuromuscular efficiency.	Dr Lily Ehrenfried with influence of Gerda Alexander in her psychocorporal approach Raymond Murcia is a disciple of Gerda Alexander. Murcia is a Eutony Therapist and helped Masamichi Noro to set up the Kinomichi.
7	Feldenkrais Method	Moshe Feldenkrais (Slavut 1904 - Tel Aviv 1984) Sports medicine	RaymonMurcia (Murcia, 1996d) Bernard Hévin (Hévin, 2014c)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 5 4 3 5 5	Awareness of specific movements to take advantage of the plasticity of the nervous system, improving and securing neuromuscular efficiency.	The Feldenkrais Method influenced the French physiotherapy in the 70s and 80s, which embraced this method and collaterally influenced previous routines in the Kinomichi. We do not find in the results the link that Masamichi Noro and Moshe Feldenkrais had.
8	Matias Alexander	Frederick Matthias Alexander (Tasmania 1869-Sidney 1955) Actor, Health	Daniel Roumanoff (Roumanoff, 1992c) Raymond Murcia (Murcia, 1996d) (Murcia, 1996f)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	4 5 2 3 5 5	To help people overcome posture and movement problems, reduce pain and stress, and improve their overall well-being.	The perspectives between the adaptive mechanisms in the postural axis are transferred to the relational perspective of the Kinomichi between Heaven and Earth. This correlation between techniques is pointed out by Daniel Roumanoff (1992) and Raymond Murcia (1996)
9	Kabat Method Proprioceptive Neuromuscular Facilitation-PNF Method	Herman Kabat (Brooklyn 1913-1995) Neurophysiology	Raymond Murcia (Murcia, 1996d)	Psychomotor therapy Somatic Therapy Gentle/Sweet/ Holistic Gymnastics Neurorehabilitation Therapy Body Psychotherapy Conscious self-observation technique	2 1 1 5 1 3	Promote motor responses through sensory stimulation in order to recover and improve motor function.	Margaret Knott & Dorothy Voss, helped to develop the method. It is the basis of the neurophysiology of the mechanisms incorporated into the body contact work in the Kinomichi. It was Raymond Murcia who brought this perspective of neurorehabilitation to the field of study of the Kinomichi.

* Degree of identification based on the type of description used in the results for each of the Western Therapies based on a 5-point Likert scale (1- Very weak identification 2- Weak identification 3- Moderate identification 4- Strong identification 5- Very strong identification) (Chomeya, 2010).

Typology of selected studies

The studies correspond to seven book chapters describing the influence of Western Therapies implemented in the dojos, Japanese martial arts practice spaces, in the city of Paris between 1969 and 1985 (main period in the construction of the Kinomichi) (Murcia, 1996a). The seven studies found are essayistic and retrospective in nature in relation to the construction of the Kinomichi: case report, according to the classification of Thompson and Panacek (2007).

Discussion

The aim of this study is to analyse the therapeutic potential of Kinomichi in relation to the Western therapies on which it is based. The therapeutic benefits of Aikido, the martial art from which Kinomichi originates, have been studied relatively late when compared to Karate or Judo (Pulido et al., 2021). Variables such as frustration tolerance, aggressiveness and self-control in Aikido were not studied until 1995 (Delva-Tauiliili, 1995). Two years later, Foster's study (Foster, 1997) examined variables such as self-esteem, anxiety and anger. Aikido has even been included in treatment programmes for patients with post-traumatic stress disorder (PTSD) (Weiss et al., 2017). But it is mindfulness that has been the most relevant aspect of the studies (Ben-Soussan et al., 2019; Cuellar Hidalgo et al., 2019; Lothes et al., 2013; Szabolcs et al., 2019; Szabolcs et al., 2021) on aikido in the last decade (Muñoz Arroyave et al., 2023). Kinomichi shares the same Taoist or Zen heritage as Aikido, although it received a strong Western influence during its consolidation process until 1979 (Murcia, 1996a). This allowed Noro, the creator of Kinomichi, to broaden the perspective of traditional Japanese martial arts beyond the borders of Japan. Elements of Central European culture (Roumanoff, 1992a) are integrated into Kinomichi with the incorporation of defining features of Western therapies (Table 3).

The results show that a total of nine types of Western therapeutic methods have influenced the development of Kinomichi: Gindler Method; Ehrenfried Method; Feldenkrais Method; Eutonia Method; Mézières Method; Antigimnasia Method; GSD-Godolieve Denys-Struyf Method; Kabat Method (FNP); and Alexander Technique (Table 3).

The Ehrenfried Method (20%) and Eutonia (20%) are the Western therapies with the most records in the Kinomichi configuration. The Ehrenfried method has its origins in German body psychotherapy from the Gindler method (6.6%) (Table 2). In other words, 26.6% of the Kinomichi's therapeutic influence is directly influenced by body psychotherapy. In a second case, Eutonia provides one of the main foundations of Kinomichi in the relationship of muscle tone during body contact between practitioners (Murcia, 1998). Raymond Murcia (1931-2015) was a close collaborator of Noro, a direct student of Gerda Alexander and a trainer of Eutonia (Table 3).

Furthermore, the Mézières method becomes a very influential discipline in Aikido's new pedagogical approach to Kinomichi. This is due to the influence of two French physiotherapists, Gisèle de Noiret and Marie-Thérèse Foix, who work directly with Noro. Both physiotherapists are transmitters of the Mézières method, as well as collaborators and students of Thérèse Bertherat, founder of the Antigymnastique, and Lily Ehrenfried, creator of the Ehrenfried method (Hevin, 2014a).

Of the nine Western therapies, only two (22.2%) of their founders had a direct personal or professional relationship with Noro: Lily Ehrenfried, creator of the Ehrenfried Method, and Thérèse Bertherat (1931- 2014) of the Antigymnastique Method (Table 3).

Although there are no studies demonstrating the therapeutic possibilities of the Kinomichi, there is an extensive bibliography (Areeudomwong et al., 2017; Carl, 2013; Díaz-Arribas et al., 2015; Gain-Duval, 2020; Little et al., 2014; Niaradi et al., 2022a; Paolucci et al., 2018; Paolucci et al., 2017; Young et al., 2015). The therapeutic possibilities of the nine Western therapies on which it is based have been recognised (Hevin, 2014a, 2014c; Roumanoff, 1992a, 1992c).

Mézières Method

Françoise Mézières (1909-1991) is the therapist who gave her name to the Mézières method. Mézières defended the idea of the existence of intertwined sets of poly-articular muscles whose characteristics are their strength and, above all, the mobility of the compensations (Mézières, 1984). Mézières also described a tendency to shorten the so-called "spinal erector muscles" with a tendency to retraction and the origin of musculoskeletal pain (Nisand, 2010). Mézières defined the concept of 'muscle chains' as an indivisible unit or globality (Gain-Duval, 2020; Paquette, 2020). The Mézières method has been shown to have superior effects on chronic low back pain (Alfonso-Mora et al., 2023; Lena et al., 2022; Savage, 2020) with associated improvement in interoceptive perception of mobility (Alfonso-Mora et al., 2023) and with improvement in temporomandibular joint function (Savage, 2020).

GDS-Godelieve Denys-Struyf Method

Godelieve Denys-Struyf (1931-2009), a student of Mézières in Paris in 1972 and 1973, contributed to this therapeutic current with the concept of "article-muscular chains" developed in the 1970s and known as the GDS method (Denys-Struyf, 2005). The GDS method is a motor control intervention that classifies the muscles that influence lumbopelvic and spinal stability into six groups of muscle chains according to their anatomy and function in posture and movement. Denys-Struyf is based on the assumption that the balance between these muscle chains contributes to proper neuro-muscular, biomechanical and psychomotor control, whereas unbalanced tension between them is the cause of subacute or chronic low back

pain (Díaz-Arribas et al., 2015). The Godelieve Denys-Struyf method, a reconceptualisation of the Mézières method, has been used specifically in the treatment of chronic low back pain as a postural rehabilitation exercise (Paolucci et al., 2018) and has been shown to reduce low back pain (Díaz-Arribas et al., 2015; Grotle et al., 2022; Lombardo et al., 2023) in both lumbar disc herniation (Grotle et al., 2022) and lumbar disc degeneration (Lombardo et al., 2023).

Ehrenfried Method

Body psychotherapy has its origins in psychoanalysis and the gymnastics and dance reform movements of the early 20th century (Loukes, 2006). The Ehrenfried Method emerged from this reform movement (Geuter, 2015). The Ehrenfried Method belongs to the line of psychocorporal therapies (Geuter, 2015). Dr Lydia Ehrenfried was one of the first teachers to train with Gindler (Machado et al., 2006; Mullan, 2016). The lineage of the Ehrenfried Method has also influenced integrated psychotherapy methods such as that of Hilarion Petzold. Its scope, like that of the Gindler Method, could be applied to complementary therapies for patients who have undergone traumatic experiences (Weiss et al., 2017). Both the Gindler Method and the Ehrenfried Method would develop self-regulation strategies in the individual to achieve a state of connectedness and safety during interactions, such as co-regulation or physical connections that trigger safety responses and enable non-threatening social interactions. (De Baets & Van Praet, 2023).

Antigymnastics Method

Thérèse Bertherat is the creator of the Méthode Antigymnastique and a student of Françoise Mézières in 1972. Bertherat explains that the Mézières method contradicted her previous training because it was a natural method that required the patient to be aware of his body and to cooperate fully (Hade-Hétu, 1978). In addition to its curative effect, the Méthode Antigymnastique allows the restoration of a neurovegetative balance, a reharmonisation of the body schema and promotes an awareness of somatisation (Gain-Duval, 2020). The Méthode Antigymnastique is a method whose scope of application has only been scientifically proven in the field of somatic awareness in variables such as well-being and a self-perception of personal improvement (Gomez, 1988).

Gindler Method

The Gindler Method was developed by Elsa Gindler (1885-1961). Gindler's work was based on the 'gymnastics' or calisthenics methods of Friedrich Ludwig Jahn (1778-1853). Gindler's recognised body psychotherapy was called Work on the Human Being. Gindler is considered the forerunner of psychoanalytic therapies such as Gestalt therapy (Gregory & Robine, 2004); Reichian vital energy theory; Lowen's bioenergetic therapy (Geuter et al., 2010; Rothe, 2014); or 'Concentrative Movement Therapy' (Carl, 2013). Gindler was also a pioneer in the development of therapeutic concepts such as Ruth Cohn's Theme-Centred Interaction or Charlotte Selver's Sensory Awareness Method (Brooks, 1966). In the late 1920s and 1930s, Elsa Gindler (1885-1961) developed a breathing method (Buchholz, 1994; Oberem, 2016) as part of a holistic body psychotherapeutic approach (Eddy, 2009), the scope of which could be applied to complementary therapies in the treatment of patients with post-traumatic stress disorder (PTSD) (Weiss et al., 2017).

Eutonia Method

The Eutonia Method was developed by Gerda Alexander (1908-1994) in the 1930s, using a key concept from her work on efficient muscle tone. Gerda was a therapist considered to be a first generation somatic pioneer (Eddy, 2009). Eutonia seeks to balance the tension and relaxation of everyday activities by promoting body awareness. The Eutonia method is based on listening to the relationship between body tone and a corresponding internal vagal tension dialogue. The neurophysiological basis of the regulation of the individual is based on the functioning of the parasympathetic system and the vagal function (Porges, 2021). For its part, the Eutonia method has been used to improve the perception of quality of life (Niaradi et al., 2022a, 2022b) or postural re-education in adolescents. It has also been used to improve phoniatrics (Murcia, 1991) and in the treatment of neurodegenerative diseases such as fibromyalgia (Maeda et al., 2006).

Feldenkrais Method

The concept was developed and created by Moshe Feldenkrais (1904-1984) as a method of self-development and a new approach to the body during a rehabilitation period after a knee injury while practising judo (Eddy, 2009). The Feldenkrais Method has been developed in mindfulness work (Mattes, 2016; Wallman-Jones et al., (2023) or the level of psychological well-being (Wallman-Jones et al., 2023) in older people (Broome et al., 2015).

Alexander Technique

Friederich Mathias Alexander (1869-1955) developed a method of voice re-education based on the concept of the psychophysical encounter of the self with the physical re-education of the movement dynamics of the axial skeleton. He was also a somatic pioneer. Mathias Alexander exported his technique to Europe (Eddy, 2009). The Alexander Technique has been used in the reduction and prevention of low back pain (Cacciatore et al., 2005; Hafezi et al., 2022; Little et al., 2014) in relation to the expression of emotions through body touch (Jones & Glover, 2014); and in relation to the improvement of symptoms of depression in Parkinson's patients (Stallibrass et al., 2002) by promoting self-confidence (Aldridge, 2019).

Kabat Method

The Kabat Method is based on the concept of proprioceptive neuromuscular facilitation developed by Dr

Herman Kabat (1913-1995) and physiotherapist Margaret Knott (1918-1978). The method is based on a deep understanding of the neurophysiology and kinesiology of human movement, based on stimulation and response patterns for the treatment of patients (Adler et al., 2003). The main principle of the Kabat method is proprioceptive neuromuscular facilitation (PNF). It uses the property of muscle sensation or proprioception (Voss, 1967). It is defined as a method that uses superficial (tactile) and deep (joint position, tendon and muscle stretch) information to stimulate the nervous system, which in turn causes the muscles to act (Murcia, 1996d). The Kabat Method has been used as a treatment to improve the symptoms of cervicalgia of degenerative joint origin (Maicki et al., 2017); chronic low back pain of various origins (Areeudomwong et al., 2017; Ling-Xin et al., 2022; Young et al., 2015), which is one of the leading causes of disability worldwide (Areeudomwong et al., 2017; Young et al., 2015). It has also been shown to improve the quality of life of stroke survivors (Guiu-Tula et al., 2017) and to prevent serious pathologies by treating overuse injuries in athletes or dancers (Hoogenboom & Voight, 2015).

Final considerations

The profession of physiotherapist is the same as that of kinesiotherapist (Kine) or massage kinesiotherapist (MK) in the French Republic. The French term is 'Kinésithérapeute' (Paquette, 2020). The scope of practice of a kinesiotherapist includes a variety of techniques and approaches such as massage, mobilisation or kinesiotherapy, taping, muscle chain stretching, cryotherapy and electrotherapy. Kinomichi addresses specific areas of intervention using techniques such as mobilisation or kinesiotherapy and muscle chain stretching, and shares these elements with kinesiotherapy or conventional physiotherapy.

Through the Mézières Method, Françoise Mézières pioneered a school of disciples within the French kinesiotherapy movement. Her approach, based on the global concept of muscle chains, conceived in 1947, stands out in the field of holistic rehabilitation (Mézières, 1984).

Godolieve Denis-Struyf, a student of Mézières in 1972-1973, introduced the concept of joint chains as well as muscle chains (Denys-Struyf, 2005) In addition, Denis-Struyf incorporated the principles of proprioceptive facilitation developed by Herman Kabat and Margaret Knott in the 1940s and later completed by Dorothy Voss in 1954, adding the word neuromuscular (Hernández & Pérez, 2015).

Lydia Ehrenfried, through her method, and Thérèse Bertherat, through the Antigymnastique method, transmitted the principles of the Mézières method, in particular the spiral stretching of the muscle chains, to the methodology of Master Noro (Murcia, 1996d). The decisive contribution of the French physiotherapists Gisèle de Noiret and Marie-Thérèse Foix, both students of Noro for a long time in his dojo, marks a milestone in the evolution of practices such as Aikido towards Kinomichi (Murcia, 1996e).

Kinomichi is based on the reunion, mostly in pairs, with a natural, efficient movement and without unnecessary tension between the two practitioners. In this sense of neuromuscular repatterning (Gómez-Lozano, 2023; Krasnow, 1997; Krasnow et al., 1997; Krasnow et al., 2001), the nine therapeutic methods are designed to stimulate the ventral pathway of the vagus nerve, according to the polyvagal theory. This theory postulates that the vagus nerve is divided into three branches: ventral, dorsal and metabolic. The ventral pathway, associated with social connectedness and emotional regulation, is activated when we experience safety and connectedness, promoting relaxation and bonding responses (Porges, 2021).

Western therapies would aim to enhance the adaptive response of Kinomichi practitioners (in an agreed practice, the 'uke' receives the attack while the 'tori' executes the technique). The additional therapeutic benefits of this practice, usually in pairs, can lead to a significant improvement in interpersonal communication, harmony and psychophysical balance of the individual.

Conclusions

Although there is no scientific evidence that Kinomichi has been used therapeutically in studies, we have well-founded reasons to support it has significant therapeutic potential. Areas of intervention could include: improving mindfulness, preventing and treating pain and injury, improving quality of life for people with degenerative diseases and the elderly. It could also be used as a complementary therapy for anxiety, depression or general behavioural disorders and therefore has considerable potential as a psychosomatic therapy.

It justifies the need for quantitative experimental or quasi-experimental studies to ascertain the potential benefits of Kinomichi.

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Biomechanical differences between hip thrust and glute bridge for hip extensors

Efecto de las diferencias biomecánicas del hip thrust y el glute bridge para los extensores de cadera

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Abstract

The aim of this study was to compare the biomechanical characteristics of two similar exercises used to strengthen hip extensors: the Hip Thrust and the Glute Bridge. Ten resistance-trained participants were recruited and performed three repetitions of each exercise in a randomized order at 80% of their one repetition maximum of the Hip Thrust. Kinematic and kinetic variables were assessed. Significant differences were found between the Hip Thrust and Glute Bridge for the concentric phase in time (0.8 ± 0.14 s vs. 0.58 ± 0.07 s; p < .002), vertical displacement (35.65 ± 3.4 cm vs. 15.45 ± 4.82 cm; p < .002), total displacement (39.36 ± 4.03 cm vs. 19.22 ± 5.63 cm; p<.002), displacement vector magnitude (36.68 ± 3.51 cm vs. 17.84 ± 5.42 cm; p < .002), displacement vector angle (102.18 ± 6.32 deg vs. 61.79 ± 11.08 deg; p < .002), vertical positive impulse (1315.28 ± 300.34 Ns vs. 940.65 ± 93.59 Ns; p < .002), and total impulse (1422.11 ± 321.59 Ns vs. 1024.02 ± 105.48 Ns; p < .002). All effect sizes ranged between 1.59 and 4.64.

Keywords: Displacement vector index, impulse, gluteus maximus, kinematics, force.

Resumen

El objetivo de este estudio es comparar las características de dos ejercicios similares que se usan para desarrollar la fuerza de los extensores de cadera: el Hip Thrust y el Glute Bridge. Diez sujetos experimentados en el entrenamiento de fuerza realizaron tres repeticiones de cada ejercicio usando el 80% de su repetición máxima en el Hip Thrust. Se evaluaron variables cinéticas y cinemáticas. Se hallaron diferencias significativas entre el Hip Thrust y el Glute Bridge en la duración de la fase concéntrica (0.8 ± 0.14 s vs. 0.58 ± 0.07 s; p <.002), desplazamiento vertical (35.65 ± 3.4 cm vs. 15.45 ± 4.82 cm; p <.002), desplazamiento total (39.36 ± 4.03 cm vs. 19.22 ± 5.63 cm; p <.002), magnitud del vector de desplazamiento (36.68 ± 3.51 cm vs. 17.84 ± 5.42 cm; p <.002), ángulo del vector de desplazamiento (102.18 ± 6.32 deg vs. 61.79 ± 11.08; deg; p <.002), impulso vertical positivo (1315.28 ± 300.34 Ns vs. 940.65 ± 93.59 Ns; p < .002), e impulso total (1422.11 ± 321.59 Ns vs. 1024.02 ± 105.48 Ns; < .002). Todos los tamaños del efecto estuvieron entre 1.59 y 4.64.

Palabras clave: Displacement vector index, impulse, gluteus maximus, kinematics, force.

Introduction

There is an emerging body of evidence that shows the importance of hip extensors for sports performance (Cahalan et al., 1989). Hip extensors are the muscles that produce the greatest torque at the hip joint, and these muscles are of paramount importance in daily living, such as walking (Lieberman et al., 2006). The role of hip extensors in sports performance is critical to accelerate the body, especially when starting from a deep hip flexion, e.g., in cycling (Martin & Brown, 2009), sprint accelerations, rising from a deep squat or climbing very steep hills (Neumann, 2010a). Roberts and Belliveau (2005) found that the contribution of knee and ankle work during uphill running remained relatively equal as the slope increased, and the increase in total work came from the hip joint. These authors suggested that this distribution may be due to the increased moment arm on the hip (Roberts & Belliveau, 2005).

A higher ground reaction force produces faster running speeds (Weyand et al., 2000). Horizontal forces are relatively larger as running intensity increases compared to vertical forces, which are primarily produced to overcome the force of gravity and remain nearly constant (Brughelli et al., 2011). Horizontal forces are 11% of the vertical forces while running at 40% of the maximum speed, but these magnitudes increase to 18% when the subjects run at maximum speed (Brughelli et al., 2011). The hip extensor group is essential for the application of backwards force to push the body forward while sprinting 4. There is enough evidence to state that the role of the hip joint is paramount for sports performance (Comfort et al., 2012; Lieberman et al., 2006; Neumann, 2010a; Randell et al., 2011; Roberts & Belliveau, 2005), especially as the mechanical power requirements increase (Martin & Brown, 2009; Roberts & Belliveau, 2005).

Traditional exercises, such as squats and leg curls have been used to strengthen hip extensors. Seitz et al. (2014) found that squats help improve sprint times, but these authors did not analyze other training exercises that might have produced better results. However, Contreras et al. (2011) found that typical standing free-weight exercises are not optimal to strengthen the muscles involved in movements with antero-posterior force vectors, primarily because these exercises apply force vertically (Contreras et al., 2011). For example, barbell back squats may involve a powerful hip extension at the beginning of the movement, but its contribution rapidly decreases as the hip approaches full extension. This movement may be a major drawback for athletes who need the hip joint to apply high levels of force when it is fully extended, e.g., running-related sports.

The barbell Hip Thrust (HT) was first described in the scientific literature by Contreras et al. (2011). The HT is a free-weight exercise that consists of performing a hip extension with a loaded barbell placed in the hip while lying supine with the upper back on a bench and the knees in a 90° flexion. The concentric part of the movement starts with the plates in contact with the ground and finishes when the hip reaches full extension. The barbell displacement must be as perpendicular to the ground (or vertical) as possible, so that gravitational forces make the hip undergo a large torque during the entire movement (Bezodis et al., 2017). However, the scientific evidence on the value of the HT is not clear for all sports because some researchers found an improvement in sprint performance (Contreras et al., 2017) while others found no benefits (Jarvis et al., 2019). Nonetheless, there is clear evidence that the HT plays a major role in training the gluteus maximus because it activates this muscle to a greater degree than the back squat (Contreras et al., 2016).

The recently increased popularity of the HT among movement science professionals has led to the creation of many new variations, such as the "loaded Glute Bridge" (GB). This exercise is technically almost identical to the HT, with the only difference consisting of the placing of the upper back on the ground instead of on a bench. This difference led many practitioners to believe that the HT and GB are interchangeable. However, to the best of our knowledge, no study has analyzed these exercises from a biomechanical standpoint. Therefore, the aim of the present research is to study the biomechanical differences between the HT and GB exercises when the same external load is lifted. We also introduce a new concept, the displacement vector index. This index is used to numerically express the relationship between the vertical and horizontal components of the barbell displacement relative to the ground.

Methods

Participants

Eleven healthy men (age 23.5 ± 3.63 years, body mass 78.6 ± 13.7 kg, height 1.78 ± 0.08 m) volunteered to participate in this study. Participants had resistance training experience of at least 3 years, and they had performed the HT in their training sessions twice weekly for at least one year. The participants showed various training backgrounds, but most were athletes that used resistance training as a way to enhance their physical capacities (n = 3). Other participants had resistance training as their sport, in the case of weightlifters (n = 2), powerlifters (n = 4), and crossfitters (n = 2). The participants' one repetition maximum (1RM) in the HT exercise was 211.6 ± 27.27 kg. One participant could not complete the experimental protocol for reasons that were not related to the study. The anthropometric data of the 10 participants who completed the study is displayed in Table 1.

The study was approved by the Ethics Committee of the local University. All the participants were informed about the benefits and risks of participation in the current study and signed informed consent prior to participation. The study was developed according to the declaration of Helsinki.

Table 1. Descriptive statistics of the subjects

	Age (y)	Body mass (kg)	Height (m)	Hip Thrust 1RM* (kg)	80% 1RM (kg)
Subject 01	22	82	1.75	235	188
Subject 02	33	78	1.8	229	183.2
Subject 03	25	80	1.92	205	164
Subject 04	20	64	1.61	192	153.6
Subject 05	23	114	1.8	245	196
Subject 06	22	75	1.76	235.5	188.4
Subject 07	22	75	1.82	224.6	179.68
Subject 08	21	79	1.82	210	168
Subject 09	24	73	1.77	164.5	131.6
Subject 10	23	66	1.71	175	140
Average	23.5	78.6	1.8	211.6	169.2
SD	3.6	13.7	0.1	27.3	21.8

*1RM = One repetition máximum
*y = Years
*m = Meters
*kg = Kilograms
**SD* = Standard Deviation

Procedure

Participants attended the laboratory on two separate days, with at least one week between visits. Participants underwent a familiarization session during the first visit, in which investigators provided the participants with instruction about how to correctly perform the HT and GB. Specifically, we emphasized the importance of a linear movement pattern and a symmetrical barbell movement. One hour was sufficient for all of the participants to become accustomed to the exercise requirements. Each participant's 1RM was estimated for the HT after a 10-minute rest using the Powerlift app. The Powerlift app is a valid and reliable mobile phone app that allows the user to estimate the 1RM of a participant in certain exercises based on the velocity of the barbell (Balsalobre-Fernández et al., 2018). This app helped avoid any kind of potential risk involved in the lifting of higher loads.

During the second visit, the participants performed a standard warm up involving the HT and GB exercises of increasing loads (20%, 40%, 60% and 80% of 1RM). A dense pad was placed between the barbell and the participants' crease of the hips to protect the abdominal and pubis areas, as described by Contreras et al. (2011). An active LED marker was placed at the end of the barbell on the side to be filmed, and participants performed two sets of three consecutive repetitions of the HT or GB exercises in a randomized order using 80% of the 1RM of the HT exercise that was estimated in the previous session. Half of the subjects performed the HT first, and the other half performed the GB first. To ensure equal conditions between HT and GB assessments, the same load was also used for the GB. Even if this meant that subjects were not lifting the same relative intensity in both exercises, we considered this could help us avoid the fatigue accumulation that another 1RM calculation can carry. Recovery time between both sets was at least three minutes. An experienced coach supervised the exercises, which were deemed valid if performed according to the following criteria: the hips reached full extension, the barbell was pulled symmetrically and parallel to the ground, and the movement was as vertical as possible.

Instruments

A Casio Exilim EX-F1 digital camera with a sampling rate of 300 Hz was used to film the HT and GB exercises. To reduce the perspective error, the camera was placed at ten meters with the zoom as close as possible to ensure that the whole motion was captured (Payton, 2008). The videos were digitalized using the Kinovea 8.15 video analysis software to track the bar's endpoint two-dimensional position. The raw data were filtered using a fourth-order zero-lag Butterworth low-pass filter at a cut-off frequency of 10 Hz. The ensemble averages were created by reducing each individual exercise to 100 points using linear interpolation. Data were analyzed using a Microsoft Excel 2016 spreadsheet (Microsoft, Redmond, WA, USA) to calculate the bar's position, velocity and acceleration.

All the variables were assessed during the concentric phase of the movement, which was defined from the initial vertical barbell displacement to its maximum vertical height for each repetition. The following variables were assessed: time in seconds; horizontal displacement in centimeters, which was the sum of all the forward and backward barbell displacements that occurred in the horizontal axis; vertical displacement in centimeters, which was the sum of all the upward barbell displacement that occurred in the vertical

axis; total displacement in centimeters, which was the sum of instantaneous linear barbell displacements in the two-dimensional space; displacement vector magnitude in centimeters, which was the linear distance between the initial and final barbell positions; displacement vector angle in degrees, which was the angle formed between the initial and final barbell positions with respect to the horizontal axis; and displacement vector index, which is an adimensional ratio between displacement vector magnitude and total displacement that assesses the linearity of the barbell displacement. A linear path for the HT and GB is supposed to more specifically target the hip extensor muscle group. The displacement vector index ranges from 0 to 1, with 1 indicating a perfect linear motion of the barbell and lower values meaning a more circular motion, and it is calculated as follows: displacement vector index = displacement vector magnitude / total displacement. The vertical positive impulse, measured in Newtons per second, is the positive area under the vertical force / time curve, and it is calculated using the trapezoidal rule. The instantaneous vertical force was calculated using the mass of the external load (barbell plus plates) and the calculated vertical acceleration plus the resistance of gravity. The horizontal total impulse, measured in Newtons per second, is the total area under the horizontal force / time curve, and calculated using the trapezoidal rule. The instantaneous horizontal force was calculated using the mass of the external load and the measured horizontal acceleration. The total impulse, measured in Newtons per second, was the vectorial sum of instantaneous linear impulses in the two-dimensional space.

Statistical analyses

Descriptive data is represented as means and Standard Deviations. Data were evaluated for normality using Shapiro-Wilks tests and for homoscedasticity using Levene's test. The variables that passed both criteria were assessed using a paired Student's t-test, and the other variables were compared using Wilcoxon's test. All data were analyzed using SPSS 23.0 (IBM, Armonk, NY, United States of America) statistical software. Statistical significance was set at $p < .05$. Because of the small sample size, Hedge's g was calculated to measure effect sizes instead of Cohen's d and considered small ($ES \leq .2$), medium ($ES \leq .5$), large ($ES \leq .8$) or extremely large ($ES > 1.0$).

Results

All the variables were distributed normally, and all the variables were homoscedastic, except the vertical positive impulse and total impulse. Table 2 summarizes the average differences and ranges of all of the variables between the HT and GB. There were no significant differences between the HT and GB in horizontal displacement, total horizontal impulse or displacement vector index. The rest of the analyzed variables showed significantly larger values for the HT compared to the GB, with effect sizes that ranged from 1.59 to 4.64 and *p* values lower than .002. See Table 2 for full details.

Table 2. Results for the concentric phase of the HT and GB exercises

	HT (Avg ± *SD*)			HT Range (min - max)			GB (Avg ± *SD*)			GB Range (min - max)			Effect Size (Hedge's *g*)
Time (s)	0.8	±	0.14 †	0.53	-	0.98	0.58	±	0.07	0.46	-	0.65	1.91
DisplHor (cm)	11.47	±	3.74	7.64	-	20.38	9.19	±	3.35	4.68	-	15.38	0.61
DisplVert (cm)	35.65	±	3.4 ‡	29.92	-	40.26	15.45	±	4.82	7.06	-	23.49	4.64
DisplTot (cm)	39.36	±	4.03 ‡	33.02	-	46.3	19.22	±	5.63	9.42	-	29.83	3.94
DisplVectMag (cm)	36.68	±	3.51 ‡	30.91	-	41.42	17.84	±	5.42	8.02	-	28.08	3.95
DisplVectAng (deg)	102.18	±	6.32 ‡	87.72	-	109.32	61.79	±	11.08	48.25	-	79.47	4.29
DisplVectIndex	0.93	±	0.05	0.84	-	0.99	0.92	±	0.04	0.85	-	0.99	0.19
ImpPosVert (Ns)	1315.28	±	300.34 †	880.53	-	1773.63	940.65	±	93.59	796.84	-	1112.19	1.61
ImpTotHor (Ns)	107.04	±	28.84	70.56	-	158.56	83.37	±	26.53	46.22	-	124.76	0.82
ImpTot (Ns)	1422.11	±	321.59 †	958.95	-	1932.2	1024.02	±	105.48	856.1	-	1236.67	1.59

Results (Average ± SD and Range) of the concentric phase for the Hip Thrust (HT) and Glute Bridge (GB) exercises. DipslHor = horizontal displacement of the barbell; DisplVert= vertical displacement of the barbell; DisplTot = total displacement of the barbell; DisplVectMag = displacement vector magnitude; DisplVectAng = displacement vector angle; DisplVectIndex = displacement vector index; ImpPosVert = positive vertical impulse; ImpTotHor = total horizontal impulse; ImpTot = total impulse.

† Significantly different from GB ($p < .05$)
‡ Significantly different from GB ($p < .001$)

There was a high variability in barbell displacement in the HT and GB. Some participants showed a linear barbell displacement, while others showed a clear arched pattern in both exercises. This pattern is reflected in the displacement vector index, which ranged from 0.84 to 0.99 for the HT and 0.85 to 0.99 for the GB. Figure 1 shows the two-dimensional barbell displacements of four participants while performing the HT and GB.

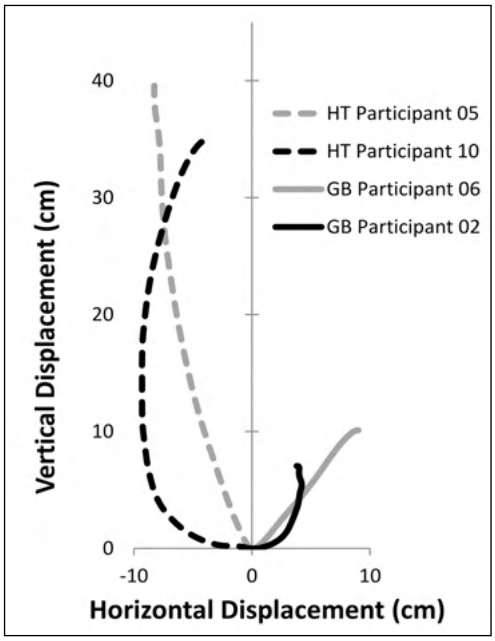

Figure 1. 2-dimensional barbell displacement for the HT and GB in participants with higher and smaller displacement vector indexes

Note: Gray dashed line: HT barbell displacement for participant 05 (displacement vector index = 0.99). Black dashed line: HT barbell displacement for participant 10 (displacement vector index = 0.84). Gray solid line: GB barbell displacement for participant 06 (displacement vector index = 0.99). Black solid line: GB barbell displacement for participant 02 (displacement vector index = 0.85). Patterns are normalized to show the (0.0) coordinate as the initial point of motion.

Figure 2 shows the average barbell displacement patterns with corresponding displacement vectors. Average displacement vector magnitude and angle were 36.68 ± 3.51 cm and 102.18 ± 6.32 degrees (p < .002), respectively, for the HT and were 17.84 ± 5.42 cm 61.79 ± 11.08 degrees, respectively, for the GB (p < .002).

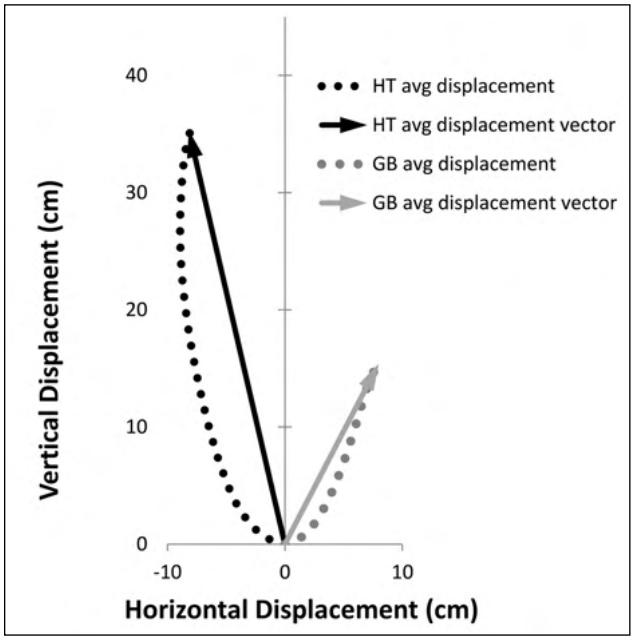

Figure 2. 2-dimensional barbell displacement and corresponding displacement vectors for average HT and GB patterns

Note: Black dotted line: HT average barbell displacement. Black arrow: HT average displacement vector. Gray dotted line: GB average barbell displacement. Gray arrow: GB average displacement vector. Refer to Table 2 for the magnitude and angle of average displacement vectors.

Discussion

The main objective of the present study was to compare a series of biomechanical variables between the HT and GB performed with the same load. All of the statistically significant differences found in this study were larger for the HT and had extremely large effect sizes, which reveals that both exercises have very different biomechanical characteristics. Overall, the HT elicited larger vertical and total displacements and impulses than the GB, with horizontal variables remaining equal.

It is known that the largest extensor moment on the hip during the hip thrust exercise happens when the hip is near full extension (Bezodis et al., 2017; Brazil et al., 2021). Near full extension, gluteus maximus muscle is strongest when compared to other regions of the hip extension Range of Motion (Németh & Ohlsén, 1985; Neumann, 2010b). For that reason, we consider that the GB may be a better suited exercise to develop gluteal muscles, as a lower degree of hip flexion implies less contribution from other hip extensors. However, this may not be true if we consider that according to recent findings, muscle elongation during a resistance exercise may increase the growth potential of muscles (Pedrosa et al., 2023). Whether a more pronounced degree of muscle elongation can beat a greater moment arm as a relevant factor for muscle growth is a question that remains to be answered.

The biggest findings of this study were that the HT vector magnitude was twice as large as the GB vector magnitude, and its displacement angle was much more vertical. The larger displacement vector magnitude of the HT likely allows a greater hip extension range of movement, which could be more beneficial for sports that require large hip extension ranges, even if this may not be as positive as it seems, as recent evidence suggests that the greatest extensor moment happens when the hip is near full extension (Brazil et al., 2021). The athlete is supposed to lift the barbell completely vertical during the HT to create the highest possible gravitational resistance for hip extensors. Surprisingly, the angle of the HT displacement vector was not completely vertical, which raises concerns about its supposed verticality. This absence of a completely vertical angle is very likely due to the lack of movement restriction during the free-weight HT, which implies that movement also occurs in the horizontal axis and reduces the effectiveness of the exercise.

The GB displacement vector angle was less vertical (Figure 2). This result was expected because the lifting trajectory is not totally opposed to the force of gravity (at least it is less opposed than in the HT). This trajectory creates a higher horizontal displacement and a lower gravitational resistance for the hip extensors, which means that lower force is likely needed to move a given weight in the GB. Consequently, one may expect to observe a higher 1RM in the GB compared to the HT, allowing athletes to lift higher absolute loads with the same relative intensity.

Therefore, the assessment of the horizontal displacement is a key parameter of the technique. However, we found no differences in the horizontal displacement or the horizontal impulse between the HT and GB when both exercises were performed with the same load. This result may be explained by the particular technique of some lifters during the performance of both exercises. Some lifters showed a clear trend towards performing a horizontal forward movement at the very beginning of the concentric phase and a backwards horizontal movement at the end of the HT (Figure 1), but no forward movement was observed in the GB. We hypothesize that these horizontal movements are an unconscious strategy of the lifters to lift the weight more easily by taking advantage of the horizontal inertia that this movement creates. The start of the repetition was considered as soon as a movement was recorded in the vertical axis from a totally stopped position, and it was considered finished when the movement in the vertical axis ended. Most of the two-dimensional trajectories analyzed showed a clear “arch” pattern in this frame during both exercises, even if there were interparticipant differences when lifting (Figure 1). This particularity reveals new aspects of this exercise that must be considered by coaches when choosing the HT or the GB for their training sessions.

The present study is the first time the displacement vector index was used in the scientific literature. This index is a novel kinematic indicator that assesses the way that the total displacement occurs compared to the displacement vector. This index ranges from 0 to 1, and it numerically expresses the extent to which the actual movement reflects the desired linear pattern. A scale for this index must be developed, but its initial classification is quite simple: the closer the displacement vector index value is to the number one, the higher the adjustment of the bar displacement is to its theoretical linear displacement and the lesser the movement pattern is arch-shaped. Notably, this index was equal for the HT and GB, and the effect size was small. These results may be due to the similarities in the mechanics of the HT and GB, e.g., both exercises use free weights to perform a hip extension that starts while lying supine on the floor with the bar in the pubis area. The displacement vector index ranged from 0.84 to 0.99 in the HT and 0.85 to 0.99 in the GB in our tests, which means that some participants correctly followed the exercise instructions for a linear movement pattern, and other participants took advantage of the horizontal movement. Figure 1 shows different movement patterns for participants with higher and lower displacement vector index values. Therefore, the displacement vector index precisely reflects the movement linearity and may be used to assess it.

The primary aim of this research was to analyze the biomechanical differences between the HT and GB. Therefore, the study used equal loads to evaluate the exercises under equal conditions. However, this decision was proven as a limitation because the GB likely allows higher absolute loads to be lifted. Additionally, the low

number of subjects and the fact that only two dimensions could be measured can be considered limitations. Therefore, future research should focus on assessing biomechanical differences between the HT and GB when proportional percentages of the 1RM loads are lifted.

Conclusions

The larger vertical and total displacements of the HT render this exercise more relevant to sports that require the application of strength from smaller hip angles or higher ranges of motion. Notably, the HT exhibits larger vertical positive and total impulses, which suggests that it has superior properties for sports in which large amounts of force per unit time must be applied, e.g., weightlifting. We suggest to maintain the barbell trajectory as vertical as possible during this exercise to produce a displacement vector index of close to 1.

The GB is an interesting exercise for practitioners looking for a high amount of force application close to hip lockout because its range of motion is very small and very near to full hip extension where the gluteus maximus is very strong. This movement is similar to the powerful hip extension seen in many resistance training-related sports exercises, e.g., snatch. The GB may also be used by athletes looking for a new stimulus for the gluteus maximus to avoid a stalemate in muscle hypertrophy.

We consider that these conclusions only apply to trained subjects, as our sample is mainly compound by trained subjects.

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Prediction of disruptive behaviors from boredom and satisfaction with physical education

Predicción de las conductas disruptivas a partir del aburrimiento y la satisfacción con la educación física

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Abstract

The aim of the present study was to analyze the psychometric properties of the Questionnaire for Disruptive Behavior in Physical Education (CCD-EF) in the Mexican context. A non-experimental, cross-sectional, correlational-causal study was designed in which 378 girls (*M* = 13.99; *SD* = .30) and 375 boys (*M* = 14.02; *SD* = .33), all high school students participated. The psychometric properties of the scale were analyzed by means of different exploratory and confirmatory analyzes that demonstrate that this instrument with four correlated factors, and as higher order models, is valid, reliable, and invariant as a function of sex. A regression model with latent variables showed a positive and significant prediction of boredom with Physical Education on disruptive behaviors, finding that this prediction is higher in boys than in girls. The CCD-EF has proven to be a reliable and valid instrument to use with Mexican high school students.

Keywords: Physical education, disruptive behaviors, boredom, satisfaction, high school.

Resumen

El objetivo del presente estudio fue analizar las propiedades psicométricas del Cuestionario de Conducta Disruptiva en Educación Física (CCD-EF) en el contexto mexicano. Se diseñó un estudio no experimental, transversal, correlacional-causal, en el que participaron 378 niñas (*M* = 13.99; *DT* = .30) y 375 niños (*M* = 14.02; *DT* = .33), todos estudiantes de secundaria. Las propiedades psicométricas de la escala fueron analizadas mediante diferentes análisis exploratorios y confirmatorios que demuestran que este instrumento con cuatro factores correlacionados, y como modelos de orden superior, es válido, confiable e invariante en función del sexo. Un modelo de regresión con variables latentes mostró una predicción positiva y significativa del aburrimiento con la Educación Física sobre las conductas disruptivas, encontrando que esta predicción es mayor en niños que en niñas. El CCD-EF ha demostrado ser un instrumento confiable y válido para utilizar con estudiantes mexicanos de secundaria.

Palabras clave: Educación física, conductas disruptivas, aburrimiento, satisfacción, secundaria.

Introduction

School violence is one of the most worrying social problems in adolescents, and it leads to behaviors such as physical and verbal abuse among students, with disrespect for the teacher's authority, constant disorder in the classroom being among the most common (Manzano, 2021). In addition to this, classroom violence increases the probability of school failure, which, together with the dissatisfaction of adolescents, is even related to a higher suicide rate (Benbenisthy et al., 2018), which increases concern about this problem (Hinduja & Patchin, 2015). In fact, interpersonal violence is the fourth leading cause of adolescent and youth mortality worldwide, although its weight varies substantially from one region of the world to another, according to the World Health Organization [WHO] (WHO, 2021). In the low- and middle-income countries of the Region of the Americas, it is the cause of almost one third of all adolescent male deaths. According to data from the Global School Health Survey (GSHS), 42% of adolescent boys and 37% of girls were exposed to bullying (WHO, 2021), with low school engagement and school failure being a major risk factor (WHO, 2020). Different studies (Baños, Baena-Extremera & Granero-Gallegos, 2019; Fernández-Garcimartín et al., 2023; Hoyo-Guillot & Ruiz-Montero, 2023; Palacios-Gómez et al., 2023), have highlighted the importance of studying the disruptive behaviors of young people at school since they spend most of their time there.

These matters are of even greater concern in the Mexican context, as it continues to rank first internationally among Organization for Economic Cooperation and Development [OECD] countries in cases of bullying and school violence, a phenomenon that affects more than 18 million primary and secondary students in public and private schools in the country (Senado de la República de México, 2019). Furthermore, Mexico is one of the three OECD member countries where suicide rates rose between 1990 and 2015 for young people aged 15 to 19 years (Burns & Gottschalk, 2019).

Disruptive behaviors are defined as those that disrupt school activities, particularly behaviors that disturb teachers and/or students in class (Maddeh et al., 2015). For teachers, this set of inappropriate student behaviors hinders the normal development of classroom activities during the sessions, causing a great loss of time due to constant calls for attention that cause interruption of school planning and low academic performance (Sulbarán & León, 2014). Regarding the typification of disruption, school regulations and teachers› perceptions classify it under misconduct as: misbehavior, aggressiveness, repeated annoyance, indiscipline, rudeness, transgression of the truth, attention deficit and distancing (Sulbarán & León, 2014).

The subject of Physical Education (PE) has been labeled as a conflictive curricular area due to the frequent interactions that occur in it because of its eminently practical and competitive nature (Buscà et al., 2014). These conflicts in the PE classroom are usually more prone to occur in sessions where students have to demonstrate that they are more skilled than their peers (Baños, 2021), when students find PE classes monotonous and boring (Olweus & Breivik, 2014), and when they experience feelings of dissatisfaction with the subject (Baños, 2020). By contrast, when the adolescent experiences feelings of fun and satisfaction with PE the probability of negative behaviors in the classroom is reduced. Thus, boredom is a determining factor in the increase of inappropriate behaviors in PE (Baños et al., 2017), with the teacher being an important element in reducing it (Baños, Barretos-Ruvalcaba et al., 2019).

There are certain behaviors that are identified more frequently in PE, such as aggressive, low engagement or irresponsibility, fails to follow directions, distract or disturbs others, and poor self-management (Cothran & Kulinna, 2007; Kulina et al., 2006). Among the students' explanations for their inappropriate behaviors in the PE classroom the boredom they experience in their classes stands out as they find them to be monotonous, and dissatisfaction with the teacher is also significant. It is common to find these behaviors reiterative in the same subjects (Cothran & Kulinna, 2007). Along these lines, disruptive behaviors in the PE class can reduce learning and the opportunity for classroom activities (Supaporn et al., 2003). As some studies highlight, adolescents often show some problematic behaviors in classrooms, such as idleness, disrespect, irresponsibility, disobedience of rules, talking out of turn, and/or skipping class, which generates a negative impact on the learning environment (Baena-Extremera et al., 2015; Kulinna et al., 2006). The learning environment that the teacher is able to create in PE classes can influence inappropriate behaviors, motivation, and student learning (Baños et al., 2017).

In this vein, questionnaires have been designed and validated to measure disruptive behaviors in the PE classroom from the students' (Granero-Gallegos & Baena-Extremera, 2016; Krech et al., 2010) and the teachers' perspectives (Krech et al., 2010; Kulinna et al., 2006). Focusing on students, first Kulinna et al. (2003) and Cothran and Kulinna (2007) designed the 59 item Physical Education Classroom Instrument (PECI) to measure both the frequency of indiscipline and the severity of students' disruptive behavior. This scale began with six factors: aggressive, low engagement or irresponsibility, fails to follow directions, distract or disturbs others, poor self-management, and disruptive and illegal behaviors (Kulinna et al., 2003). However, none of these studies presented validity analyses of the instrument and also did not provide values related to goodness-of-fit indices. Later, the PECI evolved to a short version of 20 items from which the dimension of harmful and illegal behaviors was eliminated, and which did present acceptable validity and reliability values, Krech et al. (2010). Subsequently, the PECI was adapted and validated for PE in the Spanish context by

Granero-Gallegos and Baena-Extremera (2016) receiving the name Questionnaire for Disruptive Behavior in Physical Education (CCD-EF). This adaptation obtained acceptable validity and reliability values. However, in Mexico there are no adapted and validated questionnaires available that assess disruptive behaviors in PE classrooms and that could contribute to evaluating the origin of the very high rates of violence among Mexican adolescents. Likewise, it is worth mentioning that none of the previously mentioned versions of this instrument have analyzed it as a higher-order model (Lévy-Mangin & Varela, 2006) in which negative behaviors are evaluated from a global perspective, in addition to evaluating their variables in a correlated manner. Given that previous research presented a high correlation between the different factors (Granero-Gallegos & Baena-Extremera, 2016; Krech et al., 2010), it would be interesting to analyze the psychometric properties of the CCD-EF as a higher-order model in which it would function as a single latent variable.

It should be noted that of all the studies mentioned above, the only one that reported results of factorial invariance as a function of academic level was the study by Krech et al. (2010), who studied factorial invariance as a function of academic level (primary vs. secondary) and as a function of student and teacher perception. However, in the adaptation and validation of the instrument to the Spanish context (Granero-Gallegos & Baena-Extremera, 2016) the factorial invariance of the instrument was not reported, although recently obtained valid results in the factorial invariance analysis of the CCD-EF as a function of gender with another Spanish sample (Martínez-Molina et al., 2020). However, it is necessary to continue studying the validity of the instrument in different samples.

In view of the above, adapting and validating this instrument to the Mexican context may be of great interest, as it could contribute to the analysis of violence among school adolescents with such worrying figures as discussed in the previous paragraphs. In this way, PE teachers could establish general strategies to address disruptive environments and maintain discipline in the classroom. Therefore, the objectives of the present study are: (i) to analyze the psychometric properties of the CCD-EF scale in the Mexican context; (ii) to analyze a higher order model from the subscales included in the CCD-EF; (iii) to analyze the factorial invariance of the CCD-EF scale as a function of gender; and (iv) to analyze the predictive relationship of satisfaction with PE on disruptive behaviors. Based on all the literature reviewed, the following hypotheses are proposed based on the objectives of the present study: H1, the CCD-EF will obtain adequate validity and reliability in the Mexican context; H2, the higher order model will obtain adequate validity and reliability values; H3, the CCD-EF will be gender invariant; H4, satisfaction with PE will negatively and significantly predict disruptive behaviors in the classroom; H5, boredom with PE will positively and significantly predict disruptive classroom behaviors. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative (Von Elm et al., 2008) was used to description of the research.

Method

Design

The present study has a non-experimental, cross-sectional, and correlational-causal design (Hernández et al., 2014). The sample design was probabilistic by centers, stratified, multistage by proportional allocation, and was made up of students in the third year of secondary education in the state of Nuevo León (Mexico). The secondary schools that participated in the study were randomly selected. To do this, all schools were listed and selected using a random number table. The number of students in the third year of secondary school in the State of Nuevo León in 2019 was 13396 girls and 13831 boys. These data were provided by the Secretary of Public Education of the State of Nuevo León.

Eligibility criteria

Any secondary school in the State of Nuevo León could be selected to participate in the study. The main condition is that only public secondary schools would participate in the randomization process. Once all centers had been enumerated, they were randomly selected using a numerical randomization table. The criteria for excluding the schools from the present study were that they were private schools or that they received a negative response from the director of the secondary education center to participate in the study. In addition, the subjects who did not present the informed consent signed by the father/mother/guardian to participate in the research were excluded.

Adaptation to the Mexican context

The CCD-EF items from Granero-Gallegos and Baena-Extremera (2016) were adapted to the Mexican context. Two native speakers adapted the 20 items to the Mexican context. To judge the goodness of the adaptation, the degree of coincidence with the original version was considered. Following Lynn (1986), four experts in secondary education analyzed the final version to ensure the adequate design of the items for the measurement of the construct it was intended to measure and that it maintained the original meaning. The experts evaluated the relevance and comprehension of each item on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). If the mean item scores were < 2.5, the items were revised. If an item was not rated by at least three of the four experts within the theoretical dimensions of the scale, it was further revised. The overall agreement of four experts on relevance and comprehension was measured by the Intraclass Correlation Coefficient (*ICC*); the values obtained were: *ICC* = .83 for relevance and *ICC* = .85 for comprehension. The Mexican version was administered to 45 high school

students between 12 and 14 years of age and they showed full comprehension of the items. The final Mexican version of the CCD-EF was thus arrived at.

Instruments

The Any secondary school Questionnaire for Disruptive Behavior in PE (CCD-EF). The CCD-EF validated to the Spanish context by Granero-Gallegos and Baena-Extremera (2016) was adapted to the Mexican context from the original Physical Education Classroom Instrument by Krech et al. (2010). This instrument presents 20 items that measure negative behaviors in the PE classroom. It is composed of five dimensions with four items each: a) aggressive, b) low engagement or irresponsibility, c) fails to follow directions, d) distract or disturbs others, and e) poor self-management. The scale was preceded by the statement, "Tell us your degree of agreement or disagreement regarding PE classes." Responses were collected on a 5-point Likert- type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Satisfaction with PE (SSI-EF). The version adapted to the Mexican context by Baños, Baena-Extremera, and Granero-Gallegos (2019) of the Sport Satisfaction Instrument (SSI) by Castillo et al. (2001) was used. This scale is composed of eight items and measures levels of satisfaction/fun with PE (five items) and boredom with PE (three items). The scale was preceded by the statement: "Tell us your degree of agreement or disagreement with regard to the PE classes" The responses were collected using a Likert type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Procedure

The Any This research was conducted in accordance with the Declaration of Helsinki 1961 (revised in Edinburgh in 2000). Approval was obtained by the Secretaría de Educación Pública of México and Universidad Autónoma of Baja California, México (identification number: 431/569/E). In order to carry out this research, a research proposal was submitted to the Secretaría de Educación Pública de México entitled: "Programme for International Student Assessment: relationship of school performance in secondary school students with psychological, family and physical activity variables", which was approved and subsidized by the aforementioned organization. Subsequently, permission was requested from the management of the secondary schools, and the parents/ guardians of the students gave informed consent after the objectives and purpose of the study were stated to them. Once the aforementioned permissions had been obtained, data collection proceeded by informing the participants of the objective of the study, the anonymous and voluntary nature of their participation, the confidential treatment of their responses, that there were no right or wrong answers and requesting that they answer with the utmost sincerity. The questionnaires were completed in the classroom, with the principal investigator always present to resolve any doubts during the process, which lasted 15-20 minutes.

Risk of bias

Regarding bias control, it should be noted that there was randomization of the educational centers but not of the participants. There was blinding between the participants and the investigators responsible for the treatment and data analysis. Regarding selection bias, participation in the study was voluntary and communication with the students was in person in the classroom.

Sample size

Any secondary school Regarding the sample size, the requirement stipulated by Carretero-Dios and Pérez (2005) were met; namely, that there were 10 participants for each item to carry out a Confirmatory Factor Analysis (CFA). In addition, the Free Statistics Calculator v.4.0 (Soper, 2022) software was used, which calculated that a minimum of 717 subjects would be sufficient to detect effect sizes (*f2*) = 0.19 with a statistical power of .95 and a significance level of α = .05 in a structural equation model (SEM) with eight latent variables and 28 observed variables. A total of 755 students participated in the research.

Statistical analysis

For the achievement of the objective of this study, statistical analyses of homogeneity of each item and Cronbach's alpha (α) were carried out in the first instance

The evaluation of the factorial structure of the instrument analyzed was carried out through confirmatory factor analysis (CFA) Several fit indices were calculated for the evaluation of the different proposed models, combining absolute and relative fit indexes (Bentler, 2007; Markland, 2007). Among the absolute ones: the *p*-value, associated with the Chi-square statistic ($\chi 2$), the ratio between and degrees of freedom (*gl*; $\chi 2/gl$) and *GFI* (goodness-of-fit index). Among the relative indexes: *TLI* (Tucker-Lewis index) and *CFI* (comparative fit index). Also, *RMSEA* (root mean square error of approximation) and *SRMR* (standardized root mean square), were used as incremental indexes (Browne & Cudeck, 1993). In the case of $\chi 2/gl$ model fit values < 5.0 were considered acceptable, and ratios < 2.0 considered as indicators of excellent model fit (Tabachnick & Fidell, 2007). Values of *CFI* and *TL I*> .95, *RMSEA* < .06 and *SRMR* < .05, were considered as indices of excellent model goodness-of-fit (Hooper et al., 2008; Hu & Bentler, 1998). Values of *CFI* and *TL I* > .90 and *RMSEA* and *SRMR* < .08 were considered acceptable indices of model goodness-of-fit (Hooper et al., 2008; Marsh et al., 2004). The reliability of each dimension was assessed with α, and composite reliability (*CR*) and average variance were extracted (*AVE*) to measure convergent validity. Reliability values > .70 and *AVE* > .50 were considered acceptable as were values > .50 (Hair et al., 2014).

Attending to the high correlations that often occur between lower-order factors, researchers follow their initial CFA with a post-hoc test of a higher-order (e.g., second order) model (Myers et al., 2014). In a higher-order model, each item is specified as loading on its target first-order

subscale and each first-order factor is allowed to load on one or more higher-order factors (Rindskopf & Rose, 1988). Thus, alternative models were tested to find the best factor structure approach of the CCD-EF, including a higher-order model (H-CFA) as an alternative to the first-order model (CFA).

The invariance according to the sex variable (multigroup invariance) of the CCD-EF was tested following the methodological proposal advanced by Milfont and Fisher (2010), of testing four successively more constrained models. Following Chen (2007), these nested models were compared considering the change (*Δ*) in goodness-of-fit indexes (i.e., increase in *RMSEA* of at least .015 or decrease in *CFI* and *TLI* of at least .01, indicate lack of invariance).

Finally, to test the nomological validity of the scale, a regression model with latent variables was performed to test the predictive relationship of the SSI-EF (satisfaction/enjoyment and boredom with PE). For a better interpretation of the results, R2 was used as effect size (*ES*), having calculated the *CI* (95%) to confirm that no value was below the minimum required for interpretation (*R2* = .02) (Domínguez-Lara, 2017). The cut-off points established to score it are: .02, .13 and .26, for small, medium, and large, respectively (Cohen, 1992).

Results

Participants

The representative sample was calculated according to sex, for a finite population with a confidence level of 95% and a margin of error of + 5%, 378 being girls (*Mage* = 13.99; *SD* =. 30) and 375 boys (*Mage* = 14.02; *SD* = .33).

Table 1. Descriptive, internal consistency and homogeneity statistics (n = 375)

Dimensions:	*M*	*SD*	*CCIT-c*	*α without item*	*Q1*	*Q2*
Factor 1: Aggressive (**α** = .56)						
1. Amenazo a los demás compañeros/as de clase. [Threatens others]	1.47	0.95	0.35	0.48	2.23	4.39
2. Hablo correctamente a mis compañeros/as de clase. [Smart mouth toward students]	2.27	1.15	0.38	0.45	0.65	- 0.32
3. Hablo de los demás a sus espaldas. [Talking back]	1.81	1.10	0.32	0.49	1.36	1.05
4. Hablo de forma correcta al profesor/a. [Smart mouth toward teacher]	1.90	1.17	0.32	0.50	1.34	0.91
Factor 2: Low Engagement or Irresponsibility (**α** = .69).						
5. Me quejo habitualmente. [Whining]	2.57	1.33	0.42	0.61	0.41	- 0.96
6. Soy perezoso en clase. [Lazy]	2.47	1.37	0.42	0.62	0.46	- 1.01
7. Busco llamar la atención. [Attention seeking]	1.73	1.09	0.45	0.59	1.43	1.08
8. Me muevo lentamente a propósito. [Moves slowly on purpose]	1.89	1.22	0.50	0.56	1.23	0.37
Factor 3: Fails to Follow Directions (**α** = .71).						
9. Interrumpo las clases. [Interrupts]	1.72	1.12	0.53	0.70	1.55	1.43
10. Me siento inseguro en clase de EF. [Unsafe actions]	1.96	1.29	0.45	0.74	1.10	- 0.06
11. No presto atención en clase de EF. [Doesn't pay attention]	2.07	1.37	0.57	0.67	1.02	- 0.30
12. No sigo las instrucciones. [Not following directions]	1.86	1.17	0.64	0.64	1.23	0.41
Factor 4: Distract or Disturbs Others (**α** = .85).						
13. Tengo mal genio y me enojo. [Temper tantrums]	2.08	1.26	0.48	0.83	0.92	- 0.30
14. Abandono el grupo durante una actividad. [Leaving the group during an activity]	1.69	1.11	0.69	0.72	1.68	1.90
15. Miento en clase. [Lying]	1.71	1.11	0.68	0.73	1.58	1.54
16. Me salto las clases de EF. [Sneaks out of class]	1.51	1.00	0.67	0.74	2.10	3.62
Factor 5: Poor Self-Management (**α** = .70)						
17. Soy peleónero/a. [Quarrelsome]	1.82	1.16	0.58	0.58	1.31	0.70
18. Me burlo de otros/as compañeros/as de clase. [Makes fun of other students]	1.89	1.18	0.58	0.57	1.22	0.45
19. Argumento mis actos. [Arguing]	2.76	1.39	0.32	0.75	0.17	- 1.19
20. Acoso a algunos/as compañeros/as de clase. [Bullying]	1.49	1.08	0.50	0.63	2.29	4.12

Note: *M* = Mean; *SD* = Standard Deviation; *CCIT-c* = Corrected coefficient of item-total correlation; **α** = Cronbach's alpha; *Q1* = Skewness; *Q2* = Kurtosis.

Item descriptive analysis

The item statistics for each of the dimensions are presented in Table 1. In the aggressive dimension, it should be noted that the *SD* of item 1 was < 1 and the skewness and kurtosis values presented values < 2. In addition to this, the internal consistency of the dimension with the four items was inadequate (α = .56) and does not improve if any of the items are eliminated. These results should be considered for the evaluation of model fit in confirmatory analyses. The items of the dimensions of low engagement or irresponsibility, fails to follow directions and distract or disturbs others, obtained adequate values in *SD*, *CCIT-c*, skewness, kurtosis, and reliability. The irresponsibility and low commitment factor obtained values slightly below those accepted in reliability; however, according to Taylor et al. (2008), when a factor is composed of a small number of items (in this case by four items) an internal consistency index < .70 can be considered acceptable. Regarding the items of the poor self-management factor, the deletion of item 19 improved the internal consistency to .75 and item 20 obtained skewness and kurtosis values > *2*. These results should be considered for the evaluation of model fit in confirmatory analyses.

Confirmatory factor analysis and reliability

The representative Next, the original dimensionality theoretically proposed by Krech et al. (2010) was analyzed with CFA and, following authors such as Markland (2007), several models were formulated and analyzed, given that the data so recommended, and the most relevant results were reported. Considering the above in the analysis of scale items, it was appropriate to perform and compare several structural regression models to check the best fit. Several models were hypothesized (see Table 2). The first of the models included the 20 items and the five factors of the original scale (Krech et al., 2010) that presented some unacceptable fits (*TLI* = .87; *CFI* = .89), and two of the items of the aggressive dimension presented low regression weights < .33 (Hair et al., 2014) and high values (> 2.58) in their standardized residuals (Byrne, 2013). Considering the above, as well as the unacceptable internal consistency of the aggressive factor (α = .56) this factor was eliminated and a model with the other four factors was evaluated, it presented acceptable goodness-of-fit indices. However, taking into account the index modification values of the statistical program, the errors of items 11 and 12 of the fails to follow directions factor and items 14 and 16 of the distract or disturbs others factor were correlated and the model presented acceptable (*TLI* = .94; *CFI* = .95) and excellent (*SRMR* = .036; *RMSEA* = .058) goodness-of-fit indices. Thus, H1 is fulfilled. Despite the good fits of this model, it was considered that the high correlations (.94) between some of the factors (i.e., distract or disturbs others with poor self-management and fails to follow directions with low poor self-management) could limit the discriminant validity of the scale, as values < .85 are considered adequate (Henseler et al., 2015), although some authors consider values <. 90 to be (Teo et al., 2008), so a higher-order model (Lévy-Mangin & Varela, 2006) was evaluated, which also presented acceptable (*TLI* = .94; *CFI* = .95) and excellent (*SRMR* = .038; *RMSEA* = .060) goodness-of-fit indices. To examine the model comparison, the AIC (Akaike Information Criteria) and BIC (Bayesian Information Criterion) were also taken into account, in which, although they do not describe the model fit, lower values are considered to reflect a better fit (Table 3).

Table 2. Fit indices for each model

Models	χ^2	*df*	*p*	χ^2/*gl*	*TLI*	*CFI*	*SRMR*	*RMSEA (90%IC)*	*AIC*	*BIC*
Model 5 factors	765.80	160	.000	4.79	.87	.89	.049	.071 (.066;.076)	865.80	1097.00
Models 4 factors	456.10	98	.000	4.65	.91	.92	.042	.070 (.063;.076)	532.10	707.81
Models 4 factors*	339.49	96	.000	3.54	.94	.95	.036	.058 (.051;.065)	419.49	604.45
Higher order model*	361.22	.98	.000	3.69	.94	.95	.038	.060 (.053;.066)	437.22	612.94

Note: $\chi 2$ = chi-square; *df* = degrees of freedom; *TLI* = Tucker Lewis index; *CFI* = comparative fit index; *SRMR* = Standardized Root Mean-Square; *RMSEA* = root-mean squared approximation; *IC* = confidence interval; *AIC* = Akaike Information Criteria; *BIC* = Bayesian Information Criterion; *model with correlation of the errors of items 11 with 12 and 14 with 16.

To evaluate the reliability and validity of the scale, α, composite reliability and average variance extracted, and *AVE* were measured for each factor. The results can be seen in Table 4. The α values are acceptable and only the low engagement or irresponsibility dimension presented values < .70, although considering the stipulations of Taylor et al. (2008), given the low number of items, this value can be accepted. All factors present acceptable composite reliability values (Hair et al., 2014). In relation to the *AVE*, these same authors indicate that convergent validity values are considered acceptable when all the values of the standardized regression weights in a latent variable are significant and > .50, even if its *AVE* is < .50. This is the case for low engagement or irresponsibility and fails to follow directions. H2 is, thus, satisfied.

Table 3. Standardized factor loadings for first-order CFA and H-CFA of the CCD-EF

	CFA				*H-CFA*				
Item	*LEI*	*FFD*	*DDO*	*PSM*	*LEI*	*FFD*	*DDO*	*PSM*	*DB*
Low engagement or irresponsibility (LEI)									.842**
Item5	.570**				.578**				
Item6	.562**				.568**				
Item7	.662**				.653**				
Item8	.588**				.690**				
Fails to follow directions (FFD)									.972**
Item9		.761**				.762**			
Item10		.515**				.506**			
Item11		.525**				.528**			
Item12		.668**				.674**			
Distract or disturbs others (DDO)									.974**
Item13			.577**				.576**		
Item14			.745**				.748**		
Item15			.794**				.794**		
Item16			.743**				.743**		
Poor self-management (PSM)									.944**
Item17				.720**				.722**	
Item18				.696**				.697**	
Item19				.354**				.353*	
Item20				.713**				.711**	
Correlations									
FFD	.892**								
DDO	.792**	.938**							
PSM	.766**	.898**	.944**						

Note: *CFA* = first order confirmatory factorial analysis; *H-CFA* = higher order CFA; *DB* = disruptive behaviors; **$p < 0.01$.

Table 4. Reliability and validity of the CCD-EF factors

Factors	Composite Reliability	*AVE*	Cronbach´s Alpha
Low engagement or irresponsibility	.72	.38	.69
Fails to follow directions	.71	.39	.75
Distract or disturbs others	.81	.52	.81
Poor self-management	.72	.41	.70

Note: *AVE* = average variance extracted.

Factorial invariance across gender

The invariance of the CCD-EF was evaluated across gender (i.e., male = 375, female = 378) based on the first order CFA model and the higher order (H-CFA) model, the results of which are shown in Table 5. Starting with a configural invariance model, invariance constraints were progressively added to the factor loadings (i.e., weak invariance, intercepts (i.e., strong invariance), and residual variances (i.e., strict invariance), weak invariance), intercepts (i.e., strong invariance), and residual variances (i.e., strict invariance). The values of these restrictive models were acceptable, except for the strict invariance of the H-CFA, as the *CFI* results were outside the cut-off values. The values of these restrictive models of the H-CFA did not exceed the cut-off points for *RMSEA* ($\Delta > .015$), *CFI* ($\Delta > .01$), and *TLI* ($\Delta > .01$) so it can be considered fully invariant. In the case of the first-order model, it can be considered partially invariant, since the strict invariance model showed a decrease that slightly exceeded the limits of the recommended values (ΔCFI = -.013). H3 is, thus, fulfilled.

Table 5. Invariance test across gender for the CCD-EF

Model	χ^2	*df*	*RMSEA [90% IC]*	*CFI*	*TLI*	*ΔRMSEA*	*ΔCFI*	*ΔTLI*
Measurement across gender (First order CFA)								
1.- Configural invariance	489.542*	192	.045 [.040;.050]	.936	.920			
2.- Weak invariance	505.856*	204	.044 [.040;.049]	.935	.924	- .001	- .001	.004
3.- Strong invariance	553.927*	214	.046 [.041;.051]	.927	.918	.002	- .008	- .006
4.- Strict invariance	632.163*	232	.048 [.043;.052]	.914	.911	.002	- .013	- .007
Measurement across gender (H-CFA)								
1.- Configural invariance	514.016*	196	.046 [.042;.051]	.932	.917			
2.- Weak invariance	529.478*	208	.045 [.041;.050]	.931	.921	-.001	- .001	.004
3.- Strong invariance	554.529*	212	.046 [.042;.051]	.927	.917	.001	- .004	- .004
4.- Strict invariance	95.473*	212	.046 [.042;.051]	.927	.917	.000	.000	.000

Note: *CFA* = first order confirmatory factorial analysis; *H-CFA* = higher order *CFA*; χ *2*= Chi square; *df* = degrees of freedom; *RMSEA* = root mean square error of approximation; 90% *CI* = 90% confidence interval of the *RMSEA*; *CFI* = comparative fit index; *TLI* = Tucker–Lewis index; * *p* < .01.

Nomological validity

A regression analysis with latent variables was performed to test the extent to which the dimensions of the SSI-EF (independent variable) predict disruptive behaviors (dependent variable). Firstly, to indicate that the SSI-EF showed excellent goodness-of-fit indices in CFA: $\chi 2$ = 34.30; *gl* = 19; *p* = .01; $\chi 2/gl$ = 1.80; *GFI* = .99; *CFI* = .97, *RMSEA* = .04, *SRMR* = .05, as well as adequate reliability: satisfaction/fun, *CR* = .84; *AVE* = .52; *α* = 78; boredom, *CR* = .71; *AVE* = .45; *α* = .65. Next, the measure of invariance of the linear regression model was tested according to the sex variable (girls, *n* = 378; boys, *n* = 375). The regression model was found to be invariant by sex, as the restrictive increase/decrease of the models for *RMSEA* was < .015, *CFI* < .01, and *TLI* < .01, the results are shown in Figure 1. In both boys and girls, the prediction of satisfaction/fun with PE on disruptive behaviors was not significant (H4 is not satisfied), but it was significant for boredom with PE (H5 is satisfied). When males are bored in PE classes, the predictive relationship for disruptive behaviors is .51 (*p* < .0001), with 23% of variance explained; while among female students the predictive relationship of boredom with PE for disruptive behaviors in class is .36 (*p* < .0001), with 15% of variance explained.

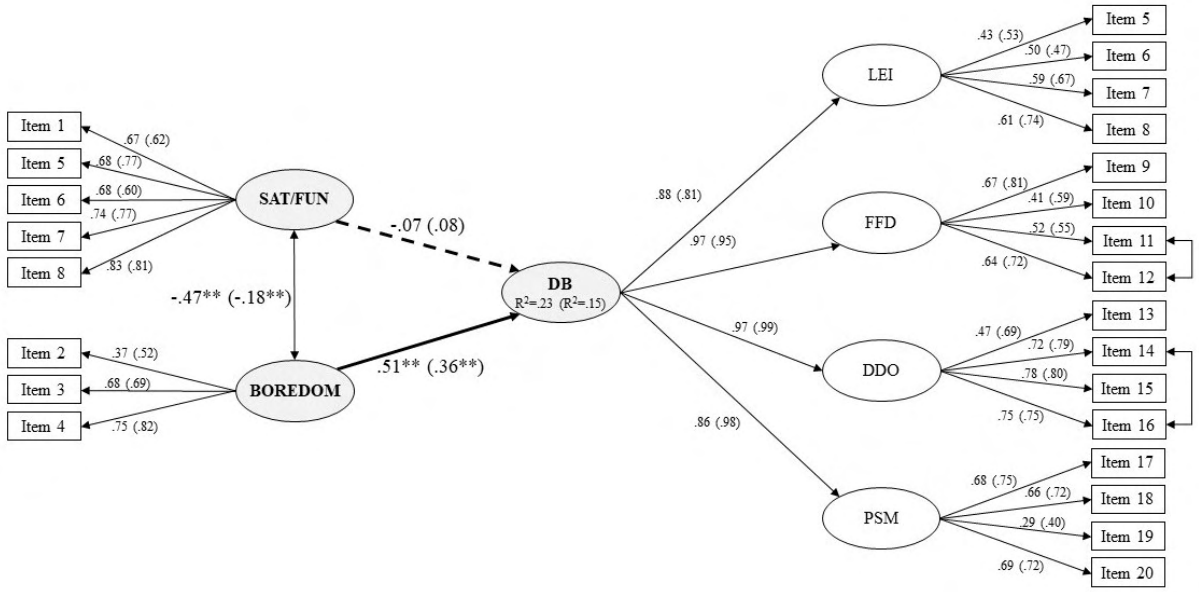

Figure 1. Structural regression model of satisfaction/fun and boredom with physical education classes and disruptive behaviors (higher order model)

Note: girls' values are in parentheses; *SAT/FUN*=satisfaction/fun; *DB*=disruptive behaviors; *LEI*=Low engagement or irresponsibility; *FFD*=Fails to follow directions; *DDO*=Distract or disturbs others; *PSM*=poor self-management. In parentheses are the values corresponding to the girls' model.

Discussion

The objectives of the present study were: (i) to analyze the psychometric properties of the CCD-EF scale in the Mexican context; (ii) to analyze a higher-order model based on the subscales that make up the CCD-EF; (iii) to analyze the factorial invariance of the CCD-EF scale as a function of sex; and (iv) to analyze the predictive relationship of satisfaction with PE on disruptive behaviors. The main results show that both the model with four correlated factors (first order) and the higher-order factor have adequate goodness-of-fit indices. In addition, the scale is invariant according to sex, and boredom with PE is a significant and positive predictor, stronger in males, of disruptive behaviors in the school context of secondary education in Mexico.

Concerning H1, the analysis of the data shows that the internal consistency obtained by the CCD-EF is adequate in all its dimensions, except for aggressive, which does not reach the minimum score to be accepted (Nunnaly & Bernstein, 1995). This same problem with the aggressive factor was already found in the validation of the instrument with Spanish adolescents (Granero-Gallegos & Baena-Extremera, 2016), it not being possible to make a comparison with the original English version, since it did not report internal consistency values. This result obtained in the aggressive dimension should be considered for the elimination of the factor. It is worth noting that the rest of the indicators suggest maintaining all the items of the scale (Nunnally & Bernstein, 1995).

Regarding the data obtained from the goodness-of-fit index, the present study analyzed several models following the indications of authors such as Markland (2007). The five-factor model did not reach the minimum acceptable values set by authors such as Hooper et al. (2008) to consider the CCD-EF as a valid instrument applicable in the Mexican context, so it was decided to eliminate the aggressive factor from the instrument since it presented problems in both reliability and validity analyses. Similar results were previously obtained by Granero-Gallegos and Baena-Extremera (2016) in their validation with a Spanish sample, in which they also proposed the elimination of the aggressive dimension. By contrast, in the original version, this factor was maintained since the results obtained in the validity of the instrument were acceptable. Subsequently, the instrument was analyzed with only four factors (i.e., low engagement or irresponsibility, fails to follow directions, distract or disturbs others and poor self-management), in which an excellent fit was obtained if two errors were correlated, one between items 11-12 and the other between items 14-16. Also, in the Spanish version (Granero-Gallegos & Baena-Extremera, 2016) an excellent fit was obtained in the four-factor model proposed. Thus, we can state that the four-dimensional CCD-EF is a valid and reliable instrument, as it has been used in different countries, and in the adaptation to the Mexican context, good results for reliability, validity and goodness-of-fit indexes have been obtained. In addition to this, it is worth highlighting the important contribution that the present study makes to the Mexican educational system and society, since it provides an instrument that evaluates the negative behaviors of adolescents in the PE classroom, in the country with the highest rate of violence among its elementary and high school students (Senado de la República de México, 2019). Therefore, H1 is fulfilled.

Regarding H2, the present work showed a higher-order factor of a reflective type (Lévy-Mangin & Varela, 2006) from the four subscales, obtaining adequate goodness-of-fit values. This means that the same student can have irresponsible behaviors, disobey the rules, be disruptive in class, and/or have no control over it, but, in addition, the CCD-EF can be used as a single latent variable that measures disruptive behaviors in general. This makes a contribution to the scientific literature that had not previously been made either in the original validation of the PECI (Krech et al., 2003; Krech et al., 2010) or in the adaptation and validation to the Spanish context carried out by Granero-Gallegos and Baena-Extremera (2016). Therefore, H2 is fulfilled.

In relation to H3, the present study has obtained that the Mexican version of the instrument is invariant according to sex, both for the four-factor model and for the higher order factor model. Thus, the factorial invariance of the CCD-EF is confirmed, and the CCD-EF can be considered to be valid and invariant instrument in the Mexican context for comparison studies based on the sex variable. Given its strength in the known psychometric properties of the CCD-EF (Granero-Gallegos & Baena-Extremera, 2016; Martínez-Molina et al., 2020), and the use in other languages (Krech et al., 2010), the data obtained have the potential to confirm construct validity. Thus, this study represents a contribution to the consistency of the psychometric properties of the CCD-EF, so that it can be used in future research regardless of gender. Therefore, H3 is confirmed.

In relation to H4 and H5, the prediction model proposed in this study showed that boredom with PE classes is a positive and statistically significant predictor of disruptive behaviors, both in girls and boys, although with higher predictive values in boys. This gender difference could be due to the fact that boys engage in negative behaviors more frequently than girls in the PE classroom (Baños, 2021; Cothran & Kulinna, 2007; Kulina et al., 2006). This can be explained by boys pretending to show superiority over their peers in order to attract the attention of girls (Glock & Kleen, 2017). Similar results were found other studies in which boredom in PE classes or at school predicted CCD-EF dimensions (Baños, 2020; Cothran et al., 2009; Granero-Gallegos et al., 2020). This could be due to the learning climates created by the teacher since when environments are created where the adolescent has to demonstrate superiority to the rest of his or her peers or avoid not showing incompetence (Hansen & Rindgal, 2018; Manzano-Sánchez et al., 2023) conflicts and disruptive behaviors among students are generated

(Baños, 2021). This highlights the importance of students not experiencing feelings of boredom as they will increase disruptive behaviors of some students in the classroom, who will then try to distract their peers in classes (Glock & Kleen, 2017). However, satisfaction and enjoyment with PE do not significantly predict CCD-EF, although it obtained a negative relationship. In this line Baños (2021) and Cothran et al. (2009), did obtain a statistically significant negative relationship between the dimensions of CCD-EF and satisfaction with PE, with the exception of the dimension of aggressive at work by Baños (2021), a factor that has been eliminated in the present study. It is worth mentioning that the scientific literature highlights the importance of students feeling satisfied at school as it reduces disruptive behaviors in both boys and girls (Asun-Dieste & Guíu, 2023; Aznar-Ballesta & Vernetta, 2023; Sun, 2016), increases satisfaction with life (Scharenberg, 2016) and is a relevant factor in the competencies acquired by the teacher for the creation of ideal learning climates for the student body (Invernizzi et al., 2019). Therefore, H5 is fulfilled, but not H4.

Conclusion

To conclude, the findings of this study have demonstrated that the CCD-EF is a reliable and valid instrument for application in the Mexican context and that it can be applied independently of the sex variable. Furthermore, it has been shown that the CCD-EF can be used as a higher order model, so that this scale can measure disruptive behaviors in a unidimensional way and, in turn, low engagement or irresponsibility, fails to follow directions, distract or disturbs others and poor self-management. This is a significant contribution to the existing literature since no scale of negative behaviors in PE had previously been validated with Mexican adolescents. In addition, boredom with PE positively and significantly predicts disruptive behaviors in both girls and boys.

Limitations and strengths

The present research has a series of strengths that should be mentioned, among them is the sample design, which is probabilistic and randomized by centers, stratified, multistage and with proportional allocation. In this way, the results of the study can be generalized to the State of Nuevo León in Mexico. Another important strength is the subject matter it addresses since it can contribute to generating solutions to the main problems related to adolescent behavior at school, a very worrying problem in Mexican society. It is also necessary to admit a series of limitations. For example, the CCD-EF scale can be applied at the high school level regardless of the subject's gender; however, it cannot be held that this scale can be used at different educational levels, so the results of the present study cannot be generalized to students of other ages. We consider it important to mention the need to carry out future studies of a longitudinal nature and using a mixed research methodology (quantitative and qualitative), also classifying the subjects at both socio-demographic and socio-economic levels.

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Evaluation of the accuracy of different body composition prediction formulas compared to DXA in Colombian Women's Professional Soccer

Evaluación de la exactitud de distintas fórmulas de predicción de la composición corporal en comparación con DEXA en el Fútbol Profesional Femenino Colombiano

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Abstract

The aim of the present study was to compare different body composition prediction formulas with the reference method, DEXA, in the context of Colombian professional women's soccer during a competitive season. The purpose of this was to determine which of these formulas most closely replicates the gold standard and could offer an alternative for evaluating body fat percentage (%) and lean mass in the absence of more precise methods. Formulas were used to calculate body fat percentage using two components, specifically, those conceived by Yuhasz (15.17 [13.98 – 16.72]%), Durnin and Rahaman (25.57 [24.95 - 28.07]%), Jackson and Pollock (16.71 [14.33 – 19.33]%), and Durnin and Womersley (24.90 [24.02 – 27.01]%). For five components, lipid mass was calculated from body weight (19.80 [17.80 – 22.30]%), whilst DEXA provided body fat percentage data (23.94 ± 3.51%). A cross-sectional analytical study with non-probabilistic convenience sampling was conducted of 24 female soccer players from two first-division teams. A total of 26 anthropometric variables were measured. Descriptive analysis was performed using *SPSS v.21*, in addition to correlation (*SP*), Lin's concordance, and Bland and Altman analyses. The lowest inter-method difference relative to DEXA was obtained via the Durnin and Womersley formula, with a value of – 0.70, indicating that fat % estimates would, on average, overestimate DEXA by a value of 0.7. Durnin and Womersley formula produced the closest body fat % values to those produced by the reference method, DEXA.

Keywords: Anthropometry, performance, sport, women, muscle.

Resumen

El objetivo fue comparar diferentes fórmulas de predicción de composición corporal con el método de referencia DEXA en el contexto del Fútbol Profesional Femenino Colombiano durante la temporada competitiva. Esto se hizo para determinar cuáles de estas fórmulas se acercan más al estándar de referencia y pueden ser utilizadas para evaluar el porcentaje (%) de grasa y la masa magra en ausencia de métodos más precisos. Para hallar % de grasa en dos componentes se usaron Yuhasz (15.17 (13.98 - 16.72)%), Durnin y Rahaman (25.57 (24.95 – 28.07)%), Jackson y Pollock (16.71 (14.33 – 19.33)%) y Durnin y Womersley (24.90 (24.02 – 27.01)%), para cinco componentes se calculó masa lipídica del peso (19.80 (17.80 – 22.30)%) y en DEXA los datos del % de grasa (23.94 ± 3.51%). Se llevó a cabo un estudio analítico transversal con muestreo no probabilístico por conveniencia en 24 futbolistas de dos equipos de primera división usando 26 variables antropométricas, se realizó un análisis descriptivo en el *SPSS v.21*; y un análisis de correlaciones (*SP*), índices de concordancia de Lin y método de Bland y Altman. La menor diferencia intermétodo con DEXA la obtuvo Durnin y Womersley con valor de – 0.70, así que % de grasa hallados sobreestimarían DEXA en promedio 0.7 puntos. Los % de grasa calculados mediante la fórmula de Durnin y Womersley, fueron los más parecidos a los valores de % de grasa arrojados por el método de referencia DEXA.

Palabras clave: Antropometría, rendimiento, deporte, mujer, músculo.

Introduction

Body composition refers to the quantification of body components. It provides evidence of the relationship between respective components and the changes they are subjected to by external factors (González, 2013). In the 20th century, body composition assessment began through the dissection of corpses. This became known as the direct method. Over time, other methods evolved such as hydrostatic weighing, and the two and five component methods, amongst others (Costa et al., 2015). This means that values vary widely depending on the assessment method used (Merrigan et al., 2018). Nevertheless, dual-energy X-ray absorptiometry (DEXA) has been described as the criterion method (Zulet et al., 2019), given that other methods, such as bioelectrical impedance and anthropometry, exhibit large error terms. This has led to substantial variations in outcomes even within the same subjects (Cumberledge et al., 2018).

It has been discussed that muscle mass can vary among athletes and is one of the most strongly related components with sports performance. For this reason, it has become of great importance in professional football, which is one of the most popular sports in the world according to the International Federation of Association Football (FIFA, 2018). In addition, body composition varies according to playing position (Holway, 2008; López et al., 2021; Rodríguez et al., 2019). In order to address this, different methods have been used to assess body composition in a number of sports such as football (Pons et al., 2015). A better understanding of these variables provides useful information for the specification of training loads (Almăjan et al., 2015), diet and nutritional planning, and injury prevention, amongst other important aspects (Ceballos et al., 2021; García et al., 2014).

Research in professional football has been mainly inclined towards the male sex; hence, knowledge and information about the female population is limited. Thus, the main aim was to evaluate different methods used for the estimation of body composition, in comparison with DEXA, in Colombian women's professional football during a competitive period of the season. The reason for this was to assess the accuracy of alternative field methods for instances when the criterion method may not be available.

Methodology

Study Design and Sample

A cross-sectional analytical study was carried out using prospectively gathered data. Non-probabilistic convenience sampling was used to select the study sample. The final study sample comprised 24 Colombian professional female soccer players signed to one of two Colombian women's professional soccer teams competing in the first division. Data was collected between September 2021 and March 2022, which corresponded to a competitive period of the season. During the study period, participating footballers presented optimal levels of hydration, given that during training and competition they consumed isotonic sports drinks alongside water. It is important to mention that the level of hydration of each study participant was based on personal needs.

All soccer players participating in the study were over 18 years old and, prior to the beginning of the study, signed an informed consent form which included details about the assessments to be carried out. The study did not include players with injuries or pacemakers, or those who were pregnant or breastfeeding. Additionally, the authors had no financial or personal relationships with participants that could lead to any conflict of interest.

The present research adhered to international ethical principles laid out by the Declaration of Helsinki made by the World Medical Association (1975), and national guidelines and Resolution 8430 of October 1993 established by the Ministry of Health and Social Protection of Colombia (1993), which establishes the scientific, technical and administrative standards for health research. The study was classified as minimal risk and approved by the Ethics Committee of CES University, under minutes No. 0031, dated February 9th, 2021, with the code Act0031Proy117TG.

Data Collection: Techniques Used and Instruments

All data were collected during a single session with a time requirement of one hour per player. Demographic and anthropometric information were gathered and evaluated via the two- and five-component methods, as well as via DEXA.

The Lunar Prodigy from General Electric Healthcare (United States) was used for dual-energy X-ray absorptiometry (DEXA) assessment. For two and five-component measurements, a SECA brand scale and stadiometer were used (Hamburg, Germany/Cali, Colombia). Skinfold thickness was measured using a Harpenden Skinfold caliper (Holtain Ltd., Wales, United Kingdom). Diometers, segmometers and anthropometers were sourced from CESCORF (Porto Alegre, Brazil), and a Lufkin measuring tape (LUFKIN INDUSTRIES, Texas, United States) was used for circumferences. All equipment was calibrated and accompanied by their respective certificates.

Anthropometric measurements were taken in accordance with the Protocol of the International Society for the Advancement of Kinanthropometry (ISAK), and all anthropometrists responsible for taking measurements were ISAK I and II certified (Marfell & Steward, 2006).

All data were collected at the Center for Advanced Studies, CESNUTRAL, within CES University between September 2021 and March 2022.

Data Analysis

A database was elaborated to house data collected from which body mass index (BMI), percentages (%), and adiposity, muscle mass, bone mass, skin mass, and

residual tissue (all in kilograms [kg]) were calculated via the five-component anthropometric model proposed by Kerr (1988). Fat mass and fat-free mass were also analyzed, according to the two-compartment model, using formula conceived by Yuhasz and modified by Carter (1982), and formula conceived by Durnin and Womersley (1974), Jackson and Pollock (1978), Faulkner (1968), Reilly et al. (2009), and Parizkova and Buskova (1971).

In addition, results obtained by DEXA for fat mass, lean mass and bone mineral content were analyzed. In order to compare adipose mass estimated made via the five-component method and fat mass obtained via DEXA, the lipid fraction of the adiposity % was calculated using the equation proposed by Martin et al. (1994): Lipid fraction (%) = 0.327 + (0.0124 x % adiposity). Subsequently, this value was multiplied by overall adipose mass in kilograms.

Data analysis was conducted using statistical software including *SPSS version 21.0, Excel* and *R*. For qualitative variables, univariate analysis was performed of absolute and relative frequencies pertaining to the variables of gender, playing position, body mass index and Cormic index. Quantitative variables, such as age, height weight and body composition variables calculated according to the two- and five-component methods and DEXA, were analyzed using measures of central tendency and dispersion (mean, median, standard deviation, interquartile range) in order to describe the general and anthropometric characteristics of participating athletes.

Subsequently, bivariate analysis was conducted to examine the relationship of variables such as playing position with anthropometric characteristics of participating athletes. The aim of this was to compare the outcomes produced by the different body composition estimation methods under analysis. With regards to DEXA, correlational analysis was performed using the Pearson or Spearman test, according to data distribution of the variables. Concordance analysis was also performed to calculate intraclass correlation coefficients and the Bland & Altman graphical method was employed.

Results

A total of 24 Colombian professional female football players were evaluated, of which two were goalkeepers, three were defenders, three were forwards, four were wingers and twelve were midfielders. Average age was 24 ± 3.7 years, with a weight of 57 ± 5.2 kg, height of 161 ± 5.2 cm and BMI of 22 ± 1.8 kg/m².

Outcomes produced using the five-component model are presented in Table 1. Based on this methd, it was observed that goalkeepers exhibited the highest measurements pertaining to adiposity (18.73 ± 2.04 kg), followed by forwards (17.95 ± 2.52 kg) and defenders (16.44 ± 2.96 kg). In contrast, adiposity was lowest in midfielders and wingers (15.85 ± 2.49 kg and 14.92 ± 2.58 kg, respectively). With regards to muscle mass, highest values emerged in forwards, followed by goalkeepers (28.94 ± 1.82 kg and 26.14 ± 1.03 kg, respectively). Lowest muscle mass values were recorded in defenders and wingers (25.38 ± 1.83 kg and 22.48 ± 1.68 kg, respectively). Bone mass was highly similar in all athletes, regardless of playing position. This being said, highest values pertained to forwards (6.23 ± 0.55 kg), whilst lowest values were found in wingers (5.26 ± 0.53 kg).

Table 1. Body composition data calculated using the five-component method according to playing position

Variable		Goalkeeper	Centerback	Forward	Fullback	Midfielder
Kg Mass	Adipose Mass (*Kg*)	18.73 ± 2.04	16.44 ± 2.96	17.95 ± 2.52	14.92 ± 2.58	15.85 ± 2.49
	Muscle Mass (*Kg*)	26.14 ± 1.03	25.38 ± 1.83	28.94 ± 1.82	22.48 ± 1.68	25.60 ± 2.86
	Bone Mass (*Kg*)	6.02 ± 0.82	5.94 ± 1.286	6.23 ± 0.55	5.26 ± 0.53	6.17 ± 0.61
	Skin Mass (*Kg*)	3.40 ± 0.17	3.22 ± 0.25	3.55 ± 0.24	3.17 ± 0.12	3.28 ± 0.20
	Residual Mass (*Kg*)	5.54 ± 0.36	5.73 ± 0.51	6.28 ± 0.53	4.60 ± 0.50	5.42 ± 0.77
% Mass	Adipose Mass (%)	31.26 ± 1.29	28.85 ± 2.60	28.48 ± 3.65	29.49 ± 3.94	28.15 ± 3.80
	Muscle Mass (%)	43.73 ± 1.26	44.94 ± 2.95	45.99 ± 3.02	44.62 ± 2.83	45.40 ± 2.97
	Bone Mass (%)	10.04 ± 0.68	10.39 ± 1.12	9.89 ± 0.69	10.44 ± 0.98	10.99 ± 1.12
	Skin Mass (%)	5.71 ± 0.68	5.70 ± 0.43	5.64 ± 0.38	6.29 ± 0.39	5.83 ± 0.34
	Residual Mass (%)	9.26 ± 0.03	10.13 ± 0.73	9.99 ± 1.06	9.16 ± 1.18	9.63 ± 1.24

Note: Reported statistics correspond to the Mean ± *DS*.

DEXA measurements revealed average body fat % to be 23.90 ± 3.51. In the same way, data on lean mass, bone mineral content and fat mass, expressed as kg or %, where appropriate, were also obtained. These outcomes can be observed in detail in Table 2.

Table 2. Average and standard deviation (±) of body composition via DEXA

	Variable	$\dot{X}$	*SD*	*ME*	*IR*
Kg Mass	Fat Mass (*Kg*)	13.60	2.65	13.40	(12.00 - 15.50)
	Lean Mass* (*Kg*)	40.70	3.88	39.90	(38.40 - 44.10)
	BMC** (*Kg*)	2.46	0.21	2.41	(2.29 - 2.61)
% Mass	Fat Mass (%)	23.90	3.51	24.10	(22.10 - 26.00)
	Lean Mass* (%)	71.70	3.39	71.90	(69.70 - 73.60)
	BMC** (%)	4.34	0.32	4.29	(4.14 - 4.47)

Note: *Muscle + residual; ***BMC*: Bone Mineral Content; $\dot{X}$: Mean; *SD*: Standard deviation; *ME*: Median; *IR*: Interquartile range

Next, outcomes produced following the calculation of fat % through application of formulas proposed by Yuhasz, Durnin and Rahaman, Jackson and Pollock, and Durnin and Womersley for two components are compared with lipid mass outcomes produced through five-component calculations. Following this analysis it was evident that fat mass outcomes produced using the Yuhasz formula, with a median of 15.17% and an interquartile range (*IQR*) of 13.98% - 16.72%, are always indicative of a lower mass than that suggested by the other formulas. The highest fat mass % calculation was produced using the Durnin and Rahaman formula, with a median of 25.57% and an IQR of 24.95% - 28.07% (Table 3).

Table 3. Fat percentage data measured with various body composition prediction formulas for the two-component method according to playing position

Position	Yuhasz (%)	Durnin & Rahaman (%)	Jackson & Pollock (%)	Durnin & Womersley (%)	Lipid Mass of Weight (%) five-component
Goalkeeper (n=2)	17.37 ± 4.05 17.37 (15.94 - 18.80)	27.51 ± 4.58 27.51 (25.89 - 29.12)	19.24 ± 2.74 19.24 (18.27 - 20.21)	26.92 ± 2.58 26.92 (26.01 - 27.83)	22.35 ± 1.42 22.35 (21.85 - 22.85)
Centerback (n= 3)	16.30 ± 2.88 16.12 (14.82 - 17.70)	28.27 ± 3.14 27.90 (26.62 - 29.74)	17.74 ± 3.48 17.82 (16.02 - 19.50)	27.21 ± 3.11 26.84 (25.57 - 28.66)	19.81 ± 2.67 20.78 (18.79 - 21.32)
Forward (n= 3)	16.19 ± 3.88 15.81 (14.16 - 18.02)	27.06 ± 3.19 25.30 (25.21 - 28.02)	17.14 ± 4.84 17.52 (14.82 - 19.65)	26.00 ± 3.17 24.26 (24.17 - 26.96)	19.48 ± 3.78 19.35 (17.56 - 21.34)
Fullback (n= 4)	13.67 ± 2.32 14.69 (13.48 - 14.88)*	23.89 ± 2.76 25.02 (23.58 - 25.33)*	14.95 ± 3.13 15.68 (13.47 - 17.16)	22.86 ± 2.74 23.98 (22.55 - 24.29)*	20.57 ± 4.13 20.90 (18.17 - 23.30)
Midfielder (n= 12)	14.80 ± 2.63 15.30 (13.67 - 16.72)	25.02 ± 4.46 26.45 (23.61 - 27.99)	16.38 ± 3.39 15.45 (14.68 - 19.33)	23.86 ± 4.33 25.40 (22.15 - 26.92)	19.19 ± 3.73 19.44 (17.83 - 21.66)
Total	15.19 ± 2.82 15.17 (13.98 - 16.72)	25.70 ± 3.92 25.57 (24.95 - 28.07)	16.64 ± 3.39 16.71 (14.33 - 19.33)	24.63 ± 3.79 24.90 (24.02 - 27.01)	19.80 ± 3.42 19.80 (17.80 - 22.30)

Note: The reported statistics correspond to Mean ± *SD* and Median (*Q*1 – *Q*3); * Values that did not present a normal distribution.

In order to ensure appropriate comparisons of body fat % calculations and compare outcomes produced by formulas applying two- and five-component methods, the lipid fraction of mass calculated by the five-component method was first determined. This indicated more similar outcomes between methods with body fat values no longer

being overestimated by the five-component method. In fact, estimates were approximately 14 points higher than body fat % estimates produced using the Yuhasz formula and 3 points higher than those produced using the Durnin and Rahaman formula.

With respect to correlational analysis using Pearson or Spearman coefficients, in accordance with variable data distribution (Table 4), all fat % values produced using the two- and five-component methods correlated data provided by DEXA, which, for the purpose of the present study, provided the criterion method (García et al., 2014). Outcomes pertaining to the formulas proposed by Yuhasz and Durnin, and Rahaman stand out due to their high correlations with DEXA, specifically, 0.825 and 0.809, respectively ($p < .001$). Other outcomes also correlated well with DEXA (> 0.6-0.8), with lipid fraction of adipose tissue outcomes calculated using the five-component method producing the lowest correlation ($r < .616$; $p < .001$).

Table 4. Correlation coefficients between fat percentages calculations made with various body composition prediction formulas in relation to DXA

Test	Parameter 1	Parameter 2	*r*	*CI*	*p*
Pearson	DXA	% Lipid mass of weight	.616	.282 - .826	.345
	DXA	% Fat Jackson & Pollock	.757	.509 - .889	.237
	DXA	% Fat Yuhasz	.825	.632 - .922	.653
	DXA	% Fat Durnin & Rahaman	.809	.601 - .914	.055
Spearman	DXA	% Fat Durnin & Womersley*	.749	.559 - .903	.042
	DXA	% Fat Slaughter*	.679	.542 - .898	.035

Note: * Spearman's coefficient was used according to the distribution of the variable, other coefficients are Pearson's; **p < .05.

With regards to Lin concordance coefficients (Table 5), the highest intraclass correlation coefficient was produced for fat % calculations made using the Durnin and Womersley formula (ccc = 0.768), followed by those made using formula proposed by Durnin and Rahaman (ccc = 0.719). The method producing the lowest concordance correlation coefficient was Yuhasz with 0.163.

Table 5. Lin's Concordance Correlation Coefficients Between Fat Percentages Measured with Various Body Composition Prediction Formulas in Relation to DXA

Parameter 1	Parameter 2	*rho*	*CI*
DXA	% Lipid mass of weight	.352	.119 - .548
	% Fat Jackson & Pollock	.227	.093 - .352
	% Fat Yuhasz	.163	.069 - .254
	% Fat Durnin & Rahaman	.719	.491 - .855
	% Fat Durnin & Womersley*	.768	.543 - .891
	% Fat Slaughter*	.633	.385 - .796

Table 6. Inter-method difference (IMD) and agreement limits between fat percentages measured with various body composition prediction formulas in relation to DXA

Body Composition Method	% Fat *(Ẋ- SD)*	*IMD with respect to DXA (Ẋ- SD)**	Agreement Limits	
			Lower	Upper
DXA	23.94 ± 3.507	-	-	-
% Lipid mass of weight	19.80 ± 3.417	4.14	2.86	5.43
% Fat Jackson & Pollock	16.64 ± 3.389	7.30	6.28	8.31
% Fat Yuhasz	15.19 ± 2.816	8.75	7.91	9.59
% Fat Durnin & Rahaman	25.70 ± 3.921	- 1.76	- 2.75	- 0.78
% Fat Durnin & Womersley*	24.63 ± 3.793	- 0.70	- 1.71	0.32
% Fat Slaughter*	26.27 ± 3.580	- 2.33	- 3.33	- 1.3

Note: *Difference obtained by the Bland-Altman method

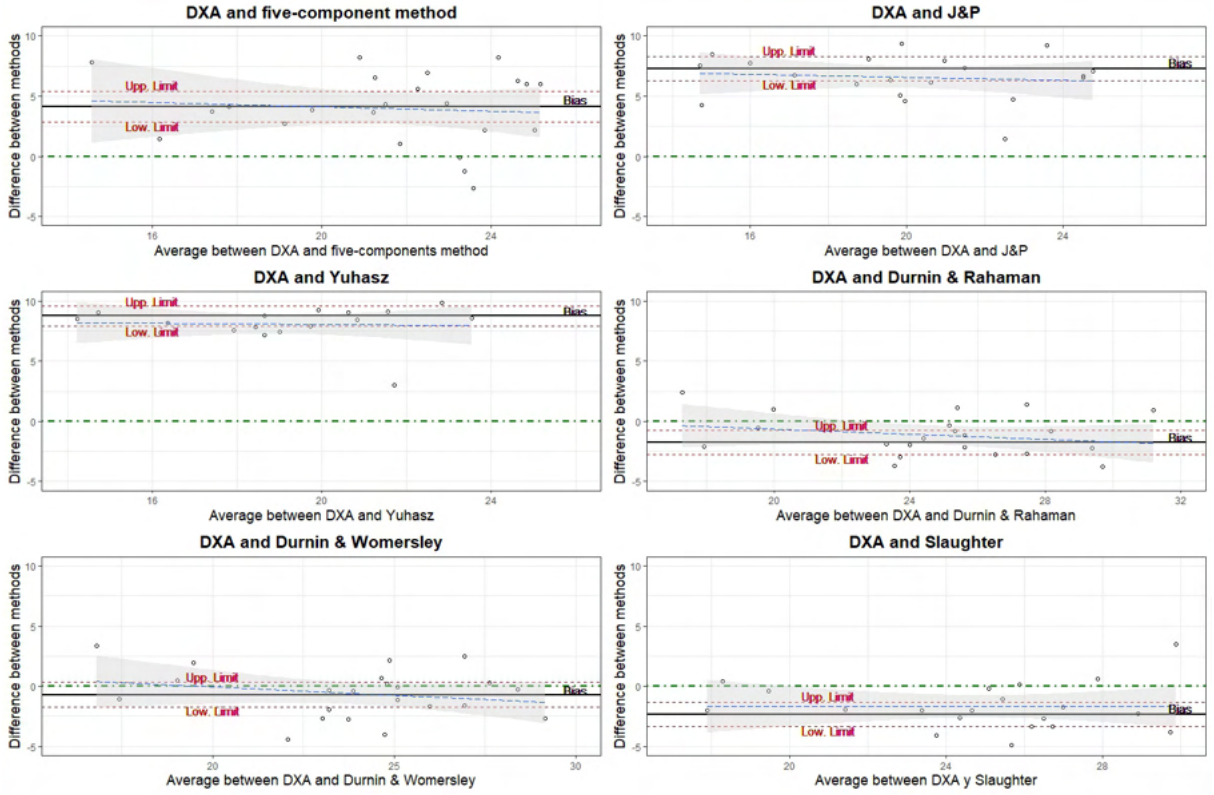

Figure 1. Comparison of fat mass percentage measured with body composition prediction formulas and DXA in Bland-Altman Plots

Discussion

The importance of properly determining body composition lies in its correlation with various aspects such as agility, lower limb power, flexibility and overall athlete performance (Zanini et al., 2020). However, body composition values vary widely depending on the method or formula used, with greater differences observed in variables such as body fat, fat mass and fat-free mass (Merrigan et al., 2018; Vaquero 2023). Additionally, body fat % is an indicator that varies significantly based on subject gender and age (López et al., 2018; Reilly et al., 2009; Santos & Tavares, 2007).

Present findings coincide with those reported in a study conducted with Chilean professional footballers, in which it was evidenced that the adipose mass of goalkeepers (18 ± 2.1 kg) was greater than that of defenders (16.2 ± 2.8 kg), forwards (15.5 ± 2.4 kg) and playmakers (15.0 ± 2.0 kg) (López, 2018; Rodríguez et al., 2019). In the same way, other studies describe that playmakers have lower body weight, adipose mass and muscle mass. This is explained by the fact that they provide support and act as a link between defenders and forwards, normally exhibiting physical characteristics such as endurance, speed and power, and high levels of maximum oxygen consumption (Ochoa, 2008).

Previous studies using the DEXA technique to analyze body composition, such as that conducted with a sample of 175 university women's soccer players, have reported average body fat to be 25.7% during preseason (Roelofs, 2020). This is similar to outcomes produced in the present research, in which the average was 23.9%; however, the peculiarity of these studies is that fat mass estimates vary depending on the formula used (Randell, 2021) and the population studied. On the other hand, it is also worth highlighting that the two-component method only considers chemically defined lipid mass, whilst the five-component method considers anatomically defined adipose mass, i.e., adipocytes with lipids, water, electrolytes and proteins. As the five-component method produces higher values (Holway, 2008), it was necessary to adjust fat mass values produced by the five-component model using the formula proposed by Alan Martin (Lipid Fraction (%) = 0.327 + (0.0124 x % adiposity) so that these values could be compared with fat mass values yielded using the two-component formulas.

In the present study, fat % values calculated according to the two-component method using the Durnin and Womersley formula were found to be the most similar to those calculated using the DEXA reference method. Similar findings were reported in another study conducted with male footballers. In this previous case, *DIM* outcomes pertaining to fat mass when using the Durnin and Womersley formula were rho= 0.66 (Kammerer et al., 2021), whilst, in the present study, a rho of 0.77 was produced when using this formula. Moreover, previous studies have

also concluded that fat % estimates in young footballers and other elite athletes using the Durnin and Womersley equation are highly similar to those produced with the reference method, arguing that this method could be used to assess body fat when more precise methods are not available (Blue et al., 2018; España et al., 2015). This being said, fat mass estimates will continue to demonstrate high variability as a function of the exact method employed. Similar findings were reported in a study conducted on obese or overweight individuals. In this aforementioned study, high correlations were found between values produced using DEXA and the four-component model (4C), however, fat % values were significantly higher using DEXA compared to the 4C model (García et al., 2015).

It is also important to note that, despite the fact that anthropometry has been used over the years as a double indirect method of evaluating body composition in athletes, when comparing Yuhasz's equation with the criterion method (Hind et al., 2018), it presented the lowest correlation-concordance and the highest *DIM*, with values of 0.163 and 8.75, respectively. This means that Yuhasz formula fat mass estimates would be underestimated by almost nine percent, preventing the realization of effective nutritional interventions.

In a study conducted on sub-elite rugby players, both the Yuhasz and Faulkner equations tended to underestimate fat % compared to the Reilly equation, with the Yuhasz equation showing higher systematic error (Escrivá et al., 2021). This is consistent with the findings of the present research, in which the Yuhasz formula underestimated body fat mass in comparison with the reference method.

Alongside the findings discussed above, a number of studies have demonstrated the importance of the availability of information on the body composition of professional soccer players, with such information being highly useful to coaches and managers when it comes to directing training processes (Randell et al., 2021). In light of this, it is important to highlight that the anthropometric method that most closely mirrors the criterion method (DEXA) is the Durnin and Womersley formula. Further present findings suggest that the Yuhasz formula is obsolete when it comes to the calculation of body fat % in athletes, since it produces fairly distinct outcomes to those of the criterion method. Based on that discussed here, the need to determine parameters and shape anthropometric and body composition objectives for professional female soccer players that vary as a function of playing position is highlighted. This is of great importance given that the consideration of such parameters is currently absent from existing research evaluating the influence of body composition on performance achievement (Sedano et al., 2009) in women's soccer.

Limitations

One of the main limitations of the present study was its use of a relatively small sample that was recruited according to convenience. However, it is important to keep in mind that women's soccer in Colombia continues to experience significant growth and, despite this limitation, it was possible to analyze all playing positions based on the sample used. Another limitation is that not all soccer players were measured by the same evaluator, introducing potential measurement bias. However, all evaluators were ISAK certified and all measurements were performed in accordance with a standardized protocol and using the same equipment for all measurements.

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Evaluación de la exactitud de distintas fórmulas de predicción de la composición corporal en comparación con DEXA en el Fútbol Profesional Femenino Colombiano

Evaluation of the accuracy of different body composition prediction formulas compared to DXA in Colombian Women's Professional Soccer

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Resumen

El objetivo fue comparar diferentes fórmulas de predicción de composición corporal con el método de referencia DEXA en el contexto del Fútbol Profesional Femenino Colombiano durante la temporada competitiva. Esto se hizo para determinar cuáles de estas fórmulas se acercan más al estándar de referencia y pueden ser utilizadas para evaluar el porcentaje (%) de grasa y la masa magra en ausencia de métodos más precisos. Para hallar % de grasa en dos componentes se usaron Yuhasz 15.17% (13.98 - 16.72%), Durnin y Rahaman 25,57% (24.95 - 28.07%), Jackson y Pollock 16.71% (14.33 - 19.33%) y Durnin y Womersley 24.90% (24.02 - 27.01%), para cinco componentes se calculó masa lipídica del peso 19.80% (17.80 - 22.30%) y en DEXA los datos del % de grasa (23.94 ± 3.51%). Se llevó a cabo un estudio analítico transversal con muestreo no probabilístico por conveniencia en 24 futbolistas de dos equipos de primera división usando 26 variables antropométricas, se realizó un análisis descriptivo en el *SPSS v.21*; y un análisis de correlaciones (*SP*), índices de concordancia de Lin y método de Bland y Altman. La menor diferencia intermétodo con DEXA la obtuvo Durnin y Womersley con valor de - 0.70, así que porcentajes de grasa hallados sobreestimarían DEXA en promedio 0.7 puntos. Los porcentajes de grasa calculados mediante la fórmula de Durnin y Womersley, fueron los más parecidos a los valores de porcentaje de grasa arrojados por el método de referencia DEXA.

Palabras clave: Antropometría, rendimiento, deporte, mujer, músculo.

Abstract

The objective was to compare different body composition prediction formulas with the reference method DEXA in the context of Colombian Professional Women's Soccer during the competitive season. This was done to determine which of these formulas come closest to the reference standard and can be used to evaluate body fat percentage (%) and lean mass in the absence of more precise methods. To calculate body fat percentage using two components, the Yuhasz 15.17% (13.98 - 16.72%), Durnin and Rahaman 25,57% (24.95 - 28.07%), Jackson and Pollock 16.71% (14.33 - 19.33%) and Durnin and Womersley 24.90% (24.02 - 27.01%) formulas were used. For five components, the lipid mass of body weight was calculated 19.80% (17.80 - 22.30%) and DEXA provided body fat percentage data (23.94 ± 3.51%). A cross-sectional analytical study was conducted with non-probabilistic convenience sampling of 24 female soccer players from two first-division teams using 26 anthropometric variables. A descriptive analysis was performed using *SPSS v.21*, as well as correlation analysis (*SP*), Lin's concordance indices, and Bland and Altman method. The lowest inter-method difference with DEXA was obtained with the Durnin and Womersley formula, with a value of - 0.70, indicating that fat percentage estimates would, on average, overestimate DEXA by 0.7 points. The body fat percentage calculated using the Durnin and Womersley formula were the closest to the values of body fat percentage obtained by the reference method DEXA.

Keywords: Anthropometry, Performance, Sports, Women, Muscle.

Introducción

La composición corporal cuantifica los componentes corporales, y permite evidenciar la relación entre estos y los cambios relacionados con los factores externos (González, 2013). En el siglo XX se inició la evaluación de la composición corporal mediante la disección de cadáveres, denominado método directo. No obstante, evolucionó a métodos como pesaje hidrostático, dos, cinco componentes, entre otros (Costa et al., 2015), lo que permite que los valores varíen ampliamente dependiendo del método utilizado para su evaluación (Merrigan et al., 2018) sin embargo, se ha descrito la absorciometría dual de rayos X (DEXA) como el método criterio (Zulet et al., 2019), teniendo en cuenta que otros métodos como la impedancia bioeléctrica y la antropometría muestran amplio % de error, por lo que los resultados varían ampliamente en el mismo sujeto (Cumberledge et al., 2018).

Se ha descrito que la masa muscular puede variar entre deportistas y es uno de los componentes más relacionados con el rendimiento deportivo, cobrando gran importancia en el fútbol profesional, que es uno de los deportes más populares del mundo según la Federación Internacional de Fútbol Asociado, (2018). Además, la composición corporal varía según la posición de juego (Holway, 2008; López et al., 2021; Rodríguez et al., 2019); así, los métodos para evaluar la composición corporal se han empleado dentro de diversos deportes como el fútbol (Pons et al., 2015), ya que al conocer estas variables se puede obtener información útil para el direccionamiento de cargas de entrenamiento (Almäjan et al., 2015), planificación alimentaria y nutricional, prevención de lesiones, entre otros aspectos importantes (Ceballos et al., 2021; García et al., 2014).

Las investigaciones en fútbol profesional se han inclinado principalmente hacia el sexo masculino, por lo tanto, el conocimiento y la información sobre la población femenina es limitada. Por lo que se plantea como objetivo principal evaluar los diferentes métodos utilizados para la estimación de la composición corporal, en comparación con DEXA en el Fútbol Profesional Femenino Colombiano en periodo competitivo.

Con el fin de conocer la precisión de los métodos de campo cuando no se disponga del método criterio.

Metodología

Tipo de estudio y muestra

Se realizó un estudio analítico transversal y la direccionalidad de los datos fue prospectiva. El método de selección de la población participante en el estudio fue a través de un muestreo no probabilístico por conveniencia. La población total de referencia del estudio fueron 24 futbolistas profesionales colombianas en periodo competitivo de primera división de dos equipos del fútbol profesional femenino colombiano, evaluadas entre septiembre de 2021 y marzo de 2022. Dentro del periodo de estudio, las futbolistas presentaron un nivel de hidratación óptimo debido a que durante los entrenamientos y competencias consumieron bebidas deportivas isotónicas, además del agua; es importante mencionar que el nivel de hidratación de cada una de las participantes en el estudio fue a necesidad personal.

Las futbolistas participantes en el estudio fueron mayores de 18 años y, previo al comienzo del estudio, todas firmaron un consentimiento informado acerca de las evaluaciones a desarrollar; no se incluyeron en el estudio las jugadoras lesionadas, con marcapasos, en estado de gestación o lactancia. Además, no se presenta ningún tipo de relación financiera o personal por parte de los autores que pudiera dar lugar a un conflicto de interés.

Esta investigación siguió los principios éticos internacionales, la Declaración de Helsinki de la Asociación Médica Mundial (1975), las directrices nacionales y la Resolución 8430 de octubre de 1993, por la cual se establecen las normas científicas, técnicas y administrativas para la investigación en salud, del Ministerio de Salud y Protección Social de Colombia (1993), clasificándose con riesgo mínimo, y adicionalmente fue avalado por el Comité de ética de la Universidad CES mediante el acta No. 0031 del nueve de febrero de 2021 y bajo el código: Acta0031Proy117TG.

Recolección de datos: técnicas utilizadas e instrumentos

Todos los datos fueron recolectados en una única sesión con una duración de una hora por jugadora, donde se incluyeron características demográficas e información antropométrica y se evaluaron por método de dos y cinco componentes, así como DEXA.

El equipo con el que se evaluó la densitometría dual de rayos X fue el Lunar Prodigy de General Electric Healthcare (Estados Unidos); para la toma de dos y cinco componentes, se utilizaron una báscula y tallímetro de marca SECA (Hamburgo-Alemania/Cali-Colombia); los pliegues se midieron con un adipometro Harpenden Skinfold (Holtain Ltd., Gales, Reino Unido); para los diámetros, segmómetros y antropómetros (CESCORF, Porto Alegre, Brasil); y para los perímetros, una cinta métrica Lufkin (LUFKIN INDUSTRIES, Texas, Estados Unidos). Todos los equipos estaban calibrados y contaban con sus respectivos certificados.

Las medidas antropométricas fueron tomadas de acuerdo con el Protocolo de la Sociedad Internacional para el Avance de la Cineantropometría (ISAK) y los antropometristas que realizaron las mediciones estaban certificados en ISAK I y II (Marfell y Steward, 2006).

Todos los datos se recolectaron en el Centro de Estudios Avanzados CESNUTRAL de la Universidad CES entre septiembre de 2021 y marzo de 2022.

Análisis de datos

Se elaboró una base de datos con la información recolectada para analizar el índice de masa corporal (IMC), los porcentajes (%) y las masas en kilogramos (kg) de adiposidad,

masa muscular, masa ósea, masa piel y tejido residual, por el modelo antropométrico de cinco componentes planteado por Kerr (1988). También se analizó la masa grasa y la masa libre de grasa, por el modelo bicompartimental, empleando la fórmula Yuhasz modificada por Carter (1982), Durnin y Womersley (1974), Jackson y Pollock (1978), Faulkner (1968), Reilly et al. (2009) y Pariskova y Buskova (1971).

Adicionalmente, se analizaron los resultados obtenidos por DEXA: masa grasa, masa magra y contenido mineral óseo. Para comparar la masa adiposa del método de cinco componentes y el % de grasa obtenido con DEXA se obtuvo la fracción lipídica del % de adiposidad por medio de la ecuación de Martin et al. (1994): Fracción lipídica (%) = 0.327 + (0.0124 x % de adiposidad) y posteriormente este valor se multiplicó por el total de kg pertenecientes a la masa adiposa.

El análisis de los datos se realizó mediante los softwares estadísticos *SPSS versión 21.0*, *Excel y R*. Para las variables cualitativas se empleó un análisis univariado con frecuencias absolutas y relativas, teniendo en cuenta variables como sexo, posición de juego, índice de masa corporal e índice córmico. Las variables cuantitativas tales como edad, talla y peso, así como las variables de composición corporal por método de dos y cinco componentes y DEXA, se analizaron mediante medidas de tendencia central y dispersión (media, mediana, desviación estándar, rango intercuartil), con el fin de describir las características generales y antropométricas de las deportistas.

Posteriormente, se realizó un análisis bivariado para relacionar variables como la posición de juego según las características antropométricas de las deportistas, esto con la finalidad de comparar los diferentes métodos de medición de la composición corporal. Respecto al DEXA, se realizó un análisis de correlación mediante la prueba de Pearson o Spearman, según la distribución de las variables y el análisis de concordancia con coeficiente de correlación intraclase y método gráfico de Bland y Almant.

Resultados

Se evaluaron 24 mujeres futbolistas profesionales colombianas, de las cuales, dos eran arqueras, tres centrales, tres delanteras, cuatro laterales y doce volantes, cuyo promedio de edad fue de 24 ± 3.7 años, su peso de 57 ± 5.2 kg, talla de 161 ± 5.2 cm, e IMC de 22 ± 1.8 kg/m2.

A partir del método de cinco componentes se observó que las arqueras son quienes poseen más adiposidad (18.73 ± 2.04 kg), seguidas de las delanteras (17.95 ± 2.52 kg) y las centrales (16.44 ± 2.96 kg), y que la adiposidad es menor en las volantes y las laterales (15.85 ± 2.49 kg y 14.92 ± 2,58 kg, respectivamente). Con respecto a la masa muscular, fue mayor en las delanteras seguida de las arqueras (28.94 ± 1.82 kg, y 26.14 ± 1.03 kg, respectivamente), y menor en las centrales y las laterales (25.38 ± 1.83 kg; y 22.48 ± 1.68 kg, respectivamente); el peso de la masa ósea fue muy similar en todas las deportistas, sin embargo, fue mayor en las delanteras (6.23 ± 0.55 kg) y menor en las laterales (5.26 ± 0.53 kg) tal y como puede observarse en la Tabla 1.

Tabla 1. Datos de la composición corporal calculados a partir del método de cinco componentes según posición de juego

Variable		Arquera	Central	Delantera	Lateral	Volante
Kg Masas	Masa Adiposa (Kg)	18.73 ± 2.04	16.44 ± 2.96	17.95 ± 2.52	14.92 ± 2.58	15.85 ± 2.49
	Masa Muscular (Kg)	26.14 ± 1.03	25.38 ± 1.83	28.94 ± 1.82	22.48 ± 1.68	25.60 ± 2.86
	Masa Ósea (Kg)	6.02 ± 0.82	5.94 ± 1.286	6.23 ± 0.55	5.26 ± 0.53	6.17 ± 0.61
	Masa Piel (Kg)	3.40 ± 0.17	3.22 ± 0.25	3.55 ± 0.24	3.17 ± 0.12	3.28 ± 0.20
	Masa Residual (Kg)	5.54 ± 0.36	5.73 ± 0.51	6.28 ± 0.53	4.60 ± 0.50	5.42 ± 0.77
% Masas	Masa Adiposa (%)	31.26 ± 1.29	28.85 ± 2.60	28.48 ± 3.65	29.49 ± 3.94	28.15 ± 3.80
	Masa Muscular (%)	43.73 ± 1.26	44.94 ± 2.95	45.99 ± 3.02	44.62 ± 2.83	45.40 ± 2.97
	Masa Ósea (%)	10.04 ± 0.68	10.39 ± 1.12	9.89 ± 0.69	10.44 ± 0.98	10.99 ± 1.12
	Masa Piel (%)	5.71 ± 0.68	5.70 ± 0.43	5.64 ± 0.38	6.29 ± 0.39	5.83 ± 0.34
	Masa Residual (%)	9.26 ± 0.03	10.13 ± 0.73	9.99 ± 1.06	9.16 ± 1.18	9.63 ± 1.24

Nota: Los estadísticos reportados corresponden a Media ± DS.

A través de DEXA, se encontró un promedio en él % de masa grasa de 23.90 ± 3.51; de igual manera fueron obtenidos los datos de masa magra, contenido mineral óseo y masa grasa que se expresan en kg o % según corresponda; estos resultados se observan detalladamente en la Tabla 2.

Tabla 2. Promedio y desviación estándar (±) de composición corporal a través de DEXA

Variable		$\dot{X}$	*DS*	*ME*	*RI*
Kg Masas	Masa grasa (Kg)	13.60	2.65	13.40	(12.00 - 15.50)
	Masa Magra* (Kg)	40.70	3.88	39.90	(38.40 - 44.10)
	*CMO*** (Kg)	2.46	0.21	2.41	(2.29 - 2.61)
% Masas	Masa grasa (%)	23.90	3.51	24.10	(22.10 - 26.00)
	Masa Magra* (%)	71.70	3.39	71.90	(69.70 - 73.60)
	*CMO*** (%)	4.34	0.32	4.29	(4.14 - 4.47)

Nota: *Músculo + residual; ***CMO*: Contenido mineral óseo; $\dot{X}$: Media; *DS*: Desviación estándar; *ME*: Mediana; *RI*: Rango intercuartil.

Al analizar los datos obtenidos del cálculo de % de grasa aplicando las fórmulas de Yuhasz, Durnin y Rahaman, Jackson y Pollock, Durnin y Womersley para dos componentes y hallando el % de masa lipídica del peso de cinco componentes, se evidenció que él % hallado con la fórmula de Yuhasz siempre fue más bajo que el arrojado por las otras fórmulas, con una mediana de 15.17% y un rango intercuartil (*RI*) (13.98% - 16.72%), y que él % más alto fue dado por la fórmula de Durnin y Rahaman con una mediana de 25.57% y un *RI* (24.95% - 28.07%) (Tabla 3).

Tabla 3. Datos del porcentaje de grasa medido con las distintas fórmulas de predicción de la composición corporal para el método dos componentes según posición de juego

Posición	Yuhasz (%)	Durnin y Rahaman (%)	Jackson y Pollock (%)	Durnin y Womersley (%)	Masa lipídica del peso (%) 5 componentes
Arquera (n = 2)	17.37 ± 4.05 17.37 (15.94 - 18.80)	27.51 ± 4.58 27.51 (25.89 - 29.12)	19.24 ± 2.74 19.24 (18.27 - 20.21)	26.92 ± 2.58 26.92 (26.01 - 27.83)	22.35 ± 1.42 22.35 (21.85 - 22.85)
Central (n = 3)	16.30 ± 2.88 16.12 (14.82 - 17.70)	28.27 ± 3.14 27.90 (26.62 - 29.74)	17.74 ± 3.48 17.82 (16.02 - 19.50)	27.21 ± 3.11 26.84 (25.57 - 28.66)	19.81 ± 2.67 20.78 (18.79 - 21.32)
Delantera (n = 3)	16.19 ± 3.88 15.81 (14.16 - 18.02)	27.06 ± 3.19 25.30 (25.21 - 28.02)	17.14 ± 4.84 17.52 (14.82 - 19.65)	26.00 ± 3.17 24.26 (24.17 - 26.96)	19.48 ± 3.78 19.35 (17.56 - 21.34)
Lateral (n = 4)	13.67 ± 2.32 14.69 (13.48 - 14.88)*	23.89 ± 2.76 25.02 (23.58 - 25.33)*	14.95 ± 3.13 15.68 (13.47 - 17.16)	22.86 ± 2.74 23.98 (22.55 - 24.29)*	20.57 ± 4.13 20.90 (18.17 - 23.30)
Volante (n = 12)	14.80 ± 2.63 15.30 (13.67 - 16.72)	25.02 ± 4.46 26.45 (23.61 - 27.99)	16.38 ± 3.39 15.45 (14.68 - 19.33)	23.86 ± 4.33 25.40 (22.15 - 26.92)	19.19 ± 3.73 19.44 (17.83 - 21.66)
Total	15.19 ± 2.82 15.17 (13.98 - 16.72)	25.70 ± 3.92 25.57 (24.95 - 28.07)	16.64 ± 3.39 16.71 (14.33 - 19.33)	24.63 ± 3.79 24.90 (24.02 - 27.01)	19.80 ± 3.42 19.80 (17.80 - 22.30)

Nota: Los estadísticos reportados corresponden a Media ± *DS* y Mediana (*Q*1 – *Q*3); *Valores que no presentaron distribución normal.

Para que la comparación de % de grasa fuera adecuada y se pudieran comparar los resultados de las fórmulas aplicadas a dos componentes con cinco componentes, se halló primero la fracción lipídica del peso que arrojó el cálculo de cinco componentes, evidenciando así que estos resultados eran más parecidos y que no se estaba sobreestimando el valor del % de grasa por cinco componentes; que incluso se ubicaba aproximadamente 14 puntos por encima de los % de grasa calculados con la fórmula de Yuhasz y tres puntos por encima de los % de grasa calculados con Durnin y Rahaman.

Con respecto a los coeficientes de correlación de Pearson o Spearman, según la distribución de las variables (Tabla 4), todos los % de grasa de dos y cinco componentes tienen correlación con los datos arrojados por DEXA, que para efectos del presente estudio es usado como método criterio (García et al., 2014). Se destacan los % de Yuhasz, y Durnin y Rahaman con correlación muy alta de 0.825 y 0.809 respectivamente y $p < .001$. Los demás datos tuvieron una correlación alta ($p > 0.6 - 0.8$), siendo la fracción lipídica del % de adiposidad por el método de cinco componentes la que tuvo la menor correlación ($r < .616$) ($p < .001$).

Tabla 4. Coeficientes de correlación entre porcentajes de grasa medidos con las distintas fórmulas de predicción de la composición corporal con respecto al DEXA

Prueba	Parámetro 1	Parámetro 2	*r*	*IC*	*p*
Pearson	DEXA	% masa lipídica del peso	.616	.282 - .826	.345
	DEXA	% grasa Jackson y Pollock	.757	.509 - .889	.237
	DEXA	% grasa Yuhasz	.825	.632 - .922	.653
	DEXA	% grasa Durnin & Rahaman	.809	.601 - .914	.055
Spearman	DEXA	% grasa Durnin y Womersley*	.749	.559 - .903	.042
	DEXA	% grasa Slaughter*	.679	.542 - .898	.035

Nota: *Se utilizó el coeficiente de Spearman conforme a la distribución de la variable, los demás coeficientes corresponden a Pearson

***p* < .05.

En los coeficientes de concordancia de Lin (Tabla 5), el método con mayor coeficiente de correlación intraclase fue el % de grasa, hallado con la fórmula de Durnin y Womersley, seguido de los % hallados por Durnin y Rahaman con 0.768 y 0.719 respectivamente. El método con la menor correlación-concordancia fue Yuhasz con 0.163.

Tabla 5. Coeficientes de correlación – concordancia de Lin entre porcentajes de grasa medidos con las distintas fórmulas de predicción de la composición corporal con respecto al DEXA

Parámetro 1	Parámetro 2	*rho*	*IC*
DEXA	% masa lipídica del peso	.352	.119 - .548
	% grasa Jackson y Pollock	.227	.093 - .352
	% grasa Yuhasz	.163	.069 - .254
	% grasa Durnin & Rahaman	.719	.491 - .855
	% grasa Durnin y Womersley	.768	.543 - .891
	% grasa Slaughter	.633	.385 - .796

Por último, se compararon los datos de % de grasa obtenidos mediante diferentes métodos y fórmulas con el método de referencia (DEXA), mediante la diferencia intermétodos (*DIM*) por el sistema de Bland y Altman (Tabla 6). De esta comparación, se obtuvo que la menor *DIM* fue dada por la fórmula de Durnin y Womersley, con un valor de - 0.70, lo que significa que los % de grasa hallados con este método arrojarían en promedio 0.7 puntos más que los datos obtenidos por el DEXA (Figura 1).

Tabla 6. Diferencia intermétodo (DIM) y límites de concordancia entre porcentajes de grasa medidos con distintas fórmulas de predicción de la composición corporal con respecto al DEXA

Método de composición corporal	% grasa *(X̄- DS)*	*DIM* con respecto al DEXA *(X̄- DS)**	Límites de concordancia	
			Inferior	Superior
DEXA	23.94 ± 3.507	-	-	-
% masa lipídica del peso	19.80 ± 3.417	4.14	2.86	5.43
% grasa Jackson y Pollock	16.64 ± 3.389	7.30	6.28	8.31
% grasa Yuhasz	15.19 ± 2.816	8.75	7.91	9.59
% grasa Durnin & Rahaman	25.70 ± 3.921	- 1.76	- 2.75	- 0.78
% grasa Durnin y Womersley	24.63 ± 3.793	- 0.70	- 1.71	0.32
% grasa Slaughter	26.27 ± 3.580	- 2.33	- 3.33	- 1.3

*Diferencia obtenida por el método de Bland y Altman

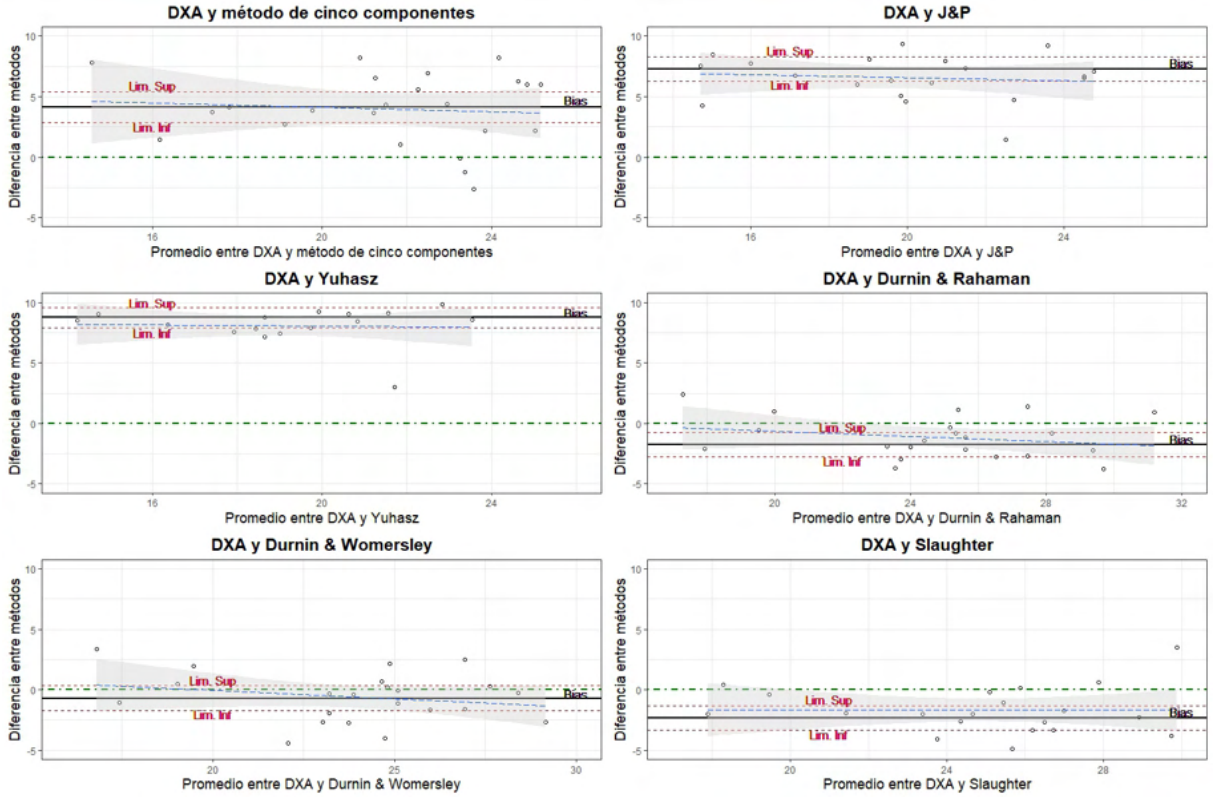

Figura 1. Comparación del porcentaje de masa grasa medido con fórmulas de predicción de composición corporal y DEXA en gráficos de Bland y Altman

Discusión

La importancia de determinar de manera adecuada la composición corporal reside en que esta se relaciona con diferentes aspectos como la agilidad, la potencia de los miembros inferiores, la flexibilidad y en general con el rendimiento de los deportistas (Zanini et al., 2020); no obstante, los valores de la composición corporal varían ampliamente dependiendo del método o de las fórmulas empleadas, observándose mayores diferencias en variables como él % de grasa, masa grasa y masa libre de grasa (Merrigan et al., 2018; Vaquero, 2023), además, el % de grasa es un indicador que presenta grandes variaciones según el sexo y la edad de los sujetos (López et al., 2018; Reilly et al., 2009; Santos y Tavares, 2007).

Los resultados de la presente investigación coinciden con los encontrados en un estudio realizado en futbolistas profesionales chilenos en el que se evidenció que la masa adiposa de porteros (18 ± 2.1 kg), es mayor que la de defensas (16.2 ± 2.8 kg), delanteros (15.5 ± 2.4 kg) y volantes (15.0 ± 2.0 kg) (López, 2018; Rodríguez et al., 2019). De la misma manera, otros estudios describen que los volantes tienen menor peso corporal, masa adiposa y masa muscular, asociado a que son quienes apoyan y enlazan a los defensas y delanteros, con características físicas como resistencia, velocidad y potencia, y presentan mayores niveles de consumo máximo de oxígeno (Ochoa, 2008).

En estudios que emplearon la técnica de DEXA para analizar la composición corporal, como el llevado a cabo con una muestra de 175 jugadoras universitarias de fútbol femenino, se observó que él % de masa grasa fue del 25.7% durante la pretemporada (Roelofs, 2020), similar a los resultados arrojados en la presente investigación, en los que el promedio fue de 23.9%; sin embargo, la particularidad de los estudios es que el % de grasa varía dependiendo de la fórmula empleada (Randell, 2021) y de la población estudiada. Por otra parte, vale la pena resaltar que el método de dos componentes solo mide la parte lipídica químicamente definida, mientras que el método de cinco componentes mide la masa adiposa anatómicamente definida, o sea, sus adipocitos con lípidos, agua, electrólitos y proteínas; por lo que fue necesario ajustar el valor de la masa grasa arrojada por el modelo de cinco componentes, mediante la fórmula propuesta por Alan Martin (Fracción lipídica (%) = 0.327 + (0.0124 x % de adiposidad) para que estos valores se pudieran comparar con él % de grasa arrojado con las fórmulas de dos componentes, teniendo en cuenta que el método de cinco componentes genera valores mayores (Holway, 2008).

En el presente estudio, los % de grasa calculados por el método de dos componentes mediante la fórmula de Durnin y Womersley fueron los más parecidos a los valores de % de grasa arrojados por el método de referencia DEXA. Resultados similares se encontraron en otro estudio rea-

lizado en futbolistas masculinos en el que él % de grasa corporal presentó menor *DIM* por la fórmula de Durnin y Womersley (coeficiente de correlación (*rho*) = 0.66) (Kammerer et al., 2021), comparado con el presente estudio con un *rho* de 0.77. A su vez, otros estudios concluyeron que los resultados de % de grasa calculado mediante la ecuación de Durnin y Womersley son más cercanos al método de referencia en futbolistas jóvenes y otros deportistas de élite, y podría utilizarse para evaluar el % de grasa corporal si no se dispone de métodos más precisos (Blue et al., 2018; España et al., 2015); por otro lado, la variabilidad del % de grasa va a depender del método empleado. Resultados similares se encontraron en un estudio realizado en individuos con sobrepeso u obesidad donde, comparando el DEXA con el modelo de cuatro componentes (4C) se encontró que existía una alta correlación entre ambos métodos, sin embargo, el % de grasa fue significativamente mayor mediante el DEXA con respecto al modelo de 4C (García et al., 2015).

Otro hallazgo importante fue que aunque la antropometría ha sido utilizada a lo largo de los años como método doblemente indirecto para evaluar la composición corporal de deportistas, al comparar la ecuación de Yuhasz con el método criterio (Hind et al., 2018), presentó la menor correlación-concordancia con valores de *rho* de 0.163 y la mayor *DIM* con valores de 8.75, lo que significa que al calcular con la fórmula de Yuhasz se estaría subestimando el % de grasa en casi nueve puntos, impidiendo la realización de intervenciones nutricionales efectivas.

En un estudio realizado en jugadores de rugby sub-élites tanto la ecuación de Yuhasz como la de Faulkner tendieron a subestimar el % de grasa en comparación con la ecuación de Reilly, siendo la ecuación de Yuhasz la que proporcionó un mayor error sistemático (Escrivá et al., 2021), encontrando resultados similares a la presente investigación, donde esta fórmula subestimaba el % de grasa corporal comparado con el método criterio.

Teniendo en cuenta las conclusiones anteriores y que múltiples trabajos han demostrado la importancia de generar información sobre el nivel de composición corporal para futbolistas profesionales, así como su utilidad para los procesos de formación por parte de entrenadores y directivos (Randell et al., 2021), se considera importante resaltar que el método antropométrico que mejor concordancia presenta con el método criterio (DEXA) es la fórmula de Durnin y Womersley; significando que la fórmula de Yuhasz debe entrar en obsolescencia para calcular % de grasa en deportistas, ya que presenta muy baja concordancia con el método criterio tal como lo muestra la evidencia. A partir de lo anterior, se resalta también la necesidad de determinar unos parámetros y rangos con objetivos antropométricos y de composición corporal para las futbolistas profesionales por posiciones de juego, considerando que actualmente no están establecidos en ninguno de los estudios en los que se evalúa la influencia de la composición corporal en el alto rendimiento (Sedano et al., 2009) en el fútbol femenino.

Limitaciones

Uno de los factores limitantes fue el tamaño de la muestra y que la misma se hizo a conveniencia. No obstante, es importante tener en cuenta que el fútbol femenino en Colombia sigue experimentando un crecimiento significativo, y a pesar de estas limitaciones, la muestra analizada logró de manera adecuada incorporar las diferentes posiciones de juego. Como otra limitante se reconoce que el evaluador no fue el mismo para todas las futbolistas, sin embargo, cada evaluador contaba con su certificación ISAK, y cada medición se realizó bajo el mismo protocolo con los mismos equipos para todas las mediciones.

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Epidemiology of injuries in Spanish elite throwers

Epidemiología lesional en lanzadores de elite españoles

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Abstract

Determining the most relevant injuries in each sport, both in terms of frequency and severity, is essential and represents the initial step in their prevention. The aim of this research was to perform an epidemiological study in athletics throwing, involving 66 Spanish elite throwers. We analyzed the injury rate, the most affected body region, the most frequent injuries, and their relationship with variables such as gender, throwing modality, category, and competitive level. A questionnaire, developed ad hoc from the Injury Surveillance System questionnaire of the National Collegiate Athletic Association (NCAA), was administered. The results showed that, despite a higher number of exposure hours at a higher competitive level, there was a lower injury rate. The lower limb was identified as the most affected body part, with overloads being the most common injury, particularly related to muscle problems.

Keywords: Sport injury, incidence, performance, athletics.

Resumen

Determinar las lesiones más relevantes en cada deporte, frecuencia y gravedad es fundamental, y representa el primer paso para la prevención de las mismas. El objetivo principal de la investigación fue realizar un estudio epidemiológico en la modalidad atlética de lanzamientos. Participaron 66 lanzadores de élite españoles. Se analizó el índice de lesión, región corporal más afectada, lesiones más frecuentes y relación existente entre éstas y el sexo, modalidad de lanzamiento, categoría y nivel competitivo. Se administró un cuestionario desarrollado ad hoc a partir de la herramienta Injury Surveillance System de la National Collegiate Athletic Association (NCAA). Los resultados mostraron que los deportistas de mayor nivel competitivo, a pesar de tener mayor número de horas de exposición, obtuvieron menor índice de lesión. La extremidad inferior fue la más afectada. El tipo de lesión más común fue el de las sobrecargas, concretamente los problemas musculares.

Palabras clave: Lesión deportiva, incidencia, rendimiento, atletas.

Introduction

Competitive sports impose significant physical and psychological demands on athletes, often leading to a high incidence of injuries (Pargman, 2007). Research conducted on 25 Spanish sports modalities confirmed that 78.4% of federated athletes had experienced at least one injury throughout their sports careers. Injury rates ranged from five injuries per 1,000 hours of training to 22 injuries per 1,000 hours of competition, with a global injury rate of 4.1 injuries per 1,000 hours (Pujals et al., 2016).

Injuries can have a profound impact on sports participation, affecting individuals, teams, and communities (Hägglund et al., 2013; Ivarsson et al., 2017). They rank among the most common reasons for sports withdrawal (Crane & Temple, 2015; Pierpoint et al., 2016; Witt & Dangi, 2018). Additionally, these injuries are associated with emotional and cognitive reactions (damage perception, loss, sadness, anger, fear, etc.) which could detrimentally impact the well-being of the athlete and contribute to increased medical expenses resulting from these injuries (Ivarsson et al., 2017; Johnson, 2011).

The initial step in injury prevention is understanding the most significant injuries in each sports modality in terms of both frequency and severity (Edouard et al., 2010; Fuller, 2007). Conducting surveillance on injuries helps in determining the magnitude of the problem, identifying the mechanisms that lead to injuries, and understanding their specific characteristics. This information serves as a valuable source to guide preventive programs and develop new models for treatment, rehabilitation, and functional recovery. It also aids in optimizing sports readaptation processes (Jiménez-Olmedo et al., 2018; Joyce & Lewindon, 2016; Mendiguchia et al., 2012).

Traditionally, research on injury epidemiology has primarily focused on team sports (football, basketball, volleyball, etc.) with relatively limited attention to Athletics, especially in throwing events. A notable exception is the study conducted by Edouard et al. (2010), which involved 121 elite French throwers. This study underscored a moderate to high prevalence of lower limb injuries (59-87%), with a higher incidence during training (60-71%) and often resulting from overuse (43-71%). Additionally, a review by Meron and Saint-Phard (2017) emphasized the importance of technique in injury prevention among these athletes. The authors highlighted the potential risk posed by the necessity to generate high force levels in very short periods, which could stress tendons, muscles, ligaments, and joints.

The methodology for recording injuries should derive from scientific research findings, aiming for simplicity, clarity, and a universally applicable definition of sports injury. It should be free of ambiguities and designed to efficiently collect data on both the incidence and severity of the issue (Best & Shier, 2007; Hägglund et al., 2010).

Various systems have been employed for injury registration in diverse sports events, including American university leagues (Hootman et al., 2007), the World Athletics Championships 2007 (Junge et al., 2008), the Rugby World Cup 2011 (Fuller et al., 2013), and the London Olympics 2012 (Engebretsen et al., 2013). Nevertheless, the heterogeneity in injury definitions, data collection methods, observation periods, study designs, and sample characteristics poses a challenge for result comparison (Butragueño, 2015). These factors collectively limit the feasibility of implementing these instruments or recording systems on a medium and/or large scale. They are less effective for registering various sports disciplines and/or in different locations.

Numerous organizations have established and implemented their injury registration systems, including The Australian Football League's Injury Survey, The Canadian Intercollegiate Sport Injury, The England Professional Rugby Injury Surveillance Project (PRISP), the Fédération Internationale de Football Association Medical Assessment and Research Centre (F-MARC) in football, The Oslo Sports Trauma Research Center (OSTRC) Questionnaire on Health Problems, and The National College Athletic Association Injury Surveillance System (ISS), among others.

In many of these instances, substantial databases have been created, proving highly valuable for formulating preventive measures and assessing their effectiveness in each discipline (Dick et al., 2007). Sports with greater participation, tradition, or significance often have epidemiological studies covering specific periods, presenting data in terms of the injury rate (number of injuries per 1,000 exposure hours) and the severity of injuries (number of missed competitions and/or training sessions) (Fuller et al., 2006). However, there remains a lack of methodological uniformity that would facilitate result comparison across different research studies.

In Spain, several injury registration systems have been developed. LEFUTPRO (Noya, 2008; 2015) conducted a classification of football injuries using the Orchard Sports Injury Classification System (OSICS) (Till et al., 2007). Ortín (2009) developed a system for collecting injuries in professional footballers based on Buceta (1996) and Olmedilla (2003). García-González et al. (2015) designed a tool based on the Enquête permanente sur les accidents de la vie courante from the Institut de Veille Sanitaire (EPAC), adapted for recreational sports. Another group of authors focused on sports injuries in the school environment (Gutierrez-Castañón, 2008; 2014; Martínez de Quel et al., 2019) or, in the case of strength training, PRONAF (Butragueño, 2015; Butragueño & Benito, 2014). It's worth noting the study by Pujals et al. (2016) using an instrument created from Fuller et al. (2006) and Junge et al. (2008) but without achieving the desired standardization in a sports context and national implementation.

Based on the presented evidence, the main aim of this study was to conduct an epidemiological investigation into injuries suffered by elite Spanish throwers. The study

focused on key variables, including body region, injury rate, time lost, and the moment of injury. Additionally, factors such as gender, throwing modality and category were taken into consideration. To accomplish this, the research utilized the translation and adaptation of a widely recognized international tool, the ISS. This method will facilitate result comparisons across studies, ultimately amplifying the overall significance of the findings.

Method

Participants

The sample comprised 66 elite Spanish throwers, whose distribution based on gender, category, discipline, and competitive level is shown in Table 1. This accounted for 21.2% of the overall sample.

Table 1. Distribution of participants according to category, gender, modality, and competitive level

Variables		*fr*	%
Gender	Male	27	40.9
	Female	39	59.1
Category	U18/U20	19	28.8
	U23 (Promise)	20	30.3
	Senior	27	40.9
Modality	Shot put	20	30.3
	Discus	15	22.7
	Hammer	12	18.2
	Javelin	19	28.8
Competitive Level	National	46	69.7
	International	20	30.3

Note: *fr*: frequency. %: percentage. U18: Under 18. U20: Under 20. U23: Under 23.

The inclusion criterion defining them as elite was being ranked among the top 12 throwers according to the Real Federación Española de Atletismo at the time of data collection. This ranking determined their eligibility for participation in the Spanish Championships.

This research adhered to the Ethical Standards of the University of León (Spain) and followed the guidelines set forth by the World Medical Association and the Declaration of Helsinki (World Medical Association, 2013).

Instruments

The instrument employed for data collection was a questionnaire crafted from the Injury Surveillance System (ISS) developed by the National Collegiate Athletic Association (NCAA) (Dick et al., 2007). Comprising 29 closed-type questions, the questionnaire captured sociodemographic details (gender, category, throwing modality, and competitive level), injury-related information (severity, context of the injury, time lost, and modifications in training and/or competition), the athlete's personal circumstances at the time of injury, season period, injury recurrence, as well as training time, weekly training load, competitions, etc., to quantify risk factors.

Following the National Collegiate Athletic Association's guidelines (Dick et al., 2007), injuries were classified as sports-related if they met the following criteria:

a) The injury was considered if it occurred due to participation in organized practice or competition.

b) The injury was deemed if it required medical attention from a coach or sports doctor.

c) The injury was identified if it led to the limitation of the athlete's participation or performance for one or more days after the day of the injury.

Additionally, due to the high level of specificity in the collected data, the injury classification proposed by Gusi and Rodríguez (2002) was used:

1. Traumatic injury (injury to organs or tissues resulting from external mechanical action) was further subdivided into three groups:

- Bone injury: particularly observed in collision-contact sports (football, basketball, handball) or high-risk activities (skiing, mountaineering). It includes fissures, fractures, and dislocations.

- Ligamentous injury: the most common, encompasses sprains or strains from grades I to III grades (tearing).

- Contusion: involving muscles and joints, and minor trauma (associated synovitis).

2. Overuse pathology (all non-traumatic joint problems occurring up to seven days prior to the record) (Marsalli et al., 2017), subdivided into two groups:

- Tendinopathy: highly prevalent, encompasses everything from tendon rupture to tendinitis due to microtraumas, specific modality tendinitis.

- Muscle problems: arising from modality-specific muscle development, including asymmetries, contusions, and muscle tears.

In accordance with the ISS, the injury rate was computed by recording the number of injuries per 1,000 exposure hours. Exposure hours was defined as the duration during which the athlete was exposed to the possibility of injury while engaging in sports practices, including both training and competition.

Procedure

Human observational research was performed to collect information using the administration of a recall questionnaire.

Utilizing data retrieved from the official website of the Real Federación Española de Atletismo (RFEA) (https://www.rfea.es/), which provided access to various rankings spanning different categories and events, a comprehensive list of 394 potential participants was compiled. By cross-referencing and eliminating duplicates from diverse rankings (each athlete included only in the modality where they held the highest position), the potential sample was refined to 284 athletes. Contact was established with each athlete through various ways, wherein they were informed about the study's aims and its voluntary nature. Those who consented to participate subsequently completed an informed consent form along with the ISS questionnaire. Following this, the data were categorized for statistical analysis.

Statistical Analysis

A descriptive analysis of the data was conducted using means, standard deviations for quantitative variables, and frequencies and percentages for categorical variables. Following normality and homoscedasticity tests, a comparative analysis was performed using the independent samples T-Student test and ANOVA based on the independent variables to identify statistically significant differences. The significance level considered for the study was set at $p < .05$*. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) 26.0. Graphical representation was created using Microsoft Office Excel 2019.

Results

Table 2 shows that 59.1% of the reported injuries were from women. In terms of modalities, the javelin stands out, with 50% of participants reporting experiencing three or more injuries during the studied season.

Table 2. Frequency analysis of injuries during the study season based on gender, modality, category, and competitive level

Variables *fr*		No injury		1 injury		2 injuries		3 or more injuries		Total	
		%	*fr*	*%*	*fr*	*%*	*fr*	*%*	fr	%	
Gender	Male	5	71.4	10	64.3	8	38.1	4	40	27	40.9
	Female	2	28.6	18	35.7	13	61.9	6	60	39	59.1
Modality	Shot put	2	28.6	11	39.3	4	19	3	30	20	30.3
	Discus	1	14.3	7	25	5	23.8	2	20	15	22.7
	Hammer	2	28.6	4	14.3	6	28.6	0	0	12	18.2
	Javelin	2	28.6	6	21.4	6	28.6	5	50	19	28.8
Category	Senior	3	42.9	14	50	6	28.6	4	40	27	40.9
	U23 (Promise)	3	42.9	5	17.9	9	42.9	3	30	20	30.3
	U18/U20	1	14.3	9	32.1	6	28.6	3	30	19	28.8
Competitive Level	National	5	71.4	19	67.9	14	66.7	8	80	46	69.7
	International	2	28.6	9	32.1	7	33.3	2	20	20	30.3

Note: *fr*: frequency. %: percentage. U18: Under 18. U20: Under 20. U23: Under 23.

Table 3 illustrates a profile of throwers with a higher predisposition to injuries. This profile is characterized by being male, participating in the discus modality, belonging to the U18/U20 category, and competing at the national level.

Table 4 presents the frequency of injuries based on the modality, considering the moment of the injury. It is evident that the highest frequency of injuries occurred during training. Specifically, a more in-depth analysis reveals that the highest frequency was observed during practice sessions related to specific technique training (33.3%) and strength training (32.2%).

Table 3. Injuries, exposure hours (training and competition), and injury rate (injuries/1,000 exposure hours) during the study season

Variables M (Sd)		Number of injuries	Training time	Competition time	Exposure hours	Injury Rate
		M (Sd)	*M (Sd)*	*M (Sd)*	*M (Sd)*	
Gender	Male	1.56 (1.31)	471.93 (176.13)	14.85 (5.87)	486.78 (177.70)	3.38 (2.75)
	Female	1.59 (0.08)	445.85 (147.80)	18.85 (8.15)	464.69 (150.51)	3.31 (2.27)
	p	n.s.	n.s.	.033*	n.s.	n.s.
Modality	Shot put	1.40 (0.88)	487.60 (156.10)	19.50 (6.05)	507.10 (155.22)	2.73 (2.46)
	Discus	1.53 (0.83)	432.40 (187.90)	19.67 (9.90)	452.07 (192.85)	3.83 (2.56)
	Hammer	1.33 (0.78)	417.83 (135.12)	15.50 (7.34)	433.33 (139.93)	3.13 (2.50)
	Javelin	1.95 (1.39)	467.26 (156.57)	13.95 (5.67)	481.21 (157.37)	3.71 (2.41)
	p	n.s.	n.s.	n.s.	n.s.	n.s.
Category	Senior	1.48 (1.09)	478.74 (125.82)	16.48 (7.18)	495.22 (129.95)	2.99 (2.27)
	U23 (Promise)	1.70 (1.17)	473.80 (179.78)	19.30 (8.66)	493.10 (181.99)	2.44 (2.71)
	U18/U20	1.58 (0.84)	406.74 (175.67)	16.05 (6.58)	422.79 (175.12)	3.72 (2.51)
	p	n.s.	n.s.	n.s.	n.s.	n.s.
Competitive Level	National	1.63 (1.12)	415.00 (146.56)	15.57 (6.29)	430.57 (147.36)	3.78 (2.53)
	International	1.45 (0.83)	552.00 (148.50)	21.00 (8.83)	573.00 (150.38)	2.33 (2.00)
	p	n.s.	.001**	.006**	.001**	.027*
Total		1.58 (1.04)	456.52 (159.21)	17.21 (7.52)	473.73 (161.23)	3.34 (2.46)

Note: *M: Mean. Sd: Standard Deviation*. U18: Under 18. U20: Under 20. U23: Under 23. *p: Significance*. n.s.: *Not significant.* *: $p < .05$. **: $p < .01$.

Table 4. Moment of the injury, modality, and frequency of the injury

Moment of injury	Shot put		Discus		Hammer		Javelin		Total	
	fr	%	*fr*	%	*fr*	%	*fr*	%	*fr*	%
TRAINING	28	30.77	20	21.98	13	14.29	30	32.97	91	100
Before training	0	0.00	1	5.00	0	0,00	0	0.00	1	1.10
During training	28	100	19	95.00	13	100	30	100	90	98.90
Warm-up	1	3.57	0	0.00	1	7.69	0	0.00	2	2.22
Specific Technique Training	8	28.57	3	15.79	4	30.77	15	50.00	30	33.33
Strength Training	14	50.00	8	42.11	3	23.08	4	13.33	29	32.22
Plyometric	1	3.57	3	15.79	0	0.00	3	10.00	7	7.78
Running	3	10.71	4	21.05	2	15.38	4	13.33	13	14.44
Others	1	3.57	1	5.26	3	23.08	4	13.33	9	10.00
After training	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
COMPITING	4	30.77	4	30.77	2	15.38	3	23.08	13	100
Before competition	0	0.00	0	0.00	1	50.00	0	0.00	1	7.69
During competition	4	100	4	100	1	50.00	2	66.67	11	84.62
After competition	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
OTHERS	0	0.00	0	0.00	0	0.00	1	33.33	1	7.69
Total	32		24		15		33		104	

Note: *fr:* frequency. %: percentage.

Figure 1 illustrates the body parts affected by the recorded injuries, categorized by gender, category, discipline, and competitive level. Detailed information is provided regarding the affected body regions, including head/neck, upper limb, trunk/back, and lower limb.

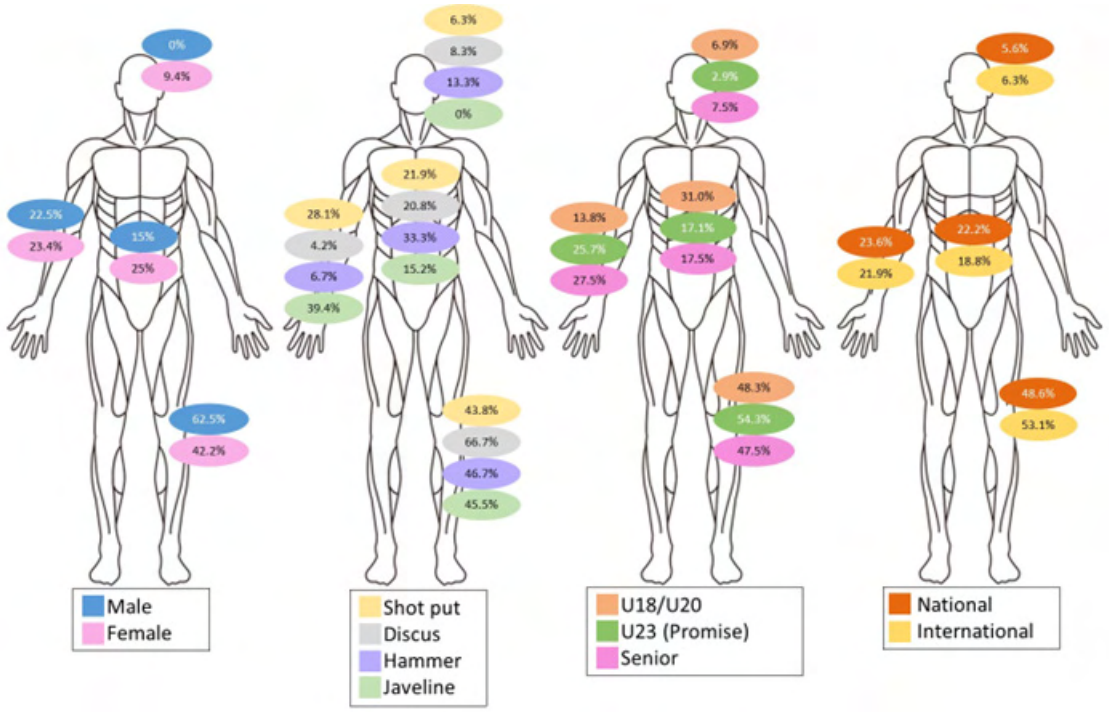

Figure 1. Anatomical location of injuries based on gender, modality, category, and competitive level

It is notable that the lower limb was the most affected across all the analysed independent variables. However, the substantial percentage of upper limb injuries, especially among javelin throwers (39.4%), should not be overlooked. An exception was observed among athletes in the U18/U20 category, where there was a higher percentage of injuries in the trunk/back region (30.0%).

When examining each of the throwing modalities, out of the total 104 recorded injuries, 31.7% were classified as traumatic, while 68.3% were attributed to overload. Hammer throwers exhibited a higher incidence of both ligamentous (23.1%) and muscle (40.4%) injuries (Figure 2).

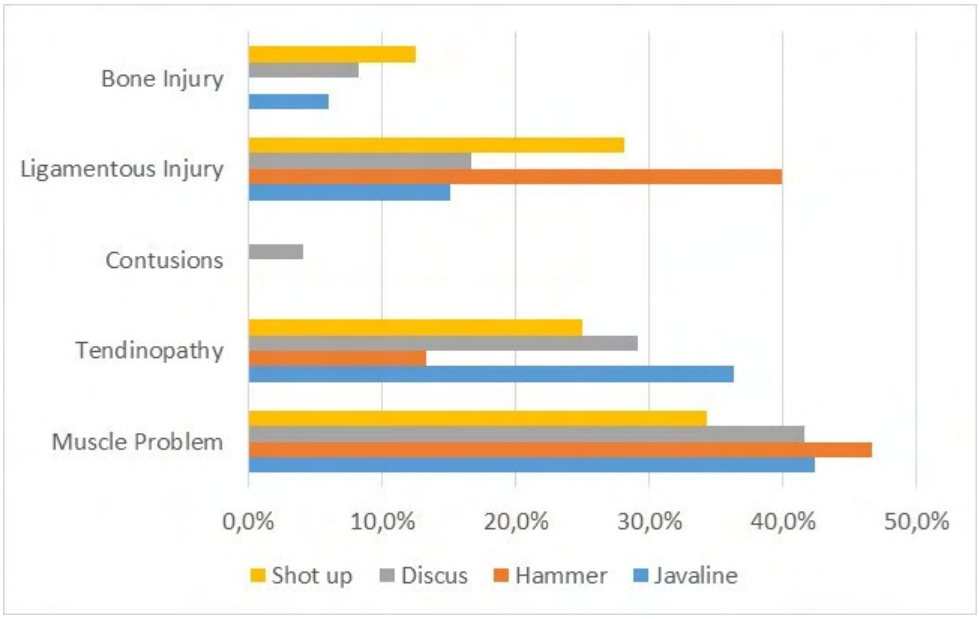

Figure 2. Type of injury based on modality

Lastly, Table 5 compiles the recorded injuries categorized by training sessions. It is noteworthy that the highest number of injuries (n = 45) occurred among those who trained between three and six sessions per week.

Table 5. Injuries based on weekly training sessions

Injuries	From 3 to 6 sessions/ week		From 7 to 9 sessions/ week		More than 9 sessions/ week		TOTAL	
	fr	%	*fr*	%	*fr*	%	*fr*	%
No injury	5	10.0	2	15.4	0	0	7	10.6
1 injury	24	48.0	2	15.4	2	66.7	28	42.4
2 injuries	14	28.0	6	46.2	1	33.3	21	31.8
3 injuries	5	10.0	3	23.1	0	0	8	12.1
5 injuries or more	2	4.0	0	0	0	0	2	3.0
TOTAL	50	100	13	100	3	100	66	100

Note: *fr:* frequency. %: percentage.

Discussion

The present study contributes valuable insights into the epidemiology of sports-related injuries among Spanish elite throwers. The results provide novel and noteworthy data, particularly as the study focuses on a specific discipline within athletics, addressing a gap in scientific publications. Notably, the study goes beyond considering only competitive category (age) and gender; it also differentiates among various events within throwing competitions and their respective competitive levels. This comprehensive approach aligns with recommendations from authors such as Meron and Saint-Phard (2017).

Women exhibit a higher injury frequency at 59.1%, compared to 40.9% in men. These percentages closely align with those reported by specialists in throwing events studied by Edouard et al. (2010), where women accounted for 60% of injuries compared to 40% in men. In terms of the number of training hours per year, men trained significantly more than women (p = .024*). However, women engaged in more competitions, resulting in similar total exposure hours.

The data obtained do not provide statistical evidence to assert that a particular throwing modality is significantly more injurious. However, it is notable that both discus and javelin exhibit a higher injury rate. These findings differ from those reported by Edouard et al. (2010), where hammer throwers were identified as the most injured.

Concerning the category of athletes, senior and U23 (Promise) throwers exhibit the same frequency of injuries, even though the former, albeit not significantly, accumulate a greater number of exposure hours (frequency and training sessions, number of competitions, etc.). This phenomenon could be attributed to the protective effect of training, as well as a more effective transfer of specific strength training and technique, particularly in the case of higher-category athletes (Meron & Saint-Phard, 2017; Romero & Tous, 2010).

The injury frequency among throwers is considerable, with 59 out of 66 participants experiencing at least one injury during the studied season. Additionally, it is noteworthy that international athletes tend to have lower injury rates than national athletes, despite having a greater number of exposure hours. This trend is observed in other sports modalities such as beach volleyball (Jiménez-Olmedo et al., 2018). Various studies suggest that international athletes invest more time in training and potentially focus more exclusively on sports preparation, enhancing their physical condition and refining their technique, two fundamental aspects in injury prevention (Meron & Saint-Phard, 2017; Romero & Tous, 2010).

Concerning the moment of injury, many injuries occur during training. Javelin throwers experience the highest number of injuries during specific technique training, while shot put athletes are more prone to injuries during strength training. This differs from the findings of Morgan and Oberlander (2001), who observed the highest number of injuries during competitions in a sample of football players. The discrepancy could be attributed to the contest format of throwing competitions, which lacks direct contact or opposition. Additionally, the protective effect that coaches provide through direct feedback during competitions may contribute to these differences (D'Souza, 1994). A higher frequency of injuries during training could also be justified by a decrease in concentration, leading to a distortion of the load/technique (D'Souza, 1994).

The most of recorded injuries in Spanish throwers were in the lower limb, contrary to what might be expected based on the technical characteristics of the modalities. Similar findings were observed in the study by Ahuja and Ghosh (1985), which reported that the most of injuries in athletics were in the lower limb, ranging from 59% to 87%. It's important to note that this study does not differentiate between modalities. D'Souza (1994) also concurred that the most common injuries in throwers were in the lower limb, specifically in the ankle, followed by the back. These lower limb injuries could be attributed to a forced inversion

movement when stepping on the perimeter of the throwing area, the rotational technique, and biomechanical/ morphological factors (inertia, mass centre, etc.).

The analysis of each throwing modality revealed that javelin throwers, who experienced a higher number of injuries during specific technique training, also stand out for suffering more injuries on the upper limb. Similar results were obtained by Schmitt et al. (2001), attributing it to the technique and/or biomechanics. The shoulder undergoes extreme forces in sports with a movement pattern similar to javelin throwing, such as baseball (Lin et al., 2018) or paddle tennis (García-Fernández et al., 2019). It's important to note that although shoulder and elbow injury patterns vary by sport and position, throwing sports share a common reliance on the kinetic chain integrity to generate and transfer energy from larger to smaller body parts (Edouard et al., 2010; Fleisig et al., 1996; Meron & Saint-Phard, 2017).

Finally, concerning the type of injury, the ones that most affected the sample were overloads, primarily muscle problems. Meron and Saint-Phard (2017) also highlighted muscle and tendon problems as the most common, irrespective of the throwing modality. Edouard et al. (2010) observed that the most prevalent injuries were tendinopathies (31%) and ligamentous injuries (33%). This type of pathology can influence joint stability and predispose individuals to future degenerative injuries (Schmitt et al., 2001).

Conclusions

Based on the obtained results, there are significant differences in the injury rate depending on the competitive level. The higher the level, the greater the number of exposure hours, but paradoxically, the lower the injury rate. This phenomenon could be justified by the preventive effects of enhanced physical fitness, technical proficiency, and the professionalization of athletes at an international competitive level.

The lower limb was the most affected area, with a notable prevalence of injuries in the upper limb, particularly in the javelin modality. The predominant type of injury was overload, attributed to the elevated physical demands of the sport.

Despite variations in coaches, training models, work plans, and the frequency of sessions and competitions per year within the sample, striking similarities have been observed in terms of the causes and timing of injuries. While the technique and biomechanics of each throwing modality entail specific demands, there is a consensus on the common need to generate high levels of force in very short periods, resulting in similar and generalizable injuries.

The adaptation of the ISS has proven to be a valuable tool for collecting epidemiological data, enabling the design and implementation of injury prevention plans.

A potential limitation of this research stems from the absence of a unified tool for collecting injury data, hindering direct comparisons with studies conducted in other countries. Consequently, future research endeavours should focus on standardizing this instrument to facilitate genuine quantification and the implementation of measures for injury reduction within the national sports context. Moreover, while the sample size could be deemed adequate concerning the population under study, its homogeneity might have influenced significant differences in some of the analysed independent variables.

Finally, it is worth noting that the applicability of this study lies in the wealth of data it provides. The study contributes to a more profound understanding of the injury phenomenon in this sport modality. This information can be valuable for future research, the formulation of primary prevention protocols, enhancing the injury readaptation process, reducing recovery times, and ultimately improving the performance and well-being of the athletes.

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Epidemiología lesional en lanzadores de elite españoles

Epidemiology of injuries in Spanish elite throwers

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Resumen

Determinar las lesiones más relevantes en cada deporte, frecuencia y gravedad es fundamental, y representa el primer paso para la prevención de las mismas. El objetivo principal de la investigación fue realizar un estudio epidemiológico en la modalidad atlética de lanzamientos. Participaron 66 lanzadores de élite españoles. Se analizó el índice de lesión, región corporal más afectada, lesiones más frecuentes y relación existente entre éstas y el sexo, modalidad de lanzamiento, categoría y nivel competitivo. Se administró un cuestionario desarrollado ad hoc a partir de la herramienta Injury Surveillance System de la National Collegiate Athletic Association (NCAA). Los resultados mostraron que los deportistas de mayor nivel competitivo, a pesar de tener mayor número de horas de exposición, obtuvieron menor índice de lesión. La extremidad inferior fue la más afectada. El tipo de lesión más común fue el de las sobrecargas, concretamente los problemas musculares.

Palabras clave: Lesión deportiva, incidencia, rendimiento, atletas.

Abstract

Determining the most relevant injuries in each sport, both in terms of frequency and severity, is essential and represents the initial step in their prevention. The aim of this research was to perform an epidemiological study in athletics throwing, involving 66 Spanish elite throwers. We analyzed the injury rate, the most affected body region, the most frequent injuries, and their relationship with variables such as gender, throwing modality, category, and competitive level. A questionnaire, developed ad hoc from the Injury Surveillance System questionnaire of the National Collegiate Athletic Association (NCAA), was administered. The results showed that, despite a higher number of exposure hours at a higher competitive level, there was a lower injury rate. The lower limb was identified as the most affected body part, with overloads being the most common injury, particularly related to muscle problems.

Keywords: Sport injury, incidence, performance, athletics.

Introducción

El deporte de competición implica grandes demandas para los deportistas que lo practican. Dichas demandas se manifiestan tanto a nivel físico como psicológico, lo que comúnmente tiene como consecuencia una alta frecuencia de lesiones (Pargman, 2007). Pujals et al. (2016), en un estudio realizado en España sobre 25 modalidades deportivas, comprobaron que el 78.4% de los deportistas federados habían sufrido alguna lesión durante su carrera deportiva, y observaron que los índices de lesión variaban desde las cinco lesiones por cada 1,000 horas de entrenamiento, hasta las 22 lesiones por cada 1,000 horas de competición (Índice Lesional Global = 4.1 lesiones/1,000 horas).

Las lesiones pueden tener efecto en la participación deportiva como individuo, como equipo, y a nivel comunitario (Hägglund et al., 2013; Ivarsson et al., 2017), y son una de las razones más comunes para el abandono deportivo (Crane & Temple, 2015; Pierpoint et al., 2016; Witt & Dangi, 2018). Además, éstas se asocian con reacciones emocionales y cognitivas (percepción de daño, pérdida, tristeza, ira, miedo, entre otros), que podrían afectar al bienestar del deportista, y generar un incremento en los gastos médicos derivados de las mismas (Ivarsson et al., 2017; Johnson, 2011).

Conocer cuáles son las lesiones más relevantes en una modalidad deportiva, determinadas por su frecuencia y/o gravedad, se considera fundamental, y representa, para muchos autores, el primer paso en su prevención (Edouard et al., 2010; Fuller, 2007). Llevar a cabo una vigilancia de las lesiones para determinar la magnitud del problema, así como conocer los mecanismos que las producen y las características específicas de las mismas, puede revelarse como una magnífica fuente de información de cara a orientar programas preventivos, y nuevos modelos de rehabilitación y recuperación funcional, así como optimizar los procesos de readaptación deportiva (Jiménez-Olmedo et al., 2018; Joyce & Lewindon, 2016; Mendiguchia et al., 2012).

Tradicionalmente, el foco de la investigación sobre epidemiología lesional se ha puesto sobre los deportes de equipo (fútbol, baloncesto y voleibol, entre otros). En el caso del atletismo, y en concreto la modalidad de lanzamientos, los estudios han sido más bien escasos. Se podría destacar alguno, como el llevado a cabo por Edouard et al. (2010), con 121 lanzadores de élite franceses, con una prevalencia moderada/alta de lesiones localizadas en el miembro inferior (59-87%), con mayor frecuencia en los entrenamientos (60-71%) y derivadas de un uso excesivo (43-71%). Por otro lado, la revisión llevada a cabo por Meron y Saint-Phard (2017), puso de manifiesto la importancia de la técnica en la prevención de lesiones de estos atletas, apuntando como un factor de riesgo para los lanzadores, la necesidad de generar grandes niveles de fuerza en periodos muy cortos, lo que sometería a un gran estrés a sus tendones, músculos, ligamentos y articulaciones.

La metodología de registro lesional se debe basar en los resultados de investigaciones científicas, y el sistema debe de ser tan sencillo como sea posible, sin ambigüedades, conteniendo al menos una definición de lesión deportiva aplicable universalmente, y debe de ser útil para que pueda recoger la incidencia y la gravedad del problema (Best & Shier, 2007; Hägglund et al., 2010).

Para llevar a cabo el registro de lesiones se han venido utilizado distintos sistemas. Sirvan como ejemplo los realizados en las ligas universitarias estadounidenses (Hootman et al., 2007); los Campeonatos del Mundo de Atletismo de 2007 (Junge et al., 2008); el Mundial de Rugby de 2011 (Fuller et al., 2013); o los Juegos Olímpicos de Londres 2012 (Engebretsen et al., 2013). El problema es que muchos de estos resultados no pueden ser comparados entre sí, debido a la heterogeneidad en la definición de lesión, en los métodos de recogida de datos, los periodos observados, el diseño del estudio y/o las características de la muestra utilizada (Butrageño, 2015). Todo esto hace que estos instrumentos o sistemas de registro muestren poca viabilidad para una implantación a media y/o gran escala, y sean poco útiles para registrar varias modalidades deportivas y/o ser utilizados en distintas localizaciones.

Varias organizaciones han desarrollado e implantado un sistema propio de registro de lesiones durante la temporada, como por ejemplo: The Australian Football League's Injury Survey (Seward et al., 1993); The Canadian Intercollegiate Sport Injury (Meeuwisse & Love, 1998); The England Professional Rugby Injury Surveillance Project (PRISP; Kemp et al., 2002); Assessment and Research Centre (F-MARC) en fútbol (Fuller et al., 2006); The Oslo Sports Trauma Research Center (OSTRC) Questionnaire on Health Problems (Clarsen et al., 2013); o The National College Athletic Association Injury Surveillance System (ISS; Dick et al., 2007), entre otros.

En la mayoría de estos casos se han generado importantes bases de datos que han resultado de gran utilidad a la hora de desarrollar medidas preventivas y evaluar la eficacia de las mismas en cada una de las disciplinas estudiadas (Dick et al., 2007). Existen deportes con elevados índices de participación, o entidades con relevancia, donde ha sido más frecuente el desarrollo de estudios epidemiológicos durante periodos específicos, mostrando los datos mediante el índice de lesiones (nº de lesiones x 1,000 horas de exposición) y la gravedad de las mismas (nº de competiciones y/o entrenamientos perdidos) (Fuller et al., 2006), pero una vez más, se echa en falta una uniformidad metodológica que facilite el contraste de resultados entre investigaciones.

En España se han llevado a cabo diversos intentos de registro, como LEFUTPRO (Noya, 2008; 2015), donde a través del instrumento Orchard Sports Injury Classification System (OSICS) (Till et al., 2007), se realizó una clasificación de las lesiones en fútbol. Ortín (2009) elaboró un sistema de recogida de lesiones en futbolistas profesionales, basándose en trabajos anteriores como el de Buceta (1996) y el

de Olmedilla (2003). García-González et al. (2015) diseñaron una herramienta tomando como referencia la Enquête permanente sur les accidents de la vie courante del Institut de Veille Sanitaire (EPAC), la cual se modificó y adaptó al deporte de ocio. Otro grupo de autores han centrado sus esfuerzos en el registro epidemiológico de las lesiones deportivas producidas en el entorno escolar (Gutierrez-Castañón, 2008; 2014; Martínez de Quel et al., 2019), o en el caso del entrenamiento de fuerza (PRONAF) (Butragueño, 2015; Butragueño & Benito, 2014). Destacar el ya mencionado trabajo de Pujals et al. (2016), a través de un instrumento creado a partir de Fuller et al. (2006) y Junge et al. (2008), y donde se analizaron deportistas de 25 modalidades diferentes, pero sin conseguir llegar a la ansiada estandarización e implantación a nivel nacional.

En base a la evidencia aquí expuesta, nos planteamos como objetivo principal de esta investigación el realizar un estudio epidemiológico de las lesiones sufridas por lanzadores de élite españoles (región corporal, índice de lesión, tiempo de retirada y momento de lesión) en función del sexo, de la modalidad de lanzamiento y de la categoría competitiva, lo cual podría ser de gran relevancia de cara al desarrollo de esta modalidad deportiva. Todo ello a partir de la traducción y adaptación de un instrumento de uso extendido a nivel internacional como es el ISS, que nos permita la posterior comparación de los resultados.

Método

Participantes

La muestra estuvo formada por 66 lanzadores de élite españoles, cuya distribución en función del sexo, categoría, modalidad y nivel competitivo se muestran en la tabla 1, que representa el 21.2% de la tasa de muestra.

Tabla 1. Distribución de los participantes según la categoría, sexo, modalidad y nivel competitivo

Variables		*fr*	%
Sexo	Hombre	27	40.9
	Mujer	39	59.1
Categoría	Junior/Juvenil	19	28.8
	Promesa	20	30.3
	Absoluto	27	40.9
Modalidad	Peso	20	30.3
	Disco	15	22.7
	Martillo	12	18.2
	Jabalina	19	28.8
Nivel competitivo	Nacional	46	69.7
	Internacional	20	30.3

Nota: *fr*: frecuencia. %: porcentaje.

El criterio de inclusión para la consideración de élite fue estar entre los 12 primeros lanzadores del ranking de la Real Federación Española de Atletismo en el momento de recogida de los datos, que determinaba el acceso a los Campeonatos de España.

La presente investigación se realizó atendiendo a las normas éticas de la Universidad de León (España) y de acuerdo con la Asociación Médica Mundial y la Declaración de Helsinki (World Medical Association, 2013).

Instrumentos

El instrumento utilizado para el registro de los datos fue un cuestionario desarrollado a partir de publicaciones científicas de referencia en otros deportes, como es el Injury Surveillance System (ISS) desarrollado por la National Collegiate Athletic Association (NCAA) (Dick et al., 2007). Dicho cuestionario constaba de 29 preguntas cerradas, en la cuales se recogían datos sociodemográficos de interés (sexo, categoría, modalidad de lanzamiento y nivel competitivo), lesiones, gravedad y contexto de la misma, tiempo de retirada o modificación del entrenamiento y/o competición, situación personal del deportista en ese instante, momento de la temporada, recidiva de la lesión si la hubiera, así como un intento de cuantificación de los factores de riesgo como horas de entrenamiento, carga semanal de entrenamiento, competiciones, etc.

En base a la propuesta por la National Collegiate Athletic Association (Dick et al., 2007), fue considerada lesión deportiva, aquella que cumplía las siguientes características:

a) Ocurrió como resultado de la participación en una práctica o competición organizada.

b) Requirió de atención médica por un entrenador o un médico deportivo.

c) Tuvo como resultado la restricción de la participación o rendimiento del atleta durante uno o más días después del día de la lesión.

Así mismo, y debido al alto nivel de concreción de los datos recogidos, se utilizó la clasificación de lesiones propuesta por Gusi y Rodríguez (2002):

1. Lesión traumática (aquella lesión de los órganos o los tejidos que se produce por una acción mecánica externa). Subdividida a su vez en tres grupos:

- Lesión ósea: más habitual en deportes de choque-oposición (fútbol, baloncesto, balonmano) o riesgo (esquí, montaña). Dentro de ella se encuentran las fisuras, fracturas y luxaciones.

- Lesión ligamentosa: la más común, incluye esguinces o distensiones con niveles o grados I a III (rotura).

- Contusión: a nivel muscular y articular, y traumatismo menor (sinovitis asociada).

2. Patología por sobrecarga (todos los problemas articulares de origen no traumático, ocurridos hasta los siete días previos al registro) (Marsalli, et al., 2017), subdividida en dos grupos:

- Tendinopatía: muy frecuente, incluye desde la ruptura del tendón hasta tendinitis por microtraumas, tendinitis específica modalidad.

- Problemas musculares: generadas por el desarrollo muscular según modalidad, incluyendo desde desequilibrios musculares, contusiones a roturas musculares.

En base al ISS, se calculó el índice de lesión registrando el número de lesiones por cada 1,000 horas de exposición, entendidas éstas como el tiempo que el deportista estuvo expuesto a la posibilidad de lesión, participando en una práctica deportiva (entrenamiento o competición).

Procedimiento

Se llevó a cabo una investigación observacional en humanos con la que se ha pretendido recoger información a través de la administración de un cuestionario de recuerdo.

A partir de los datos facilitados por la página oficial de la Real Federación Española de Atletismo (RFEA) (https://www.rfea.es/), accediendo a los diferentes rankings de las distintas categorías y pruebas de ambos sexos, se elaboró un listado de 394 posibles participantes. Una vez contrastados y eliminados los duplicados en los diferentes rankings, dado que solo se incluyó al atleta en aquella modalidad en la que estuviera mejor posicionado, la muestra potencial se redujo 284 deportistas. Se procedió a contactar con cada uno de ellos a través de distintos medios, informándoles de los objetivos del estudio y el carácter voluntario de su participación. Seguidamente, aquellos que accedieron a participar, cumplimentaron un consentimiento informado, y se les administró el cuestionario ISS. Posteriormente se procedió a la tipificación y tratamiento estadístico de los datos.

Análisis de Datos

Se realizó un análisis descriptivo de los datos a través de medias, desviaciones estándar para las variables cuantitativas, y mediante frecuencias y porcentajes en el caso de las variables categóricas. Tras la comprobación de la normalidad y homocedasticidad de la muestra, se llevó a cabo un análisis comparativo empleando la prueba T-Student para muestras independientes y ANOVA en función de la variable independiente, para identificar las diferencias estadísticamente significativas. El nivel de significación tenido en cuenta para el estudio fue de $p < .05$*. El análisis de los datos se realizó mediante el Statistical Package for Social Sciences (SPSS) versión 26.0. El tratamiento gráfico ha sido realizado con el programa Microsoft Office Excell 2019.

Resultados

A continuación, se muestran los datos más relevantes en base a los objetivos propuestos.

Como se observar en la tabla 2, el 59.1% de las lesiones correspondió a mujeres. Según las modalidades deportivas, destacó el caso de la jabalina, ya que el 50% de los participantes en ésta indicaron haber sufrido tres lesiones o más en la temporada estudiada.

Tabla 2. Análisis de frecuencia de las lesiones en la temporada de estudio en función del sexo, modalidad, categoría, nivel competitivo

Variables ***fr***		**Sin Lesión**		**1 lesión**		**2 lesiones**		**3 lesiones o más**		**Total**	
		%	***fr***	**%**	***fr***	**%**	fr	%	fr	%	
Sexo	Hombre	5	71.4	10	64.3	8	38.1	4	40	27	40.9
	Mujer	2	28.6	18	35.7	13	61.9	6	60	39	59.1
Modalidad	Peso	2	28.6	11	39.3	4	19	3	30	20	30.3
	Disco	1	14.3	7	25	5	23.8	2	20	15	22.7
	Martillo	2	28.6	4	14.3	6	28.6	0	0	12	18.2
	Jabalina	2	28.6	6	21.4	6	28.6	5	50	19	28.8
Categoría	Absoluto	3	42.9	14	50	6	28.6	4	40	27	40.9
	Promesa	3	42.9	5	17.9	9	42.9	3	30	20	30.3
	Junior/Juvenil	1	14.3	9	32.1	6	28.6	3	30	19	28.8
Nivel competitivo	Nacional	5	71.4	19	67.9	14	66.7	8	80	46	69.7
	Internacional	2	28.6	9	32.1	7	33.3	2	20	20	30.3

Nota: *fr*: frecuencia. %: porcentaje.

En vista de los resultados de la tabla 3, se identificó un perfil de lanzador con mayor propensión a lesionarse, y sería un hombre, practicante de la modalidad de disco, perteneciente a la categoría junior/juvenil y con un nivel competitivo nacional.

Tabla 3. Lesiones, horas de exposición (entrenamiento y competición) e índice de lesiones (lesiones/1,000 horas exposición) en la temporada de estudio

Variables *M (SD)*		Nº lesiones	Horas entrenamiento	Horas competición	Horas Exposición	Índice de lesiones
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	
Sexo	Hombre	1.56 (1.31)	471.93 (176.13)	14.85 (5.87)	486.78 (177.70)	3.38 (2.75)
	Mujer	1.59 (0.08)	445.85 (147.80)	18.85 (8.15)	464.69 (150.51)	3.31 (2.27)
	p	n.s.	n.s.	.033*	n.s.	n.s.
Modalidad	Peso	1.40 (0.88)	487.60 (156.10)	19.50 (6.05)	507.10 (155.22)	2.73 (2.46)
	Disco	1.53 (0.83)	432.40 (187.90)	19.67 (9.90)	452.07 (192.85)	3.83 (2.56)
	Martillo	1.33 (0.78)	417.83 (135.12)	15.50 (7.34)	433.33 (139.93)	3.13 (2.50)
	Jabalina	1.95 (1.39)	467.26 (156.57)	13.95 (5.67)	481.21 (157.37)	3.71 (2.41)
	p	n.s.	n.s.	n.s.	n.s.	n.s.
Categoría	Absoluto	1.48 (1.09)	478.74 (125.82)	16.48 (7.18)	495.22 (129.95)	2.99 (2.27)
	Promesa	1.70 (1.17)	473.80 (179.78)	19.30 (8.66)	493.10 (181.99)	2.44 (2.71)
	Junior/Juvenil	1.58 (0.84)	406.74 (175.67)	16.05 (6.58)	422.79 (175.12)	3.72 (2.51)
	p	n.s.	n.s.	n.s.	n.s.	n.s.
Nivel competitivo	Nacional	1.63 (1.12)	415.00 (146.56)	15.57 (6.29)	430.57 (147.36)	3.78 (2.53)
	Internacional	1.45 (0.83)	552.00 (148.50)	21.00 (8.83)	573.00 (150.38)	2.33 (2.00)
	p	n.s.	.001**	.006**	.001**	.027*
Total		1.58 (1.04)	456.52 (159.21)	17.21 (7.52)	473.73 (161.23)	3.34 (2.46)

Nota: *M:* Media. *SD:* Desviación estándar. *p:* Significación. n.s.: No significativo. *: $p < .05$. **: $p < .01$.

En la tabla 4, se muestra la frecuencia de las lesiones según la modalidad y teniendo en cuenta el momento o situación de la lesión. Se puede observar que la mayor frecuencia de lesiones se produjo entrenando frente a compitiendo. Profundizando, atendiendo al momento en el que se produjo la lesión, la mayor frecuencia se detectó en las partes de práctica relacionadas con el trabajo de técnica específica (33.33%) y el trabajo pesas (32.22%).

Tabla 4. Momento de la lesión, modalidad de lanzamiento y frecuencia de la lesión

Momento de la lesión	Peso		Disco		Martillo		Jabalina		Total	
	fr	%	*fr*	%	*fr*	%	*fr*	%	*fr*	%
ENTRENANDO	28	30.77	20	21.98	13	14.29	30	32.97	91	100
Antes del entrenamiento	0	0.00	1	5.00	0	0,00	0	0.00	1	1.10
Durante el entrenamiento	28	100	19	95.00	13	100	30	100	90	98.90
Calentando	1	3.57	0	0.00	1	7.69	0	0.00	2	2.22
Técnica Específica	8	28.57	3	15.79	4	30.77	15	50.00	30	33.33
Pesas	14	50.00	8	42.11	3	23.08	4	13.33	29	32.22
Pliometría	1	3.57	3	15.79	0	0.00	3	10.00	7	7.78
Carreras	3	10.71	4	21.05	2	15.38	4	13.33	13	14.44
Otros	1	3.57	1	5.26	3	23.08	4	13.33	9	10.00
Después del entrenamiento	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
COMPITIENDO	4	30.77	4	30.77	2	15.38	3	23.08	13	100
Antes de la competición	0	0.00	0	0.00	1	50.00	0	0.00	1	7.69
Durante la competición	4	100	4	100	1	50.00	2	66.67	11	84.62
Después de la competición	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
OTROS	0	0.00	0	0.00	0	0.00	1	33.33	1	7.69
Total	32		24		15		33		104	

Nota: *fr:* frecuencia. %: porcentaje.

En los pictogramas que componen la figura 1, se observan las diferentes partes del cuerpo afectadas por las lesiones registradas en función del sexo, categoría, modalidad y nivel competitivo. Se muestra información detallada entorno a la región corporal afectada: cabeza/cuello, extremidad superior, tronco/espalda, y extremidad inferior.

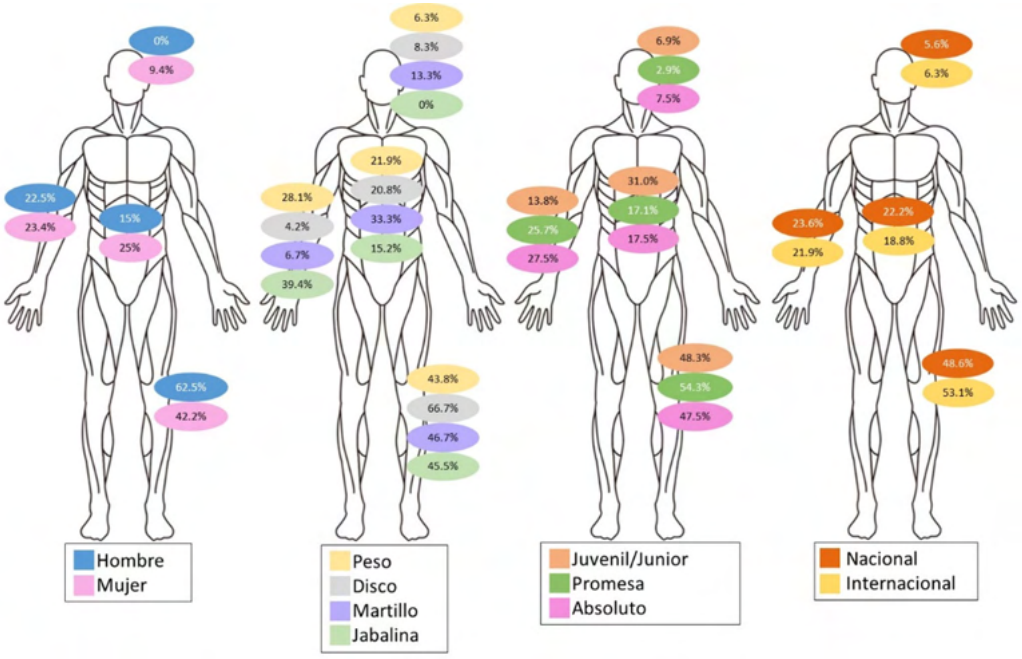

Figura 1. Localización anatómica de las lesiones en función del sexo, modalidad, categoría y nivel competitivo

Destacar que la extremidad inferior fue la más afectada teniendo en cuenta todas las variables independientes analizadas, aunque no se debe pasar por alto el elevado porcentaje de lesión en la extremidad superior en el caso concreto de los lanzadores de jabalina (39.4%). Se produjo una excepción en los deportistas de la categoría junior/juvenil, con un mayor porcentaje de lesión en tronco/espalda (30.0%).

Atendiendo a cada una de las modalidades de lanzamiento estudiadas, del total de 104 lesiones registradas, 31.7% fueron de tipo traumático y el 68.3% por sobrecarga. Los lanzadores de martillo mostraron una mayor incidencia tanto en lesiones ligamentosas (23.1%), como musculares (40.4%) (Figura 2).

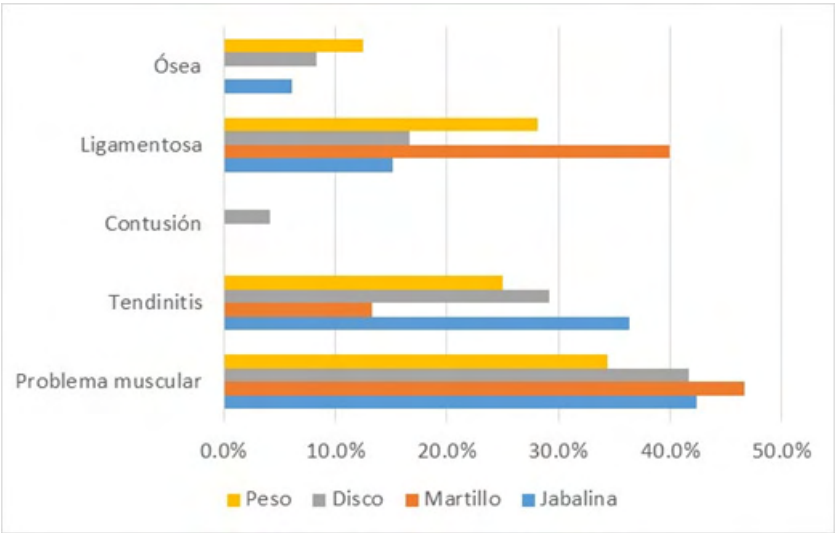

Figura 2. Tipo de lesión en función de la modalidad practicada

Finalmente, la tabla 5 recoge las lesiones registradas en función de las sesiones de entrenamiento que realizan los atletas. Incidir que el mayor número de personas lesionadas (n = 45) se encontraron entre aquellas que entrenaban entre tres y seis sesiones por semana.

Tabla 5. Lesiones en función de las sesiones de entrenamiento por semana (frecuencia y porcentaje)

Lesiones	De 3 a 6 sesiones/ semana		De 7 a 9 sesiones/ semana		Más de 9 sesiones/ semana		TOTAL	
	fr	%	*fr*	%	*fr*	%	*fr*	%
Ninguna	5	10.0	2	15.4	0	0	7	10.6
1 lesión	24	48.0	2	15.4	2	66.7	28	42.4
2 lesiones	14	28.0	6	46.2	1	33.3	21	31.8
3 lesiones	5	10.0	3	23.1	0	0	8	12.1
5 lesiones o más	2	4.0	0	0	0	0	2	3.0
TOTAL	50	100	13	100	3	100	66	100

Nota: *fr:* frecuencia. %: porcentaje.

Discusión

El presente estudio proporciona información sobre epidemiología lesional de origen deportivo de los lanzadores de elite españoles. Los resultados ofrecen datos interesantes y novedosos, ya que se centran en una disciplina concreta del atletismo, que no cuenta con muchas referencias en publicaciones científicas. No sólo se han tenido en cuenta la categoría competitiva (edad) y el sexo, sino que se ha diferenciado también entre las modalidades que componen el concurso de lanzamientos, así como su nivel competitivo, diferenciando entre atletas de nivel nacional e internacional, atendiendo así a las demandas señaladas por autores como Meron y Saint-Phard (2017).

Las mujeres presentan una mayor frecuencia de lesión, 59.1% frente a 40.9% de los hombres, porcentajes muy similares a los obtenidos por los especialistas en lanzamiento estudiados por Edouard et al. (2010), 60% frente a 40% respectivamente. En cuanto al número de horas de entrenamiento al año, los hombres entrenaron significativamente más que las mujeres, (p = .024*), aunque fueron éstas las que más compitieron, haciendo así que las horas de exposición totales fueran muy similares.

Los datos obtenidos no permiten afirmar que exista una modalidad de lanzamiento estadísticamente más lesiva que otra, aunque sí se puede apreciar como disco y jabalina presentan un mayor índice de lesión. Estos resultados difieren de los obtenidos por Edouard et al. (2010), donde fueron los lanzadores de martillo los que más se lesionaron.

En cuanto a la categoría de los deportistas, los lanzadores absolutos y promesas se lesionan aproximadamente el mismo número de veces, a pesar de que los primeros, aunque no de forma significativa, acumulan un mayor número de horas de exposición (frecuencia y duración de los entrenamientos, número de competiciones, etc.). Esto podría explicarse debido al efecto protector del entrenamiento, así como a una mayor transferencia del trabajo específico de fuerza y eficacia del gesto deportivo, en el caso de los deportistas de mayor categoría (Meron & Saint-Phard, 2017; Romero & Tous, 2010).

La frecuencia lesional en los lanzadores es alta, ya que, 59 de los 66 participantes al menos sufrieron una lesión durante la temporada estudiada. También es destacable que los atletas internacionales se lesionan menos que los nacionales, aun teniendo mayor número de horas de exposición, de forma similar a lo que ocurre en otras modalidades deportivas como el vóley playa (Jiménez-Olmedo et al., 2018). Según muestran distintos trabajos, los atletas internacionales, al invertir más horas en el entrenamiento y dedicarse, posiblemente, más en exclusiva a la preparación deportiva, también aumentan su condición física y perfeccionan su técnica, dos de los pilares básicos en la prevención de lesiones (Meron & Saint-Phard, 2017; Romero & Tous, 2010).

En cuanto al momento de la lesión, el mayor número de éstas se produce durante el entrenamiento. Los lanzadores de jabalina son los que más lesiones sufren dentro del momento de trabajo de técnica específica y, por otro lado, los lanzadores de peso los que se lesionan más durante el entrenamiento de pesas. Morgan y Oberlander (2001), por el contrario, aunque con una muestra de futbolistas, obtuvieron que el mayor número de lesiones se producía durante la competición, justificado por la gran intensidad que supone la misma, y a la posible sobre solicitación de las capacidades del deportista. En el caso de los lanzadores, la competición se realiza en formato concurso (sin contacto y/u oposición directa), lo cual unido al efecto protector que podría tener el entrenador durante la competición ajustando el gesto deportivo en tiempo real, podría justificar las diferencias con otras investigaciones (D'Souza, 1994). Una mayor incidencia de lesiones en los entrenamientos podría justificarse también por la disminución de la concentración en los mismos y la distorsión de la carga/gesto que ello conlleva (D'Souza, 1994).

El mayor número de lesiones en los lanzadores españoles se registra en la extremidad inferior, en contra de

lo que podría pensarse dadas las características técnicas de la modalidad. Algo similar ocurrió ya en el estudio de Ahuja y Ghosh (1985), los cuales pudieron comprobar que, en el atletismo, la mayoría de las lesiones se localizaban en el miembro inferior, con valores entre 59% y 87%, aunque debemos matizar que en este estudio no se diferenció entre las distintas disciplinas atléticas. D'Souza (1994) también coincidió en señalar que la lesión más común en los lanzadores se producía en la extremidad inferior, y más concretamente en el tobillo, seguido de la espalda. Estas lesiones de extremidad inferior podrían estar generadas por un movimiento de inversión forzada en apoyo al pisar en el perímetro del área de lanzamiento, junto con la técnica rotacional empleada en estas modalidades, y factores biomecánicos/morfológicos (inercia, centro de masas, etc.).

El análisis individual de cada una de las disciplinas que componen la modalidad atlética de los lanzamientos, permite observar cómo los lanzadores de jabalina, atletas que sufren un mayor número de lesiones durante el entrenamiento de técnica específica, también destacan por sufrir más lesiones en la extremidad superior. Schmitt et al. (2001) obtuvieron resultados similares achacándolo a la técnica y/o biomecánica, concretamente a la velocidad del gesto, la cual somete al hombro a fuerzas extremas, como sucede en otras modalidades deportivas como béisbol (Lin et al., 2018), o pádel (García-Fernández et al., 2019), deportes éstos, que, en ciertos momentos, tienen un patrón de movimiento muy similar al del lanzamiento de jabalina. Señalar que, aunque los patrones de lesión de hombro y codo varían según el deporte y la posición, los deportes de lanzamiento comparten una dependencia común de la integridad de la cadena cinética para generar y transferir energía de las partes más grandes del cuerpo a otras más pequeñas (Edouard et al., 2010; Fleisig et al., 1996; Meron & Saint-Phard, 2017).

En cuanto al tipo de lesión, las que más afectan a los deportistas estudiados son las denominadas sobrecargas, y en su mayor parte hacen referencia a problemas musculares. Meron y Saint-Phard (2017) también apuntaron a los problemas en músculos y tendones como los más habituales, con independencia de la modalidad de lanzamiento, mientras que Edouard et al. (2010), observaron que las lesiones más comunes, en su caso, fueron las tendinopatías (31%) y las de tipo ligamentoso (33%). Este tipo de patologías pueden tener un impacto en la estabilidad de la articulación y en la aparición de futuras lesiones degenerativas, tal y como ya señalaron Schmitt et al. (2001).

Conclusiones

Según los resultados arrojados por el presente estudio, el índice de lesión muestra diferencias significativas en función del nivel competitivo, observando que, a mayor nivel, mayor número de horas de exposición, pero menor índice de lesión, lo que podría estar justificado por la capacidad preventiva de la forma física, el perfeccionamiento técnico y la profesionalización de aquellos que tienen un nivel competitivo internacional.

La extremidad inferior resultó ser la zona más afectada, destacando también el alto porcentaje de lesiones en la extremidad superior en la modalidad de jabalina. El tipo de lesión más común fue el de las sobrecargas y dentro de ellas los problemas musculares, debido al alto nivel de exigencia física.

Aunque los deportistas participantes tuvieron diferentes entrenadores, modelos de entrenamiento, planes de trabajo, número de sesiones y competiciones al año, se han observado grandes semejanzas en cuanto a las causas y momento del entrenamiento en que se sufre la lesión. La técnica y/o biomecánica del lanzamiento de cada modalidad demanda unos requisitos específicos, pero todos coinciden en la necesidad de generar grandes niveles de fuerza en periodos muy cortos, lo cual genera que las lesiones sean similares, y se podría decir que generalizables dentro de la modalidad deportiva.

La adaptación del ISS ha demostrado ser una herramienta útil para la recogida de datos epidemiológicos que permitan el diseño e implantación de planes preventivos de lesiones.

La principal limitación de esta investigación sería la derivada de la falta de una herramienta única a la hora de recoger la epidemiología lesional, la cual permitiera la comparación con otros trabajos realizados en otros países. Por este motivo, se considera que las futuras líneas de investigación deberían dirigirse hacia la sistematización de este instrumento en la recogida de datos lesionales, lo que podría permitir una cuantificación real del fenómeno y la implantación e implementación de las medidas necesarias para su reducción dentro del deporte nacional. Por otro lado, si bien el tamaño de la muestra se podría considerar adecuado en relación a la población objeto de estudio, la homogeneidad de la misma ha podido influir a la hora de detectar posibles diferencias estadísticamente significativas en alguna de las variables independientes analizadas.

Por último, destacar que la aplicabilidad de este estudio reside en la gran cantidad de información que ofrece y que contribución a una mejor comprensión del fenómeno lesional en la modalidad deportiva estudiada. Esta información podrá ser útil para futuros trabajos de investigación y para facilitar a los profesionales relacionados con este ámbito deportivo, el diseño de protocolos de prevención primaria, así como mejorar el proceso de readaptación de la lesión, favoreciendo acortar los tiempos de recuperación, mejora del rendimiento y de la calidad de vida del deportista.

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Effectiveness of manual therapy in carpal tunnel syndrome: Systematic review and meta-analysis

Efectividad de la terapia manual en el síndrome del túnel carpiano: Revisión sistemática y metaanálisis

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Summary

The aim of this systematic review is to determine the effectiveness of manual therapy applied alone on pain, function, symptom severity, nerve conduction and strength in people with carpal tunnel syndrome. We searched MEDLINE, WOS, SCOPUS, PEDro, CENTRAL, LILACS and Epistemonikos. Twelve studies met the eligibility criteria and nine were included in the quantitative synthesis. Pain had a standardized mean difference of - 1.83 (95% *CI* = - 2.62, - 1.03, *p* = < .00001), function a mean difference of - 0.88 (95% *CI* = - 1.05, - 0.71, *p* = < .00001), symptom severity a mean difference of - 0.94 (95% *CI* = - 1.58, - 0.30, *p* = .004), sensory conduction velocity a mean difference of 7.46 (95% *CI* = - 0.11, 14.98, *p* = .05), motor conduction velocity a mean difference of 1.85 (95% *CI* = 0.68, 3.01, *p* = .002), motor latency a mean difference = - 0.57, (95% *CI* = - 0.96, - 0.17, *p* = .005), grip strength a mean difference = - 0.24, 95% *CI* = - 2.22, 1.74, *p* = .81) and grip strength a mean difference = 0.21 (95% *CI* = - 0.42, 0.83, *p* = .52). Finally, it is concluded that manual therapy applied alone is an effective short-term option for people with mild to moderate carpal tunnel syndrome.

Keywords: Median neuropathy, musculoskeletal manipulation, physiotherapy, pain.

Resumen

El objetivo de esta revisión sistemática es determinar la efectividad de la terapia manual aplicada de forma aislada en el dolor, la función, la severidad de síntomas, la conducción nerviosa y la fuerza en personas con síndrome del túnel carpiano. Se realizó una búsqueda en MEDLINE, WOS, SCOPUS, PEDro, CENTRAL, LILACS y Epistemonikos. Doce estudios cumplieron los criterios de elegibilidad y nueve fueron incluidos en la síntesis cuantitativa. El dolor obtuvo una diferencia de media estandarizada de -1.83 (*IC* al 95% = - 2.62, - 1.03, *p* = < .00001), la función una diferencia de media de - 0.88 (*IC* al 95% = - 1.05, - 0.71, *p* = < .00001), la severidad de síntomas una diferencia de media de - 0.94 (*IC* al 95% = - 1.58, - 0.30, *p* = *.004*), la velocidad de conducción sensitiva una diferencia de media de 7.43 (*IC* al 95% = - 0.11, 14.98, *p* = *.05*), la velocidad de conducción motora una diferencia de media de 1.85 (*IC* al 95% = 0.68, 3.01, *p* = .002), la latencia motora una diferencia de media = - 0.57, (*IC* al 95% = - 0.96, - 0.17, *p* = *.005*), la fuerza de agarre una diferencia de media = - 0.24, *IC* al 95% = - 2.22, 1.74, *p* = *.81*) y la fuerza de pinza una diferencia de media = 0.21 (*IC* al 95% = - 0.42, 0.83, *p* = .52). Finalmente, se concluye que la terapia manual aplicada de forma aislada es una opción efectiva a corto plazo para personas con síndrome del túnel carpiano leve a moderado.

Palabras clave: Neuropatía mediana, manipulación musculoesquelética, fisioterapia, dolor.

Introduction

Carpal tunnel syndrome (CTS) is a condition involving entrapment of the median nerve in the carpal tunnel area of the wrist (Foley et al., 2007), is one of the most common peripheral neuropathies of the upper extremity with a prevalence ranging from 1-5% of the general population (Thiese et al., 2014), and increases to 11.7% in more specific symptomatic and working class populations (Bland et al., 2003; Thiese et al., 2014), affecting women more frequently, with a three to ten times higher prevalence than men (Kozak et al., 2015; Lewanska & Walosiak-Skorupa, 2014). Diseases such as diabetes, obesity, osteoarthritis and rheumatoid arthritis could be contributing factors to the development of this pathology (Pourmemari & Shiri 2016; Pourmemari et al., 2018; Shiri, 2016). It's a etiology is based on theories such as Lundborg's, which proposes that intraneural blood microcirculation, myelin sheath, axons and supporting connective tissue are disturbed (Lundborg, 1988) or the double crush theory, which mentions that proximal compression of a nerve can disrupt axoplasmic transport in other areas. Others mention the relevance of local inflammatory changes, mechanical deformation of the nerve fibres and decreased mobility due to oedema or inflammation (Ettema et al., 2004; Oh et al., 2006; Schmid, 2015). Occupational mechanical factors are a relevant cause to consider, as there is an increased risk of CTS in activities that require a high degree of repetition and forced exertion (Kozak & Schedlbauer, 2015). Diagnosis is based primarily on clinical criteria such as pain, loss of function, altered sensation with paraesthesia in phalanges I, II and III and in more advanced stages loss of strength in the tenar area (Vogt & Scholz, 2002), and is usually complemented by tests such as the Phalen, Tinel, Paley/McMurley, among others (Palumbo & Szabo, 2002). Tests such as ultrasound, magnetic resonance imaging and electromyography are used to complement and confirm the diagnosis obtained through clinical criteria (Corlobé, 2004; Cudlip et al., 2002; Jarvik et al., 2008).

Treatment options are varied, and conservative treatment generally focuses on treating the main clinical symptoms, where pain, function, strength and nerve conduction are relevant for improving activities of daily living, quality of life and ultimately reducing healthcare costs (Bland & Rudolfer, 2003; Mondelli et al., 2002). One of the most widely used conservative treatment options is manual therapy (MT), which is widely used in musculoskeletal system disorders and CTS (Akalin et al., 2002; Carlesso et al., 2014; Pettman, 2007). The most commonly used TM techniques in CTS are neurodynamic manoeuvres, joint mobilisation or manipulation techniques, massage or soft tissue management techniques, and instrumental manual therapy (Klokkari & Mamais, 2018). Although there are studies that support the application of TM techniques in CTS, its mechanism of action is still unclear, as TM is a complex intervention based on the interaction of several complementary systems, and independent of the technique used, the effects of TM could be due to a neurophysiological mechanism, which states that a mechanical stimulus generates a cascade of neurophysiological responses at the peripheral and central levels that ultimately produces a decrease in musculoskeletal pain (Bialosky et al, 2009; Bialosky et al., 2018).

In recent years, there has been an increase in the scientific literature on the application of TM in CTS, which has led to various systematic reviews (SR). On the one hand, there are those by Medina and Yancosek (2008), Lim et al. (2017) and Araya et al. (2018), which focus on neural mobilisation techniques, presenting contradictory results, as Medina and Yancoseek (2008) and Lim et al. (2017) conclude that there is insufficient evidence to support the use of neurodynamic techniques in users with CTS, while the SR of Araya et al. (2018) determines that there is moderate evidence to support the application of neurodynamic techniques for the improvement of pain and function in subjects with CTS. On the other hand, the SR of Sault et al. (2020) and Du et al. (2022) focus on establishing the effects of TM applied alone or in combination with other therapies (exercise, laser, ultrasound, etc.), demonstrating that TM combined with other interventions are effective for functional recovery, decreased pain, increased joint range, improved sensory and motor function. Finally, the SR with meta-analysis (MA) by Jiménez et al. (2022) is the only SR that includes clinical studies applying TM techniques in isolation, concluding that it is effective in reducing pain, improving function and nerve conduction. However, it includes few studies and does not incorporate all published clinical trials. For this reason, the aim of this SR is to determine whether there is scientific evidence to support the use of TM techniques applied in isolation or in combination with other TM techniques on pain, function, symptom severity, nerve conduction and strength in users with CTS.

Methodology

Protocol

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement and considered the recommendations of the Cochrane Collaboration manual (Higgins & Green, 2008; Liberati et al., 2009; Moher et al., 2009).

Elegibility criteria

Studies related to manual therapy intervention in carpal tunnel syndrome were eligible if they met the following criteria: 1) population: people with a diagnosis of carpal tunnel syndrome confirmed by clinical criteria (pain, loss of function, hand paresthesia, etc.), radiological criteria (ultrasound, magnetic resonance imaging) or electromyographic criteria (nerve conduction). 2) Type of intervention: Manual therapy alone or in combination with other manual therapy techniques (joint techniques, neurodynamic, soft tissue management, etc.). The technique must be applied by a certified physiotherapist.

3) Type of comparison: Other therapies, other manual therapy techniques, placebo interventions, surgery or no intervention control group. 4) Type of outcomes: clinical variables such as pain, strength, joint range, function, sensation, nerve conduction, etc. 5) Type of study: Randomised clinical studies published in English or Spanish. Exclusion criteria were: 1) Studies combining treatments other than manual therapy in the experimental group (ultrasound, laser, exercise, pharmacology, splinting, etc.). 2) Studies that included subjects with other pathologies of the upper extremity (shoulder, arm, elbow, forearm, wrist and hand). 3) Studies scoring <5 points on the PEDro scale.

Sources of information

The databases used for the electronic search of articles were MEDLINE (via PubMed), Web of science, SCOPUS, the Physiotherapy Evidence Database (PEDro), Cochrane Central Register of Controlled Trials (CENTRAL), Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS) and Epistemonikos, being these consulted until September 2022.

Electronic search

An advanced computerised search strategy including Medical Subjects Heading (MeSH) terms and free text terms was used for the article collection process. On the one hand, the MeSH terms used were: Carpal tunnel syndrome, musculoskeletal manipulation, clinical trial and randomized controlled trial. While the free text terms were: carpal tunnel, manual therapy, manipulation, mobilization and massage therapy. All terms used were combined with "AND" and "OR" booleans according to their nature. For the MEDLINE database search we used the sensitive search strategy proposed by Cochrane (Moher et al., 2009). The search was performed by two independent reviewers (CC-M and SR-D) and a third reviewer was consulted in case of disagreement (MC-C). Table 1 presents the search commands for each database.

Table 1. Search Commands for the databases

Data bases	Search commands
Medline	((((“Carpal Tunnel Syndrome”[Mesh]) OR (carpal tunnel)) OR (median nerve entrapment)) AND (((((“Musculoskeletal Manipulations”[Mesh]) OR (manual therapy)) OR (manipulation)) OR (mobilization)) OR (massage))) AND ((“Clinical Trial” [Publication Type]) OR (“Randomized Controlled Trial” [Publication Type]))
Scopus	(TITLE-ABS-KEY (“carpal tunnel syndrome”) OR TITLE-ABS-KEY (“carpal tunnel”) OR TITLE-ABS-KEY (“median nerve entrapment”) AND TITLE-ABS-KEY (“musculoskeletal manipulation”) OR TITLE-ABS-KEY (“manual therapy”) OR TITLE-ABS-KEY (manipulation) OR TITLE-ABS-KEY (mobilization) OR TITLE-ABS-KEY (massage) AND TITLE-ABS-KEY (“clinical trial”))
Web of Science	(((ALL = (carpal tunnel syndrome)) OR ALL = (carpal tunnel)) AND ALL = (manual therapy)) AND ALL = (clinical trial)
PEDro	Abstract & title: Syndrome carpal tunnel; Therapy: stretching, mobilization, manipulation, massage; body part: Hand or wrist; Subdiscipline: musculoskeletal
CENTRAL	MeSH descriptor: [Carpal Tunnel Syndrome] explode all trees AND MeSH descriptor: [Musculoskeletal Manipulations] explode all trees AND trials
LILACS	(carpal tunnel syndrome) OR (carpal tunnel) AND (musculoskeletal manipulation) OR (manual therapy) AND (clinical trial)
Epistemonikos	(title: (carpal tunnel syndrome) OR abstract: (carpal tunnel syndrome)) AND (title: (manual therapy) OR abstract: (manual therapy)) OR (title:(manipulation) OR abstract: (manipulation)) OR (title: (mobilization) OR abstract: (mobilization)) OR (title: (massage) OR abstract: (massage)) AND (title: (clinical trial) OR abstract: (clinical trial)) OR (title: (randomized controlled trial) OR abstract: (randomized controlled trial))

Study selection

Two independent reviewers (CC-M and SR-D) screened articles by title and abstract, relevant articles were then reviewed in full text and inclusion and exclusion criteria were applied, in case of disagreement a third reviewer (MC-C) was involved.

Data collection

Two independent reviewers (MC-C and VS-A) performed the extraction of results from the selected articles. Criteria included: 1) author and year of publication, 2) study design, 3) sample characteristics (number of participants, age, sex), 4) type of intervention and dose used in the experimental group (TM, dose, time, etc.), 5) type of intervention in the comparison group (TM, surgery, physical agents, etc.), 6) follow-up, 7) variables, 8) outcomes.

Risk of bias assessment

Two independent reviewers conducted the risk of bias assessment of the included studies (SR-D and VS-A) and

a third reviewer was involved in case of disagreement (CC-M). The assessment was conducted according to the recommendations of the Cochrane Collaboration handbook (Moher, et al., 2009) and the risk of bias (RoB) tool (Higgins & Green, 2011) was used. This tool assesses risk of bias across seven domains: generation of the random sequence, concealment of the randomization sequence, blinding of participants and treatments, blinding of the evaluation of the results, incomplete results data, selective reporting of results and other biases. Each of these aspects can be categorised as "low risk of bias" (green), "nuclear risk of bias" (yellow) or "high risk of bias" (red).

Statistical methods

The DerSimonian and Laird random-effects or Mantel-Haenszel fixed-effects method was used, depending on heterogeneity (DerSimonian & Kacker, 2007; Mantel & Haenszel, 1959). For pooled estimation, mean difference (MD) or standardised mean difference (SMD) with 95% confidence interval (CI) was used for pain, strength, symptom severity, functionality and nerve conduction. Statistical heterogeneity was assessed using the I2 statistic (Higgins & Thompson, 2002), which considers 0-40% heterogeneity as unimportant, 30-60% moderate, 50-90% substantial and 75-100% as considerable heterogeneity (Higgins & Green, 2008). Meta-analysis (MA) was performed with RevMan 5.4 software considering significant differences with an alpha value < .05.

Results

Study selection

A total of 364 studies were found in the electronic search process (figure 1), where finally 12 ECAS met the selection criteria to be included in the SR (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jimenez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019).

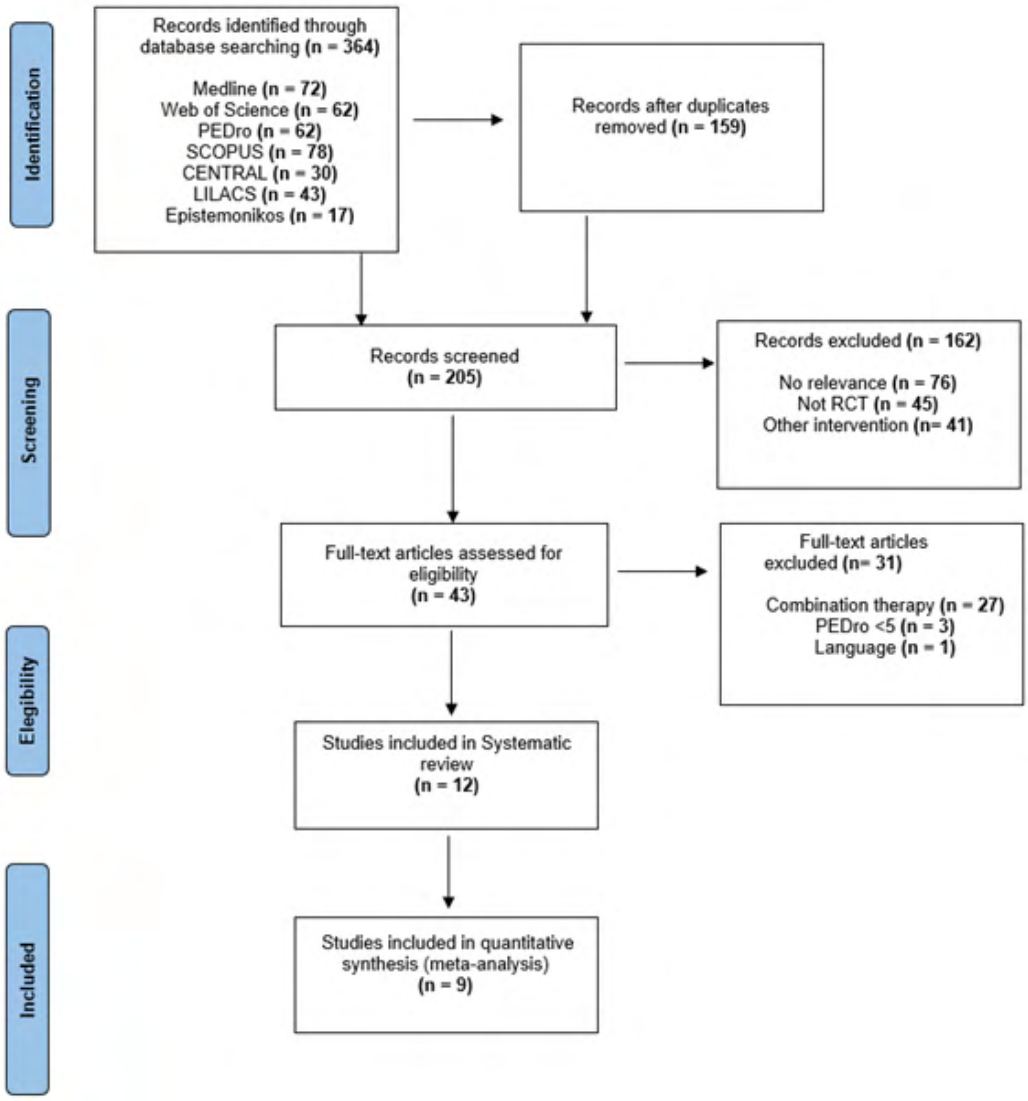

Figure 1. Flow diagram for study selection process

Studies characteristics

The summary of included studies is presented in table 2. The total population included 1,198 treated hands with a diagnosis of CTS (626 in the TM-treated groups and 572 in the groups treated with other interventions). Eighty-six per cent of all treated persons were female and had an average age of 50 years.

In all included studies the diagnosis was mainly based on clinical criteria such as pain in the wrist or hand, paresthesias related to the median nerve pathway, increased symptoms at night and positive Phalen's or Tinel's test. In addition, alteration in electrophysiological aspects was considered through the measurement of nerve conduction in electromyography, where three ECAS considered the recommendations of the "American Academy of Physical Medicine and Rehabilitation", and the diagnosis was confirmed with a conduction velocity < 40 m/s and a motor latency > 4.20 m/s (Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022), while five articles confirmed the diagnosis with conduction velocity levels < 50 m/s and motor latency > 4 m/s (Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019). Exclusion criteria were mainly based on subjects with previous surgeries, corticosteroid injection treatments and other drugs, pregnancy, trauma and systemic comorbidities (cervical radiculopathies, fibromyalgia, osteoarthritis, arthritis, thyroid disorders, diabetes, etc.). Only one study excluded subjects with depression with a score > 8 on the Beck Depression Inventory II (BDI-II) (Fernández et al., 2015). Only the article by Talebi et al. (2018) incorporated a population with CTS and associated diabetes. Finally, ten SCAS included subjects with mild or moderate diagnosis (Beddaa et al., 2022; Jiménez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019) while only one included user with mild, moderate or severe CTS (Fernandez et al., 2015).

Ten studies performed sample size calculations to select their (Beddaa et al., 2022; Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019) and all met ethical safeguards and were approved by ethics committees.

Tabla 2. Characteristics of the studies included in the systematic review and meta-analyses

Author	Manual therapy				Other intervention				Results
	N (women%)	Aged *(SD)*	Intervention	Sessions (time per session)	*N* Women %)	Aged *(SD)*	Intervention	Sessions (time per session)	Between groups difference
Beddaa (2022)	62 (100%)	52.5 (10.6)	Carpal bone mobilization and neurodynamics for median nerve	20 (UE)	62 (100%)	52.5 (10.6)	Sham carpal bone mobilization and sham neurodynamics for median nerve	20 (UE)	**During Treatment (5 semanas)** BSTQ-FS *p* = .0001* NPRS *p* = .001* GS *p* = .05l **End of treatment** BCTQ-FS *p* = .003* NPRS *p* = .0001* GS *p* = .02*
Fernández (2015)	60 (100%)	47 (10)	Neurodynamic median nerve Soft tissue management Joint mobilization of the spine	3 (30 min)	60 (100%)	46 (9)	Surgery	NA	**1 and 3 month follow-up:** NPRS *p* < .001* BCTQ-SS *p* >.05 BCTQ-FS *p* < .01* **6 and 12 month follow-up:** NPRS *p* >.1 BCTQ-SS *p* > .05 BCTQ-SF *p* > .3 GROC *p* > .1
Hains (2010)	37 (70%)	46 (6.7)	Biceps ischemic compression therapy	15	18 (44%)	47 (7.2)	Shoulder and clavicle ischemic compression therapy	15	**End of treatment** PIS *p* = .02*
Jiménez (2018)	30 (80%)	44.9 (9.3)	Diacutaneous fibrolysis	5 (20 min)	30 (83%)	48.8 (7.9)	Sham diacutaneous fibrolysis	5 (20 min)	**End of treatment** SCV *p* < .01* DML *p* = .029* VAS *p* < .01* DASH *p* <.01* **1 month follow-up:** VAS *p* < .01* DASH *p* <.01*

Jiménez (2022)	30 (80%)	44.2 (10)	Diacutaneous fibrolysis	5 (20 min)	30 (87%)	48.9 (8.7)	Sham diacutaneous fibrolysis	5 (20 min)	**End of treatment** VAS, CSA (cross-sectional área) TCL p < .01* TCL (transversal carpal ligament) p < .03*
Moraska (2008)	14 (71%)	47 (8.8)	Targeted massage (probable sites of nerve entrapment along the afflicted upper extremity)	12 (30 min)	13 (92%)	50.3 (15.1)	General massage (back, neck, arms)	12 (30 min)	**End of treatment** GS p = .001* PS p = .11 FSS p = .34 SSS (symptom severity scale) p = .80 GPT p = .41
Talebi (2018)	15 (UE)	49 (10.2)	Neurodynamics for median nerve Soft tissue management Carpal bone mobilization	12 (25 min)	15 (UE)	50.2 (10.2)	TENS + TU	12 (25 min)	**End of treatment** VAS p < .1 BCTQ-SS p = .006* BCTQ-FS p = .04* MNT p = .000*
Wolny (2016)	70 (89%)	53 (8.7)	Neurodynamics for median nerve wrist opening and closing techniques Trapezious functional massage	20 (30 min)	70 (86%)	51.5 (10.3)	Láser + TU	20 (25 min)	**End of treatment** 2PD: DS: Finger I, II, III p > .05 RDS: Finger I p < .001*, II p < .02*, III p < .001*
Wolny (2017)	70 (89%)	53 (8.7)	Neurodynamics for median nerve wrist opening and closing techniques Trapezious functional massage	2 (25 min)	70 (86%)	51.5 (10.3)	Láser + US	20 (25 min)	**End of treatment** SCV, MCV, ML, p > .05 VAS p < .01* BCTQ-SS p < .01* BCTQ-FS p < .01*
Wolny (2018a)	102 (88%)	52.6 (9.3)	Neurodynamics for median nerve wrist opening and closing techniques Trapezious functional massage de muñeca	20 (45 min)	87 (91%)	53.1 (8.9)	No intervention	NA	**End of treatment** SF-36 (physical): PF p < .001* RF p < .001, BP p < .01* GH p < .001* SF-36 (mental): RE p < .01* VT p < .001* MH p <.03* SF p < .001* PCS p <.001* MCS p <.001*
Wolny (2018b)	78 (90%)	54.2 (9.5)	Neurodynamics for median nerve¿	20 (20 min)	72 (90%)	52.2 (10.4)	Sham neurodynamics for median nerve	20 (20 min)	**End of treatment** SVC, MCV, ML p < .01* D2P (finger I, II, III) p < .01* VAS p < .01* BCTQ-SS/FS p < .01* GS p = 0.1 PG p = 0.9
Wolny (2019)	58 (90%)	54.6 (9.1)	Neurodynamics for median nerve	20 (20 min)	45 (89%)	53.1 (10.1)	No intervention	NA	**End of treatment** GS, PG p > .05 BCTQ-FS p < .01* BCTQ-SS p < .01* NPRS p < .01* ML p < .01* SCV p = .01* MCV p = .83

Nota: BCTQ = Boston Carpal Tunnel Questionnaire, BCTQ-FS = Boston Carpal Tunnel Questionnaire-Function severity, BCTQ-SS = Boston Carpal Tunnel Questionnaire-Symptom severity, BP = Bodily Pain, CSA = Cross-Section Area, DASH =

Disability Arm, Shoulder and Hand, DS = discrimination sensation, DML = Distal motor latency, FSS = Functional Status Scale, GH = General Health, GPT = Grooved Pegboard test, GROC = Global Rating of Change, GS = Grip Strength, MCS = Mental Component Summary, MCV = Motor Conduction Velocity, MH = Mental Health, MNT **=** median neurodynamic test, ML = Motor Latency, NA **=** not applicable, NPRS = Numeric Pain Rating Score, PCS Physical Component Summary, PG = Pinch Grip, PIS = Perceived Improvement Scores, 2PD = 2 point discrimination, RDS = Relative Discrimination Sensation, RE = Role limitations because of Emotional problems, RF = Rol Limitations because of physical health problems, SSS = Symprom Severity Scale, SF **=** Social Functioning, SF-36 = Short Form (Quality of life), SVC = Sensory Conduction Velocity, TENS = Transcutaneous electrical nerve stimulation, TU = Therapeutic Ultrasound, UE = Unspecified, VAS = Vidual Analogue Scale, VT = Vitality, * = Significant differences.

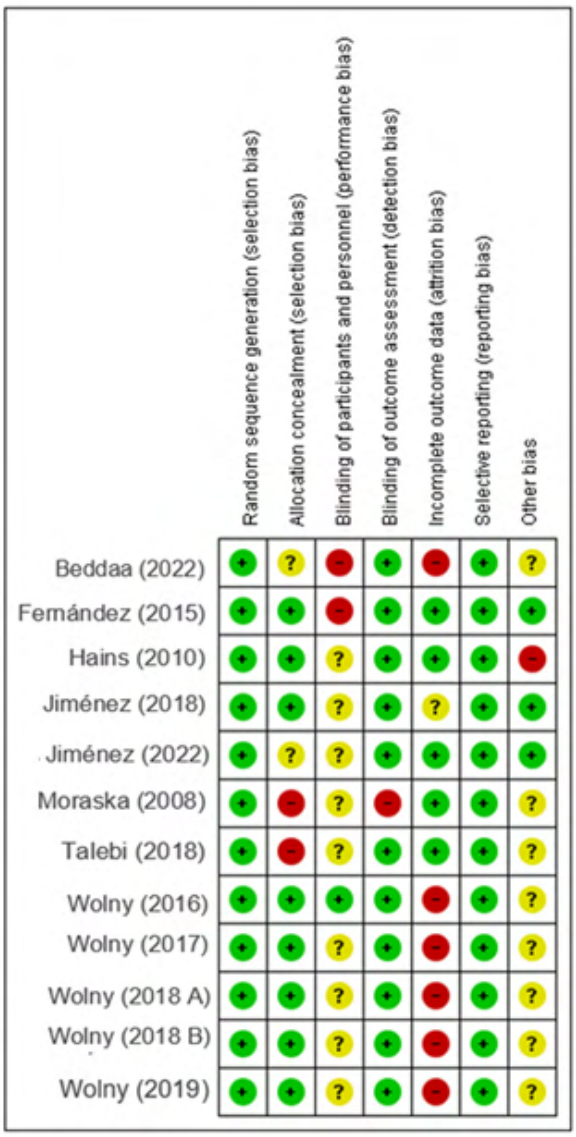

Figure 2. Risk of bias summary for each included study

Risk of bias

The risk of bias analysis is presented in figure 2 and 3, where 100% of the studies present a low risk of bias (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019), while random sequence blinding obtained a 67% low risk of bias (Fernández et al., 2015; Hains et al. 2010; Jiménez et al., 2018; Wolny et al., 2016; Wolny et al. 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019). In blinding participants and staff, it is noted that 75% had unclear risk of bias (Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska et al., 2008; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). Outcome assessors were adequately blinded and at low risk of bias in 92% of studies (Beddaa et al., 2022; Fernández et al., 2015; Hains

et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). In incomplete data reporting 50% of the studies had a high risk of bias (Beddaa et al., 2022; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). 100% of the studies performed selective reporting of the data (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019) and finally, 67% of the studies present unclear risk in other biases (Beddaa et al., 2022 Moraska et al., 2018; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linekb, 2018; Wolny & Linek, 2019).

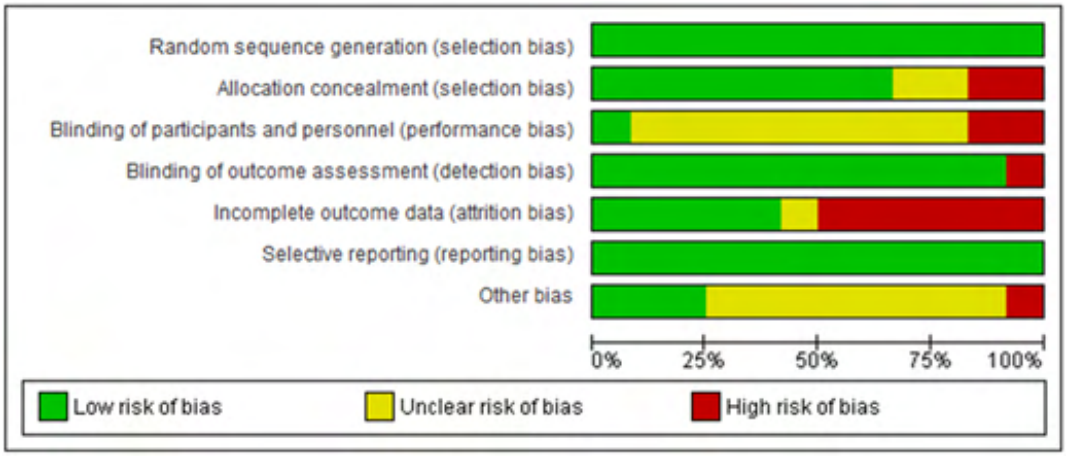

Figure 3. Risk of bias graph presented as percentages across all included studies

Synthesis of results

Of the 12 studies, four assessed grip strength Beddaa et al., 2022; Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) and three assessed grip strength (Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019), where all specified that it was measured with a dynamometer expressed in kilograms (kg) and reported the data needed to perform the MA. Eight assessed (Beddaa et al., 2022; Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019), where five measured it with the numerical scale (ENA) (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) and the other three assessed it with the visual analogue scale (VAS) (Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018). All reported data for inclusion in the MA.

Symptom function and severity was assessed with different instruments by nine studies (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b, Wolny & Linek, 2019). However, five studies assessed function with the Boston carpal tunnel questionnaire (CBTC-SF) (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) and reported data for necessary to be included in the MA. While four RCTs assessed symptom severity with the Boston Carpal Tunnel Questionnaire for Symptom Severity (CBTC-SS) and reported data for inclusion in the MA (Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019). Nerve conduction (NC) was assessed by four ECAS (Jiménez et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019), only three specified that it was with surface electromyography (Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019), while the other mentions that it was through neurophysiological parameters (Jiménez et al., 2018), of the four studies that assessed CN, all reported the data needed to perform the MA for sensory conduction velocity (SCV) and motor latency (LM) (Jiménez et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019 while for motor conduction velocity (MCV), three reported the data to be included in the MA (Wolny et al., 2017; Wolny & Linek, 2018 b; Wolny & Linek, 2019).

Strength

The four studies included in the strength MA demonstrate *MD* with no significant difference between the TM groups compared to the group that applied other interventions on grip strength (*MD* = -0.24, 95% *CI* = - 2.22, 1.74, *p* = .81) (Beddaa et al., 2022; Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) and gripper strength (*MD* = 0.21, 95% *CI* = -0.42. 0.83, *p* = .52), (Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) where both show substantial heterogeneity (*I2* = 69%, *p* = .02 and *I2* = 62%, *p* = .07, respectively).

Table 3. Summary comparison manual therapy versus other interventions for grip strength and pinch grip after treatment

	Manual therapy			Other intervention				
Autor (year)	Mean	*SD*	*N*	Mean	*SD*	*N*	Weigth	Mean difference, 95% *CI*
Grip Strength								
Beddaa (2022)	20.84	3.56	62	20.33	3.29	62	35.5%	0.61 [- 0.60, 1.82]
Moraska (2008)	30.52	8.76	14	24.0	9.01	13	7.2%	6.52 [- 0.19, 13.23]
Wolny (2018 B)	28.4	6.11	78	30.3	5.38	72	30.2%	-1.90 [3.74, - 0.06]
Wolny 2019	28.8	5.62	58	30.1	5.74	45	27.1%	- 1.30 [- 3.51, 0.91]
Total			212			192	100%	-0.24[- 2.22, 1.74]
Heterogeneity: Tau^2 = 2.49; Chi^2 = 9.81, df = 3 p = .02; I^2= 69%								
General effect test: Z = 0.24 (0.81)								
Pinch Grip								
Moraska (2008)	8.58	2.06	14	6.91	1.77	13	14.1%	1.67 [0.22, 3.12]
Wolny (2018 B)	8.16	1.49	78	8.25	1.24	72	45.3%	- 0.09 [- 0.53, 0.35]
Wolny (2019)	8.36	1.44	58	8.33	1.34	45	40.6%	0.03 [- 0.51, 0.57]
Total			120			130	100%	0.21 [- .42, 0.83]
Heterogeneity: Tau^2 = 0.17; Chi^2 = 5.22, df = 2; p = 0.07; I^2 = 62%								
General effect test: Z = 0.65 (0.52)								

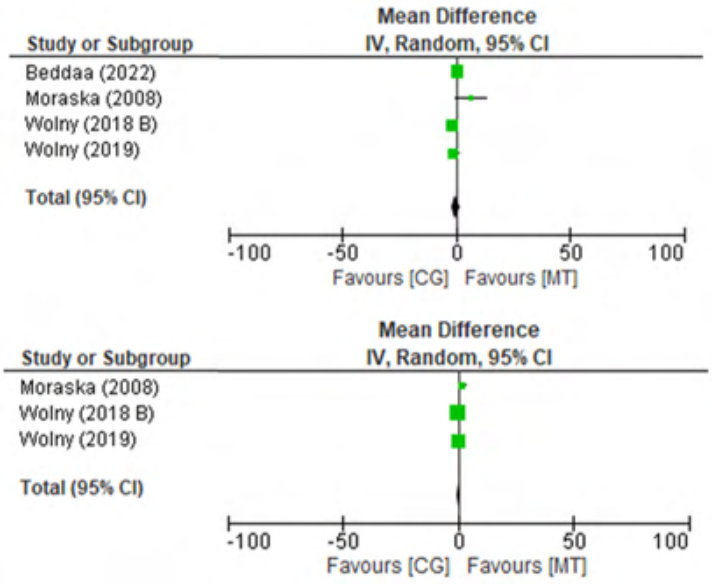

Figure 4. Forest plot comparison manual therapy versus other interventions for grip strength and pinch strength after treatment

Pain

The eight studies included in the MA of pain show a SMD with significant differences in favour of the TM group compared to the group with other interventions at the end of treatment (*SMD* = - 1.83, 95% *CI* = -2.62, - 1.03, *p* = < .00001), with considerable heterogeneity (*I2* = 95%, *p* = < .00001) (Beddaa et al., 2022; Fernandez et al, 2015; Jimenez et al., 2018; Jimenez et al. 2022; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019).

Table 4. Summary of manual therapy compared to other intervention for pain interventions after treatment

	Manual therapy			Other intervention				
Author (year)	**Mean**	***SD***	***N***	**Mean**	***S***	***N***	**Weigth**	**Mean Difference, 95% *CI***
				Pain				
Beddaa (2022)	1.52	1.5	62	5.52	1.76	62	12.9%	- 1.22 [- 1.60, - 0.83]
Fernández (2015)	1.4	1.9	55	3.4	2.3	56	12.9%	- 0.94 [- 1.33, - 0.55]
Jiménez (2018)	0.42	0.82	30	3.48	2.67	30	12.4%	- 1.53 [- 2.11, - 0.95]
Jiménez (2022)	0.23	0.54	30	2.87	2.5	30	12.4	- 1.44 [- 2.01, - 0.87]
Talebi (2018)	3.75	2.22	15	4.44	1.31	15	12%	- 0.37 [- 1.09, 0.35]
Wolny (2017)	1.47	1.2	70	3.58	1.93	70	12.9%	- 1.31 [- 1.67, - 0.94]
Wolny (2018b)	1.42	1.02	78	5.42	0.99	72	12.5%	- 3.96 [- 4.51, - 3.40]
Wolny (2019)	1.38	1.01	58	5.46	1.05	45	12.1%	- 3.94 [- 4.61, - 3.27]
Total			398			380	100%	- 1.83 [- 2.62, - 1.03]
Heterogeneity: Tau^2 = 1.24; Chi^2 = 144.28, *df* = 7 (*p* = <0.00001); I^2 = 95%								
General effect test: *Z* = 4.51 (*p* < .00001)								

Table 5. Summary comparison manual therapy versus other interventions for function severity (BCTQ-FS) and symptom severity (BCTQ-SS) after treatment

	Manual therapy			Other intervention				
Author (year)	**Mean**	***SD***	***N***	**Mean**	***SD***	***N***	**Weigth**	**Meam differenc, *CI* 95%**
				Function Severity (BCTQ-FS)				
Beddaa (2022)	1.4	0.4	62	2.24	0.88	62	19.8%	- 0.84 [- 1.08, - 0.60]
Fernández (2015)	1.5	0.4	55	2.3	0.7	56	21.8%	- 0.80 [- 1.01, - 0.59]
Wolny (2017)	1.9	0.62	70	2.55	0.95	70	18.1%	- 0.65 [- 0.92, - 0.38]
Wolny (2018b)	1.94	0.61	78	3.09	0.68	72	22.1%	- 1.15 [- 1.36, - 0.94]
Wolny (2019)	1.96	0.64	58	2.87	0.71	45	18.2%	- 0.91 [- 1.17, - 0.65]
Total			323			305	100.0%	- 0.88 [- 1.05, - 0.71]
Heterogeneity: Tau^2 = 0.02; Chi^2 = 10.06, *df* = 4 (*p* = 0.04); I^2 = 60%								
General effect test: *Z* = 10.28 (*p* = < .00001)								
				Symptom severity (BCTQ-SS)				
Fernández (2015)	1.6	0.5	55	1.7	0.5	56	25.3%	- 0.10 [- 0.29. 0.09]
Wolny (2017)	1.78	0.47	70	2.57	0.77	70	25.1%	- 0.79 [- 1.00, - 0.58]
Wolny (2018b)	1.77	0.48	78	2.86	0.72	72	25.2%	- 1.09 [- 1.29, - 0.89]
Wolny (2019)	1.08	0.86	58	2.87	0.68	45	24.4%	- 0.94 [- 1.58, - 0.30]
Total			261			243	100%	- 0.94 [- 1.58, - 0.30]
Heterogeneity: Tau^2 = 0.41; Chi^2 = 105.09, *df* = 4 (*p* = <0.00001); I^2 = 97%								
General effect test: *Z* = 2.86 (*p* = .004)								

Function and symptom severity

The five studies included in the MA of function and symptom severity show a *MD* with significant differences in favour of the TM group compared to the group using other interventions at the end of treatment for the two variables assessed; on the one hand CBTC-SF (*MD* = - 0. 88, 95% *CI* = - 1.05, - 0.71, *p* = < .00001) and on the other, the CBTC-SS (*MD* = - 0.94, 95% *CI* = - 1.58, - 0.30, *p* = .004), with substantial significant (I2 = 60%, *p* = .04) and considerable significant heterogeneity (I2 = 97%, *p* = < .00001) respectively (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018 b; Wolny & Linek, 2019).

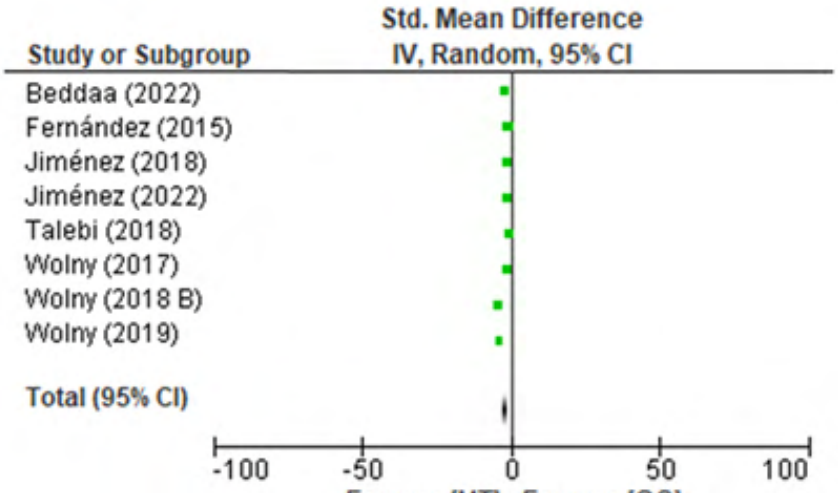

Figure 5. Forest plot comparison manual therapy versus other interventions for pain after treatment

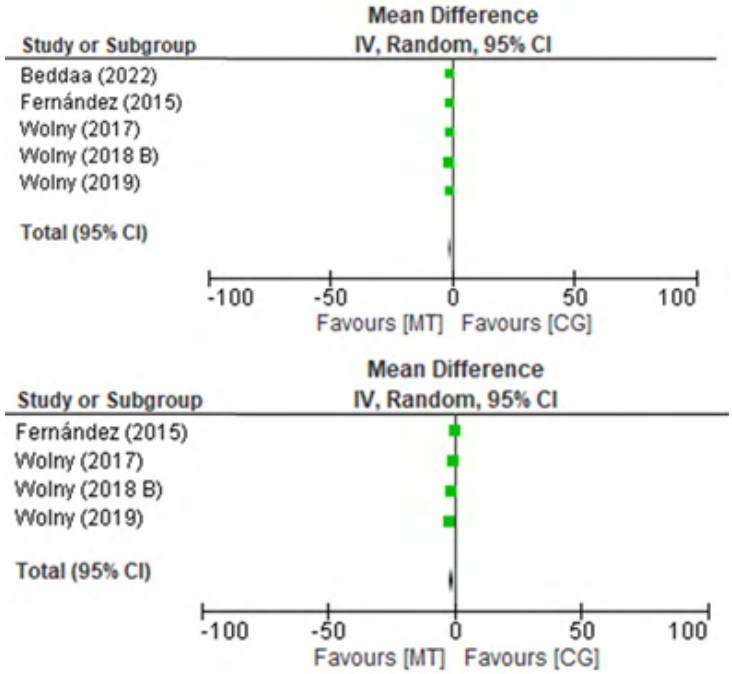

Figure 6. Forest plot comparison manual therapy versus other interventions for function severty (BCTQ-FS) and symptom severity (BCTQ-SS)

Nerve conduction

The four studies included in the MA of nerve conduction show a *MD* with significant differences in favour of the TM group compared to the group with other interventions at the end of treatment for CMV and LM, but not for SVC. On the one hand, VCM with *MD* = 1.85 (95% *CI* = 0.68, 3.01, *p* = .002) and non-significant heterogeneity (*I2* = 0%, *p* = .80) (Wolny et al., 2017; Wolny & Linek, 2018b; Wolny et al., 2019) and LM with *MD* = - 0.57, 95% *CI* = -9.96, - 0.17, *p* = .005) and substantial heterogeneity (*I2* = 86%, *p* = < .0001). On the other hand, VCS presented a *MD* = 7.43 (95% *CI* = -0.11, 14.98, *p* = .05) and substantial heterogeneity (*I2* = 96%, *p* = < .00001) (Jiménez et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019).

Table 6. Summary comparison manual therapy versus other interventions for nerve conduction (sensory conduction velocity, motor conduction velocity and motor latency) after treatment

	Manual therapy			Other intervention				
Author (year)	**Mean**	***SD***	***N***	**Mean**	***SD***	***N***	**Weigth**	**Mean difference, *CI* 95%**
Sensory conduction velocity (SVC)								
Jiménez (2018)	46.9	5.78	30	40.39	5.82	30	25.3%	6.51 [3.57, 9.45]
Wolny (2017)	35.1	12.1	70	39.2	11.9	70	24.6%	- 4.10 [- 8.08, - 0.12]
Wolny (2018 B)	39.8	11.3	78	25.1	7.77	72	25.2%	14.70 [11.62, 17.78]
Wolny (2019)	38.3	11.1	58	25.9	7.72	45	24.8%	12.40 [8.76, 16.04]
Total			236			217	100%	7.43 [- 0.11, 14.98]
Heterogeneity: $Tau^2 = 56.23$; $Chi^2 = 60.22$, $df = 3$ ($p < .00001$); $I^2 = 95\%$								
General effect test: $Z = 1.93$ ($p = .05$)								
Motor conduction velocity (MCV)								
Wolny (2017)	56.5	7.8	70	55.3	5.7	70	26.5%	1.20 [- 1.06, 3.46]
Wolny (2018 B)	56.1	6.52	78	54.1	4.32	72	43.9%	2.00 [0.24, 3.76]
Wolny (2019)	55.8	6.92	58	53.6	4.08	45	29.6%	2.20 [0.06, 4.34]
Total			206			187	100%	1.85 [0.68, 3.01]
Heterogeneity: $Chi^2 = 0.45$, $df = 2$ ($p = .80$); $I^2 = 0\%$								
General effect test: $Z = 3.11$ ($p = .002$)								
Motor latency (ML)								
Jiménez (2018)	3.74	0.49	30	3.99	0.39	70	27.6%	- 0.25 [- 0.45, - 0.05]
Wolny (2017)	5.02	1.13	70	5.24	1.17	70	23..2%	- 0.22 [- 0.60, 0.16]
Wolny (2018 B)	4.43	0.18	78	5.33	1.13	72	26.2%	- 0.90 [- 1.16, - 0.64]
Wolny (2019)	4.49	0.72	58	5.41	1.18	45	22.9%	- 0.92 [- 1.31, - 0.53]
Total			236			257	100%	- 0.57 [- 0.96, - 0.17]
Heterogeneity: $Tau^2 = 0.14$; $Chi^2 = 21.45$, $df = 3$ ($p = < .0001$); $I^2 = 86\%$								
General effect test: $Z = 2.83$ ($p = .005$)								

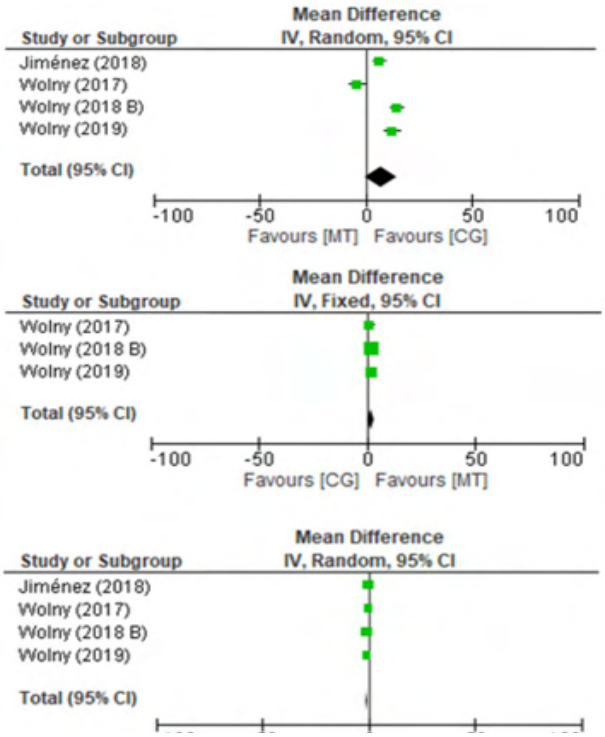

Figure 7. Forest plot comparison manual therapy versus other interventions for nerve conduction (sensory conduction velocity, motor conduction velocity and motor latency) after treatment

Discussion

This SR with MA kprovides a synthesis of the evidence regarding the effectiveness of MT when applied in isolation compared to other interventions for pain, function, symptom severity, nerve conduction, and strength. Significant differences favoring MT were found in all variables except for grip strength and pinch strength. Currently, the favorable effects of MT have not been fully understood; however, Bialosky et al. (2009) proposed a model applicable to all MT approaches, including neurodynamic techniques, joint mobilizations, and massages. The approach suggests that the mechanical stimulus of an MT intervention generates a neurophysiological chain at the central and peripheral levels, ultimately resulting in pain inhibition and, consequently, improvement in other variables. This occurs because MT alters the sensory processing of supraspinal structures, a concept supported by functional magnetic resonance imaging studies. Research has demonstrated that after the application of MT, changes occur in the activation and interaction of cortical areas linked to sensory discrimination, affective regions, and nociceptive processing regions (Gay et al., 2014; Meier et al., 2014; Sparks et al., 2013). Bialosky et al. (2018) updated model incorporates the therapist's personal attributes (preferences, expectations, beliefs about pain, and clinical experience) and how these interact with the patient, emphasizing that they could influence the outcomes of individuals treated with MT. On the other hand, a more specific explanation of neural mobilizations indicates that the positive effect of neurodynamic techniques focuses on reducing edema and intraneural pressure. Nuñes de Arenas-Arroyo et al. (2022) demonstrate in their MA that neurodynamic maneuvers are effective in peripheral neuropathies, noting that tension techniques significantly increase fluid dispersion, and sliding techniques could have a positive effect on reducing intraneural edema. This is relevant because intraneural circulation and axoplasmic flow could compromise microvascular permeability and increase endoneural fluid pressure. However, it should be noted that the five studies included in the MA by Nuñes de Arenas-Arroyo et al. (2022) were conducted on cadavers, and these presented moderate methodological quality.

One relevant factor to consider in clinical aspects is the number of sessions used in treatments. Despite this SR with MA incorporating studies with varying treatment frequencies of Manual Therapy (MT), the results seem to be independent of the number of sessions used. Studies that implemented 20 sessions found significant results in favor of the groups applying MT in most outcomes (Beddaa et al., 2022; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019). Similarly, Randomized Controlled Trials (RCTs) with three sessions (Fernández et al., 2015), five sessions (Jiménez et al., 2018; Jiménez et al., 2022), 12 sessions (Moraska et al., 2008; Talebi et al., 2018), and 15 sessions (Hains et al., 2010) also demonstrated significant results in most variables in favor of the MT groups. Therefore, the optimal minimum dose to achieve results in pain, function, and symptom severity reduction was obtained with three sessions (Fernández et al., 2015). Another clinically relevant aspect to consider is understanding clinical prediction rules to identify individuals who might benefit from MT techniques. Fernández et al. (2016) study aimed to determine if the status of a clinical prediction rule could predict individuals benefiting from an MT program. Initially, the rule's status indicated that a lower pain threshold to pressure in the cervical area and a lower pain threshold to temperature in the affected wrist were related to beneficial effects after an MT program. This was justified by the potential superiority of segmental sensitization over central sensitization (Fernández et al., 2010). Ultimately, the study concluded that the outcome could not be predicted, as women with both negative and positive status in the clinical prediction rule showed similar findings. All studies included in this SR had samples with a high prevalence of females, exceeding 80% in most studies. This is largely related to the high prevalence of this condition in women. Few studies have focused on samples predominantly consisting of males. In the case of the RCTs included in this review, Hains et al. (2010) study had a higher percentage of men in the control group (56%), so the results found in the meta-analyses of this review should be considered more applicable to a female population. In contrast to previous systematic reviews, it can be established that the favorable results towards MT found in this study are similar to earlier reviews for the mentioned variables. However, it should be noted that only Jiménez et al. (2022) review included RCTs where MT was applied in isolation, which demonstrated favorable results in pain, function, symptoms, and nerve conduction through its meta-analysis. The systematic reviews by Araya et al. (2018), Du et al. (2022), Lim et al. (2017), Medina y Yancosek (2008) and Sault et al. (2020), included studies that applied MT in combination with other therapies, showing that the inclusion of MT in programs with ultrasound, laser, exercises, and splints is effective for individuals with Carpal Tunnel Syndrome (CTS). However, Lim et al. (2017) and Medina and Yancosek (2008) concluded that, despite a favorable trend for programs using neurodynamic techniques, more studies are needed, while Araya et al. (2018) systematic review determined that there is moderate evidence supporting the use of neurodynamic techniques in combination with other interventions for pain reduction and improved function.

Grip strength and pinch strength have not been addressed in previous meta-analyses involving isolated MT treatment, likely due to intervention-related heterogeneity. Previous studies have suggested that the application of MT techniques may not be a significant factor in increasing strength in individuals with CTS, as most have shown that adding neurodynamic techniques to other interventions does not provide additional benefits in strength (Bialosky et al., 2009; Hamzeh et al., 2021; Ijaz et al., 2022; Sheereen et

al., 2022). Fernández et al. (2017) is one of the few authors who found beneficial effects for increasing pinch strength after applying five sessions of cervical mobilization, soft tissue management, and cervical stretching exercises. However, these effects only persisted during the first month after therapy, as no differences were observed with surgery at three, six, and twelve months. These results are likely due to the passive and therapist-assisted nature of MT, which does not allow for active engagement of the involved musculature (Bruder et al., 2013). In addition, this SR included Talebi et al. (2018) study, which involved individuals with CTS and associated diabetes diagnosis. It found positive findings and significant differences compared to an ultrasound and laser program in function, symptoms, and neural tissue dynamics after applying a twelve-session program of joint mobilization in carpal bones, soft tissue management, and neurodynamic techniques. However, it is the only study conducted on diabetic individuals with CTS, as for all others included in this systematic review, metabolic diseases were an exclusion criterion.

Regarding the studies and variables not included in the MA, the study by Wolny and Linek (2018a) stands out as the sole assessment of overall health using the SF-36 instrument. It demonstrated a significant improvement in both physical (27%) and mental (13%) components after twenty treatment sessions compared to a non-intervention group. Additionally, the studies by Wolny and Linek (2018b) and Wolny et al. (2016) showed beneficial and significant effects on two-point discrimination and relative two-point discrimination in fingers I, II, and III, respectively. These improvements were observed following a twenty-session program of neurodynamic techniques, massage, and opening and closing techniques.

Limitations

The limitations of this study are as follows: 1) the search process was conducted in seven databases and in two languages, potentially missing relevant articles for the review. 2) the limited number of included studies. 3) methodological limitations, such as adequate concealment in the randomization process, blinding of participants and therapists, loss of individuals in the research process, intention-to-treat analysis, and follow-up, which could overestimate the effects of the therapy used. 4) the high degree of clinical and statistical heterogeneity, likely due to variations in intervention protocols (technique, dose, number of sessions used). 5) there was an intention to perform subgroup analyses by age, sex, severity, and TM technique used. Finally, despite several reviews yielding similar results, these findings should be approached with caution due to the mentioned limitations, and it is suggested that future systematic reviews may address and improve upon these aspects.

Conclusion

Based on the results of this SR with MA, it can be determined that, in the short term, isolated application of MT is an option that yields favorable effects in individuals with mild to moderate CTS, resulting in reduced pain and symptom severity, increased function, and improved electrophysiological parameters of nerve conduction compared to other interventions. Additionally, it may be an option to enhance two-point sensory discrimination. However, grip strength and pinch strength do not show benefits when applying a MT protocol. A validated clinical prediction rule regarding who may benefit from a MT program has not been identified. Therefore, it is essential to conduct new studies to identify the most optimal protocol, including technique, dose, and the number of sessions for effective rehabilitation of individuals with CTS in the short, medium, and long term.

Conflict of interest

The authors declare no potential conflict of interest concerning the research, authorship, and/or publication of this article.

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Efectividad de la terapia manual en el síndrome del túnel carpiano: Revisión sistemática y metaanálisis

Effectiveness of manual therapy in carpal tunnel syndrome: Systematic review and meta-analysis

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Resumen

El objetivo de esta revisión sistemática es determinar la efectividad de la terapia manual aplicada de forma aislada en el dolor, la función, la severidad de síntomas, la conducción nerviosa y la fuerza en personas con síndrome del túnel carpiano. Se realizó una búsqueda en MEDLINE, WOS, SCOPUS, PEDro, CENTRAL, LILACS y Epistemonikos. Doce estudios cumplieron los criterios de elegibilidad y nueve fueron incluidos en la síntesis cuantitativa. El dolor obtuvo una diferencia de media estandarizada de - 1.83 (*IC* al 95% = - 2.62, - 1.03, *p* = < .00001), la función una diferencia de media de - 0.88 (*IC* al 95% = - 1.05, - 0.71, *p* = < .00001), la severidad de síntomas una diferencia de media de - 0.94 (*IC* al 95% = - 1.58, - 0.30, *p* = .004), la velocidad de conducción sensitiva una diferencia de media de 7.43 (*IC* al 95% = - 0.11, 14.98, *p* = .05), la velocidad de conducción motora una diferencia de media de 1.85 (*IC* al 95% = 0.68, 3.01, *p* = .002), la latencia motora una diferencia de media = - 0.57, (*IC* al 95% = - 0.96, - 0.17, *p* = .005), la fuerza de agarre una diferencia de media = -0.24, *IC* al 95% = - 2.22, 1.74, *p* = .81) y la fuerza de pinza una diferencia de media = 0.21 (*IC* al 95% = - 0.42, 0.83, *p* = .52). Finalmente, se concluye que la terapia manual aplicada de forma aislada es una opción efectiva a corto plazo para personas con síndrome del túnel carpiano leve a moderado.

Palabras clave: Neuropatía mediana, manipulación musculoesquelética, fisioterapia, dolor.

Abstract

The aim of this systematic review is to determine the effectiveness of manual therapy applied alone on pain, function, symptom severity, nerve conduction and strength in people with carpal tunnel syndrome. We searched MEDLINE, WOS, SCOPUS, PEDro, CENTRAL, LILACS and Epistemonikos. Twelve studies met the eligibility criteria and nine were included in the quantitative synthesis. Pain had a standardized mean difference of - 1.83 (95% *CI* = - 2.62, - 1.03, *p* = < .00001), function a mean difference of - 0.88 (95% *CI* = - 1.05, - 0.71, *p* = < .00001), symptom severity a mean difference of - 0.94 (95% *CI* = - 1.58, - 0.30, *p* = .004), sensory conduction velocity a mean difference of 7.46 (95% *CI* = - 0.11, 14. 98, *p* = .05), motor conduction velocity a mean difference of 1.85 (95% *CI* = 0.68, 3.01, *p* = .002), motor latency a mean difference = - 0.57, (95% CI = - 0.96, - 0. 17, *p* = .005), grip strength a mean difference = -0.24, 95% *CI* = - 2.22, 1.74, *p* = .81) and grip strength a mean difference = 0.21 (95% *CI* = - 0.42, 0.83, *p* = .52). Finally, it is concluded that manual therapy applied alone is an effective short-term option for people with mild to moderate carpal tunnel syndrome.

Keywords: Median neuropathy, musculoskeletal manipulation, physiotherapy, pain.

Introducción

El síndrome del túnel carpiano (STC) es una afección que involucra el atrapamiento del nervio mediano en la zona del túnel del carpo de la muñeca (Foley et al., 2007), es una de las neuropatías periféricas más comunes de la extremidad superior con una prevalencia que varía entre el 1-5% de la población general (Thiese et al., 2014) y aumenta al 11.7% en poblaciones más específicas que cursan con síntomas y pertenecen a la clase trabajadora (Bland et al., 2003; Thiese et al., 2014), afecta en mayor frecuencia a las las mujeres, las cuales presentan un aumento entre tres a diez veces más que los hombres (Kozak et al., 2015; Lewanska & Walosiak-Skorupa, 2014). Enfermedades como la diabetes, la obesidad, la artrosis y la artritis reumatoide podrían ser factores que contribuyan al desarrollo de esta patología (Pourmemari & Shiri, 2016; Pourmemari et al., 2018; Shiri, 2016). Su etiología se basa en teorías como la de *Lundborg,* la cual propone que se altera la microcirculación sanguínea intraneural, la vaina de mielina, los axones y el tejido conectivo de soporte (Lundborg, 1988) o la teoría *double crush,* la que menciona que la compresión proximal de un nervio puede interrumpir el transporte axoplasmático en otras zonas, fundamentando que el atrapamiento del nervio mediano podría estar situado en zonas proximales como la columna cervical o el plexo braquial (Upton & McComas, 1973) y otras que mencionan la relevancia de los cambios inflamatorios locales, la deformación mecánica de las fibras del nervio y la disminución de su movilidad por edema o inflamación (Ettema et al., 2004; Oh et al., 2006; Schmid, 2015). Los factores mecánicos ocupacionales son una causa relevante a considerar, ya que existe mayor riesgo de padecer STC en actividades que requieren un alto grado de repetición y esfuerzo forzado (Kozak & Schedlbauer, 2015). El diagnóstico se basa primordialmente en criterios clínicos como dolor, pérdida de la función, alteración de la sensibilidad con parestesias en las falanges I, II y III y en etapas más avanzadas pérdida de la fuerza en la zona tenar (Vogt & Scholz, 2002), además se suele complementar con pruebas como la de Phalen, Tinel, Paley/McMurley, entre otras (Palumbo & Szabo, 2002). Exámenes como el ultrasonido, la resonancia nuclear magnética y la electromiografía son utilizados para complementar y confirmar el diagnóstico obtenido a través de los criterios clínicos (Corlobé, 2004; Cudlip et al., 2002; Jarvik et al., 2008).

Las opciones de tratamiento son variadas y de forma general el tratamiento conservador se enfoca en tratar los principales síntomas clínicos, donde el dolor, la funcionalidad, la fuerza y la conducción nerviosa resultan relevantes para mejorar las actividades de la vida diaria, la calidad de vida y finalmente la reducción de los costos en salud (Bland & Rudolfer, 2003; Mondelli et al., 2002). Una de las opciones más utilizadas dentro de los tratamientos conservadores es la terapia manual (TM), la cual es ampliamente utilizada en los trastornos del sistema musculoesquelético y en el STC (Akalin et al., 2002; Carlesso et al., 2014; Pettman, 2007). Las técnicas de TM más utilizadas en el STC son las maniobras neurodinámicas, las técnicas de movilización o manipulación articular, las técnicas de masaje o manejo del tejido blando, y la terapia manual instrumental (Klokkari & Mamais, 2018). A pesar de que existen estudios que avalan la aplicación de las técnicas de TM en el STC, aún no está claro su mecanismo de acción, ya que la TM es una intervención compleja que se basa en la interacción de varios sistemas complementarios, e independiente de la técnica utilizada, los efectos de la TM se podrían deber a un mecanismo neurofisiológico, el cual establece que un estímulo mecánico genera una cascada de respuestas neurofisiológicas a nivel periférico y central que finalmente produce una disminución del dolor musculoesquelético (Bialosky et al., 2009; Bialosky et al., 2018).

En el último tiempo se ha presentado un aumento de la literatura científica en relación a la aplicación de TM en el STC, lo que ha permitido la realización de distintas revisiones sistemáticas (RS). Por una parte, se encuentran las de Medina y Yancosek (2008), Lim et al. (2017) y Araya et al. (2018), las que se enfocan en las técnicas de movilización neural, presentando resultados contradictorios, ya que Medina y Yancoseek (2008) y Lim et al. (2017) concluyen que no existe suficiente evidencia que avale el uso de las técnicas neurodinámicas en usuarios con STC, mientras que la RS de Araya et al. (2018) determina que existe moderada evidencia que avala la aplicación de las técnicas neurodinámicas para la mejora del dolor y la función en sujetos con STC. Por otra parte, se encuentra la RS de Sault et al. (2020) y Du et al. (2022) las que se enfocan en establecer los efectos de la TM aplicada de forma aislada o en combinación con otras terapias (ejercicio, láser, ultrasonido, etc.), demostrando que la TM combinada con otras intervenciones son efectivas para la recuperación funcional, la disminución del dolor, el aumento del rango articular, la mejora de la función sensitiva y motora. Finalmente, la RS con metaanálisis (MA) de Jiménez et al. (2022) es la única RS que incluye estudios clínicos que apliquen técnicas de TM de forma aislada, concluyendo que es efectiva para la disminución del dolor, la mejora de la función y la conducción nerviosa. Sin embargo, incluye pocos estudios y no incorpora todos los ensayos clínicos publicados. Es por esto que el objetivo de la presente RS es determinar si existe evidencia científica que avale el uso de técnicas de TM aplicadas de forma aislada o en combinación con otras técnicas de TM en el dolor, la función, la severidad de síntomas, la conducción nerviosa y la fuerza en usuarios con STC.

Metodología

Protocolo

Esta revisión sistemática se realizó según la declaración Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) y consideró las recomendaciones del manual de la colaboración Cochrane (Higgins & Green, 2008; Liberati et al., 2009; Moher et al., 2009).

Criterios de elegibilidad

Los estudios relacionados a la intervención de terapia manual en el síndrome del túnel carpiano eran elegibles si cumplían los siguientes criterios: 1) población: personas con diagnóstico de síndrome del túnel carpiano confirmado por criterios clínicos (dolor, pérdida de la función, parestesia en la mano, etc.), criterios radiológicos (ultrasonido, resonancia nuclear magnética) o criterios electromiográficos (conducción nerviosa). 2) Tipo de intervención: Terapia manual aislada o en combinación con otras técnicas de terapia manual (técnicas articulares, neurodinámicas, manejo de tejido blando, etc.). La técnica debe ser aplicada por un fisioterapeuta certificado. 3) Tipo de comparación: Terapias de otros tipos, otras técnicas de terapia manual, intervenciones placebo, cirugía o grupo control sin intervención. 4) Tipo de outcomes: variables clínicas como dolor, fuerza, rango articular, función, sensibilidad, conducción nerviosa, etc. 5) Tipo de estudio: Estudios clínicos aleatorizados publicados en inglés o español. Los criterios de exclusión fueron: 1) Estudios que combinen otros tratamientos diferentes a la terapia manual en el grupo experimental (ultrasonido, láser, ejercicio, farmacología, férula, etc.). 2) Estudios que incluyeron sujetos con otras patologías de la extremidad superior (hombro, brazo, codo, antebrazo, muñeca y mano). 3) Estudios que tengan un puntaje <5 puntos en la escala PEDro.

Fuentes de información

Las bases de datos utilizadas para la búsqueda electrónica de artículos fueron MEDLINE (vía PubMed), Web of science, SCOPUS, the Physiotherapy Evidence Database (PEDro), Cochrane Central Register of Controlled Trials (CENTRAL), Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS) y Epistemonikos, siendo estas consultadas hasta septiembre del 2022.

Estrategia de búsqueda

Para el proceso de recolección de los artículos se utilizó una estrategia de búsqueda computarizada avanzada que incluyó términos Medical Subjects Heading (MeSH) y términos de texto libre. Por una parte, los términos MeSH utilizados fueron: Carpal tunnel syndrome, musculoskeletal manipulation, clinical trial y randomized controlled trial. Mientras que los términos de texto libre fueron: carpal tunnel, manual therapy, manipulation, mobilization y massage therapy. Todos los términos utilizados se combinaron con los boleanos "AND" y "OR" según su naturaleza. Para la búsqueda en la base de datos MEDLINE se utilizó la estrategia de búsqueda sensible propuesta por la Cochrane (Moher et al., 2009). La búsqueda fue realizada por dos revisores independientes (CC-M y SR-D) y se consultó a un tercer revisor en caso de desacuerdo (MC-C). La tabla 1 presenta los comandos de búsqueda para cada base de datos.

Tabla 1. Comandos de búsqueda para las bases de datos

Base de datos	Comando de búsqueda
Medline	((((“Carpal Tunnel Syndrome”[Mesh]) OR (carpal tunnel)) OR (median nerve entrapment)) AND (((((“Musculoskeletal Manipulations”[Mesh]) OR (manual therapy)) OR (manipulation)) OR (mobilization)) OR (massage))) AND ((“Clinical Trial” [Publication Type]) OR (“Randomized Controlled Trial” [Publication Type]))
Scopus	(TITLE-ABS-KEY (“carpal tunnel syndrome”) OR TITLE-ABS-KEY (“carpal tunnel”) OR TITLE-ABS-KEY (“median nerve entrapment”) AND TITLE-ABS-KEY (“musculoskeletal manipulation”) OR TITLE-ABS-KEY (“manual therapy”) OR TITLE-ABS-KEY (manipulation) OR TITLE-ABS-KEY (mobilization) OR TITLE-ABS-KEY (massage) AND TITLE-ABS-KEY (“clinical trial”))
Web of Science	(((ALL = (carpal tunnel syndrome)) OR ALL = (carpal tunnel)) AND ALL = (manual therapy)) AND ALL = (clinical trial)
PEDro	Abstract & title: Syndrome carpal tunnel; Therapy: stretching, mobilization, manipulation, massage; body part: Hand or wrist; Subdiscipline: musculoskeletal
CENTRAL	MeSH descriptor: [Carpal Tunnel Syndrome] explode all trees AND MeSH descriptor: [Musculoskeletal Manipulations] explode all trees AND trials
LILACS	(carpal tunnel syndrome) OR (carpal tunnel) AND (musculoskeletal manipulation) OR (manual therapy) AND (clinical trial)
Epistemonikos	(title: (carpal tunnel syndrome) OR abstract: (carpal tunnel syndrome)) AND (title: (manual therapy) OR abstract: (manual therapy)) OR (title: (manipulation) OR abstract: (manipulation)) OR (title: (mobilization) OR abstract: (mobilization)) OR (title: (massage) OR abstract: (massage)) AND (title: (clinical trial) OR abstract: (clinical trial)) OR (title: (randomized controlled trial) OR abstract: (randomized controlled trial))

Selección de los estudios

Dos revisores independientes (CC-M y SR-D) examinaron los artículos a través del título y resumen, posteriormente se revisaron a texto completo los artículos relevantes y fueron aplicados los criterios de inclusión y exclusión, en caso de desacuerdo se involucró un tercer revisor (MC-C).

Recopilación de datos

Dos revisores independientes (MC-C y VS-A) realizaron la extracción de los resultados de los artículos seleccionados. Dentro de los criterios se encontraban: 1) autor y año de publicación, 2) diseño del estudio, 3) características de la muestra (número de participantes, edad, sexo) 4) tipo de intervención y dosis utilizada del grupo experimental (TM, dosis, tiempo, etc.) 5) tipo de intervención del grupo de comparación (TM, cirugía, agentes físicos, etc.), 6) seguimiento, 7) variables, 8) resultados.

Evaluación del riesgo de sesgo

Dos revisores independientes realizaron la evaluación del riesgo de sesgo de los estudios incluidos (SR-D y VS-A) y un tercer revisor fue involucrado en caso de desacuerdo (CC-M). La evaluación fue realizada de acuerdo a las recomendaciones del manual de la colaboración Cochrane (Moher et al., 2009) y se utilizó la herramienta *risk of bias* (RoB) (Higgins & Green, 2011). Esta herramienta evalúa el riesgo de sesgo a través de siete dominios: generación de la secuencia aleatoria, ocultamiento de la secuencia de aleatorización, cegamiento de los participantes y el personal, cegamiento de la evaluación de los resultados, datos de resultados incompletos, reporte selectivo de los resultados y otros sesgos. Cada uno de estos aspectos puede categorizarse como "bajo riesgo de sesgo" (color verde), "algunas preocupaciones" (color amarillo) o "alto riesgo de sesgo" (color rojo).

Métodos estadísticos

Se utilizó el método de efectos aleatorios de DerSimonian y Laird o de efectos fijos de Mantel-Haenszel, en función de la heterogeneidad (DerSimonian & Kacker, 2007; Mantel & Haenszel, 1959). Para la estimación conjunta se utilizó la diferencia de media (*DM*) o la diferencia de media estandarizada (*DME*) con el intervalo de confianza (*IC*) al 95% para el dolor, la fuerza, la severidad de síntomas, la funcionalidad y la conducción nerviosa. La heterogeneidad estadística se evaluó mediante el estadístico I^2 (Higgins & Thompson, 2002), el cual considera una heterogeneidad del 0-40% como no importante, 30-60% moderada, 50-90% sustancial y 75-100% como heterogeneidad considerable (Higgins & Green, 2008). El metaanálisis (MA) se realizó con el software RevMan 5.4 considerando diferencias significativas con un valor de alfa < .05.

Resultados

Selección de los estudios

Un total de 364 estudios fueron encontrados en el proceso de búsqueda electrónica (figura 1), donde finalmente 12 ECAS cumplieron con los criterios de selección para ser incluidos en la RS (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jimenez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019).

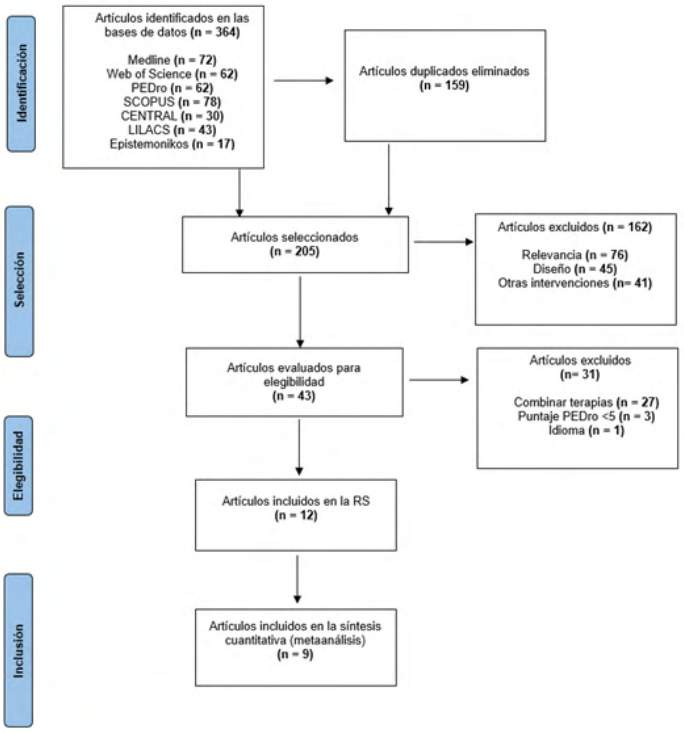

Figura 1. Diagrama de flujo del proceso de selección de los artículos

Características de los estudios

El resumen de los estudios incluidos se presenta en la tabla 2. La población total incluyó 1.198 manos tratadas con diagnóstico del STC (626 en los grupos con tratamiento de TM y 572 en los grupos tratados con otras intervenciones). El 86% del total de personas tratadas correspondían al sexo femenino y presentaban una edad promedio de 50 años.

En todos los estudios incluidos el diagnóstico se basó principalmente en criterios clínicos como dolor en la muñeca o mano, parestesias relacionadas al recorrido del nervio mediano, aumento de los síntomas durante la noche y test de Phalen o Tinel positivos. Además, se consideró la alteración en aspectos electrofisiológicos a través de la medición de la conducción nerviosa en la electromiografía, donde tres ECAS consideraron las recomendaciones de la "*American Academy of Physical Medicine and Rehabilitation*", y el diagnóstico fue confirmado con una velocidad de conducción < 40 m/s y una latencia motora > 4.20 m/s (Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022), mientras que cinco artículos confirmaron el diagnóstico con niveles de velocidad de conducción < 50 m/s y una latencia motora > 4 m/s (Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019). Los criterios de exclusión se basaron principalmente en sujetos que tenían cirugías previas, tratamientos de inyección con corticoesteroides y otros fármacos, embarazo, comorbilidades traumatológicas y sistémicas (radiculopatías cervicales, fibromialgia, artrosis, artritis, alteraciones tiroideas, diabetes, etc.). Solo un estudio excluyó sujetos con depresión con un puntaje > 8 en el Beck Depression Inventory II (BDI-II) (Fernández et al., 2015). Solo el artículo de Talebi et al. (2018) incorporó una población con STC y diabetes asociada. Finalmente, diez ECAS incluyeron sujetos con diagnóstico leve o moderado (Beddaa et al., 2022; Jiménez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019) mientras que solo uno incluyó usuarios con STC leve, moderado o severo (Fernández et al., 2015).

Diez estudios realizaron cálculo de tamaño muestral para seleccionar a su muestra (Beddaa et al., 2022; Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019) y todos cumplieron los resguardos éticos siendo aprobados por comités de ética.

Tabla 2. Características de los estudios incluidos

Autor	Terapia Manual				Grupo control				Resultados
	***N* total (% mujeres)**	**Edad (*DE*)**	**Intervención**	**Frecuencia (tiempo por sesión)**	***N* (% mujeres)**	**Edad (*DE*)**	**Intervención**	**Frecuencia (tiempo por sesión)**	**Resultados entre grupos**
Beddaa (2022)	62 (100%)	52.5 (10.6)	Movilización de huesos del carpo y neurodinamia para nervio mediano	20 sesiones	62 (100%)	52.5 (10.6)	Movilización de huesos del carpo y neurodinamia placebo	20 sesiones	**Durante el tratamiento (5 semanas)** CBTC-SF *p* = .0001* ENA *p* = .001* FA *p* = .05l **Fin del tratamiento** CBTC-SF *p* = .003* ENA *p* = .0001* FA *p* = .02*
Fernández (2015)	60 (100%)	47 (10)	Neurodinamia nervio mediano Manejo de tejido blando Movilización articular de columna	3 sesiones (30 min)	60 (100%)	46 (9)	Cirugía liberación/ descompresión	NA	**Mes 1 y 3 post:** ENA *p* < .001* CBTC-SS *p* > .05 CBTC-SF *p* < .01* **Mes 6 y 12 post:** ENA *p* > .1 CBTC-SS *p* > .05 CBTC-SF *p* > .3 CGC *p* > .1
Hains (2010)	37 (70%)	46 (6.7)	Compresión isquémica en zona del bíceps	15 sesiones	18 (44%)	47 (7.2)	Compresión isquémica en zona de clavícula y deltoides	15 sesiones	**Fin del tratamiento** CSFA *p* = .02*

Jiménez (2018)	30 (80%)	44.9 (9.3)	Fibrólisis diacutánea en antebrazo y mano	5 sesiones (20 min)	30 (83%)	48.8 (7.9)	Fibrólisis diacutánea placebo	5 sesiones (20 min)	Fin del tratamiento VCS p < .01* LMD p = .029* EVA p < .01* DHBM p <.01* **1 mes post:** EVA p < .01* DHBM p <.01*
Jiménez (2022)	30 (80%)	44.2 (10)	Fibrólisis diacutánea en antebrazo y mano	5 sesiones (20 min)	30 (87%)	48.9 (8.7)	Fibrólisis diacutánea placebo	5 sesiones (20 min)	Fin del tratamiento EVA, CGC y ASTNM p < .01* ELT p < .03*
Moraska (2008)	14 (71%)	47 (8.8)	Masaje localizado (zonas de posible atrapamiento del nervio mediano)	12 sesiones (30 min)	13 (92%)	50.3 (15.1)	Masaje generalizado (espalda, cuello, EESS)	12 sesiones (30 min)	**Fin del tratamiento** FA p = .001* FP p = .11 PFL p = .34 PSL p = .80 PTR p = .41
Talebi (2018)	15 (NE)	49 (10.2)	Neurodinamia para nervio mediana Manejo de tejido blando Movilización de huesos del carpo	12 sesiones (25 min)	15 (NE)	50.2 (10.2)	EET + US	12 sesiones (25 min)	**Final del tratamiento** EVA p < .1 CBTC-SS p = .006* CBTC-SF p = .04* PNMS1 p = .000*
Wolny (2016)	70 (89%)	53 (8.7)	Neurodinamia para nervio mediano Masaje funcional en trapecio Apertura y cierre de muñeca	20 sesiones (30 min)	70 (86%)	51.5 (10.3)	Láser + US	20 sesiones (25 min)	**Final del tratamiento** DS: I, II, III p > .05 DSR: I p < .001*, II p < .02*, III p < .001*
Wolny (2017)	70 (89%)	53 (8.7)	Neurodinamia para nervio mediano masaje funcional del trapecio movilización de muñeca	20 sesiones (25 min)	70 (86%)	51.5 (10.3)	Láser + US	20 sesiones (25 min)	**Final del tratamiento** VCS, VCM, LM, p > .05 ENA p < .01* CBTC-SS p < .01* CBTC-SF p < .01*
Wolny (2018 A)	102 (88%)	52.6 (9.3)	Neurodinamia para nervio mediano Masaje funcional en trapecio Movilización de muñeca	20 sesiones (45 min)	87 (91%)	53.1 (8.9)	Sin intervención	NA	**Fin del tratamiento** SF-36 (físico): LF p < .001* LR p < .001, DC p < .01* SG p < .001* SF-36 (mental): LER p < .01* V p < .001* SM p < .03* FS p < .001* RCF: p <.001* RCM: p <.001*

Wolny (2018 B)	78 (90%)	54.2 (9.5)	Neurodinamia para nervio mediano (deslizamiento y tensión)	20 sesiones (20 min)	72 (90%)	52.2 (10.4)	Neurodinamia placebo	20 sesiones (20 min)	**Fin del tratamiento** VCS, VCM, LM $p < .01$* D2P (I, II, III) $p < .01$* ENA $p < .01$* CBTC-SS/SF $p < .01$* FA $p = 0.1$ FP $p = 0.9$
Wolny (2019)	58 (90%)	54.6 (9.1)	Neurodinamia para nervio mediano (deslizamiento y tensión)	20 sesiones (20 min)	45 (89%)	53.1 (10.1)	Sin intervención	NA	**Final del tratamiento** FA y FP $p > .05$ CBTC-SF $p < .01$* CBTC-SS $p < .01$* ENA $p < .01$* LM $p < .01$* VCS $p = .01$* VCM $p = .83$

Nota: ASTNM = Área de sección transversal del nervio mediano, CBTC = Cuestionario Boston del túnel carpiano, CBTC-SF = Cuestionario Boston para severidad de la funcionalidad, CBTC-SS = Cuestionario Boston para severidad de síntomas, CGC = clasificación global del cambio, CSFA = cuestionario de síntomas y función autoadministrado, D2P = discriminación de 2 puntos, DC = dolor corporal, DHBM = disfunción del brazo, hombro y mano, DS = discriminación sensitiva, DSR = discriminación sensitiva relativa, EET = estimulación eléctrica transcutánea, ELT = espesor del ligamento transversal, ENA = escala numérica análoga de dolor, EVA = escala visual análoga, FA = fuerza de agarre, FP = fuerza de pinza, FS **=** función social, LER = limitación emocional del rol, LF = limitación física, LM = latencia motora, LMD = latencia motora distal, LR = limitación del rol, NA **=** no aplicable, NE = no especificado, PFL = puntaje de función de Levine, PNMS 1 **=** prueba neurodinámica de miembro superior, PSL = puntaje de síntomas de Levine, PTR = prueba de tablero ranurado, RCF = resumen componente físico, RCM = resumen componente mental, RDM **=** rango de movimiento, SG = salud general, SM = salud mental, SF-36 = calidad de vida, US = ultrasonido, V = vitalidad, VCS = velocidad de conducción sensorial, VCM = velocidad de conducción motora, * = diferencias significativas.

Riesgo de sesgo

El análisis del riesgo de sesgo se presenta en la figura 2 y 3, donde el 100% de los estudios presenta un bajo riesgo de sesgo (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019), mientras que el ocultamiento de la secuencia aleatoria obtuvo un 67% de bajo riesgo de sesgo (Fernández et al., 2015; Hains et al. 2010; Jiménez et al., 2018; Wolny et al., 2016; Wolny et al. 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019). En el cegamiento de los participantes y el personal se observa que el 75% tuvo un riesgo de sesgo poco claro (Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska et al., 2008; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). Los evaluadores de los resultados estaban cegados adecuadamente y con bajo riesgo de sesgo en el 92% de los estudios (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). En el reporte incompleto de los datos el 50% de los estudios presentó un alto riesgo de sesgo (Beddaa et al., 2022; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019). El 100% de los estudios realizó un reporte selectivo de los datos (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Jiménez et al., 2022; Moraska et al., 2008; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b, Wolny & Linek, 2019) y finalmente, el 67% de los estudios presenta riesgo poco claro en otros sesgos (Beddaa et al., 2022 Moraska et al., 2018; Talebi et al., 2018; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linekb, 2018; Wolny & Linek, 2019).

Síntesis de los resultados

De los 12 estudios, cuatro evaluaron la fuerza de agarre (Beddaa et al., 2022; Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) y tres la fuerza de pinza (Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019), donde todos especificaron que fue medida con un dinamómetro expresado en kilogramos (Kg) y reportaron los datos necesarios para realizar el MA. Ocho evaluaron el dolor (Beddaa et al., 2022; Fernández et al., 2015; Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018; Wolny et

al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) donde cinco lo midieron con la escala numérica (ENA) (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) y los otros tres lo evaluaron con la escala visual análoga (VAS) (Jiménez et al., 2018; Jiménez et al., 2022; Talebi et al., 2018). Todos reportaron los datos para ser incluidos en el MA.

La función y severidad de los síntomas fue evaluada con diferentes instrumentos por nueve estudios (Beddaa et al., 2022; Fernández et al., 2015; Hains et al., 2010; Jiménez et al., 2018; Moraska, et al., 2008; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b, Wolny & Linek, 2019). Sin embargo, cinco estudios evaluaron la función con el cuestionario de Boston del túnel carpiano (CBTC-SF) (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) y reportaron los datos para necesarios para ser incluidos en el MA. Mientras que cuatro ECAs evaluaron la severidad de síntomas con el cuestionario de Boston del túnel carpiano para severidad de síntomas (CBTC-SS) y reportaron los datos para ser incluidos en el MA (Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018 b; Wolny & Linek, 2019).

La conducción nerviosa (CN) fue evaluada por cuatro ECAS (Jiménez et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019), solo tres especificaron que fue con electromiografía de superficie (Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019), mientras que el otro menciona que fue a través de parámetros neurofisiológicos (Jiménez et al., 2018), de los cuatro estudios que evaluaron la CN, todos reportaron los datos necesarios para realizar el MA de la velocidad de conducción sensorial (VCS) y latencia motora (LM) (Jiménez et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019) mientras que para la velocidad de conducción motora (VCM), tres reportaron los datos para ser incluidos en el MA (Wolny et al., 2017; Wolny & Linek, 2018 b; Wolny & Linek, 2019).

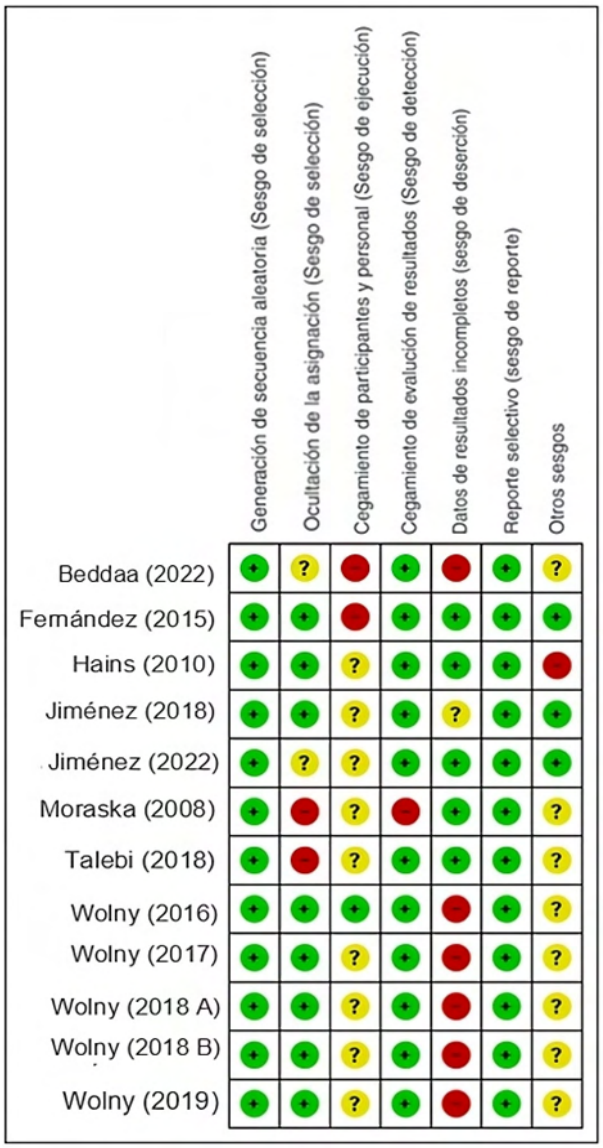

Figura 2. Resumen del riesgo de sesgo para cada estudio incluido

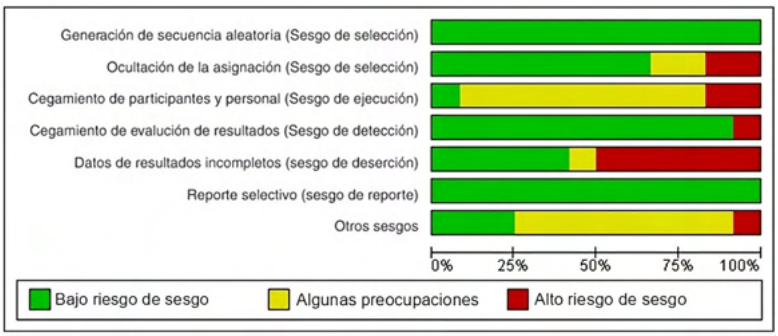

Figura 3. Riesgo de sesgo de todos los estudios sobre cada criterio presentado en porcentaje

Fuerza

Los cuatro estudios incluidos en el MA de la fuerza demuestran una DM sin diferencias significativas entre los grupos de TM en comparación al grupo que aplicó otras intervenciones en la fuerza de agarre (*DM* = -0.24, *IC* al 95% = -2.22, 1.74, *p* = .81) (Beddaa et al., 2022; Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) y fuerza de pinza (*DM* = 0.21, *IC* al 95% = -0.42. 0.83, *p* = .52), (Moraska et al., 2008; Wolny & Linek, 2018b; Wolny & Linek, 2019) donde ambas presentan una heterogeneidad sustancial (I^2 = 69%, *p* = .02 e I^2 = 62%, *p* = .07, respectivamente).

Tabla 3. Resumen de terapia manual en comparación a otras intervenciones para la fuerza de agarre y fuerza de pinza después del tratamiento

	Terapia manual			**Grupo control**				
Autor (año)	**Promedio**	***DE***	***N* total**	**Promedio**	***DE***	***N* total**	**Peso**	**Diferencia de media, *IC* al 95%**
Fuerza de agarre								
Beddaa (2022)	20.84	3.56	62	20.33	3.29	62	35.5%	0.61 [- 0.60, 1.82]
Moraska (2008)	30.52	8.76	14	24.0	9.01	13	7.2%	6.52 [- 0.19, 13.23]
Wolny (2018 B)	28.4	6.11	78	30.3	5.38	72	30.2%	- 1.90 [3.74, - 0.06]
Wolny 2019	28.8	5.62	58	30.1	5.74	45	27.1%	- 1.30 [- 3.51, 0.91]
Total			212			192	100%	-0.24 [-2.22, 1.74]
Heterogeneidad: Tau^2 = 2.49; Chi^2 = 9.81, *df* = 3 (*p* = .02; I^2= 69%								
Prueba de efecto general: *Z* = 0.24 (0.81)								
Fuerza de pinza								
Moraska (2008)	8.58	2.06	14	6.91	1.77	13	14.1%	1.67 [0.22, 3.12]
Wolny (2018 B)	8.16	1.49	78	8.25	1.24	72	45.3%	- 0.09 [- 0.53, 0.35]
Wolny (2019)	8.36	1.44	58	8.33	1.34	45	40.6%	0.03 [- 0.51, 0.57]
Total			120			130	100%	0.21 [- .42, 0.83]
Heterogeneidad: Tau^2 = 0.17; Chi^2 = 5.22, *df* = 2 (*p* = 0.07; I^2 = 62%								
Prueba de efecto general: *Z* = 0.65 (0.52)								

Dolor

Los ocho estudios incluidos en el MA del dolor muestran una *DME* con diferencias significativas a favor del grupo de TM en comparación al grupo con otras intervenciones al final del tratamiento (*DME* = -1.83, *IC* al 95% = -2.62, -1.03, *p* = < .00001), con una heterogeneidad considerable (I^2 = 95%, *p* = < .00001) (Beddaa et al., 2022; Fernandez et al, 2015; Jimenez et al., 2018; Jimenez et al. 2022; Talebi et al., 2018; Wolny et al., 2017; Wolny & Linek, 2018b; Wolny & Linek, 2019).

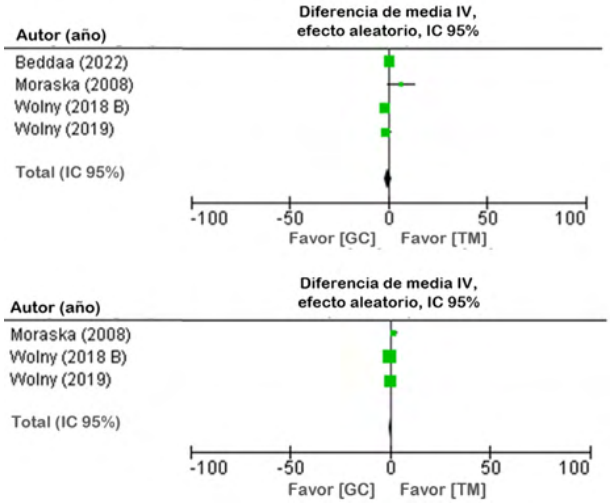

Figura 4. Diagrama de bosque para la terapia manual en comparación a otras intervenciones en la fuerza de agarre y fuerza de pinza después del tratamiento

Tabla 4. Resumen de terapia manual en comparación a otras intervenciones para el dolor después del tratamiento

	Terapia manual			Grupo control				
Autor y año	**Promedio**	***DE***	***N* total**	**Promedio**	***DE***	***N* total**	**Peso**	**Diferencia de media, *IC* al 95%**
Dolor								
Beddaa (2022)	1.52	1.5	62	5.52	1.76	62	12.9%	- 1.22 [- 1.60, - 0.83]
Fernández (2015)	1.4	1.9	55	3.4	2.3	56	12.9%	- 0.94 [- 1.33, - 0.55]
Jiménez (2018)	0.42	0.82	30	3.48	2.67	30	12.4%	- 1.53 [- 2.11, - 0.95]
Jiménez (2022)	0.23	0.54	30	2.87	2.5	30	12.4	- 1.44 [- 2.01, - 0.87]
Talebi (2018)	3.75	2.22	15	4.44	1.31	15	12%	- 0.37 [- 1.09, 0.35]
Wolny (2017)	1.47	1.2	70	3.58	1.93	70	12.9%	- 1.31 [- 1.67, - 0.94]
Wolny (2018 B)	1.42	1.02	78	5.42	0.99	72	12.5%	- 3.96 [- 4.51, - 3.40]
Wolny (2019)	1.38	1.01	58	5.46	1.05	45	12.1%	- 3.94 [- 4.61, - 3.27]
Total			398			380	100%	- 1.83 [- 2.62, - 1.03]
Heterogeneidad: Tau^2 = 1.24; Chi^2 = 144.28, df = 7 (p = <0.00001); I^2 = 95%								
Prueba de efecto general: Z = 4.51 (p < .00001)								

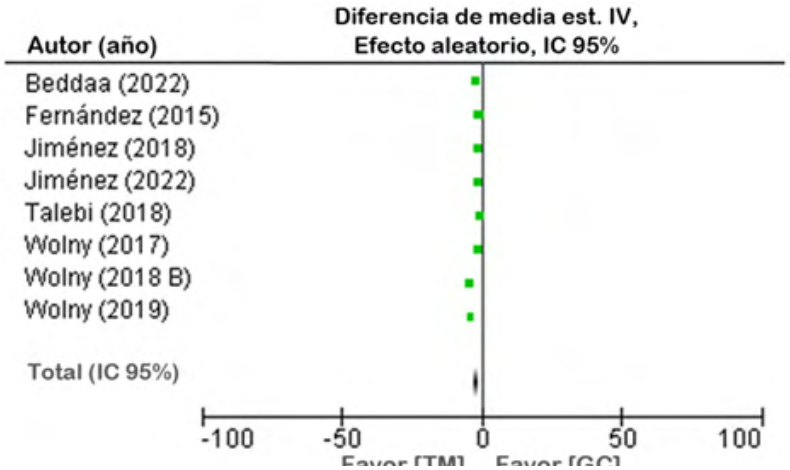

Figura 5. Diagrama de bosque de terapia manual en comparación a otras intervenciones para el dolor después del tratamiento

Función y severidad de síntomas

Los cinco estudios incluidos en el MA de la función y la severidad de síntomas muestran una DM con diferencias significativas a favor del grupo de TM en comparación al grupo que utilizó otras intervenciones al final del tratamiento para las dos variables evaluadas; por una parte el CBTC-SF (*DM* = -0.88, *IC* al 95% = -1.05, -0.71, *p* = < .00001) y por otra, el CBTC-SS (*DM* = - 0.94, *IC* al 95% = -1.58, - 0.30, *p* = .004), con una heterogeneidad sustancial significativa (I^2 = 60%, *p* = .04) y considerable significativa(I^2 = 97%, *p* = < .00001) respectivamente (Beddaa et al., 2022; Fernández et al., 2015; Wolny et al., 2017; Wolny & Linek, 2018 b; Wolny & Linek, 2019).

Tabla 5. Resumen de terapia manual en comparación a otras intervenciones para la función (CBTC-SF) y severidad de síntomas (CBTC-SS) después del tratamiento

	Terapia manual			Grupo control				
Autor y año	**Promedio**	***DE***	***N* total**	**Promedio**	***DE***	***N* total**	**Peso**	**Diferencia de media, *IC* al 95%**
Función (CBTC-SF)								
Beddaa (2022)	1.4	0.4	62	2.24	0.88	62	19.8%	- 0.84 [- 1.08, - 0.60]
Fernández (2015)	1.5	0.4	55	2.3	0.7	56	21.8%	- 0.80 [- 1.01, - 0.59]
Wolny (2017)	1.9	0.62	70	2.55	0.95	70	18.1%	- 0.65 [- 0.92, - 0.38]
Wolny (2018 B)	1.94	0.61	78	3.09	0.68	72	22.1%	- 1.15 [- 1.36, - 0.94]
Wolny (2019)	1.96	0.64	58	2.87	0.71	45	18.2%	- 0.91 [- 1.17, - 0.65]
Total			323			305	100.0%	- 0.88 [- 1.05, - 0.71]
Heterogeneidad: Tau^2 = 0.02; Chi^2 = 10.06, *df* = 4 (p = 0.04); I^2 = 60%								
Prueba de efecto general: *Z* = 10.28 (*p* = < .00001)								
Severidad de síntomas (CBTC-SS)								
Fernández (2015)	1.6	0.5	55	1.7	0.5	56	25.3%	- 0.10 [- 0.29. 0.09]
Wolny (2017)	1.78	0.47	70	2.57	0.77	70	25.1%	- 0.79 [- 1.00, - 0.58]
Wolny (2018 B)	1.77	0.48	78	2.86	0.72	72	25.2%	- 1.09 [- 1.29, - 0.89]
Wolny (2019)	1.08	0.86	58	2.87	0.68	45	24.4%	- 0.94 [- 1.58, - 0.30]
Total			261			243	100%	- 0.94 [- 1.58, - 0.30]
Heterogeneidad: Tau^2 = 0.41; Chi^2 = 105.09, *df* = 4 (*p*= <0.00001); I^2 = 97%								
Prueba de efecto general: *Z* = 2.86 (*p* = .004)								

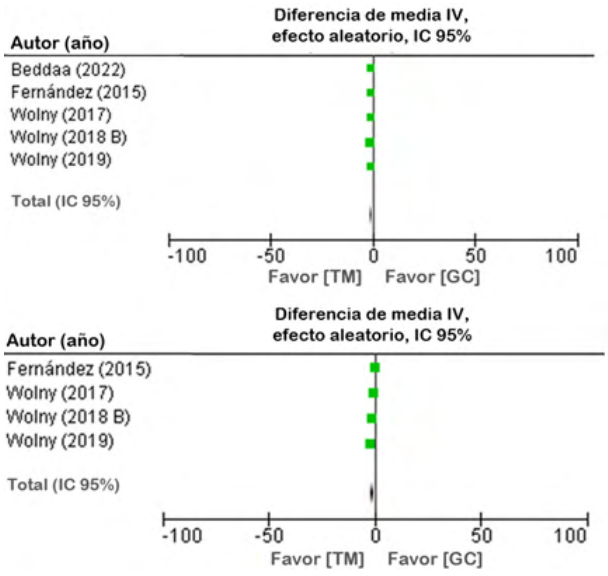

Figura 6. Diagrama de bosque de terapia manual en comparación a otras intervenciones para la función (CBTC SF) y severidad de síntomas (CBTC-SS) después del tratamiento

Conducción nerviosa

Los cuatro estudios incluidos en el MA de la conducción nerviosa muestran una DM con diferencias significativas a favor del grupo de TM en comparación al grupo con otras intervenciones al final del tratamiento para la VCM y LM, no así para la VCS. Por una parte, la VCM con una *DM* = 1.85 (*IC* al 95% = 0.68, 3.01, *p* = .002) y una heterogeneidad no importante (I^2 = 0%, *p* = .80) (Wolny et al., 2017; Wolny & Linek, 2018b; Wolny et al., 2019) y la LM con una *DM* = - 0.57, *IC* al 95% = -9.96, -0.17, *p* = .005) y heterogeneidad sustancial (I^2 = 86%, *p* = < .0001). Por otra parte, la VCS presentó una *DM* = 7.43 (*IC* al 95% = - 0.11, 14.98, *p* = .05) y una heterogeneidad considerable (I^2 = 96%, *p* = < .00001) (Jiménez et al., 2018; Wolny et al., 2017; ; Wolny & Linek, 2018b; Wolny & Linek, 2019).

Tabla 6. Resumen de terapia manual en comparación a otras intervenciones para la conducción nerviosa (VCS, VCM y LM) después del tratamiento

	Terapia manual			Grupo control				
Autor (año)	**Promedio**	***DE***	***N* total**	**Promedio**	***DE***	***N* total**	**Peso**	**Diferencia de media, *IC* al 95%**
Velocidad de conducción sensitiva								
Jiménez (2018)	46.9	5.78	30	40.39	5.82	30	23.5%	6.51 [3.57, 9.45]
Wolny (2017)	35.1	12.1	70	39.2	11.9	70	24.6%	- 4.10 [- 8.08, - 0.12]
Wolny (2018 B)	39.8	11.3	78	25.1	7.77	72	25.2%	14.70 [11.62, 17.78]
Wolny (2019)	38.3	11.1	58	25.9	7.72	45	24.8%	12.40 [8.76, 16.04]
Total			236			217	100%	7.43 [- 0.11, 14.98]
Heterogeneidad: Tau^2 = 56.23; Chi^2 = 60.22, *df* = 3 (*p* < .00001); I^2 = 95%								
Prueba de efecto general: *Z* = 1.93 (*p* = .05)								
Velocidad de conducción motora								
Wolny (2017)	56.5	7.8	70	55.3	5.7	70	26.5%	1.20 [- 1.06, 3.46]
Wolny (2018 B)	56.1	6.52	78	54.1	4.32	72	43.9%	2.00 [0.24, 3.76]
Wolny (2019)	55.8	6.92	58	53.6	4.08	45	29.6%	2.20 [0.06, 4.34]
Total			206			187	100%	1.85 [0.68, 3.01]
Heterogeneidad: Chi^2 = 0.45, *df* = 2 (*p* = .80); I^2 = 0%								
Prueba de efecto general: *Z* = 3.11 (*p* = .002)								
Latencia motora								
Jiménez (2018)	3.74	0.49	30	3.99	0.39	70	27.6%	- 0.25 [- 0.45, - 0.05]
Wolny (2017)	5.02	1.13	70	5.24	1.17	70	23..2%	- 0.22 [- 0.60, 0.16]
Wolny (2018 B)	4.43	0.18	78	5.33	1.13	72	26.2%	- 0.90 [- 1.16, - 0.64]
Wolny (2019)	4.49	0.72	58	5.41	1.18	45	22.9%	- 0.92 [- 1.31, - 0.53]
Total			236			257	100%	- 0.57 [- 0.96, - 0.17]
Heterogeneidad: Tau^2 = 0.14; Chi^2= 21.45, *df*= 3 (*p* = < .0001); I^2= 86%								
Prueba de efecto general: *Z* = 2.83 (*p* = .005)								

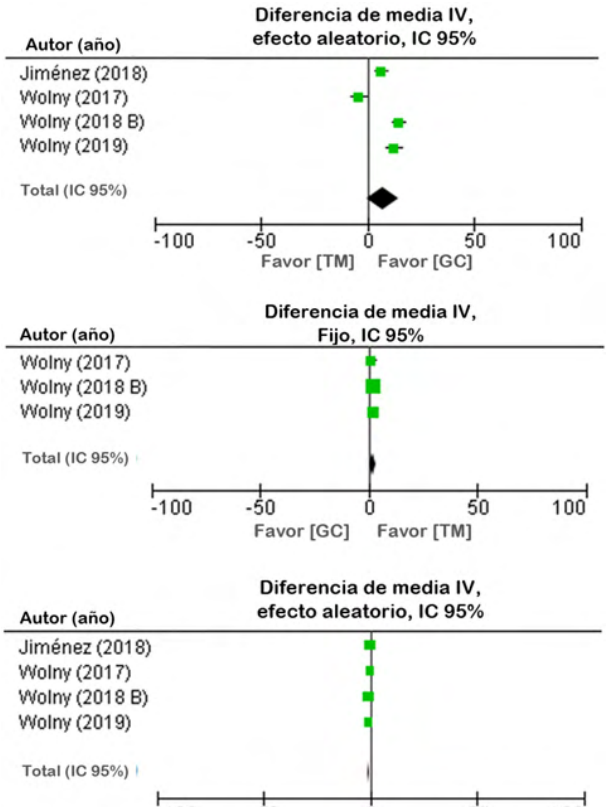

Figura 7. Diagrama de bosque de terapia manual en comparación a otras intervenciones para la conducción nerviosa (VCS, VCM y LM) después del tratamiento

Discusión

Esta revisión sistemática proporciona una síntesis de la evidencia en relación a la efectividad de la TM aplicada de forma aislada en comparación a otras intervenciones para el dolor, la función, la severidad de síntomas, la CN y la fuerza, encontrando diferencias significativas favor de la TM en todas las variables menos en la fuerza de agarre y fuerza de pinza.

Actualmente, los efectos favorables de la TM no han sido completamente comprendidos, sin embargo, Bialosky et al. (2009) propone un modelo aplicable a todos los enfoques de TM, incluyendo técnicas neurodinámicas, movilizaciones articulares y masajes. El enfoque establece que el estímulo mecánico de una intervención de TM genera una cadena neurofisiológica a nivel central y periférico que finalmente genera una inhibición del dolor y, en consecuencia, una mejora de otras variables, esto ocurre porque la TM altera el procesamiento sensorial de las estructuras supraespinales, lo que ha sido apoyado con estudios de resonancia magnética funcional. Estudios han demostrado que después de la utilización de TM se generan cambios en la activación e interacción de zonas corticales vinculadas a discriminación sensorial, regiones afectivas y regiones relacionadas al procesamiento nociceptivo (Gay et al., 2014; Meier et al., 2014; Sparks et al., 2013). El modelo actualizado de Bialosky et al. (2018) involucra los atributos personales del terapeuta (preferencias, expectativas, creencias sobre el dolor y experiencia clínica) y como estos interaccionan con el paciente, enfatizando que podrían influir en el resultado de las personas tratadas con TM. Por otra parte, una explicación más específica sobre las movilizaciones neurales señala que el efecto positivo de las técnicas de neurodinamia estaría enfocado en la disminución del edema y la presión intraneural. Nuñes de Arenas-Arroyo et al. (2022) demuestra en su MA que las maniobras neurodinámicas son efectivas en las neuropatías periféricas, señalando que las técnicas de tensión aumentan significativamente la dispersión del líquido y las técnicas de deslizamiento podrían tener un efecto positivo en la disminución del edema intraneural. Esto es relevante ya que, la circulación intraneural y el flujo axoplasmático podrían comprometer la permeabilidad microvasvular y aumentar la presión del líquido endoneural. Sin embargo, se debe considerar que los cinco estudios incluidos en la RS de Nuñes de Arenas-Arroyo et al. (2022) fueron en cadáveres y estos presentaban moderada calidad metodológica.

Uno de los factores relevantes a considerar en los aspectos clínicos es la cantidad de sesiones utilizadas en los tratamientos y a pesar de que esta RS incorpora estudios con distinta frecuencia en los tratamientos con TM, los resultados parecen ser independientes de la cantidad de sesiones utilizadas, ya que los estudios que realizaron 20 sesiones encontraron resultados significativos en la mayoría de los resultados a favor de los grupos que aplicaban TM (Beddaa

et al., 2022; Wolny et al., 2016; Wolny et al., 2017; Wolny & Linek, 2018a; Wolny & Linek, 2018b; Wolny & Linek, 2019), mientras que los ECAs que aplicaron tres sesiones (Fernández et al., 2015), cinco sesiones (Jiménez et al., 2018; Jiménez et al., 2022), 12 sesiones (Moraska et al., 2008; Talebi et al., 2018) y 15 sesiones (Hains et al., 2010) también demostraron resultados significativos en la mayoría de las variables a favor de los grupos que aplicaron TM. Por lo que la dosis mínima óptima para lograr resultados en el dolor, la función y la disminución de la severidad de síntomas se obtuvo con tres sesiones (Fernández et al., 2015) Otro aspecto relevante a considerar en lo clínico es conocer las reglas de predicciones clínicas para saber que personas podrían beneficiarse de los tratamientos que apliquen técnicas de TM. El estudio de Fernández et al. (2016) se centró en determinar si el estado de una regla de predicción clínica podría predecir a las personas que se beneficiarían de un programa de TM, considerando que inicialmente el estatus de esta regla había demostrado que un menor umbral del dolor a la presión en la zona cervical y un menor umbral del dolor a la temperatura en la muñeca afectada tenían relación con efectos beneficiosos después de un programa de TM, esto justificado porque la sensibilización segmentaria podría presentar mejores resultados que la sensibilización central (Fernández et al., 2010), finalmente el estudio concluyó que no se pudo predecir el resultado, ya que las mujeres con un estatus negativo y positivo en la regla de predicción clínica presentaron hallazgos similares.

Todos los estudios incluidos en esta RS presentan muestras con alta prevalencia de sexo femenino, siendo superior al 80% en la mayoría de los estudios, lo que se relaciona en gran medida a la alta prevalencia de esta condición en las mujeres. Pocos estudios se han centrado en muestras con predominio del sexo masculino, en el caso de los ECAs incluidos en esta RS, el estudio de Hains et al. (2010) presentó un mayor porcentaje de hombres en el grupo control (56%), por lo que los resultados encontrados en los MA de esta revisión se deben considerar en mayor medida a una población de sexo femenino.

En contraste a RS previas se puede establecer que los resultados favorables hacia la TM encontrados en este estudio son similares a las revisiones anteriores para las variables mencionadas. A pesar de esto, se debe considerar que solo la revisión de Jiménez et al. (2022) incluyó ECAs donde aplicó TM de forma aislada, el cual presentó a través de su MA resultados favorables en el dolor, la función, los síntomas y la CN. Las RS de Araya et al. (2018), Du et al. (2022), Lim et al. (2017), Medina y Yancosek (2008) and Sault et al. (2020), incluyeron estudios que aplicaron TM en combinación con otras terapias, demostrando que la inclusión de TM a programas con ultrasonido, láser, ejercicios y férulas son efectivos para personas con STC. Sin embargo, los estudios de Lim et al. (2017) y Medina y Yancosek (2008) concluyen que a pesar de que se ve una tendencia a favor de los programas que utilizan técnicas de neurodinamia se necesitan más estudios, mientras que la RS de Araya et al. (2018) determina que existe moderada evidencia que avala el uso de técnicas neurodinámicas en combinación a otras intervenciones para la disminución del dolor y la función.

La fuerza de agarre y la fuerza de pinza no han sido involucradas en MA anteriores donde se aplique un tratamiento de TM aislada, probablemente esto ocurra por la heterogeneidad relacionada a la intervención. Estudios previos han demostrado que la aplicación de técnicas de TM pareciera no ser un factor relevante al momento de aumentar la fuerza en personas con STC, ya que en su mayoría han presentado resultados que demuestran que añadir técnicas de neurodinamia a otras intervenciones no entrega beneficios adicionales en la fuerza (Bialosky et al., 2009; Hamzeh et al., 2021; Ijaz et al., 2022; Sheereen et al., 2022). Fernández et al. (2017) es uno de los pocos autores que encontró efectos beneficiosos para el aumento de la fuerza de pinza después de aplicar cinco sesiones de movilización cervical, manejo de tejido blando y ejercicios de elongación cervical, sin embargo, estos efectos solo se mantuvieron durante el primer mes después de la terapia, ya que, a los tres, seis y doce meses no se presentaron diferencias con la cirugía. Estos resultados probablemente se deben a que la TM es una terapia pasiva y asistida por un terapeuta, lo que no permite trabajar de forma activa la musculatura involucrada (Bruder et al., 2013).

En adición esta RS incluyó el estudio de Talebi et al. (2018) el cual involucró usuarios con STC y diagnóstico de diabetes asociada, el cual encontró hallazgos positivos y diferencias significativas en comparación a un programa de ultrasonido y láser en la función, los síntomas y la dinámica del tejido neural después de aplicar un programa de doce sesiones de movilización articular en los huesos del carpo, manejo de tejido blando y técnicas neurodinámicas. Sin embargo, es el único estudio que se realizó en personas diabéticas con STC, ya que para todos los otros incluidos en esta RS, tener enfermedades metabólicas fue un criterio de exclusión.

En relación a los estudios y variables que no se incluyeron en el MA, se encuentra el de Wolny y Linek (2018a), el cual fue el único que evaluó el estado general de salud con el instrumento SF-36, donde se demostró una mejoría significativa en el componente físico (27%) y mental (13%) después de veinte sesiones de tratamiento en comparación a un grupo sin intervención. Por otra parte, se encuentran los estudios de Wolny y Linek (2018b) y Wolny et al. (2016), los cuales demuestran efectos beneficiosos y significativos en la discriminación de dos puntos y discriminación relativa de dos puntos en los dedos I, II y III respectivamente, esto después de un programa de veinte sesiones de técnicas neurodinámicas, masaje y técnicas de apertura y cierre.

Limitaciones

Las limitaciones del presente estudio son: 1) se realizó el proceso de búsqueda en siete bases de datos y en dos idiomas, pudiendo perder artículos relevantes para la revisión.

2) el limitado número de estudios incluidos. 3) limitaciones metodológicas, como el adecuado ocultamiento al proceso de aleatorización, el cegamiento a los participantes y los terapeutas, la pérdida de personas en el proceso de investigación, el análisis por intención de tratar y el seguimiento lo que podría sobrestimar los efectos de la terapia utilizada. 4) el alto grado de heterogeneidad clínica y estadística, probablemente dado por las variaciones en los protocolos de intervención (técnica, dosis, número de sesiones utilizada). 5) se tuvo la intención de realizar análisis de subgrupos por edad, sexo, severidad, técnica utilizada de TM. Finalmente, a pesar de que varias revisiones tienen resultados similares, estos hallazgos se deben tomar con cautela por las limitaciones mencionadas y se sugiere que próximas RS las puedan mejorar.

Conclusión

En base a los resultados encontrados en esta RS, se puede determinar que, a corto plazo la TM aplicada de forma aislada es una opción que genera efectos favorables en personas con STC leve y moderado en la disminución del dolor y la severidad de los síntomas, el aumento de la función y la mejora de parámetros electrofisiológicos de la CN en comparación a otras intervenciones. Además, podría ser una opción para mejorar la discriminación sensitiva de dos puntos. Sin embargo, la fuerza de agarre y fuerza de pinza no presentan beneficios al aplicar un protocolo de TM.

No se ha encontrado una regla de predicción clínica validada en relación a cuáles son las personas que podrían beneficiarse de un programa de TM, a causa de esto, es necesario realizar nuevos estudios que identifiquen el protocolo más óptimo, incluyendo la técnica, la dosis y el número de sesiones para rehabilitar de la mejor forma a las personas con STC a corto, mediano y largo plazo.

Conflicto de intereses

Los autores declaran no tener ningún potencial conflicto de interés con respecto a la investigación, autoría y/o publicación de este artículo.

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Perception of fathers and mothers about the sports practice of young athletes: a qualitative study

Percepción de padres y madres sobre la práctica deportiva de jóvenes atletas: un estudio cualitativo

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Abstract

The balanced development of young athletes in cognitive, social and affective processes is influenced by the psychosocial agents in their environment. The aim of this study was to analyse the perceptions of parents about their children's participation in sport. The data of this research are from 33 semi-structured interviews with parents of athletes belonging to two athletics clubs from U14 to U18. The results indicate that the participants think that sport provides important values and that it is necessary to combine it with studies. In general, they maintain good communication with their children about their sports practice, although there is little communication with the coach, whose qualifications they do not know either. The majority of subjects indicate that they are concerned about managing their children's nerves and failure, because although they mention that they do not have performance expectations of them, they recognise that they have put them under pressure on occasion. The information gathered in this research is of great interest to find out how parents understand their children's sports practice, as this conditions the way in which they understand and experience sport.

Keywords: Young athletes, Psychosocial agents, Athletics, Motivational climate.

Resumen

El desarrollo equilibrado del joven deportista en los procesos cognitivos, sociales y afectivos está influenciado por los agentes psicosociales de su entorno. El objetivo de este estudio fue analizar las percepciones de padres y madres sobre la participación de sus hijos/as en el deporte, Los datos de esta investigación proceden de 33 entrevistas semiestructuradas realizadas a padres y madres de atletas pertenecientes a dos clubes de atletismo de categorías sub 14 a sub18. Los resultados indican que los participantes piensan que el deporte aporta valores importantes y que es necesario compaginarlo con los estudios. En general mantienen buena comunicación con sus hijos/as sobre su práctica deportiva, siendo esta escasa con el entrenador/a del que tampoco conocen su titulación, La mayoría de sujetos indica que les preocupa la gestión de los nervios y del fracaso de sus hijos/as, porque, aunque mencionan que no tienen expectativas de rendimiento sobre ellos, reconocen haberlos/as presionado en alguna ocasión. La información recabada en esta investigación es de gran interés para conocer como padres y madres entienden la práctica deportiva de sus hijos/as, ya que esta condiciona la manera de entender y vivir el deporte de estos/as.

Palabras clave: Jóvenes deportistas, Agentes psicosociales, Atletismo, Clima motivacional.

Introducción

Initiation, teaching and sports technification converge under the scheme of the holistic nature of sports training where physical characteristics, hereditary, anthropometric and social factors make up the essential parts that determine sports performance (Weineck, 2016). On the social level, in a young person, it is generally marked by the presence of family or guardianship, with him or her not making his or her own decisions. It is not until certain ages when social emancipation or overcoming the world allows it (García-Roca & Martin-Acero, 2021, p. 26).

Within this stage of sports training, it is important to highlight the characteristics that make up sports talent: mental predisposition, body constitution, physical qualities, external conditions, technical or tactical ability, and which are each associated with different areas of knowledge (Henriksen & Stambulova, 2023; Wixey & Kingston, 2023). Although the young athlete is influenced by many factors, the most determining one comes from the social aspects that surround him/her and the sport environment where he/she develops. That is why the support that parents/guardians give to the young athlete will determine both their training and their sport practice.

One of the dimensions to be taken into consideration in the support of young athletes is the value that parents give to their sport practice (Yilmaz, 2018). In this sense, the sporting example, what they think of their children doing sport, the values of sport, or the management of time between studies and sport, are fundamental elements (Amenabar et al., 2008). Along these lines, the parents' satisfaction with the sports offered in their locality is important, as well as whether their chosen sport has a sports school.

Another dimension considered in the sports training of a young person is the social relationship with other parents who take their children to the same sports activity or to the same club (Marcén et al., 2012). To this aspect must be added circumstances such as whether parents are involved in the club, in collaborating in events, in the dynamization of the club, in management and organizational tasks, and how this involvement can affect their personal life (Pinto & Samadiego, 2016).

Regarding the sporting activity of the club itself and of the youngsters, the relationship between parents and their children's coach stands out, in terms of communication, or if there is bilateral communication where parents inform the coaches of issues concerning their children (Chan et al., 2012; Garrido et al. 2010). Here there is room for the parents' opinion about the coach's sports work and how the training should be applied with their children (Romero et al., 2009).

In addition, from the dimension of support and understanding about the sport activity of young people and how it is perceived by parents, key aspects such as communication with the child about the sport activity derive: whether they talk daily about training; how they are doing in the activity or how they perceive the satisfaction of their children (Freeman et al., 2014; Pedrosa et al., 2012). Other circumstances are added that have to do with sport goals and the relationship with the coach (Holt & Hoar, 2006), as well as economic, logistical and material parental support (Vangelisti, 2009).

In addition to supporting their children, there is the directive behavior of parents on the performance of their children in sport, based on guidelines, advice and other elements on competitions and training, or related actions such as rest, nutrition, recovery, use of sports equipment, etc. (Jeanfreau et al., 2020). From here we can extrapolate the behavior of parents in competitions and trainings generating expectations in young people, created by the parents themselves (Horne et al., 2023).

At this point the presence of parents in sports competitions and communication with their children can determine a pressure on young athletes, not being clear the objectives of participation and "healthy" practice or winning in any way, finding a balance between the support and perception of the same by the young athlete and the pressure exerted by parents in training or competition (Calo et al., 2022; García-Naveira, 2018; Palheta et al., 2022).

The objective of this study is to analyze the perceptions of fathers and mothers on the participation of their children in sport, from the dimension of the value and satisfaction that the participation of their children produces in them, their involvement, relationships and behavior, expectations and direct influence on their children and the sport they practice.

Methodology

Participants and data collection procedure

The study sample consists of 33 subjects, 17 mothers and 16 fathers, with a mean age of 47.3 years (Table 1).

Table 1. Distribution of the sample according to the gender of the parent and the category of the athlete

Gender	Categories		
	Under 14	**Under 16**	**Under 18**
	(n=10)	(n = 12)	(n=11)
Man	3	8	5
Woman	7	4	6

The selection of the participants was done by non-probabilistic convenience sampling, seeking participation in the three categories. This work is part of the doctoral thesis "Self-confidence and sport: Influence on the adherence of young athletes and the effect of third parties", so when contacting parents to obtain informed consent from their children, they were offered to participate in the interviews. A total of 50 volunteers were obtained, of whom 33 were interviewed, reaching the level of theoretical saturation of the data (Glaser & Strauss, 1967).

The study data were collected through semi-structured interviews lasting between 45 and 75 minutes. The interviews were guided by a single researcher related to the research topic, so that the dependence-stability of the data could be facilitated (Guba, 1989).

The interviews were conducted in an athletics track, during the time when the children were training, to facilitate the participation of the parents. Video and audio recording of the interviews was made with the informed consent of the participants. Due to ethical criteria, pseudonyms will be used to maintain the anonymity of the participants.

Data analysis

A conventional data analysis was performed following the steps of Taylor and Bogdan (1987). The first step of this strategy, which is called discovery, was carried out prior to fieldwork, establishing blocks of content based on scientific evidence on the topic of study. The interviews were transcribed using NVivo11 software, after which the content was read on several occasions to establish the definitive blocks, code the data and establish the system of categories, ending the process with the interpretation of the data. As for the validation strategy, we used 1) triangulation of the data, using the information collected with the same interview in another similar Italian sample and 2) triangulation of the research staff in the process of coding and interpreting the data.

Results

The results obtained after analyzing the interviews according to the established content blocks are presented below, with textual fragments of the interviews. Initially, nine blocks were created to structure the questions, but after analyzing the transcripts of the interviews, the "Competition" block was eliminated and the answers were included in the blocks "Managerial behavior", "Support and understanding" and "Parental pressure".

Value given by parents to the practice of sports

This first block gives us information about the relationship that parents have with sports and the value they give to their children's sports activities.

Sporting example

Most of the interviewed subjects practice or have practiced sport during their lives. "I have always played sports until I went to college... I needed to play sports and I started running. If I'm not running, I walk or jog. Minimum I go out three days to run." (subject MIF4) Some of the interviewees take advantage of their children's training time to practice sports, and even practice together with other parents of their children's training partners.

PCF13:" I have not been involved in sports for very long, when I was a child I used to practice... when I quit smoking when I was 39 years old I started again, first hiking and then running... I usually train three or four days, but I try to make it at least three".

Evaluation of the sport practice

All the parents interviewed are pleased that their children practice sports, mainly because it is healthy and fosters social relations, but also largely because it keeps their children away from negative environments and bad habits.

> PJF29: "I am drooling, I tell you honestly, I never imagined that my daughter would compete at the level she is competing at... she is also very sporty, they would get that love, that desire to do sports, to take care of themselves, to lead a healthy life..."

> PIF9: "I think it's great... I like that she does a sport, that she relates with people and in the end it's in a team. ...she's very competitive and sometimes we sin, but it's something she feels herself and she wants to set goals... she likes to be with her friends."

Sport values

All interviewees agree that sports teach and work on values that are necessary and transferable to other areas of life, such as effort, companionship, responsibility, managing defeat and leading a healthy life. "The effort, the culture of effort... she knows that effort generally has its rewards... other things such as a healthy environment, meeting healthy people..." (subject PIF7), "there is self-improvement, there is a team aspect... by participating with other teammates or training with other people, she works a bit on values in interpersonal relationships..." (subject MIF3).

Time management. Studies and sports

Although the general opinion is that sport is very important, when it comes to combining it with studies, there is a diversity of opinions. Almost all agree that studies should be the main thing, in some cases they speak of 60% importance of studies compared to 40% of sports practice, although this percentage is also shared with other extracurricular activities. "Sports is the second most important thing he does, school is the most important, at least 75-25" (subject MIF2), "after studies, athletics I think is the first thing... it is good for his mind because I think that in each thing he works on his own thing." (subject PCF11). We observed that many athletes in the U18 category attend reinforcement classes at academies in the afternoons, before or after training. When deciding to miss training

for study reasons, it is the athletes themselves who make the decision. While in the U14 category it is the parents' decision, in the U16 category we find a mixture of both. To a lesser extent, we find parents who believe that sport is as important as studies. The majority of those surveyed affirmed that sports activities help their children to organize themselves better.

Parents' satisfaction with the sports offer

The information obtained in this second block is important because parental satisfaction may influence the decision of whether or not to keep their children in sports.

Local sports offerings

There is a diversity of opinions as to whether the quantity or variety of sports facilities is sufficient. Some of the parents claim to be unaware of it, but most of those interviewed detect that there is a deficiency in the quality and maintenance of the facilities in general and a clear preference for allocating resources to soccer. "There is a good offer, but the facilities are not in very good condition, I think... the money is not used as it should be used, I think that the majority sport, soccer fields... is often given more priority" (subject PCF12).

Satisfaction with sports schools

There is general dissatisfaction with the free offer. Although the sports offer is varied, they miss a free extracurricular sport, as this would encourage greater participation and adherence of children to sport.

> MIF6: "I think they have quality, what happens is that when there are so many children, the quality is not reflected in the same way as if there are fewer, but of course there is quality.... In the case of my daughter's school, there are extracurricular activities and they are paid for.

Satisfaction with the athletic school

All the interviewees were satisfied with the organization of the athletic club, felt that the fees were correct and that it was not an expensive activity. The simple fact that there was a waiting list is a good indicator and they recommend the club to their family and friends. "I think so when, I don't know the volume of children, there are so many...I mean what a good organization, I think maybe some materials would be missing...I think the fees seem right" (subject PIF8). Although they did not know the training of the coaches, they thought that they were well trained because they had a good relationship with the athletes, they seemed serious and provided good technical preparation. They thought that the club's philosophy of carrying out multi-training up to the U16 category and then specializing was correct, although some of them preferred to let their children specialize first if they were clear about what they liked or what they were good at. They complained that the state of the facility was inadequate and that the city council did not give value to a club that is in the highest national category.

> PCF16: "...I think that things are done better.... the kids are not specialized, they go to the competitions and they have not been prepared specifically for the tests they are going to do, and in the long run that is the best thing... otherwise in the end I think that what it does is to bore them..."

Parental involvement

This third block provides information on aspects of parental involvement in their children's sports, how it affects their lives and how they can interpret it.

Involvement in sports activity

Many of the subjects claim to be fully involved in their children's sporting activities, adapting their schedules, personal and sporting lives to meet the logistics of training and competitions whenever possible. In addition, some go to train with their children outside of school hours or take advantage of the school's training time to play sports themselves. There are a minority of parents who do not feel involved in this sense due to work issues, or who perceive it as a waste of their time.

> MIF1: "I 100%, sometimes I think more. Yes, because we are divorced and we have shared custody, sometimes I think I am the only one, I believe what she says, then I give it so much importance that I get involved 100%..."

> PCF13: "I love that she does sports... I mean if that's her hobby and I also have fun... I bring her to train and if I can't her mother brings her, but someone always brings her, she never misses a training session... and because we think it's good for her."

Social relationships

At this point we find several cases: the first and most abundant, fathers and mothers who interact both inside and outside the sports environment, but who normally knew each other before; others who share sports activities during their children's schedule; some only interact during competitions; and finally, in a minority, those who do not interact either inside or outside because they cannot accompany their children to sports activities for work reasons. "None, I know a parent of a classmate I had at school... I don't know any parent to say tomorrow you take her and another day I do, as I did before in soccer" (subject PCF11).

> PCF13: "Very good, we are very good friends... it's been many years because my daughter arrived when she was seven years old... I have gone to their house, they have come to mine, we have gone on excursions with the kids, very good, to do sports some day, to go out, we know each other, very good people..."

Involvement in the sports school

In most cases they would be willing to collaborate with the club, but the club does not request it. Many of them, when their children compete, collaborate by taking more

athletes to the competition in their vehicle. In some isolated cases, they collaborate in the canteen, as photographers in the competitions or belong to the club's board of directors, they even mobilized before the city council to make visible the poor state of the facility.

PJF29: "We have formed a group of parents ... I have always collaborated with the club whether I have been asked or not. When there is a competition, if there is a need to take children, I have taken them.... basically whatever the club has asked me to do and it's in my hand".

Impact on personal life

All the interviewees agree that it mainly affects their time, "well, especially in bringing and taking them, we live in the town and there are trips every day to take them to training, and even more on Sunday if there is a competition, which lately only the father has been going" (subject MJM26); but, in most cases, they see it as something positive and satisfactory, since the important thing is to see their children enjoying themselves. So they organize their social and family life around sport; during competitions they take the opportunity to go sightseeing or play sports in the area. In addition, it provides a healthy life for their children and keeps them away from other less advisable activities. In a more isolated way, we find cases where they see it as something negative because athletics is added to other activities of several children; others consider it an effort that reduces their personal time, which has to be compensated with the seriousness in which their child lives the sport; and in one case, the involvement is null and therefore does not affect their time.

PCF13: "What it affects is for the better, because I love it, I don't know, it's true, I love to bring her, I love to take her... If she stops doing athletics I would probably do less sport for sure, besides, the sport I do is basically because she does it.... but we always have time, if she competes on Saturday, then we meet with family or friends on Sunday".

Relationship with the sports coach

In the fourth block, the information obtained focuses on the relationship and communication between the family and the coach, their satisfaction with the coach's work and the motivational climate generated.

Relationship and communication with the sports coach

There is a poor relationship between parents and coaches. Although they consider them accessible, in most cases, they only have face-to-face communication at competitions". Little, I know them by sight, last year I knew a coach by sight because I took her to a competition... before when she was little I used to bring her, but now she comes alone, well then I have no relationship" (subject PCF11). Apart from the general information received by WhatsApp, they may approach to talk to the coaches, if special situations occur, such as injuries or lack of motivation in their children. In an isolated case, one parent talked to the coach every two weeks, as opposed to another who hardly knew who the coach was because in a year they had only spoken once.

Personal opinion

Parents do not trust the coaches to share their opinions, so in some cases they express what they think directly to their children. "We have not made any comments, because I have neither technique, nor training in this regard or anything, the only thing is if he/she has a medical problem" (subject MIM10). Some justify this by saying that it is the athletes themselves who have to communicate with them, because the coaches are already busy enough. Only some asked the coaches to evaluate the possibility of letting their children specialize early. In general, they all agree that the coach's opinion is the prevailing one and they have to trust them, either because the parents consider that they do not know about the subject or because they consider that it is the appropriate thing to do.

PJM23: "No, besides, regardless of whether they have training or not, I am of the opinion that parents should not talk to coaches about how their children should be trained, neither in this sport nor in any other sport... but in other sports everyone is a coach, especially in soccer".

Process information

All agree that they do not receive any kind of technical information on the process and evolution of their children, some consider it necessary and others do not, but all would appreciate this information at least once a quarter. "In a formal way, no, it would not be bad to have it, a kind of notes as to the effort he/she makes, if he/she can give more..." (subject MIF5), "I do not have information on that and yes it would be good" (subject MCM18).

Opinion on formative management

None of the parents interviewed were aware of the training of their children's coaches. In general, they thought that they were well trained because their children are happy, progress and improve their marks. They consider that there has been an improvement at the organizational level and that the coaches are motivating, disciplined, objective, they have won over the athletes and that each one has his or her own way of doing things, but they have to trust them.

PJM24: "Since he has had this coach, I have not commented with him on any technical aspects, because everything I have seen him do, from my point of view, was the right thing to do... everyone has improved, everyone believes in him".

Support and backup

This fifth block allows us to know the feelings of parents about the support they provide to their children, how they encourage them and communicate with them about their sports experience.

Communication with children

Communication between fathers and mothers and their children is daily, accentuated before and after competitions. "Very well, we maintain very daily especially when there are many competitions, and if it is a regular topic at home" (subject PCF13). In general they talk in the car journeys or during dinner about how the day has gone, sensations, discomfort, what they have learned or what marks they and their teammates have made. In some cases, parents also explain their own training sessions. During the competitive season, some subjects talk about competitive strategy, nutrition and rest, and if the competition went badly, they try to focus their children more on personal improvement than on the comparison with others.

PJF30: "I ask her every day, what worries me most is if something hurt, I ask her if she had a good time, I always ask her how the training went... she tells me about the training every day."

Athlete satisfaction with sports practice

There is only one case in which the daughter, despite liking athletics, has a hard time because of her shyness and physical complexes. In the rest of the cases, the message is that the children are happy, satisfied, content, motivated and proud of themselves, "I think she likes it and perhaps also because she feels at ease, she has friends here and it has been several seasons" (subject PJF31), although when the results do not go well they may collapse momentarily.

Reasons for sports participation

Most of the interviewees believe that their children do athletics for fun, to be with friends and to improve themselves and others. The competitive component comes to light on several occasions, to the point that they think that if they do not have good results they could abandon the sport. There is also the motive of doing a healthy activity and feeling good. The most ambitious want to be high-performance athletes, get a scholarship, continue with university sports and, in some cases, even participate in the Olympic Games.

MJM27: "Sometimes they feel nervous, sometimes they also collapse, you have to know how to deal with defeat, but coming here is very good, very happy, very motivated. I see my children very happy, they don't come here forced, they don't come here without desire, they don't come here with laziness..."

Athlete-Coach relationship

In the U14 and U16 categories, most of them have a good relationship with their coaches, since they speak well of them to their parents; in some cases, even with admiration, "very good, you can tell when they talk about them that they admire them, that they have a good time with them, that they have a good relationship". (subject PCF12). Trust increases as they go up in category, being in U18 where the relationship with the coach is closer and more trusting. "There is very good, there is a lot of complicity, not only in particular, I see it in the training group, who work with them a relationship of trust and a lot of complicity, very much believing in the coach" (subject PJM25). Only in one case a father does not know how his daughter's relationship with the coach is.

Relationship between the athlete and his/her teammates

In general, they maintain a good relationship, especially with classmates with whom they have coincided at school; some consider them their best friends. At least half of them stay outside the sports activity to make other plans; the other half simply communicate through social networks or have a good relationship as teammates in training. Competitiveness within the training group can hinder friendship for some; on the other hand, others make friends with rivals from other clubs, "very good, it makes me laugh because in competitions they also make friends from other clubs, that has been a discovery" (subject MJM27). In some cases, parents observe that as they move up in category, the group of friends becomes smaller and they do more activities outside.

PCF21: "Very well... as they get older her circle is more closed, kids and children that she got along well when she was younger now she doesn't get along well. Right now she doesn't get along badly with those who are not close to her. I see that she talks to everyone when she has to talk...".

PCF15: "She has gone through phases, now she has three or four that she leans on more and for the rest, she is indifferent. This year the atmosphere has become more competitive even in training and there can be tension with some..."

Parental support

Two categories are observed, one of internal support with a more emotional support through communication and, on the other hand, another of external support (economic, material, time and logistical), "I don't care about time either... he has even told me that since you never have plans, how come I don't have plans? If I do, what happens is that I prioritize his and his brother's plans" (subject MIF1), highlighting that in no case do parents report that the economic expense is high, "I encourage him to compete, and well then he wants to buy a cooler equipment because he wants something special to train... and I buy it for him... and if only for my interest and economically pay the fees" (subject PCF11); they take advantage of birthdays or Christmas parties to give their children sports equipment as gifts. As a consequence of this support, at least a third of those interviewed ask their children for dedication, seriousness, commitment and effort in their sports activity.

MCF20: "...athletics equipment is very expensive, we always want the same brand of shoes and the cheap ones are no good for us... but I don't mind, he asks me for it, but since he doesn't ask me for other things, well, shoes...,".

Parental attendance

Most of the parents have attended 90% or 100% of their children's competitions. Most of them attend as a family, in other cases only the father or the mother can go, but there is always family presence. Only in one case has not been able to attend any competition due to work and that the girl usually goes to competitions with the coach. "Competitions 99% or for work or own competition, training 60%. They love it, they ask us to stay at training and competitions to watch them..." (subject MIF3). In three cases, when the competition is far away, they are lazy to travel; few parents attend when the event takes place outside the region.

Training sessions are generally attended in the U14 category, and they decrease as they move up in category.

> PCF11: "I'm not there a lot, I support him in everything and I like him to do sports, I've been a couple of times to competitions, but I'm very busy, his mother can take her now...but I don't go so much, last year I went more".

Supporting demonstration

Most tell their children that they are very happy with their sports practice, proud to see them making an effort and their ability to excel. "I tell them that I am proud and I encourage them... but in that and in everything, I consider that it is basic, to recognize the achievements, to recognize the effort" (subject PCF12). Some consider it a way of showing their support to remember their children's marks and, when they are sad, to be able to help them in their personal improvement.

Some parents share the sport activity with their children, starting thanks to the fact that their children took up the sport. More than half express their satisfaction with words, gestures and actions, and consider it important to communicate this information and put words to feelings, as it will motivate their child to continue with the practice. The remaining cases take for granted that their children are aware of what they feel; for one subject expresses that flattering words can weaken character, "...she knows that we are very proud of her, but I try to be careful not to flatter her too much, you know that flattery weakens you... her mother tells me, that I am too hard." (subject PJF29).

Management behavior

The sixth block helps determine whether intrusive behaviors may occur on the part of parents before, during, or after a sporting event.

Management behavior with your child

Each parent has his or her own particular way of communicating with his or her child but, in general, one can distinguish a psychological or emotional aspect and another more directive part, in terms of recommendations or technical advice to prepare or correct the performance of the competition, "not in the technical aspect, unless he or she asks me something, but it is usually in the psychological aspect, in how important it is to believe in yourself" (subject PJF24). There are subjects who convey both messages, others opt for only one. Some parents do not give technical indications because they do not know the discipline; in one case, the daughter does not let her, she only wants to listen to her coaches. "She doesn't let me, she is very clear about things and follows what the coaches tell her, if I have been able to tell her a little something but she doesn't... she doesn't let me" (subject PCF16).

Competition assessment

A few comment that it is good to make an effort, but not to sacrifice oneself; that there is more to life than athletics, "I only tell them to make just enough effort, not to overexert themselves, because overexerting themselves could mean an injury, could mean a physical problem" (subject PCF11); in contrast to the generalized opinion that competition is good because of the values it transmits. Almost all describe seeing their children compete as something exciting: they cheer them on, are attentive to them, record them and take photos; in some cases they add that they have a hard time if they see that they fail in their objective.

More than half attend as a family, and many spend the day watching the entire competition, not only their children but also their peers. One parent says that, watching them, he feels that he would have liked to have lived that experience.

> PCF23: "I like to see her, what I don't like is to see her having a bad time, it's normal, what do I know, her mother also lives it, it's more fun, she signs up for everything... because she doesn't get hurt, she doesn't fall, when I see her doing hurdles I used to say, by God, don't let her fall."

Expectations

Parents' expectations about their children's abilities and the future of their children's sports practice. In this seventh block, the results of the two dimensions are presented together.

Athlete expectations vs Father or mother expectations

In this section we can find five types of relationships, 1) the athlete has competitive goals (regional, national, European and Olympic championships) and parents are confident that their children can get where they want; 2) the athlete has competitive goals, parents think they are not achievable, although they would like their children to continue in sport; 3) the athlete has competitive goals but parents think they are not achievable and that they should prioritize studies, ". ...in the last competition I was looking for the records that were in the FAMU... she sees herself as a policeman and an athlete, I wanted her to be a doctor" (subject MIF1); 4) the athlete does not have competitive goals and the parents want their children to continue in sport; 5) the athlete does not have competitive goals and the parents do not see them achieving goals. The first and second type of relationship are the most abundant and go down in the following possible relationships.

MCM18: "...he wants to get to go to a Spanish championship, but not by club, and that he is going to get it, I think so, I also think that there is a high level and that he is going to have to work a lot".

Parents' pressure

In this last block, information is sought on the importance that parents give to competition results and the pressure they can exert on their children.

Join or win

The results obtained give greater importance to participation, although many of the responses are complemented by statements of personal improvement or participating to win, especially when there are clear options, "Participate, if you win better, but always participate" (subject PJF30). They add, in some cases, that winning helps the adherence to participation. In isolation, it is mentioned that the high level carries implicitly the importance of winning. "Participating and winning, winning always helps to keep participating" (subject PJM23).

Perception of the child

The interviewees almost unanimously agree that their children perceive that their sporting activity makes their parents happy; that their presence in competitions and training makes them feel more confident and they are happy, satisfied and grateful for their involvement, "yes my daughter is a very good child, polite and she recognizes me a lot for the things I do because she knows that things do not fall from the sky ... so of course she is grateful" (subject MJF32). ... so of course she is grateful" (subject MJF32); although, on many occasions, they do not verbalize it, or simply believe that it is something implicit in the obligations of being a parent. Three subjects expressed that the relationship of involvement has to be bidirectional, that the child should make an effort and commit to his/her sports activity, "he/she knows that it is an I give you and you give me, if he/she makes an effort and commits his/her father will be there" (subject PCF12). In two cases, fathers explain that their daughters get angry because they are very strict in their comments.

Competitive coping

In a few cases, fathers and mothers declare that their children are calm and without nerves when facing the competition. Most athletes are nervous before competing; some, with nerves that serve as competitive activation, "she is doing well, it is true that at the beginning she was a little more nervous but she has already assumed it, more than nervousness she has attitude, activation, motivation" (subject PIF7); and others, with nerves that negatively affect their sleep, food and physical condition. In some cases, they explain that their children combat these feelings through a routine that helps them to be more focused and calm. In other cases, parents feel that if the competition is stressful, it is no longer a good option.

PCF21: "He gets very nervous, he gets serious, he doesn't like to be told anything, it's like he closes himself in his bubble or in his world before competing, although he doesn't tell me, I think he gets nervous...".

Analysis of competitive results

In all cases parents give feedback to their children after competing. If the performance was as expected or desired, they celebrate and congratulate their children; if expectations are not met, they try to encourage them and orient the experience towards the process of personal improvement. In isolated cases, they downplay the importance of the results or the competition, to avoid disappointing their children. Negative feedback from parents may also appear if they believe that the result was not achieved because the athlete was not focused on the competition or did not try hard enough.

PJF29: "Most of the time congratulate her for how well she did... Sometimes things didn't go well... sometimes it happens and it's an accident... but sometimes it's an accident. sometimes it happens and they are accidents, but sometimes it goes wrong because of factors... and then you can tell I'm pissed off..."

PJM24: "There is always a little bit of reflection, how did you see yourself, how did you feel there... always remove iron, we are not going to put it on a pedestal, but the effort and the hopelessness or lack of motivation must be handled.

Pressure effect

In general, parents perceive that the pressure their children feel comes from the competition and how they interpret it. Half of the parents state that their children do not perform well under pressure, and the other half, that they do know how to manage it, being an activation to face the competition; one father even explains that he puts pressure on his daughter so that she does not relax.

MJM27: "Yes, they handle it well.... not perfect either, but the pressure does not get out of control, they do not somatize it, nor do they show it in the form of aggressiveness, they tolerate it... they handle it well, I think they manage it in a balanced way... the fact of facing the competitions always with a lot of illusion."

Parents' pressure

More than half of the cases respond that they have not pressured them, but then they expose a situation (food, effort, commitment, training attendance, etc.) in which perhaps the child could have interpreted or felt this way, "no, I do not pressure her, but not because of the competitions, because of the responsibility... you don't miss training, you only miss if you are sick or for a major reason" (subject MIF1). Few responded with a resounding no to the question of whether they had ever put pressure on their children. And slightly less than half admit that they have ever pressured them and later regretted it. "If ever,

yes, well, maybe when they wanted to leave a test in the middle, well, I got one wrong and I don't go on, then yes" (subject PCM22).

The final coding of the information obtained from the interviews is shown in Table 2.

Table 2. Coding table of the results after data analysis

Content Blocks	Categories	Subcategories	Codes
Value that parents give to the practice of sports	Sports Example	He doesn't play sports.	Doesn't play sports
		Practice sports	Sport related to your child's practice
			Plays sports unrelated to your child's practice
	Evaluation of Practice of sports	Positive	
		Refusal	
		Indifferent	
	Values of sport	Instrumental	Effort, perseverance, responsibility, self-confidence, self-esteem, organization, ambition, competitiveness, security, discipline, commitment, self-regulation, health, perseverance and willpower
		Ethical or final	Respect, sacrifice, companionship, admiration and humility
	Time Management	He combines studies and athletics	Studies are more important
			They are equally important studies and sport
		He combines studies, athletics and others Activities	I study the most important things and then athletics
			I study the most important things and then the rest of the activities (including athletics)
Parent satisfaction with the offer sportive	Local sports offer	Enough	Sufficient in quantity and quality
			Sufficient in quantity and insufficient in quality
		Insufficient	Insufficient in quantity and quality
		Stranger	
	Satisfaction with sports schools		Satisfaction
			Dissatisfaction
	Satisfaction with The School of Athletics		Overall satisfaction
			Partial dissatisfaction
Implication parental	Involvement in Sports activity		Total
			Partial
	Social Relationships	Relation	Within the sports activity
			In and out of sports
		No relationship	
	Involvement in The Sports School		Involved
			Not Involved
	Impact on personal life.	Affectation	Economic
			Personal Time
			Social & Family
		Non-affectation	Does not affect
Relationship with The Sports Technician	Relationship and Communication with The Sports Technician	Frequent communication	Electronically and in person
		Sporadic communication	Electronically
			Personnel
		There is no communication	There is no relationship
	Personal Opinion		Communicate your opinions
			Doesn't communicate their opinions
	Opinion on the Training Management		Satisfied
			Dissatisfied*
	Process Information	Receives	Enough
			Insufficient
		Do not receive	He doesn't see it as necessary
			Need for more information

	Communication with children.		Frequent Occasional* Null*
	Athlete satisfaction with Practice of sports		Satisfied Unsatisfied
Support & Support	Reasons for sports participation		Fun Relational Self Competitive Bless you Instrumental
	Athlete Relationship with the coach	Good Suitcase* Unrelated* Stranger	Professional Reliable The athlete is not comfortable with the coach There is no relationship Unknown to the father
	Athlete Relationship with their peers	Good To be improved	Within the sports activity In and out of sports Relationship problems due to competitiveness Relationship problems due to shyness
Support & Support	Parental Support		Emotional Internal Support Instrumental External Support
	Parental Presence		Both parents Only one parent No parent
	Demonstration of Support		With deeds and words, they consider it beneficial With facts, they do not consider it necessary to express it With facts, they consider it counterproductive to express it
Managerial Behavior	Behaviour with your child	Instructions are given No instructions are given	Psychological or emotional recommendations Technical Directives They don't give instructions of any kind
	Evaluation of the competition		Enriching experience Inconsequential experience
Expectations	Athlete Expectations Vs Expectations Parent	Matching Expectations Differing Expectations	They agree on high performance expectations They agree on low performance expectations Athlete and parent agree on health expectations Athlete with performance expectations and health parent
Parental pressure	Enter or win.	Participate Win	Participate to Improve Yourself Enter to Win Earn to stay engaged Winning at the high level
	Perception of the child.	Positive Perception	They perceive that their participation makes their parent happy and they appreciate their involvement They perceive that their participation makes their parent happy and understand that it is implicit in parenting
	Coping competitive	Negative Perception Nervous No nerves	They perceive criticism from their parents Positively Affect (Activation) Negatively affects Positively affects Negatively affects
	Analysis of competitive results.	Positive feedback Negative feedback	Celebrate the results Comforting results Hold the athlete accountable
	Pressure effect		Athlete's own pressure Parental pressure
	Parental pressure		Conscious Pressure Unconscious pressure No pressure

Note**:** Levels of responses adjacent to those performed by the sample.

Discussion

The objective of this study was to analyze the perceptions of fathers and mothers about their children's participation in sports. The results provide valuable information that should contribute to the development and more effective organization of sports programs for beginners and grassroots sports.

In the first dimension, on the "value that parents attach to the practice of sports", most of the fathers and mothers interviewed give sport a transcendent role in the development of their children, affirming their satisfaction with the practice, and being aware of its influence on health and social relations, in addition to the acquisition and promotion of important values.

The role of parents and the family environment is decisive in sport initiation. As the main socializing agents, they promote their children's participation in sport (Keegan et al., 2009), but they also have a determining influence on the relationship that athletes establish with sport (positive, negative or indifferent), and which establishes their continuity, dedication and attitude towards the practice (Marcén et al., 2012).

In terms of values, parents are aware of the importance of sport in promoting values such as effort, companionship, and responsibility, among others, which are transferable to other areas of life. The close link between moral education and sports practice has been confirmed (Bruner et al., 2018), and provided that sport is well organized, it can be an excellent means of transmitting positive social and personal values to children and adolescents (Berengüí & Garcés de Los Fayos, 2007; Light & Harvey, 2015). Therefore, it is imperative that clubs and coaches work to ensure the promotion of value systems that foster the task orientation of the athlete, and promote these positive values (Berengüí et al., 2022). Unlike elite sport, sport at young ages should tend to explicitly advocate values that go beyond victory, bringing together diverse educational experiences, such as the development of sport skills, leadership and teamwork (English, 2018).

Regarding the second dimension, related to "satisfaction with the sports offer", most parents confirmed their satisfaction with the organization and operation of the club, finding the economic fees, the philosophy of the club in the training of athletes, and the technical training of the coaches to be appropriate. On the contrary, they were dissatisfied with municipal policies, especially with the quality and maintenance of the facilities. In this sense, parents play an essential role through their influence on their children's interests and decisions, and it is therefore essential for parents to be aware of sports opportunities in order for their children to participate (Columna et al., 2011).

In the third dimension analyzed, "parental involvement", the highest proportion of fathers and mothers affirm full participation in their children's sports activities, with a high degree of involvement in the demands and needs of the school, fostering relationships both inside and outside of sports activities among them. Although athletic practice affects their lives and daily routines, due to the investment of time and effort required, they find it rewarding for the enjoyment and healthy lifestyle it brings to their children.

The impact of parental involvement is fundamental in the initiation years, as they are the essential watchdogs in the behavioral and physical activity change of their children (Gustafson & Rhodes, 2006). Parental involvement involves sharing their time, money and interests with their children (Holt et al., 2009), and therefore they are basic and necessary agents, as they provide this instrumental support as well as psychological support (Turnnidge et al., 2012), as we see in this study, even adapting their daily obligations to suit the sporting needs of their children. Moreover, in certain studies, the athletes' perception of their parents' involvement has been positively associated with higher levels of motivation and lower levels of demotivation in young athletes (Sánchez-Miguel, Leo et al., 2013, Sánchez-Miguel, Pulido et al., 2015), although also sometimes the intensity of the involvement perceived by the athlete has been associated with greater pressure experienced (Lee & MacLean, 1997).

On the fourth dimension, of "relationship with sports coaches", in general there was a lack of knowledge on the part of parents about their training, although they trust them, as they perceive how their children were happy, and saw progress and improved marks. However, the relationship between parents and coaches is limited, and there is generally no feedback on progress from the coaches.

Both the coaches of sports schools, as well as the parents who involve their children in the different activities, are basic in the orientation and education of these children within the sports environment (Garrido et al., 2010). Coaches are considered important external assets responsible for creating motivational climates and structuring activities that help meet the developmental needs of young people (De Sousa et al., 2018).

From the results obtained, we consider that, although there is confidence in the work of coaches, communication should be more fluid with parents, in order to draw common lines that converge in the understanding of parents of the sporting process of their children, and at the same time, coaches can know the needs and particularities of each athlete, thus ensuring the effectiveness of training and that the sport is better adapted to each one.

Regarding the fifth dimension, "support from parents", it is possibly the block that provided the most information. In general, there is good communication between parents and their children on sporting aspects, they perceive their children as satisfied, happy and motivated, and allude to the fact that practice is done for fun, to be with friends and

to improve themselves and others. The relationship with the coach and teammates is good and positive.

Parental and social support in sport has been analysed for decades. Parental support for their children's sporting career guides their sporting development, and it has been found that young athletes who receive little encouragement from their parents tend not to engage effectively in sport (Calo et al., 2022). On the contrary, athletes who perceive more support present greater personalized education and protectionism from their parents (González-García et al., 2019).

Among the results found, following Beets et al. (2010), parents provide both tangible support (such as the economic cost associated with participation, time commitment, or travel to training and competition) and intangible support, through emotional support, verbal encouragement and advice. Parental support becomes imperative for children and youth at all levels of sport competition, with particular relevance for those transitioning in age to more demanding levels of competition (Todd & Edwards, 2021).

Parents' behaviour has the effect of directing and controlling their children's experience and progress and is considered a powerful source of pressure. Both parents and coaches exert influences through their leadership styles, affective responses and behaviours.

In the sixth dimension, "managerial behaviours," the results are in line with those of the qualitative study by Keegan et al. (2019), which explores the motivational climate of athletes early in their careers and the influences of social agents. The research categorizes the way parents and coaches communicate with the young athlete, both for support and instruction, "leadership styles", distinguishing two central styles, a controlling/autocratic style and an autonomistic/democratic style, which coincide, in terms of meaning, with the strands coded in the present study, psychological or emotional communication and directive communication, as the communication did not always have a valuational component, but rather reflected the tendency of the parent to show positive affection, negative affection or tolerance.

In the study by Wing et al. (2016) it was shown that high perceived parental control was negatively associated with the enjoyment of physical activity. In contrast, parental attitudes and behaviours that are considered positive and encouraging have been linked to favourable affective consequences for children and adolescents in sport (Amenabar et al., 2008). Van Yperen (1997) even highlighted the impact that the athlete's perception of positive parental encouragement of his or her results has in buffering the effect of negative sporting experiences.

The results obtained show that parents can evaluate their children's experience of competition as an enriching experience or as an unimportant one. In this respect, Brustad (1996) proposed that parents play an important role in interpreting the information referred to their children's sports achievements, influencing their children's cognition, in terms of attributions and self-perceptions in achievement environments, adding that parents prefer to give more practice opportunities in those environments where they perceive high expectations of success for their children.

The seventh block, "expectations", analyzes the relationships that exist between the athletes' sports expectations, what their parents think about them and their own expectations about the future of their children's sports participation. We found, in general, two categories, expectations that coincide and expectations that differ, and two domains, performance and health.

Parents' opinions about their children's abilities have a great influence on their perceptions of their abilities and the evolution of their interests. If young athletes perceive positive beliefs about their abilities from their parents, they will use internal criteria to evaluate their abilities and accept greater challenges. It is important to determine objectively whether young athletes' expectations are realistic or unrealistically high, because if so, they will be frustrated in sports, because even when they perform well, their aspirations will remain unfulfilled.

In almost all cases, parents have expectations that their children will continue with their sports practice, especially from a healthy point of view. There are not many cases that we find where the athlete has competitive performance goals and the parents consider that they are achievable, either because they do not trust in the qualities of their children or because it is a way to protect themselves and their children from the frustration of not achieving them. This may be influenced by the fact that athletics is not a professional sport and it is very difficult to make a living from it, which will influence the fact that few parents have high expectations of performance since they consider it complicated to go far.

Brustad (1996) observed that children's physical self-perception is related to the amount of encouragement they receive from their parents, which directly influences their intention to be physically active. Parents who do not want their children to practice sports, who do not show interest, who do not accompany them to competitions, or if they go, who comment in a derogatory manner on the effort their children make to achieve nothing, are placing negative expectations on the young athletes, which can lead to their abandonment of sports. Conversely, when parents have overly high expectations for their children, they may make them believe that they are capable of doing more than they really can. This situation is equally destructive to the enjoyment of sport, since no matter how well children perform, it can never seem enough for their parents.

Some parents identify so strongly with their children that they experience their children's performance as their own, thus projecting inordinate expectations on their children

to which the children will try to respond (Green & Chalip, 1997). Similarly, this case may also frustrate children and thwart their motivation to participate, as feelings of personal worth are equated with success in sports, and they may fear failure or rejection if they perceive that their parents' love depends on winning. As a last option, parents' expectations of their children are also not influenced, because the children have devalued the value or judgment of the parents and, therefore, of the parents themselves.

In the last dimension, "parental pressure", information is sought on the importance that parents give to competition results and the pressure they can exert on their children. The category of Participate or win is closely linked to goal orientations. Goal orientation is an avenue for defining success and judging one's competence (Duda, 1999). Children's perception of parental goal orientation and their own goal orientation have been found to be linked (Ames, 1992).

The results obtained give greater importance to participation. Participating would be related to a task orientation and winning to an ego orientation. In the first case it is more related to sport adherence, success is subjective and perceived competence results from personal improvements, task mastery and effort, and in the second case, a person feels successful and competent to the extent that he/she has demonstrated a superior ability to others, which is related to greater competitive anxiety and abandonment of sport practice (Duda, 1999).

How parents are involved in their children's sport, either through support or pressure, is one of the most important predictors of children's continued sport participation (Turman, 2007). A positive environment created by parents with positive feedback, positive affective responses, fun, pre-competition pep talks, encouragement, collaboration, and positive parental support are consistently positively related to athlete motivation (Keegan et al., 2019).

The results of the present study agree almost unanimously that children perceive that their sporting activity makes their parents happy; that their presence in competitions and training makes them feel more confident and that they are happy, satisfied and grateful for parental involvement.

When a subject perceives parental involvement as moderate, then the pressure exerted would also be adequate, being at a satisfactory level of experience. When children perceive their parents as not very involved, they are likely to abandon the sport due to the lack of attention and emotional support they require. And when the intensity of involvement is perceived as high, the pressure is high. However, there are individual differences, as some children may perceive parental involvement as high, without this meaning that they feel pressured, as they may perceive it as supportive and experience it as satisfactory and optimal (Lee & MacLean, 1997).

In the category of analysis of the results, we found that all parents give feedback to their children after competing, this can be positive or negative depending on the results obtained. Negative verbal feedback is related to negative affective responses and the weakening of motivation, and positive feedback is linked to the adoption of goals of mastery and focus and related to motivation. Boys/girls who receive consistent positive feedback, both for the outcome and for their effort to acquire mastery, will achieve a sense of competence and mastery in sport performance (Keegan et al., 2019).

The results coincide with those of Keegan et al. (2019), where the concept of "evaluative communication" also appears, assessed through the subcategories behavioural reinforcement and the aforementioned verbal feedback. Behavioural reinforcement is related to the use of punishments or rewards, and in this sense we can find references in our study in some case, where if the athlete obtained a good competitive result the parents celebrated it by eating out, or if he/she performed badly they could threaten not to bring him/her to future competitions.

Focusing on pressure, most of the interviewees expressed that their children become nervous in competition, many of them unable to control their nerves, and resulting in physiological effects, such as difficulty in sleeping or eating breakfast, being this something that worries their parents, in some cases indicating that, if the nerves reach that extreme, the competition is no longer a good option. In the latter case, parents adopt an overprotective position that may lead young athletes to try to avoid stressful situations instead of taking advantage of this opportunity to learn how to manage them. In other cases, according to the perception of the parents, it manages to channel those nerves into activation, which is beneficial for the competition.

In general, parents perceive that the pressure their children feel comes from the competition and how they interpret it, and this would be related to the term cognitive anxiety, defined as the mental component of anxiety, which is caused by negative expectations about success or negative self-evaluation (Craft et al., 2003). Weiss et al. (1989) found positive relationships between pre-competitive cognitive concerns in young gymnasts and concerns about negative evaluation by their parents.

How parents are involved in their children's sport, either through support or pressure, is one of the most important predictors of children's continued sport participation (Turman, 2007).

In the present study, more than half of the cases considered that they did not put pressure on their children, but then presented a situation (food, effort, commitment, attendance at training sessions, etc.) in which the child may have interpreted or felt this way. Young athletes and their parents have very different views on what behaviours are supportive, and the child will respond based on how he or she perceives his or her parents' attitude, regardless of their actual intentions (Lee & MacLean, 1997).

Conclusions

The aim of this study was to analyse the perceptions of fathers and mothers about their children's participation in sports. The results obtained provide us with information of great interest to know how the interviewees understand and experience their children's sports practice in order to understand the complexity and multifactorial nature of the phenomenon we are analysing. It has also served to detect certain issues that can negatively affect athletes, especially when it comes to promoting an adequate motivational climate and favouring sports adherence.

As limitations of the study we found that there may be differences between how parents perceive their behaviours, how their children perceive it and how it really is, so that future research should address the three areas in order to obtain more conclusive results and to develop strategic guidelines that provide parents with tools to guide their children towards an adequate motivational climate.

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Percepción de padres y madres sobre la práctica deportiva de jóvenes atletas: un estudio cualitativo

Perception of fathers and mothers about the sports practice of young athletes: a qualitative study

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Resumen

El desarrollo equilibrado del joven deportista en los procesos cognitivos, sociales y afectivos está influenciado por los agentes psicosociales de su entorno. El objetivo de este estudio fue analizar las percepciones de padres y madres sobre la participación de sus hijos/as en el deporte, Los datos de esta investigación proceden de 33 entrevistas semiestructuradas realizadas a padres y madres de atletas pertenecientes a dos clubes de atletismo de categorías sub 14 a sub18. Los resultados indican que los participantes piensan que el deporte aporta valores importantes y que es necesario compaginarlo con los estudios. En general mantienen buena comunicación con sus hijos/as sobre su práctica deportiva, siendo esta escasa con el entrenador/a del que tampoco conocen su titulación, La mayoría de sujetos indica que les preocupa la gestión de los nervios y del fracaso de sus hijos/as, porque, aunque mencionan que no tienen expectativas de rendimiento sobre ellos, reconocen haberlos/as presionado en alguna ocasión. La información recabada en esta investigación es de gran interés para conocer como padres y madres entienden la práctica deportiva de sus hijos/as, ya que esta condiciona la manera de entender y vivir el deporte de estos/as.

Palabras clave: Jóvenes deportistas, agentes psicosociales, atletismo, clima motivacional.

Abstract

The balanced development of young athletes in cognitive, social and affective processes is influenced by the psychosocial agents in their environment. The aim of this study was to analyze the perceptions of parents about their children's participation in sport. The data of this research are from 33 semi-structured interviews with parents of athletes belonging to two athletics clubs from U14 to U18. The results indicate that the participants think that sport provides important values and that it is necessary to combine it with studies. In general, they maintain good communication with their children about their sports practice, although there is little communication with the coach, whose qualifications they do not know either. The majority of subjects indicate that they are concerned about managing their children's nerves and failure, because although they mention that they do not have performance expectations of them, they recognize that they have put them under pressure on occasion. The information gathered in this research is of great interest to find out how parents understand their children's sports practice, as this conditions the way in which they understand and experience sport.

Key words: Young athletes, psychosocial agents, athletics, motivational climate.

Introducción

La iniciación, enseñanza y tecnificación deportiva confluyen bajo el esquema del carácter holístico del entrenamiento deportivo, donde las características físicas, los factores hereditarios, antropométricos y sociales conforman las partes esenciales que determinan el rendimiento deportivo (Weineck, 2016). El plano social en un joven, viene marcado por la presencia familiar o tutelar, no tomando el o ella sus propias decisiones hasta ciertas edades, cuando la emancipación social o superación del mundo así lo permiten (García-Roca & Martin- Acero, 2021, p. 26).

Dentro de esta etapa de formación deportiva, es importante resaltar las características que conforman el talento deportivo: la predisposición mental, la constitución corporal, las cualidades físicas, las condiciones externas, la capacidad técnica o táctica, estando estas asociadas a diferentes áreas de conocimiento (Henriksen & Stambulova, 2023; Wixey & Kingston, 2023). Aunque el joven deportista está influenciado por muchos factores, el más determinante proviene de los aspectos sociales que le rodean y del entorno deportivo donde se desenvuelve. Es por ello por lo qué, el apoyo que progenitores/tutores dan al joven deportista, va a determinar, tanto su formación, como su práctica deportiva.

Una de las dimensiones a tener en consideración en el apoyo a los deportistas jóvenes, es la valoración que los padres dan a su práctica deportiva (Yilmaz, 2018). En este sentido, el ejemplo deportivo de los progenitores, su opinión acerca de la práctica deportiva de sus hijos/as, los valores que ven implícitos en el deporte, o la gestión del tiempo entre estudios y deporte, son elementos fundamentales (Amenabar et al., 2008). Además, otro punto importante, sería la satisfacción de los padres con la oferta deportiva en su localidad, y si ese deporte elegido cuenta con una escuela deportiva.

Las relaciones sociales de los padres/madres con otros iguales, en la actividad o club deportivo al que llevan a sus hijos/as, es otra dimensión a considerar en la formación deportiva de los jóvenes (Marcén et al., 2012). A este aspecto hay que añadir circunstancias como si los padres están implicados en el club, en colaborar en eventos, en la dinamización del club, en labores de gestión y organización, y en cómo esa implicación puede afectar a su vida personal (Pinto & Samadiego, 2016).

En lo concerniente a la propia actividad deportiva del club y de los jóvenes, destaca la relación de los padres/madres con el/la entrenador/a de sus hijos/as, en cuánto a la cantidad y calidad de la comunicación, o si existe comunicación bilateral, donde los progenitores informan a los técnicos de cuestiones referentes a sus hijos/as, (Chan et al., 2012; Garrido et al., 2010). Aquí tiene cabida la opinión de padres/madres sobre el trabajo deportivo del técnico y cómo debería aplicarse el entrenamiento con sus hijos/as (Romero et al., 2009).

Además, desde la dimensión del apoyo y comprensión sobre la actividad deportiva de los jóvenes y de cómo es percibida por los padres, derivan aspectos claves como la comunicación con el hijo/a sobre la actividad deportiva: si hablan diariamente sobre los entrenamientos; cómo les va en la actividad o cómo perciben la satisfacción de sus hijos (Freeman et al., 2014; Pedrosa et al., 2012). Se añaden otras circunstancias que tienen que ver con los objetivos deportivos y la relación con el entrenador (Holt & Hoar, 2006), así como el apoyo parental económico, logístico y material (Vangelisti, 2009).

El comportamiento directivo de padres y madres sobre la actuación de sus hijos/as en el deporte, está basado en directrices consejos y otros elementos sobre las competiciones y entrenamientos, o acciones relacionadas como el descanso, la nutrición, recuperación, uso de material deportivo, etc. (Jeanfreau et al., 2020). De aquí se puede extrapolar la conducta de los padres en las competiciones y entrenamientos generando expectativas en los jóvenes, creadas por los mismos padres (Horne et al., 2023). En este punto la presencia de los padres en las competiciones deportivas y la comunicación con sus hijos/as, puede derivar en una presión sobre los jóvenes deportistas, no quedando claros los objetivos, si de participación y práctica saludable o de ganar de cualquier manera. Resultando necesario encontrar el equilibrio entre el apoyo y presión ejercida por padres y madres, y la percepción del mismo del joven deportista, en el entrenamiento y/o la competición (Calo et al., 2022; García- Naveira, 2018; Palheta et al., 2022).

Sobre todas las circunstancias mencionadas con anterioridad, el objetivo de este estudio es analizar las percepciones de padres y madres sobre la participación de sus hijos/as en el deporte, desde la dimensión del valor y la satisfacción que produce en ellos la participación de sus hijos, su implicación, las relaciones y el comportamiento, expectativas e influencia directa sobre sus hijos y el deporte que practican.

Método

Participantes y procedimiento de recogida de datos

La muestra del estudio está compuesta por 33 sujetos, 17 madres y 16 padres, con una media de 47.3 años de edad (Tabla 1).

Tabla 1. Distribución de la muestra según género del progenitor y categoría del atleta

Género	Categorías		
	Sub 14	**Sub 16**	**Sub 18**
	(*n*=10)	(*n* =12)	(*n*=11)
Hombre	3	8	5
Mujer	7	4	6

La selección de los participantes se realizó mediante un muestreo no probabilístico por conveniencia, buscando participación en las tres categorías. Este trabajo es parte de la tesis doctoral "Autoconfianza y deporte: Influencia sobre la adherencia de jóvenes atletas y el efecto de terceros", por lo que al contactar con padres y madres para obtener el consentimiento informado de sus hijos/as, se les ofreció participar en las entrevistas. Se obtuvieron un total de 50 voluntarios, de los que se entrevistó a 33, alcanzando el nivel de saturación teórica de los datos (Glaser & Strauss, 1967).

Los datos del estudio se recopilaron mediante entrevistas semiestructuradas cuya duración estuvo comprendida entre 45 y 75 minutos. Las entrevistas fueron guiadas por una única investigadora relacionada con el tema de investigación, de manera que se pudo facilitar la dependencia-estabilidad de los datos (Guba, 1989).

Las entrevistas se realizaron en una pista de atletismo, en el horario que los hijos/as estaban entrenando, para facilitar la participación de los padres y madres. Se realizó grabación en video y audio de las entrevistas, previo consentimiento informado de los participantes. Por criterio ético se utilizarán seudónimos para mantener el anonimato de los participantes.

Análisis de datos

Se realizó un análisis convencional de los datos siguiendo los pasos de Taylor y Bogdan (1987). El primer paso de esta estrategia, que se denomina descubrimiento, se realizó previo al trabajo de campo, estableciendo bloques de contenidos basados en la evidencia científica sobre el tema de estudio. La transcripción de las entrevistas se realizó a través del software NVivo11, tras los que se procede a leer en varias ocasiones el contenido para establecer los bloques definitivos, codificar los datos y establecer el sistema de categorías, finalizando el proceso con la interpretación de los datos. En cuanto a la estrategia de validación, se utilizó la 1) triangulación de los datos, utilizando la información recogida con la misma entrevista en otra muestra similar italiana y 2) triangulación del personal de investigación en el proceso de codificación e interpretación de los datos.

Resultados

Se exponen a continuación los resultados obtenidos tras el análisis de las entrevistas en función de los bloques de contenidos establecidos, exponiendo con ello fragmentos textuales de las entrevistas. En un primer momento se crearon nueve bloques para estructurar las preguntas, pero tras analizar las transcripciones de las entrevistas se eliminó el bloque "Competición" y las respuestas quedaron englobadas en los bloques "Comportamiento directivo", "Apoyo y comprensión y Presión parental".

Valor que los padres y madres otorgan a la práctica deportiva

Este primer bloque nos da información sobre la relación que padres y madres tienen con el deporte y el valor que le dan a la actividad deportiva de sus hijos/as.

Ejemplo deportivo

La mayoría de los/las sujetos entrevistados/as practican o han practicado deporte durante su vida. "Siempre he hecho deporte hasta que me fui a la universidad… necesitaba hacer deporte y empecé a correr. Sino estoy corriendo, ando o troto. Mínimo salgo tres días a correr." (sujeto MIF4) Algunos de los/as entrevistados/as aprovechan el tiempo de entrenamiento de sus hijos/as para realizar práctica deportiva, incluso practican junto con otros/as padres y madres de los compañeros/as de entrenamiento de sus hijos/as.

> PCF13: Yo llevo muy poco tiempo con el deporte, yo de pequeño practicaba… cuando me dejé el tabaco con 39 años que empecé otra vez, primero hacer senderismo y luego pues correr… Normalmente entreno tres o cuatro días, pero intento que por lo menos sean tres.

Evaluación de la práctica deportiva

A todos los padres y madres entrevistados/as les complace que sus hijos/as practiquen deporte, principalmente porque es saludable y fomenta las relaciones sociales, pero también en gran parte porque mantiene a sus hijos/as alejados/as de ambientes negativos y de malos hábitos.

> PJF29: Se me cae la baba, te lo digo sinceramente, yo nunca me imaginé que una hija mía fuera a competir al nivel que está compitiendo… ella también es muy deportista, se les pegaría ese cariño, esas ganas de hacer deporte, de cuidarse, de llevar vida sana…

> PIF9: Me parece genial… me gusta que haga un deporte, que se relacione con la gente y al final es en equipo. … es muy competitiva y a veces pecamos, pero es algo que ella misma siente y se quiere poner las metas… a ella le gusta estar con sus amigas.

Valores del deporte

Todos los/as entrevistados/a coinciden en que el deporte enseña y trabaja valores que son necesarios y transferibles a otros ámbitos de la vida, tales como el esfuerzo, compañerismo, responsabilidad, gestionar la derrota y llevar una vida sana. "El esfuerzo, la cultura del esfuerzo… ella sabe que el esfuerzo generalmente tiene sus premios… otras cosas como un ambiente sano, conocer gente sana…" (sujeto PIF7)," hay superación personal, hay una parte de equipo… al participar con otros compañeros o al entrenar con otra gente pues trabaja un poco los valores en las relaciones interpersonales…" (sujeto MIF3).

Gestión del tiempo. Estudios y deporte

Si bien la opinión general es que el deporte es muy importante, a la hora de compaginarlo con los estudios, aparecen diversidad de opiniones. Casi todos coinciden en que lo principal han de ser los estudios, en algunos casos hablan del 60% de importancia de los estudios frente al 40% de la práctica deportiva, aunque ese porcentaje es también compartido con otras actividades extraescolares. "El deporte es lo segundo más importante que hace, el colegio es

lo más importante, por lo menos un 75-25" (sujeto MIF2), "después de los estudios, el atletismo yo creo que es lo primero… le viene bien para la mente porque yo creo que en cada cosa trabaja lo suyo." (sujeto PCF11). Observamos que muchos/as atletas de la categoría sub 18 acuden por las tardes, antes o después del entrenamiento, a clases de refuerzo en academias. A la hora de decidir faltar a los entrenamientos por motivos de estudio, son los/as propios/as deportistas los/las que toman la decisión. Mientras que en la categoría sub 14 es decisión de los padres/madres; en la categoría sub 16 nos encontramos con una mezcla de ambas. En menor medida encontramos padres o madres que creen que es igual de importante el deporte que los estudios. La mayoría de los encuestados/as afirman que la actividad deportiva sirve a sus hijos/as para organizarse mejor.

Satisfacción de los padres y madres con la oferta deportiva

La información obtenida en este segundo bloque es importante porque la satisfacción de los padres y madres puede influir en la decisión de mantener o no a sus hijos/as en el deporte.

Oferta deportiva local

Hay diversidad de opiniones en cuanto si la cantidad o variedad de oferta deportiva es suficiente. Algunos/as de los padres y madres afirman desconocerla, pero la mayoría de los entrevistados/as detectan que hay una deficiencia en la calidad y mantenimiento de las instalaciones en general y una clara preferencia por destinar los recursos al fútbol. "Hay buena oferta, pero las instalaciones no están en muy buen estado, yo creo… no se emplea el dinero como se debería emplear, considero que se prima muchas veces más el deporte mayoritario, campos de fútbol…" (sujeto PCF12).

Satisfacción con las escuelas deportivas

Existe una insatisfacción generalizada en cuanto a la oferta gratuita. Aunque la oferta deportiva es variada, echan en falta un deporte extraescolar gratuito, ya que eso fomentaría una mayor participación y adherencia de los menores al deporte.

> MIF6: Pienso que tienen calidad, lo que pasa es que cuando hay tanta cantidad de niños, que la calidad no se ve reflejada igual que si vienen menos, claro calidad hay, … En el caso del cole de mi hija sí hay actividades extraescolares y si se pagan.

Satisfacción con la escuela de atletismo

Todos/as los entrevistados/as se mostraban satisfechos con la organización del club de atletismo, les parecían correctas las cuotas y que no era una actividad cara. El simple hecho de que hubiera lista de espera es un buen indicador y recomiendan el club a sus familiares y amigos. "Yo creo que sí cuando, no sé el volumen de niños, hay muchísimos… digo qué buena organización, yo creo que faltaría quizá algunos materiales …Creo que las cuotas parecen correctas" (sujeto PIF8). Aunque desconocían la formación de los técnicos, pensaban que estaban bien formados porque tenían buen trato con los atletas, se veían serios y realizaban una buena preparación técnica. Les parecía correcta la filosofía del club de realizar una multiformación hasta categoría sub 16 y después especializar, aunque algunos de ellos/as preferían que dejaran especializarse antes a sus hijos/as si tenían claro qué les gustaba o qué se les daba bien. Se quejaban de que el estado de la instalación era inadecuado y que el ayuntamiento no daba valor a un club que está en la máxima categoría nacional.

> PCF16: …pienso que se hacen mejor las cosas…. no se especializan los críos, que van a las competiciones y no se le ha preparado específicamente para las pruebas que van a hacer, y a la larga es eso lo mejor… de la otra manera al final yo creo que lo que hace es aburrirlo…

Implicación parental

Este tercer bloque otorga información sobre aspectos de implicación parental en el deporte de sus hijos/as, de cómo afecta a su vida y cómo éstos/as pueden interpretarlo.

Implicación en la actividad deportiva

Muchos de los sujetos afirman tener una total implicación en la actividad deportiva de sus hijos/as, adaptando sus horarios, vida personal y deportiva para poder cumplir con la logística en entrenamientos y competiciones, siempre que pueden. Además, algunos van a entrenar con sus hijos/as fuera del horario de la escuela o aprovechan el tiempo de entrenamiento de la escuela para hacer ellos/as deporte. Son una minoría los padres y madres que no se sienten implicados en ese sentido por temas laborales, o que lo perciben como una pérdida de su tiempo.

> MIF1: Yo al 100%, a veces pienso que más. Si, porque nosotros estamos divorciados y tenemos custodia compartida, a veces creo que soy la única, me creo lo que dice ella, entonces le doy tanta importancia que me involucro al 100%…

> PCF13: A mí me encanta que ella haga deporte… digo si ese es su hobby y yo también me lo paso bien… la traigo a entrenar y si no puedo la trae su madre, pero siempre la trae alguien la verdad, ella nunca falta a un entrenamiento… y porque creemos que le viene bien.

Relaciones sociales

En este punto encontramos varios casos: el primero y más abundante, padres y madres que se relacionan tanto dentro como fuera del ámbito deportivo, pero que normalmente se conocían con anterioridad; otros que comparten actividad deportiva en el horario de sus hijos/as; algunos solo se relacionan en las competiciones; y, por último, de manera minoritaria, quienes no se relacionan ni dentro ni fuera debido, a que no pueden acompañar a sus hijos/as a la actividad deportiva por motivos laborales. "Ninguna, conozco a algún padre de alguna compañera que tenía en el colegio… no conozco a ningún padre para decir mañana

la llevas tú y otro día yo, como sí hacía antes en el fútbol" (sujeto PCF11).

PCF13: Muy buena, somos muy buenos amigos… son muchos años porque mi hija llegó con siete años… yo he ido a su casa, han venido a la mía, hemos hecho excursiones con los críos, muy bien, de hacer deporte algún día, de salir, nos conocemos, muy buena gente…

Implicación en la escuela deportiva

En la mayor parte de los casos estarían dispuestos/as a colaborar con el club, pero el club no lo solicita. Muchos de ellos/as, cuando compiten sus hijos/as, colaboran llevando en su vehículo a más atletas a la competición. En algún caso aislado, colaboran en la cantina, como fotógrafo en las competiciones o pertenecen a la junta directiva del club, incluso se movilizaron ante el ayuntamiento para visibilizar el mal estado de la instalación.

PJF29: Hemos formado el grupo de padres …Siempre he colaborado con el club me lo haya pedido o no. Cuando hay competición si hay que llevar a niños pues he llevado a niños… básicamente lo que me haya pedido el club y está en mi mano.

Afectación en la vida personal

Todos/as los entrevistados/as coinciden en que les repercute principalmente en su tiempo, "pues sobre todo en traerlo y llevarlo, nosotros vivimos en el pueblo y son viajes todos los días para llevarlos a entrenar, y más el domingo si hay competición, que últimamente está yendo solo el padre" (sujeto MJM26); pero, en la mayoría de los casos, lo ven como algo positivo y satisfactorio, ya que lo importante es ver disfrutar a sus hijos/as. Así que organizan su vida social y familiar en torno al deporte; en las competiciones aprovechan para hacer turismo o deporte en la zona. Además, supone una vida saludable para sus hijos/as y les aparta de otras actividades menos aconsejables. De manera más aislada, encontramos casos donde lo ven como algo negativo porque al atletismo se suman otras actividades de varios hijos; otros lo consideran un esfuerzo que reduce su tiempo personal, que se ha de ver compensado con la seriedad en que su hijo/a viva el deporte; y en un caso, la implicación es nula y por lo tanto no le afecta en su tiempo.

PCF13: Lo que afecta es para bien, pues me encanta, yo que sé, es verdad, me encanta traerla, me encanta llevarla …Si ella deja hacer atletismo probablemente yo haría menos deporte seguro, además yo el deporte que hago fundamentalmente es porque ella lo hace… pero siempre tenemos tiempo, si ella compite sábado, pues quedamos con la familia o con los amigos el domingo.

Relación con el técnico deportivo

En el cuarto bloque la información obtenida se centra en la relación y comunicación entre la familia y el/la entrenador/a, su satisfacción con el trabajo del técnico y el clima motivacional generado.

Relación y comunicación con el técnico deportivo

Existe una escasa relación entre padres y madres y entrenadores/as. Aunque los consideran accesibles, en la mayoría de los casos, solo tienen comunicación en persona en las competiciones. "Poca, los conozco de vista, el año pasado conocía a una entrenadora de vista porque la lleve a una competición… antes cuando era pequeña la traía, pero ahora ya viene sola, pues entonces no tengo relación" (sujeto PCF11). Aparte de la información general que se recibe por WhatsApp, pueden acercarse a hablar con los entrenadores/as, si suceden situaciones especiales, como lesiones o falta de motivación en sus hijos/as. En algún caso aislado, un padre hablaba con la entrenadora cada dos semanas, en contraposición de otro que apenas sabía quién era el entrenador/a porque en un año solo habían hablado una vez.

Opinión personal

No se percibe confianza de los/as padres/madres con los entrenadores/as para compartir sus opiniones, por lo que algunos casos expresan lo que piensan directamente a sus hijos/as. "No hemos hecho ningún comentario, porque yo tampoco tengo ni técnica, ni formación al respecto ni nada, lo único pues si tiene algún problema médico" (sujeto MIM10). Algunos lo justifican con que son los propios atletas los que se han de comunicar con ellos, porque bastante liados van ya los entrenadores. Solo algunos solicitaron a los técnicos/as que valoraran la posibilidad de dejar a sus hijos/as especializarse antes de tiempo. En general todos/as están de acuerdo en que la opinión del entrenador/a es la que prevalece y han de confiar en ellos/as, ya sean porque los padres/ madres consideran que no saben del tema o porque consideran que es lo apropiado.

PJM23: No además con independencia de que tenga preparación o no, yo soy de la opinión de que los padres no deben hablar con los entrenadores de cómo deben entrenar sus hijos, ni en este deporte ni en ninguno… pero en otros deportes todos son entrenadores, sobre todo en el fútbol.

Información del proceso

Todos/as coinciden que no reciben ningún tipo de información técnica sobre el proceso y evolución de sus hijos/as, algunos/as lo consideran necesario y otros no, pero todos/as agradecerían esa información al menos una vez al trimestre. "De manera formal, no, no estaría mal tenerla, una especie de notas en cuanto al esfuerzo que realiza, si puede dar más…" (sujeto MIF5), "yo no tengo información de eso y si estaría bien" (sujeto MCM18).

Opinión sobre la dirección formativa

Ninguno de los padres o madres entrevistados conocían la formación de los técnicos/as de sus hijos/as. En general pensaban que estaban bien formados porque sus hijos/as están contentos/as, progresan y mejoran marcas. Consideran que se ha mejorado a nivel organizativo y que los entrenadores/as son motivadores/as, disciplinados/as, ob-

jetivos/as, se han ganado a los/as atletas y que cada uno tiene su forma de hacer, pero han de confiar en ellos/as.

PJM24: Desde que tiene este entrenador, yo aspectos técnicos no he comentado con él ninguno, porque todo lo que le he visto que la cría hacía, desde mi punto de vista era lo correcto... todos han mejorado, todos creen en él.

Apoyo y soporte

Este quinto bloque permite conocer la sensación de padres y madres sobre el apoyo que brindan a sus hijos/as, cómo los incentivan y se comunican con ellos/as sobre su experiencia deportiva.

Comunicación con los hijos/as

La comunicación entre padres y madres y sus hijos/as es diaria, acentuándose antes y después de las competiciones. "Muy bien, mantenemos muy a diario sobre todo cuando hay muchas competiciones, y si es un tema en casa habitual" (sujeto PCF13). En general hablan en los trayectos de coche o durante la cena de cómo ha ido el día, sensaciones, molestias, que han aprendido o qué marcas han hecho ellos/as y sus compañeros/as. En algunos casos, los padres y madres también explican sus propios entrenamientos. En época competitiva, algunos sujetos hablan de estrategia competitiva, alimentación y descanso, y si ha ido mal la competición, intentan centrar a los hijos/as más en la mejora personal que en la comparación con los demás.

PJF30: Yo le pregunto todos los días, yo lo que más me preocupa es si le ha dolido algo, le pregunto si se lo ha pasado bien, siempre le pregunto cómo le ha ido el entrenamiento... ella me cuenta todos los días el entrenamiento.

Satisfacción del atleta con la práctica deportiva

Solo existe un caso en el que la hija, a pesar de gustarle el atletismo, lo pasa mal por su timidez y complejos físicos. En el resto de los casos, el mensaje es que los niños/as son felices, están satisfechos/as, contentos/as, motivados/as y orgullosos/as de ellos mismos/as, "yo creo que le gusta y quizás también porque se encuentra a gusto, tiene aquí amigas y ya son varias temporadas" (sujeto PJF31), aunque cuando los resultados no acompañan pueden derrumbarse momentáneamente.

Razones de participación deportiva

La mayoría de los/las entrevistados creen que sus hijos/as hacen atletismo para divertirse, estar con amigos y superarse a sí mismo y a los demás. El componente competitivo sale a la luz en varias ocasiones, hasta el punto de que piensan que si no tuvieran buenos resultados podrían abandonar el deporte. También aparece el motivo de hacer una actividad saludable y sentirse bien. Los más ambiciosos quieren ser atletas de alto rendimiento, conseguir beca de estudios, continuar con el deporte universitario y, en algún caso, llegar a participar en los Juegos Olímpicos.

MJM27: A veces sienten nervios, a veces también se derrumban, hay que saber gestionar la derrota, pero de venir aquí y tal muy bien, muy contentos muy motivados. Yo veo muy contentos a mis hijos, aquí no vienen ni obligados, ni sin ganas, ni con pereza...

Relación del atleta con el entrenador

En las categorías sub 14 y sub 16 la mayoría tienen una buena relación con sus entrenadores/as, ya que les hablan bien de ellos/as a sus padres y madres; en algunos casos, incluso con admiración, "muy buena, se nota cuando habla de ellos que los admira, que se lo pasa bien con ellos, que tiene buena relación." (sujeto PCF12). La confianza va aumentando según suben de categoría, siendo en sub 18 donde la relación con el entrenador/a es más cercana y de confianza. "Hay muy buena, hay mucha complicidad, no sólo en particular, lo veo en el grupo de entrenamiento, que trabajan con ellos una relación de confianza y mucha complicidad, muy de creer en el entrenador" (sujeto PJM25). Solo en un caso un padre desconoce cómo es la relación de su hija con el entrenador.

Relación del atleta con sus compañeros/as

En general mantienen buena relación, sobre todo con los compañeros/as con los que han coincidido en el colegio, algunos los consideran sus mejores amigos. Al menos la mitad quedan fuera de la actividad deportiva para hacer otros planes; la otra mitad, simplemente se comunican por redes sociales o tienen buena relación como compañeros/as dentro del entrenamiento. La competitividad dentro del grupo de entrenamiento puede entorpecer la amistad para algunos/as; en cambio, otros/as hacen amigos con rivales de otros clubs, "muy buena, me hace gracia porque en competiciones también se hacen amigos de otros clubes eso ha sido un descubrimiento" (sujeto MJM27). En algún caso, los padres y madres observan que conforme van pasando de categoría se vuelve más reducido el grupo de amigos y hacen más actividades fuera.

PCF21: Muy bien... conforme cumplen años su círculo es más cerrado, críos y crías que se llevaba bien cuando era más pequeña ahora no se lleva bien. Ella ahora mismo con los que no son íntimos no se lleva mal. Yo la veo que habla con todos cuando tiene que hablar...

PCF15: Ha ido por fases, ahora tiene tres o cuatro en los que se apoya más y por los demás, indiferencia la verdad. Este año el ambiente se ha vuelto más competitivo incluso en los entrenamientos y puede haber tiranteces con algunos...

Apoyo parental

Se observan dos categorías, una de apoyo interno con un soporte más emocional a través de la comunicación y, por otro lado, otra de apoyo externo (económico, material, tiempo y logístico), "de tiempo tampoco me importa... me ha llegado a decir, es que como tú nunca tienes planes, ¿cómo que yo no tengo planes? si los tengo, lo que pasa es que priorizo los suyos y los de su hermano" (sujeto MIF1), destacando que en ningún caso los padres y madres refieren que el gasto económico sea alto, "le animo a que

compita, y bueno luego quiere comprarse un equipo más chulo porque quiere una cosa especial para entrenar… y yo se lo compro… y aunque solo sea por interesarme y económicamente pagarle las cuotas" (sujeto PCF11); aprovechan cumpleaños o fiestas de navidad para regalar a los/as hijos/as material deportivo. Como consecuencia a este apoyo, al menos un tercio de los/las entrevistados/as, pide a sus hijos/as dedicación, seriedad, compromiso y esfuerzo en su actividad deportiva.

> MCF20: …el material del atletismo es carísimo, es que siempre queremos las zapatillas de la marca cual y no nos vale las baratas… pero a mí no me importa, me lo pide, pero como no me pide otras cosas, pues zapatillas…

Presencia parental

La mayoría de los padres y madres han asistido al 90% o 100% de las competiciones de sus hijos/as. La mayoría asiste en familia, en otros casos solo puede ir el padre o la madre, pero siempre hay presencia familiar. Solo en un caso no ha podido asistir a ninguna competición por tema laboral y que la niña suele ir a las competiciones con el entrenador. "Competiciones al 99% o por trabajo o competición propia, entrenamientos al 60%. A ellas les encanta, nos piden que nos quedemos en los entrenamientos y en las competiciones para verlas…" (sujeto MIF3). En tres casos, cuando la competición es lejos, les da pereza desplazarse; pocos padres asisten cuando el evento se desarrolla fuera de la región.

A los entrenamientos, asisten de manera generalizada en categoría sub 14 y van descendiendo según suben de categoría.

> PCF11: No estoy mucho, le apoyo en todo y me gusta que haga deporte, he ido un par de veces a las competiciones, pero estoy muy liado, su madre la puede llevar ahora… pero yo no voy tanto, el año pasado si fui más.

Demostración de apoyo

La mayoría dice a sus hijos/as que están muy contentos con su práctica deportiva, orgullosos de ver que se esfuerzan y de su capacidad de superación. "Le digo que me siento orgulloso y las animo… pero en eso y en todo, considero que es básico, reconocer los logros, reconocer el esfuerzo" (sujeto PCF12). Algunos consideran una forma de demostrar su apoyo recordar las marcas de sus hijos/as y, cuando están tristes, poder ayudarles en su mejora personal.

Algunos padres comparten la actividad deportiva con sus hijos/as, comenzando gracias a que sus hijos/as se iniciaron en el deporte. Más de la mitad expresan su satisfacción con palabras, gestos y actos, y consideran importante comunicar esa información y poner palabras a los sentimientos, ya que motivará a que su hijo/a continúe con la práctica. El resto de casos da por hecho que sus hijos/as son conscientes de lo que sienten; para un sujeto expresa que las palabras de halago pueden debilitar el carácter, "… ella sabe que estamos muy orgullosos de ella, pero procuro tener cuidado de no encumbrarla mucho, ya sabes que los halagos te debilitan… su madre me lo dice, que es que soy demasiado duro." (sujeto PJF29).

Comportamiento directivo

El sexto bloque ayuda a determinar si pueden aparecer comportamientos intrusivos por parte de padres y madres, antes, durante o después de un evento deportivo.

Comportamiento directivo con su hijo/a

Cada padre o madre tiene su forma peculiar de comunicarse con su hijo/a pero, de manera general, se puede distinguir una vertiente psicológica o emocional y otra parte más directiva, en lo referente a recomendaciones o consejos técnicos para preparar o corregir la actuación de la competición, "en el aspecto técnico no, a no ser que me pregunte alguna cosa, pero suele ser en el aspecto psicológico, en lo importante que es creer en ti mismo" (sujeto PJF24). Hay sujetos que trasladan ambos mensajes, otros se decantan sólo por uno. Algunos padres no dan indicaciones técnicas porque no conocen la disciplina; en un caso, la hija no le deja, solo quiere escuchar a sus entrenadores/as. "No me deja ella, ella tiene las cosas muy claras y se rige por lo que le dicen los entrenadores, si yo le he podido decir alguna cosilla, pero no… no se deja" (sujeto PCF16).

Evaluación de la competición

Unos pocos comentan que está bien esforzarse, pero no sacrificarse; que hay más vida que el atletismo, "solamente le digo que se esfuerce lo justo y necesario, que no se esfuerce de más, porque esforzarse de más puede significar una lesión, puede significar un problema físico" (sujeto PCF11); en contraposición a la opinión generalizada de que la competición es buena por los valores que transmite. Casi la totalidad describe ver a sus hijos/as competir como algo emocionante: los animan, están pendientes de ellos, les graban y hacen fotos; en algunos casos añaden que lo pasan mal si ven que fracasan en su objetivo.

Más de la mitad asiste en familia, y muchos pasan la jornada viendo toda la competición, no solo a sus hijos/as sino también a los/as compañeros/as. Uno de los padres dice que, al verlos, siente que le hubiera gustado vivir esa experiencia.

> PCF23: A mí me gusta verla, lo que no me gusta es verla pasarlo mal, es normal, yo que sé, su madre también lo vive, es más divertido, se apunta a todo… porque no se haga daño, que no se caiga, cuando la veo hacer vallas decía, por dios que no se caiga.

Expectativas

Expectativas de padres y madres sobre las capacidades y el futuro de la práctica deportiva de sus hijos/as. En este séptimo bloque se presentan los resultados de las dos dimensiones conjuntamente.

Expectativas atleta vs Expectativas padre o madre

En este apartado podemos encontrar cinco tipos de relaciones, 1) el/la atleta tiene objetivos competitivos (cam-

peonatos regionales, nacionales, europeos y JJOO) y los padres y madres confían en que sus hijos pueden llegar a donde se propongan; 2) el/la atleta tiene objetivos competitivos los/las padres y madres piensan que no son alcanzables, aunque les gustaría que sus hijos/as continuasen en el deporte; 3) el/la atleta tiene objetivos competitivos pero los/las padres y madres piensan que no son alcanzables y que deberían priorizar los estudios, "...en la última competición iba buscando los récords que había en la FAMU... ella se ve de policía y atleta, que yo quería que fuera médico" (sujeto MIF1). ;4) el/la atleta no tiene objetivos competitivos y los/as padres y madres quieren que sus hijos/as continúen en el deporte; 5) el/la atleta no tiene objetivos competitivos y los/as padres y madres no los ven consiguiendo objetivos. El primer y segundo tipo de relación son los más abundantes y van descendiendo en las siguientes posibles relaciones.

MCM18: ...él quiere conseguir ir a un campeonato de España, pero no por club, y que lo va a conseguir, yo pienso que sí, que ahí también pienso que en ese hay mucho nivel y que va a tener que trabajar mucho.

Presión parental

En este último bloque se busca información sobre la importancia que los/las padres y madres dan a los resultados de competición y la presión que pueden ejercer sobre sus hijos/as.

Participar o ganar

Los resultados obtenidos dan mayor importancia a la participación, aunque muchas de las respuestas se complementan con afirmaciones de mejora personal o de participar para ganar, sobre todo cuando existen opciones claras, "Participar, si ganas mejor, pero participar siempre" (sujeto PJF30). Añaden, en algún caso, que ganar ayuda a la adherencia de la participación. De manera aislada, se menciona que el alto nivel conlleva implícito la importancia de ganar. "Participar y ganar, ganar siempre ayuda a seguir participando" (sujeto PJM23).

Percepción hijo/a

Los/as entrevistados/as coinciden de manera casi unánime, en que sus hijos/as perciben que su actividad deportiva hace felices a sus progenitores; que su presencia en competiciones y entrenamientos, hace que se sientan más seguros/as y están contentos, satisfechos y agradecidos de su implicación, "sí mi hija es muy buena cría, educada y ella me reconoce mucho las cosas que hago porque sabe que no caen las cosas del cielo... entonces pues ella es agradecida claro que sí" (sujeto MJF32); aunque, en muchas ocasiones, no lo verbalizan, o simplemente creen que es algo implícito en las obligaciones de ser padre o madre. Tres sujetos expresaron que la relación de implicación ha de ser bidireccional, que el hijo/a debe esforzarse y comprometerse con su actividad deportiva, "sabe que es un yo te doy y tú me das, si se esfuerza y se compromete su padre va a estar" (sujeto PCF12). En dos casos, los padres explican que sus hijas se enfadan porque son muy estrictos en sus comentarios.

Afrontamiento competitivo

En pocos casos, padres y madres declaran que sus hijos/as están tranquilos y sin nervios a la hora de enfrentar la competición. La mayoría de atletas están nerviosos antes de competir; unos, con nervios que sirven de activación competitiva, "lo lleva bien, es verdad que al principio estaba un poco más nerviosa pero ya lo tiene asumido, más que nerviosismo tiene actitud, activación, motivación" (sujeto PIF7); y otro, con nervios que les afecta negativamente en el sueño, alimentación y estado físico. En algún caso explican que sus hijos/as combaten estas sensaciones mediante una rutina que les ayuda a estar más centrados y calmados. En otros casos, los/as padres y madres opinan que si la competición es estresante deja de ser una buena opción.

PCF21: Se pone muy nervioso, se pone serio, no le gusta que le digan nada es como que se cierra en su burbuja o en su mundo antes de competir, aunque él no me lo diga yo sí creo que se pone nervioso...

Análisis de resultados competitivos

En todos los casos los/las padres y madres dan un feedback a sus hijos después de competir. Si la actuación era la esperada o deseada, lo celebran y felicitan a sus hijos/as; si no se cumplen las expectativas, intentar animarlos/las y orientar la experiencia hacia el proceso de mejora personal. En casos aislados, restan importancia a los resultados o a la competición, para evitar la decepción de sus hijos/as. También puede aparecer un feedback negativo por parte de los padres y madres, si creen que no se ha alcanzado el resultado debido a que el/la atleta no estaba centrado/a en la competición, o no se ha esforzado lo suficiente.

PJF29: La mayoría de las veces felicitarla por lo bien que lo ha hecho... Alguna vez que no han salido las cosas bien... a veces pasa y son accidentes, pero a veces sale mal por factores... y entonces a mí se me nota que estoy cabreado...

PJM24: "Siempre hay un poquito de reflexión que qué tal te has visto, cómo te has sentido ahí... siempre quitar hierro, tampoco vamos a subirlo a un pedestal, pero sí el esfuerzo y la desesperanza o esa desmotivación hay que manejarla."

Efecto presión

En general los/as padres y madres perciben que la presión que sienten sus hijos/as proviene de la competición y de cómo la interpretan. La mitad de los progenitores expone que sus hijos/as no se desenvuelven bien bajo presión, y la otra mitad, que sí saben gestionarla, siendo una activación para afrontar la competición; incluso, un padre explica que presiona a su hija para que no se relaje.

MJM27: Sí la llevan bien... tampoco perfecto, pero no se les desboca la presión, no la somatizan, ni tampoco la manifiestan en forma de agresividad, la toleran... lo

llevan bien, creo que lo manejan de manera equilibrada... el hecho de enfrentarse a las competiciones siempre con mucha ilusión.

Presión parental

Más de la mitad de los casos responden que no los /as han presionado, pero seguidamente exponen una situación (alimentación, esfuerzo, compromiso, asistencia a entrenamientos, etc.) en la que quizá el niño/a lo haya podido interpretar o sentir así, "no, yo no la presiono, pero no por las competiciones, por la responsabilidad... a los entrenamientos no se falta, solo se falta si estás enferma o por causa mayor" (sujeto MIF1). Pocos responden con un no rotundo, a si han presionado en alguna ocasión a sus hijos/as. Y algo menos de la mitad reconocen que alguna vez los han presionado y se han arrepentido después. "Si alguna vez sí, pues a lo mejor cuando han querido dejar alguna prueba a medio, bueno me ha salido una mal y ya no sigo, ahí sí" (sujeto PCM22).

La codificación final de la información obtenida de las entrevistas se muestra en la tabla 2.

Tabla 2. Tabla de codificación de los resultados tras el análisis de datos

Bloques de Contenidos	Categorías	Subcategorías	Códigos
Valor que los padres y madres otorgan a la práctica deportiva	Ejemplo Deportivo	No practica deporte.	No practica deporte
		Practica deporte	Deporte relacionado con la práctica de su hijo/a Practica deporte no relacionado con la práctica de su hijo/a
	Evaluación de la práctica deportiva	Positiva Negativa Indiferente	
	Valores del deporte	Instrumentales	Esfuerzo, constancia, responsabilidad, autoconfianza, autoestima, organización, ambición, competitividad, seguridad, disciplina, compromiso, autorregulación, salud, perseverancia y fuerza de voluntad
		Éticos o finales	Respeto, sacrificio, compañerismo, admiración y humildad
	Gestión del tiempo	Compagina estudios y atletismo	Los estudios son más importantes Son igual de importantes estudios y deporte Estudios lo más importante y después el atletismo
		Compagina estudios, atletismo y otras actividades	Estudios lo más importante y después el resto de actividades (atletismo inclusive)
Satisfacción de los padres y madres con la oferta deportiva	Oferta deportiva local	Suficiente	Suficiente en cantidad y calidad Suficiente en cantidad e insuficiente en calidad
		Insuficiente Desconocida	Insuficiente en cantidad y calidad
	Satisfacción con las escuelas deportivas Satisfacción con la escuela de atletismo		Satisfacción Insatisfacción Satisfacción en general Insatisfacción parcial
Implicación parental	Implicación en la actividad deportiva	Relación	Total Parcial
	Relaciones sociales		Dentro de la actividad deportiva Dentro y fuera de la actividad deportiva
		Ningún tipo de relación	
	Implicación en la escuela deportiva		Implicados No implicados
	Afectación en la vida personal.	Afectación	Económica Tiempo personal Social y Familiar
		No afectación	No afecta
Relación con el técnico deportivo	Relación y comunicación con el técnico deportivo	Comunicación frecuente Comunicación esporádica No existe comunicación	Vía electrónica y personal Vía electrónica Personal No existe relación
	Opinión personal		Comunica sus opiniones No comunica sus opiniones
	Opinión sobre la dirección formativa		Satisfechos Insatisfechos*
	Información del proceso	Recibe	Suficiente Insuficiente
		No recibe	No lo ve necesario Necesidad de una mayor información

Apoyo y soporte	Comunicación con los hijos/as.		Frecuente Ocasional* Nula*
	Satisfacción del atleta con la práctica deportiva		Satisfecho Insatisfecho
	Razones de participación deportiva		Diversión Relacional Superación personal Competitiva Salud Instrumental
	Relación del atleta con el entrenador	Buena Mala* Sin relación* Desconocida	Profesional De confianza El atleta no se siente cómodo con el entrenador No existe relación Desconocida por el padre
	Relación del atleta con sus compañeros/as	Buena A mejorar	Dentro de la actividad deportiva Dentro y fuera de la actividad deportiva Problemas de relación por competitividad Problemas de relación por timidez
	Apoyo parental		Apoyo interno emocional Apoyo externo Instrumental
Apoyo y soporte	Presencia Parental		Ambos progenitores Solo un progenitor Ningún progenitor
	Demostración de apoyo		Con hechos y palabras, lo consideran beneficioso Con hechos, no consideran necesario expresarlo Con hechos, consideran contraproducente expresarlo
Comportamiento directivo	Comportamiento directivo con su hijo/a	Se dan instrucciones No se dan instrucciones	Recomendaciones psicológicas o emocionales Recomendaciones directivas técnicas No dan instrucciones de ningún tipo
	Evaluación de la competición		Experiencia enriquecedora Experiencia intranscendente
Expectativas	Expectativas atleta Vs Expectativas padre o madre	Expectativas que coinciden	Coinciden en altas expectativas de rendimiento Coinciden en bajas expectativas de rendimiento Atleta y progenitor coinciden en expectativas de salud
		Expectativas que difieren	Atleta con expectativas de rendimiento y progenitor de salud
Presión parental	Participar o ganar.	Participar Ganar	Participar para superarse a si mismo Participar para ganar Ganar para seguir participando Ganar en el alto nivel
	Percepción hijo/a.	Percepción positiva	Perciben que su participación hace feliz a su progenitor y agradecen su implicación Perciben que su participación hace feliz a su progenitor y sobreentienden que es algo implícito en la labor parental
		Percepción negativa	Perciben críticas de sus progenitores
	Afrontamiento competitivo	Con nervios Sin nervios	Afectan positivamente (activación) Afecta negativamente Afecta positivamente Afecta negativamente
	Análisis de resultados competitivos.	Feedback positivo Feedback negativo	Celebran los resultados Confortan los resultados Responsabilizan al atleta
	Efecto presión		Presión propia del atleta Presión del progenitor
	Presión parental		Presión consciente Presión inconsciente Sin presión

Nota: Niveles de respuestas adyacentes a los realizados por la muestra.

Discusión

El objetivo de este estudio fue analizar las percepciones de padres y madres sobre la participación de sus hijos/as en el deporte. Los resultados aportan valiosa información que debe contribuir al desarrollo y organización más eficaz de los programas deportivos en edades de iniciación y deporte de base.

En la primera dimensión, sobre el "valor que los padres y madres otorgan a la práctica deportiva", la mayoría de padres y madres entrevistadas otorgan un trascendente papel al deporte en el desarrollo de sus hijos, afirmando su satisfacción con la práctica, y siendo conscientes de su influencia sobre la salud y las relaciones sociales, además de la adquisición y fomento de importantes valores.

El rol de los padres y el entorno familiar es decisivo en la iniciación en el deporte. Como principales agentes socializadores, promueven la participación de sus hijos en el deporte (Keegan et al., 2009), pero también influyen determinantemente en la relación que establecen los deportistas con el mismo (positiva, negativa o indiferente), y que establece su continuidad, dedicación y actitud hacia la práctica (Marcén et al., 2012).

En cuanto a los valores, los padres y madres son conscientes de la importancia del deporte para su fomento, de algunos como el esfuerzo, el compañerismo, o la responsabilidad, entre otros, que son transferibles a otros ámbitos de la vida. Ha sido confirmado el estrecho vínculo existente entre la educación moral y la práctica deportiva (Bruner et al., 2018), y siempre que ese deporte esté bien organizado, puede ser un medio excelente para transmitir valores sociales y personales positivos a los niños y adolescentes (Berengüí & Garcés de Los Fayos, 2007; Light & Harvey, 2015). Por ello, es imprescindible que los clubes y entrenadores trabajen para garantizar la promoción de sistemas de valores que fomenten la orientación hacia la tarea del deportista, y promuevan esos valores positivos (Berengüí et al., 2022). A diferencia del deporte de élite, el deporte en edades jóvenes debe tender a defender explícitamente valores que vayan más allá de la victoria, aunando diversas experiencias educativas, como el desarrollo de habilidades deportivas, el liderazgo y el trabajo en equipo (English, 2018).

Respecto a la segunda dimensión, relativa a la "satisfacción con la oferta deportiva", la mayoría de padres confirmaron su agrado con la organización y funcionamiento del club, pareciéndoles apropiadas las cuotas económicas, la filosofía del club en la formación de atletas, y la formación técnica de los entrenadores. Por el contrario, se mostraron descontentos con las políticas municipales, en especial, con la calidad y mantenimiento de las instalaciones. En este sentido, los padres juegan un rol esencial mediante su influencia sobre los intereses y decisiones de sus hijos, y por ello resulta imprescindible que los padres conozcan las oportunidades deportivas para que se produzca la participación de sus hijos/as (Columna et al., 2011).

En la tercera dimensión analizada, de "implicación parental", la mayor proporción de padres y madres afirman una total participación en la actividad deportiva de sus hijos/as, con un alto grado de implicación en las demandas y necesidades de la escuela, fomentándose las relaciones tanto dentro como fuera de las actividades deportivas entre ellos. Si bien la práctica atlética afecta sus vidas y rutinas diarias, por la inversión de tiempo y esfuerzo requeridos, les resulta gratificante por el disfrute y el estilo de vida saludable que aporta a sus hijos/as.

El impacto de la implicación de los padres y madres es fundamental en los años de iniciación deportiva, pues son los vigilantes esenciales en el cambio comportamental y de actividad física de sus hijos (Gustafson & Rhodes, 2006). La participación de los padres implica compartir con sus hijos/as su tiempo, dinero e intereses (Holt et al., 2009), y por ello son agentes básicos y necesarios, pues proveen ese soporte instrumental además del psicológico (Turnnidge et al., 2012), como vemos en este estudio, incluso adaptando sus obligaciones diarias para adaptarlas a las necesidades deportivas de sus hijos/as. Además, en determinados estudios, la percepción de implicación de sus padres por parte de los deportistas se ha asociado positivamente con mayores niveles de motivación y menores de desmotivación en jóvenes deportistas (Sánchez-Miguel, Leo et al., 2013; Sánchez-Miguel, Pulido et al., 2015), aunque también en ocasiones la intensidad de la implicación percibida por el deportista se ha asociado con una mayor presión experimentada (Lee & MacLean, 1997).

Sobre la cuarta dimensión, de "relación con los técnicos deportivos", en general existía desconocimiento por parte de los padres sobre su formación, aunque confían en ellos, ya que perciben como sus hijos/as estaban contentos/as, y veían un progreso y mejora de marcas. Sin embargo, la relación entre padres y madres con los/as entrenadores/as es limitada, no existiendo generalmente feedback sobre el progreso por parte de los técnicos.

Tanto los técnicos de las escuelas deportivas, como los padres y madres que involucran a sus hijos en las diferentes actividades, son básicos en la orientación y educación de esos niños dentro del ámbito deportivo (Garrido et al., 2010). Los entrenadores se consideran importantes activos externos responsables de crear climas motivadores y estructurar actividades que ayuden a satisfacer las necesidades de desarrollo de los jóvenes (De Sousa et al., 2018).

A partir de los resultados obtenidos, consideramos que, si bien existe confianza en la labor de los técnicos, la comunicación debe ser más fluida con los padres, con el fin de trazar líneas comunes que confluyan en el entendimiento de los progenitores del proceso deportivo de sus hijos, y al mismo tiempo, los técnicos puedan conocer las necesidades y particularidades de cada deportista, para así asegurar la efectividad del entrenamiento y que el deporte se adapte mejor a cada uno.

Atendiendo a la quinta dimensión, "apoyo o soporte de los padres y madres", entre todas, posiblemente sea el bloque que más información aportó. En general, existe una buena comunicación de los padres y madres con sus hijos/as sobre aspectos deportivos, perciben a sus hijos/as satisfechos/as, contentos/as, y motivados/as, y aluden a que la práctica es realizada para divertirse, estar con amigos y superarse a sí mismo y a los demás. La relación con el entrenador y los compañeros es buena y positiva.

El apoyo parental y social en el deporte ha sido analizado durante décadas. El apoyo de los padres respecto a la trayectoria deportiva de sus hijos orienta su desarrollo deportivo, constatándose que los jóvenes deportistas que reciben escaso ánimo por parte de sus padres tienden a no comprometerse efectivamente en la práctica deportiva (Calo et al., 2022). Por el contrario, los deportistas que perciben más apoyo presentan mayor educación personalizada y proteccionismo de sus padres (González-García et al., 2019).

Entre los resultados hallados se comprueba cómo los padres aportan, siguiendo a Beets et al. (2010), tanto apoyo tangible (como el coste económico asociado a la participación, el compromiso en tiempo, o los desplazamientos al entrenamiento y la competición), como intangible, mediante el apoyo emocional, el estímulo verbal y el asesoramiento. El apoyo de los padres se convierte en un imperativo para los niños y jóvenes en todos los niveles de la competición deportiva, con especial relevancia para aquellos que transitan en edades a niveles de competición más exigentes (Todd & Edwards, 2021).

El comportamiento de los padres y madres tiene el efecto de dirigir y controlar la experiencia y el progreso de sus hijos/as y es considerada una fuente poderosa de presión. Tanto los padres como los entrenadores ejercen influencias a través de sus estilos de liderazgo, respuestas afectivas y comportamientos.

En la sexta dimensión, "comportamiento directivo", los resultados están en consonancia con los del estudio cualitativo de Keegan et al. (2019), que explora el clima motivacional de los deportistas al principio de su carrera y las influencias de los agentes sociales. En la investigación se categoriza la forma en que los padres y entrenadores se comunican con el joven atleta, tanto para el apoyo como para la instrucción, "estilos de liderazgo", distinguiendo dos estilos centrales, un estilo controlador/autocrático y un estilo autonomista/democrático, que coinciden, en cuanto al significado, con las vertientes codificadas en el presente estudio, comunicación psicológica o emocional y comunicación directiva, ya que la comunicación no siempre tenía un componente valorativo, sino que reflejaba la tendencia del progenitor para mostrar afecto positivo, negativo o tolerancia.

En el estudio de Wing et al. (2016) se mostró que la percepción de control parental alta, fue asociada negativamente con el disfrute de la actividad física. En cambio, las actitudes y conductas de los padres que son consideradas como positivas y animadoras han sido vinculadas a consecuencias afectivas favorables para los niños y adolescentes en el deporte (Amenabar et al., 2008). Incluso, Van Yperen (1997) resaltó el impacto que tiene en la amortiguación del efecto de las experiencias deportivas negativas, que el deportista perciba ánimos positivos de sus resultados por parte de los padres.

Los resultados obtenidos nos muestran que los padres y madres pueden evaluar la experiencia de la competición de sus hijo/as como una vivencia enriquecedora o como una vivencia intrascendente. A este respecto, Brustad (1996) propuso que los padres juegan un papel importante al interpretar la información referida a los logros deportivos de sus hijos/as, influyendo a su vez en la cognición de estos, en cuanto a las atribuciones y autopercepciones en entornos de logro, añadiendo además que los padres/madres prefieren dar más oportunidades de práctica, en aquellos entornos donde perciben unas altas expectativas de éxito para sus hijos/as.

El séptimo bloque, "expectativas", analiza las relaciones que existen entre las expectativas deportivas de los/las atletas, lo que sus padres y madres piensan sobre ellas y las propias expectativas sobre el futuro de la participación deportiva de sus hijos/as. Encontramos, de forma general dos categorías, expectativas que coinciden y expectativas que difieren, y dos ámbitos, de rendimiento y de salud.

La opinión de los padres sobre las capacidades de sus hijos, tienen una gran influencia en las percepciones de sus habilidades y la evolución de sus intereses. Si los jóvenes deportistas perciben creencias positivas sobre sus capacidades por parte de sus padres y madres, utilizarán criterios internos para evaluar sus capacidades y aceptarán mayores desafíos. Es importante determinar de manera objetiva si las expectativas de los jóvenes deportistas son realistas o expectativas irrealmente altas, ya que de ser así se sentirán frustrados en los deportes, porque incluso cuando tengan un buen desempeño, sus aspiraciones seguirán sin cumplirse.

Casi en la totalidad de los casos, los padres y madres tienen expectativas de que sus hijo/as continúen con su práctica deportiva, sobre todo desde un punto de vista saludable. No son muchos los casos que encontramos donde el atleta tenga objetivos competitivos de rendimiento y los progenitores consideren que son alcanzables, bien porque no confían en las cualidades de sus hijos/as o bien porque es una forma de protegerse y protegerlos ante la frustración de no alcanzarlos. Puede influir en este sentido que el atletismo no es un deporte profesional y es muy difícil vivir de él, lo que influirá en que pocos padres tengan expectativas altas de rendimiento ya que consideran complicado poder llegar lejos.

Brustad (1996) observó que la autopercepción física de los niños está relacionada con la cantidad de ánimo que reciben por parte de sus padres lo que influye directamente

en su intención de mantenerse físicamente activos. Los padres y madres que no quieran que su hijo/a practique deporte, que no muestren interés, que no los/as acompañen a las competiciones, o si van comenten de manera despectiva el esfuerzo que hacen sus hijos/as para no conseguir nada, están volcando unas expectativas negativas sobre los jóvenes deportistas lo que podrá conducir al abandono deportivo. De manera contraria, cuando los padres tienen expectativas demasiado altas para sus hijos, pueden hacerles creer que son capaces de hacer más de lo que realmente pueden, esta situación es igualmente destructiva para el disfrute del deporte, ya que no importa lo bien que se desempeñen los/las niños/as, que nunca puede parecer suficiente para sus padres/madres.

Algunos padres se identifican de tal modo con sus hijos que vivencian el rendimiento de ellos como propio proyectando de esta manera expectativas desmedidas en sus hijos a las cuales los niños intentarán responder (Green & Chalip, 1997). De igual manera, este caso también puede frustrar a los niños y frustrar su motivación para participar, ya que los sentimientos de valor personal, se equiparan con el éxito que tengan en los deportes, y pueden tener miedo al fracaso o el rechazo si perciben que el amor de sus padres depende de ganar. Como última opción también no influir las expectativas de los padres y madres en sus hijos/as, debido que éstos/as han devaluado el valor o juicio de los padres y, por ende, de los propios padres.

En la última dimensión, "presión parental", se busca información sobre la importancia que los/las padres y madres dan a los resultados de competición y la presión que pueden ejercer sobre sus hijos/as. La categoría de Participar o ganar está estrechamente vinculada con las orientaciones de meta. La orientación de meta es una vía para definir el éxito y juzgar la propia competencia (Duda, 1999). Se ha visto que la percepción que tienen los niños de la orientación de meta de los padres y su propia orientación de meta se presentan enlazadas (Ames, 1992).

Los resultados obtenidos dan mayor importancia a la participación. Participar se relacionaría con una orientación a la tarea y ganar con una orientación al ego. En el primer caso se relaciona más con la adherencia deportiva, el éxito es subjetivo y la competencia percibida resulta de las mejoras personales, del dominio de la tarea y del esfuerzo y en el segundo de los casos, una persona se siente exitosa y competente a medida que ha demostrado una habilidad superior a los demás, lo que está relacionado con una mayor ansiedad competitiva y abandono de la práctica deportiva (Duda, 1999).

El modo en que los padres se involucran en el deporte de sus hijos, ya sea a través del apoyo o la presión, constituye uno de los más importantes predictores de la continuidad de la participación deportiva de los niños (Turman, 2007). Un ambiente positivo creado por los padres con retroalimentación positiva, respuestas afectivas positivas, diversión, charlas de ánimo previas a la competición, estímulos, colaboración y apoyo parental positivo se relacionan positivamente de manera consistente con la motivación del deportista (Keegan et al., 2019).

Los resultados del presente estudio coinciden de manera casi unánime en que los/as hijos/as perciben que su actividad deportiva hace felices a sus progenitores; que su presencia en competiciones y entrenamientos, hace que se sientan más seguros/as y están contentos, satisfechos y agradecidos de la implicación parental.

Cuando un sujeto percibe la implicación parental como moderada, entonces la presión ejercida también resultaría adecuada, encontrándose en un nivel de experiencia satisfactoria. Cuando los/as niños/as perciben a sus progenitores poco involucrados son susceptibles de abandonar el deporte debido a la falta de atención y apoyo emocional que requieren. Y cuando la intensidad de la implicación es percibida como alta, la presión lo es también. Sin embargo, existen diferencias individuales, ya que algunos niños/as pueden percibir como alta la implicación de sus padres, sin que esto signifique que se sienten presionados, ya que pueden percibirla como apoyo y experimentarla de manera satisfactoria y óptima (Lee & MacLean, 1997).

En la categoría de análisis de los resultados, encontramos que todos/as los progenitores dan un feedback a sus hijos después de competir, este puede ser positivo o negativo en función de los resultados obtenidos. La retroalimentación verbal negativa está relacionada con respuestas afectivas negativas y el debilitamiento de la motivación, y la positiva está vinculada con la adopción de metas de dominio y enfoque y relacionada a favor de la motivación. Los/as chicos/as que reciben retroalimentación positiva y consistente, tanto por el resultado como por su esfuerzo por adquirir maestría, conseguirán sentir que son competentes y que dominan la ejecución deportiva (Keegan et al., 2019).

Los resultados coinciden con los de Keegan et al. (2019), donde aparece también el concepto de "comunicación evaluativa", valorado a través de las subcategorías refuerzo conductual y la ya mencionada retroalimentación verbal. El refuerzo conductual se relaciona con el uso de castigos o recompensas, y en este sentido podemos encontrar referencias en nuestro estudio en algún caso, donde si el deportista obtenía un buen resultado competitivo los padres lo celebraban comiendo fuera, o si realizaba una mala actuación podían amenazarlo con no traerlo a futuras competiciones.

Centrándonos en la presión, la mayoría de los/as entrevistados/as expresan que sus hijos/as se ponen nerviosos en competición, muchos de ellos sin poder controlar los nervios, y derivando en efectos fisiológicos, como dificultad para dormir o desayunar, siendo esto algo que preocupa a sus progenitores, en algún caso indicando que, si los nervios llegan a ese extremo, la competición deja de ser una buena opción. En este último caso, los padres y madres adoptan una posición sobreprotectora que puede llevar a los jóvenes atletas a intentar evitar las situaciones que les resulten

estresantes en lugar de aprovechar esta oportunidad para aprender a gestionarlas. En otros casos, según la percepción de los progenitores, consigue canalizar esos nervios en activación, algo beneficioso de cara a la competición.

En general, los/as padres y madres perciben que la presión que sienten sus hijos/as proviene de la competición y de cómo la interpretan, y esto estaría relacionado con el término de ansiedad cognitiva, definida ésta, como el componente mental de la ansiedad, y que es causada por expectativas negativas sobre el éxito o por autoevaluación negativa (Craft et al., 2003). Weiss et al. (1989) encontraron relaciones positivas entre las preocupaciones cognitivas precompetitivas en jóvenes gimnastas y las preocupaciones acerca de una evaluación negativa por parte de sus progenitores.

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En el presente estudio más de la mitad de los casos consideran que no presionan a sus hijos/as, pero seguidamente exponen una situación (alimentación, esfuerzo, compromiso, asistencia a entrenamientos, etc.) en la que quizá el/la niño/a sí lo haya podido interpretar o sentir así. Los atletas jóvenes y sus padres y madres tienen muy diferentes puntos de vista sobre qué comportamientos son de apoyo y el niño responderá en función del modo en que perciba la actitud de sus padres, sin importar sus intenciones reales (Lee & MacLean, 1997).

Conclusiones

El objetivo del presente estudio era analizar las percepciones de padres y madres sobre la participación deportiva de sus hijos/as en el deporte. Los resultados obtenidos nos aportan una información de gran interés para conocer como los/as entrevistados/as entienden y viven la práctica deportiva de sus hijos/as para entender la complejidad y multifactorialidad del fenómeno que analizamos También ha servido para detectar ciertas cuestiones que pueden afectar negativamente a los deportistas, sobre todo a la hora de promover un clima motivacional adecuado y favorecer la adherencia deportiva.

Como limitaciones del estudio encontramos que pueden existir diferencias entre como el/la padre o madre percibe su comportamiento, como lo perciben sus hijos/as y cómo es en realidad, de manera que en futuras investigaciones se deberán abordar los tres ámbitos para poder obtener resultados más concluyentes y poder elaborar guías estratégicas que doten de herramientas a los padres y madres para poder orientar a sus hijos/as hacia un clima motivacional adecuado.

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ESTADÍSTICAS Y REVISORES

Resumen de Visibilidad, Calidad Editorial y Científica e Impacto de CCD (modificado a partir de la Tabla Resumen de la Memoria Anual de CCD)

Visibilidad
ISI Web of Science, SCOPUS, EBSCO, MIAR, LATINDEX, REDIB, REDALYC, DIALNET, COMPLUDOC, RECOLECTA, ERIHPLUS, CEDUS, REDINET, SPORTDISCUS, PSICODOC, DOAJ, ISOC, IN-RECS, DULCINEA, SCIRUS, WORLDCAT, LILACS, GTBib, RESEARCH GATE, SAFETYLIT, REBIUN, Universal Impact Factor, Index Copernicus, e-Revistas, Cabell's Directory, SJIF, DLP, Fuente Académica Plus, ERA, BVS, PRESCOPUS RUSSIA, JournalTOCs, Viref, Genamics

Calidad
REDALYC: Superada
LATINDEX: (Total Criterios Cumplidos: 33/33)
CNEAI: (Total Criterios Cumplidos: 18/18)
ANECA: (Total Criterios Cumplidos: 22/22)
ANEP: Categoría A
CIRC (2020): Categoría B
Valoración de la difusión internacional (DICE): 14.25
DIALNET: C1 (DEPORTE Y EDUCACIÓN)
MIAR (2020): 9.7
ARCE 2014 (FECYT): Sello de calidad - Actualizado 2020
ERIH PLUS (European Reference Index for Humanities and Social Sciences): Indexada

Redes sociales
Twitter: https://twitter.com/UCAM_CC

Impacto
ISI Web of Science 2021: 0.15 (JCI). Cuarto cuartil en Hospitality, Leisure, Sport & Tourism.

SCOPUS: 2021: 0.184 (SJR). Índice H: 14. Cuarto cuartil en Health (Social Science), Physical Therapy, Sports Therapy and Rehabilitation y en Sports Science.

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FECYT 2020: Ranking de Calidad de las Revistas Científicas Españolas Segundo cuartil en Ciencias de la Educación (puntuación: 34.23), y Psicología (puntuación: 32.23).

Ranking Iberoamericano de Revistas (REDIB)
2020: primer cuartil en el área temática de Ciencias Sociales y Humanidades, materia Hostelería, Ocio, Deporte y Turismo.

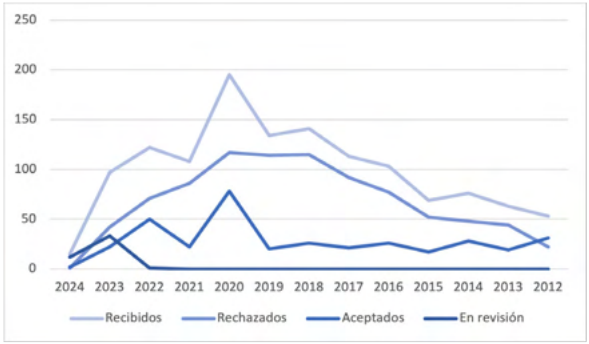
IN-RECS Education (2011): 0.103. Second quartile. Position: 47/162

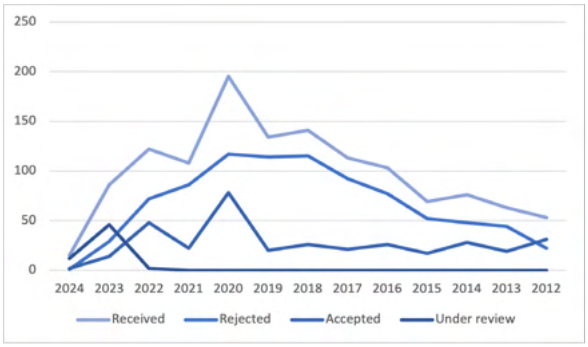
Índice H (2013-17): 11. Mediana H: 18. Posición 36/96

Scientific Journal Impact Factor (SJIF) 2018: 6.91

Nivel CONICET (Res. 2249/14): Grupo 1

Estadísticas





Lista revisores CCD 59

Alejandra Selma	Elena Marín Cáscales	Pedro Calero
Álvaro Jaramillo-Tapia	Filipe Rodrigues	Raquel Vaquero Cristóbal
Antonia Pelegrín Muñoz	Irene Baena-Chicón	Tomás Abelleira-Lamela
Antonio Peñalver	Jonathan González Santamaria	
Carlos Alix	Juan Carlos Redondo Castán	
Daniel Castillo Alvira	María Antonia Hurtudo Guapo	
Domingos Carlos Mirione	Marina Castro-García	

NORMAS DE PRESENTACIÓN DE ARTÍCULOS EN CULTURA, CIENCIA Y DEPORTE

La Revista *Cultura, Ciencia y Deporte* considerará para su publicación trabajos de investigación relacionados con las diferentes áreas temáticas y campos de trabajo en Educación Física y Deportes, que estén científicamente fundamentados. Dado el carácter especializado de la revista, no tienen en ella cabida los artículos de simple divulgación, ni los que se limitan a exponer opiniones en vez de conclusiones derivadas de una investigación contrastada. Los trabajos se enviarán telemáticamente a través de nuestra página web: http://ccd.ucam.edu, en la que el autor se deberá registrar como autor y proceder tal como indica la herramienta.

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LA REVISTA CULTURA, CIENCIA Y DEPORTE DISPONE DE UN TEMPLATE/PLANTILLA DE USO OBLIGATORIO PARA EL ENVÍO DE NUEVOS ARTÍCULOS. PUEDE ENCONTRARLO EN EL SIGUIENTE ENLACE: https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true

No debe editar el documento en la página web. Debe clicar en "Archivo", darle a la opción "Descargar" y seleccionar "Microsoft Word". Una vez que tenga el Template descargado en su dispositivo podrá editarlo.

Este Template NO incluirá las tablas ni las figuras. Estas deben incluirse en un archivo separado titulado "Tablas y Figuras". Puede encontrarlo en el siguiente enlace: https://docs.google.com/document/d/1tHreE-78C9pbLmWWhFY-Sa-IRyVb5B4HP/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true

CONDICIONES

Todos los trabajos recibidos serán examinados por el Editor y por el Comité de Redacción de *Cultura, Ciencia y Deporte,* que decidirán si reúne las características indicadas en el párrafo anterior, para pasar al proceso de revisión por pares a doble ciego, por parte del Comité Asesor. Los artículos rechazados en esta primera valoración serán devueltos al autor indicándole los motivos por los cuales su trabajo no ha sido admitido. Así mismo, los autores de todos aquellos trabajos que, habiendo superado este primer filtro, no presenten los requisitos formales planteados en esta normativa, serán requeridos para subsanar las deficiencias detectadas lo más rápidamente posible. La aceptación del artículo para su publicación en *Cultura, Ciencia y Deporte,* exigirá el juicio positivo de los dos revisores, y en su caso, de un tercero. Durante este proceso, los derechos del artículo serán de la Revista *Cultura, Ciencia y Deporte*, a no ser que el autor/es soliciten que no se continúe con la revisión de su trabajo. La publicación de artículos no da derecho a remuneración alguna. Los derechos de edición son de la revista y es necesario su permiso para cualquier reproducción. El envío de un artículo a *Cultura, Ciencia y Deporte* implica la cesión de derechos a la revista, permitiendo que el artículo pueda ser publicado. En un plazo de cuatro meses se comunicará al autor la decisión de la revisión.

3. ENVÍO DE ARTÍCULOS

3.1 Normativa general

El artículo se enviará a través de la url: http://ccd.ucam.edu/index.php/revista/login. Todo el texto debe escribirse atendiendo a las directrices presentes en **el template de la revista** (https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true), sin modificar en ningún caso la fuente del texto o el tamaño del mismo. Si su artículo es aceptado para publicación presentará la disposición del template final, por tanto, le rogamos lo revise cuidadosamente antes de proceder a su envío. La extensión máxima recomendada no deberá sobrepasar las 7500 palabras incluyendo Figuras, Tablas y Lista de Referencias.

Cada envío estará compuesto por **CUATRO DOCUMENTOS**. El primero recibirá el nombre de "**artículo anónimo**" en el que se incluirá el título del trabajo, el resumen, las palabras clave, el texto del trabajo y las referencias, **SIN NINGÚN TIPO DE INDICACIÓN QUE PERMITA A LOS REVISORES IDENTIFICAR A LOS AUTORES DEL MANUSCRITO**. **EL "ARTÍCULO ANÓNIMO" DEBE ADJUNTARSE EN LA PLATAFORMA EN LA OPCIÓN "TEXTO DEL ARTÍCULO".** El segundo recibirá el nombre de "**artículo con autores**" e incluirá en el manuscrito el nombre de todos los autores que formen parte del trabajo, así como sus afiliaciones, autor de correspondencia, códigos de comités (por ejemplo, comité de ética), proyectos de investigación vinculados, agradecimientos y financiación. **EL "ARTÍCULO CON AUTORES" DEBE ADJUNTARSE EN LA PLATAFORMA EN LA OPCIÓN "OTRO"**. El tercer documento recibirá el nombre de "**posibles revisores para el manuscrito**" y debe incluir 5 posibles revisores (nombre, apellidos, institución y email) que no hayan sido coautores de los autores del manuscrito en los últimos tres años y que no pertenezcan a la misma institución. **EL DOCUMENTO DE "POSIBLES REVISORES PARA EL MANUSCRITO" DEBE ADJUNTARSE EN LA PLATAFORMA EN LA OPCIÓN "OTRO".** Y el cuarto documento recibirá el nombre de "**Tablas y Figuras**" y debe incluir todas las tablas y figuras del manuscrito. En el "artículo anónimo" y en el "artículo con autores" debe especificarse claramente el lugar en el que debe insertarse cada Tabla y/o Figura indicando "Tabla x aquí". **EL DOCUMENTO DE "TABLAS Y FIGURAS" DEBE ADJUNTARSE EN LA PLATAFORMA EN LA OPCIÓN "OTRO".**

- En la **primera página** del manuscrito deben ir los siguientes elementos del trabajo (por este orden, presentándose en el orden contrario si el texto del artículo está en inglés). Es importante que no se incluyan los nombres de los autores ni su filiación en el documento titulado "**artículo anónimo**", pero sí deberá hacerse en "**artículo con autores**".

  - **Título** del artículo en español y en inglés (en minúscula ambos, sin punto al final). Se recomiendan 10-12 palabras. Debe ser informativo del contenido y tener fuerza por sí mismo, pues es lo que aparecerá en los índices informativos y llamará la atención de los posibles lectores. Debe procurarse la concisión y evitar un excesivo verbalismo y longitud que no añada información.

  - **Resumen** del trabajo en español y en inglés.

a. Debe reflejar el contenido y propósito del manuscrito.

b. Si es la réplica del trabajo de otro autor debe mencionarse.

c. La longitud del resumen no debe sobrepasar las **200 palabras**.

d. En estas 200 palabras debe aparecer: el problema, si es posible en una frase; los participantes, especificando las principales variables concernientes a los mismos (número, edad, género, etc.); la metodología empleada (diseño, aparatos, procedimiento de recogida de datos, nombres completos de los test, etc.); resultados (incluyendo niveles estadísticos de significación); y conclusión e implicaciones o aplicaciones. El resumen **no ha de ser estructurado** (no se deben incluir los encabezados "problema", "participantes", etc.) y debe estar escrito en un único párrafo.

- **Palabras claves** en español e inglés. Las 4 o 5 palabras que reflejen claramente cuál es el contenido específico del trabajo y no estén incluidas en el título (puede utilizar el Tesauro). En cursiva. Sólo la primera palabra se escribirá con mayúscula. Se separarán con comas y al final se incluirá un punto.

- La **segunda página** se iniciará el **texto completo** del artículo. El cuerpo de texto del trabajo deberá empezar en página independiente de la anterior de los resúmenes y con una indicación clara de los apartados o secciones de que consta, así como con una clara jerarquización de los posibles sub- apartados:

  - El primer nivel irá en negrita, sin tabular y minúscula.
  - El segundo irá sin negrita, sin tabular y minúscula.
  - El tercero irá en cursiva, sin tabulación y minúscula.

- Tras el texto completo se ha de incluir un apartado de **Agradecimientos**, a personas que hayan aportado ideas o lecturas, o que hayan participado en el trabajo de campo, etc.; y un apartado de **Financiación**, en el que se indica el proyecto en el que se inscribe la investigación y se declaran las entidades que aportaron fondos para realizarla.

- A continuación de los apartados Agradecimientos y Financiación se debe incluir un apartado de **Referencias**. Las citas y referencias tanto dentro del texto como en el apartado específico deben realizarse en normativa **APA 7ª ed**. A continuación, se presenta un resumen de la misma:

Durante el texto.

- Las citas de trabajos de tres o más autores solo incluyen el apellido del primer autor seguido por "et al.". Ejemplo: Fernández et al. (2019).
- Las citas literales se realizarán en el texto, poniendo tras la cita, entre paréntesis, el apellido del autor, coma, el año del trabajo citado, coma y la página donde se encuentra el texto: (Sánchez, 1995, 143).
- Si se desea hacer una referencia genérica en el texto, es decir, sin concretar página, a los libros o artículos de las referencias, se puede citar de la forma siguiente: paréntesis, apellido del autor, coma y año de edición: (Ferro, 2015). Las referencias citadas en el texto deben aparecer en la lista de referencias.
- Las citas incluidas en el mismo paréntesis deben seguir el orden alfabético.
- Siempre que la cita esté incluida en paréntesis se utilizará la "&". Cuando la cita no está incluida en paréntesis siempre se utilizará la "y". Las citas de dos autores van unidas por "y" o "&", y las citas de varios autores acaban en coma e "y" o "&". Ejemplo: Fernández y Ruiz (2008) o Moreno, Ferro, y Díaz (2007).
- Cuando el mismo autor haya publicado dos o más trabajos el mismo año, deben citarse sus trabajos añadiendo las letras minúsculas a, b, c... a la fecha. Ejemplo: Ferro (1994 a, 1994 b).
- Al final del artículo-Lista de referencias.
- Los autores se ordenan por orden alfabético, con independencia del número de los mismos. Cuando son varios, el orden alfabético lo determina, en cada trabajo, el primer autor, después el segundo, luego el tercero y así sucesivamente.
- Es obligado utilizar el DOI (Digital Object Identifier) en las citas bibliográficas de los artículos y publicaciones electrónicas:
- Muñoz, V., Gargallo, P., Juesas, Á., Flández, J., Calatayud, J., & Colado, J. (2019). Influencia de los distintos tipos y parámetros del ejercicio físico sobre la calidad seminal: una revisión sistemática de la literatura. *Cultura, Ciencia y Deporte*, *14(40), 25-42*. http://dx.doi.org/10.12800/ccd.v14i40.1223
- Las citas de varios autores estarán separadas por coma e "&". Algunos ejemplos son los siguientes:

  Autor, A. A., Autor, B. B., & Autor, C. C. (2020). Título del artículo. *Título de la revista, xx*(x), xxx-xxx. http://dx.doi.org/xxxxxx

  Autor, A. A. (2020). *Título del trabajo.* Editorial.

  Autor, A. A., & Autor, B. B. (2020). Título del capítulo. En A. Editor, B. Editor, y C. Editor. (Eds.), *Título del libro* (pp. xxx-xxx). Editorial.

  Autor, A. A., Autor, B. B., & Autor, C. C. (en prensa). Título del artículo. *Título de la revista.*

  - Además, para la correcta referenciación habrá que considerar:
    - Aunque haya dos autores, se pone coma antes de la "&".
    - Después de ":" (dos puntos) se empieza con mayúscula.
    - Sólo se escribe en mayúscula la primera letra de la primera palabra del título. Sin embargo, para los títulos de las revistas se pone en mayúscula la primera letra de cada palabra.

3.2 Tipos de artículos que se pueden someter a evaluación en *Cultura, Ciencia y Deporte*

3.2.1. Investigaciones originales

Son artículos que dan cuenta de un estudio empírico original configurados en partes que reflejan los pasos

seguidos en la investigación. El texto completo debe tener la siguiente estructura:

3.2.1.1 Introducción. Problema del que se parte, estado de la cuestión y enunciado del objetivo e hipótesis de la investigación.

Se debe introducir y fundamentar teóricamente el problema de estudio y describir la estrategia de investigación. En el último párrafo el objetivo del trabajo se debe establecer claramente.

Cuando se quiera llamar la atención sobre alguna palabra se usarán las cursivas. El uso de subrayado, negrita y mayúsculas no está permitido. Se evitará también, en lo posible, el uso de abreviaturas. Tampoco se admite el uso de las barras, por ejemplo, y/o, alumnos/as. Habrá que buscar una redacción alternativa. En documento aparte, se presentan las directrices generales de estilo para los informes que utilicen el sistema internacional de unidades.

3.2.1.2 Método. Descripción de la metodología empleada en el proceso de la investigación. En esta sección debería detallarse suficientemente todos aquellos aspectos que permitan al lector comprender qué y cómo se ha desarrollado la investigación. La descripción puede ser abreviada cuando las técnicas suficientemente conocidas hayan sido empleadas en el estudio. Debe mostrarse información sobre los participantes describiendo sus características básicas y los controles utilizados para la distribución de los participantes en los posibles grupos. Deben describirse los métodos, aparatos, procedimientos y variables con suficiente detalle para permitir a otros investigadores reproducir los resultados. Si utilizan métodos establecidos por otros autores debe incluirse la referencia a los mismos. No olvidar describir los procedimientos estadísticos utilizados. Si se citan números menores de diez se escribirán en forma de texto, si los números son iguales o mayores de 10 se expresarán numéricamente.

Este apartado suele subdividirse en sub-apartados:

- *Participantes.* Debe describirse la muestra (número de personas, sexo, edad, y otras características pertinentes en cada caso) y el procedimiento de selección. Además, en aquellos estudios realizados con humanos o animales es obligatorio identificar el comité ético que aprobó el estudio. Cuando se describen experimentos que se han realizado con seres humanos, se debe indicar que además del comité ético institucional o regional, el estudio está de acuerdo con la Asociación Médica Mundial y la Declaración de Helsinki. No se deben utilizar nombres, iniciales o números que permitan identificar a los participantes.
- *Instrumentos.* Especificar sus características técnicas y/o cualitativas.
- *Procedimiento.* Resumir cada paso acometido en la investigación: instrucciones a los participantes, formación de grupos, manipulaciones experimentales específicas. Si el trabajo consta de más de un experimento, describa el método y resultados de cada uno de ellos por separado. Numerarlos, Estudio 1, Estudio 2, etc.

Resultados. Exposición de los resultados obtenidos. Los resultados del estudio deberían ser presentados de la forma más precisa posible. La discusión de los mismos será mínima en este apartado. Los resultados se podrán presentar en el texto, en Tablas o Figuras.

Cuando se expresen los datos estadísticos, las abreviaturas deben ir en cursiva, así como al utilizar el *p*-valor (que irá siempre en minúscula). Por ejemplo: *p, F, gl, SD, SEM, SRD, CCI, ICC*. Es necesario que antes y después del signo igual (=) se incluya un espacio. Se debe incluir un espacio también cuando entre el número y la unidad de medida (7 Kg y no 7Kg), pero no se incluirá dicho espacio entre el número y el signo de porcentaje (7% y no 7 %). Los decimales irán precedidos de puntos (9.1 y no 9,1).

No se incluirán los mismos datos que en el texto, en las tablas o en las figuras. Tanto las Figuras como en las Tablas no deben denominarse de ninguna otra manera. Las Figuras y Tablas serán incluidas en un documento separado (Tablas y Figuras) y se indicará el lugar en que deben aparecer en el texto del artículo, con su numeración correlativa, poniendo la leyenda de las Figuras en su parte inferior y la leyenda de las Tablas en su parte superior.

Las *Tablas* son un resumen organizado de palabras o cifras en líneas o renglones. Todas las tablas deben seguir el formato APA, incluyendo: a) su numeración en número arábigos, b) un título, c) líneas solo horizontales sobre el encabezado, debajo del mismo y al fin de la tabla, sin líneas verticales, y d) fondo de tabla blanco. Los decimales dentro de las tablas deben estar separados por **puntos** (.). Se debe incluir en el pie de la tabla todas aquellas abreviaturas o símbolos utilizados en la misma. El tamaño de la fuente en las tablas podrá variar en función de la cantidad de datos que incluya, pudiéndose reducir hasta 8 cpi máximo.

Tabla 1. Ejemplo 1 de tabla para incluir en los artículos enviados a CCD

	P5	PO	SD	SD	SD	EQ	SD	ENF	CA	E	E	Esu	F	MT	ED
		T	T		SI	G		T	H		S	c			
M	9.1	21.	9.1	6.1	92.	63.6	9.0	33.3	3.0	30.	15.	12.	0.0	82.	35.
T		2			0					3	5	1		1	5
ED	33.	13.	16.	6.7	23.	70.0	16.	26.7	21.	63.	0.	30	10.0	13.	96.
	3	3	7		0		6		1	3	0			3	0

Leyenda: MT=Indicar el significado de las abreviaturas

Tabla 2. Ejemplo 2 de tabla para incluir en los artículos enviados a CCD

Nombre 1	Ítem 1. Explicación de las características del ítem 1 Ítem 2. Explicación de las características del ítem 2 Ítem 3. Explicación de las características del ítem 3
Nombre 2	Ítem 1. Explicación de las características del ítem 1 Ítem 2. Explicación de las características del ítem 2 Ítem 3. Explicación de las características del ítem 3

Las *Figuras* son exposiciones de datos en forma no lineal mediante recursos icónicos de cualquier género. En caso de incluirse fotografías deben ser seleccionadas cuidadosamente, procurando que tengan una calidad de al menos 300 píxeles/pulgada y 8 cm de ancho. Si se reproducen fotografías no se debe poder identificar a los sujetos. En todo caso los autores deben haber obtenido el consentido informado para la realización de dichas imágenes, autorizando su publicación, reproducción y divulgación en *Cultura, Ciencia y Deporte*. Las Figuras deben ser incluidas dentro del texto, incluyendo: a) su numeración en número arábigos, b) un título.

Discusión. En este apartado se procederá a la interpretación de los resultados y sus implicaciones. Este apartado debe relacionar los resultados del estudio con las referencias y discutir la significación de lo conseguido en los resultados. No debe incluirse una revisión general del problema. Se centrará en los resultados más importantes del estudio y se evitará repetir los resultados mostrados en el apartado anterior. Evitar la polémica, la trivialidad y las comparaciones teóricas superficiales. La especulación es adecuada si aparece como tal, se relaciona estrechamente con la teoría y datos empíricos, y está expresada concisamente. Identificar las implicaciones teóricas y prácticas del estudio. Sugerir mejoras en la investigación o nuevas investigaciones, pero brevemente.

Conclusiones. Recapitulación de los hallazgos más importantes del trabajo para el futuro de la investigación. Sólo deben relacionarse conclusiones que se apoyen en los resultados y discusión del estudio. Debe comentarse la significación del trabajo, sus limitaciones y ventajas, aplicación de los resultados y trabajo posterior que debería ser desarrollado.

3.2.2. Artículos de revisión

Los artículos de revisión histórica contemplarán los apartados y el formato de las *investigaciones originales*. Las revisiones sobre el estado o nivel de desarrollo científico de una temática concreta deberán ser sistemáticas.

3.2.3. Ensayos

Esta sección de *Cultura, Ciencia y Deporte* admitirá ensayos, correctamente estructurados y suficientemente justificados, fundamentados, argumentamos y con coherencia lógica, sobre temas relacionados con el deporte, que tengan un profundo trasfondo filosófico o antropológico que propicie el avance en la compresión del deporte como fenómeno genuinamente humano. Pretende ser una sección dinámica, actual, que marque la línea editorial y la filosofía del deporte que subyace a la revista. No precisa seguir el esquema de las investigaciones originales, pero sí el mismo formato.

3.3. Información relevante de la revista

3.3.1. La revista *Cultura, Ciencia y Deporte* se adhiere al *"Code of Conduct and the Best Practices Guidelines for Journals Editors del Committee on Publication Ethics – COPE"* y a las recomendaciones del *"International Committee of Medical Journal Editors - ICJME".* Existe compromiso por parte de la revista para la detección de plagio y otros tipos de fraude en la redacción y presentación de artículos a *Cultura, Ciencia y Deporte.*

3.3.2. La política editorial de la revista promueve el uso de lenguaje inclusivo en los artículos científicos. Por favor, tenga en cuenta esta directriz y revise su documento antes de remitirlo a la revista.

4. TRATAMIENTO DE DATOS PERSONALES

En virtud de lo establecido en el artículo 17 del Real Decreto 994/1999, por el que se aprueba el Reglamento de Medidas de Seguridad de los Ficheros Automatizados que contengan Datos de Carácter Personal, así como en la Ley Orgánica 15/1999 de Protección de Datos de Carácter Personal, y la Ley Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales, la Dirección de *Cultura, Ciencia y Deporte* garantiza el adecuado tratamiento de los datos de carácter personal.

5. INFORMACIÓN RELATIVA A LA CORRECCIÓN DE PRUEBAS / GALERADAS UNA VEZ ACEPTADO EL ARTÍCULO

En caso de aceptación, el autor designado como responsable de correspondencia recibirá un informe de estilo (con aspectos de formato a modificar, en caso de que sea necesario) junto con un documento donde se solicitarán los nombres y apellidos de todos los autores junto a su afiliación (para el encabezado del artículo), la aportación de cada uno de los autores, las redes sociales de los autores y los agradecimientos. Dichos documentos se devolverán completos en un plazo máximo de tres días. Posteriormente, recibirá en su email una prueba de imprenta del artículo en formato PDF. La prueba se revisará y se marcarán los posibles errores con la opción notas de Adobe Acrobat, devolviendo las pruebas corregidas a la redacción de la revista en un plazo máximo de 48 horas. De no recibir estas pruebas en el plazo fijado, el Comité Editorial de la revista podrá decir publicar el artículo en su estado origi-

nal, no pudiendo hacerse cambios tras su publicación y no haciéndose responsable la revista de cualquier error u omisión que pudiera publicarse; o retrasar su publicación a un número posterior. En esta fase de edición del manuscrito, las correcciones introducidas deben ser mínimas (erratas). El equipo editorial se reserva el derecho de admitir o no las correcciones efectuadas por el autor en la prueba de impresión.

6. INFORMACIÓN SOBRE LA APORTACIÓN DE TODOS LOS FIRMANTES DEL ARTÍCULO

Los autores deberán informar sobre el criterio escogido para decidir el orden de firma y sobre la contribución específica realizada por cada uno de ellos en el trabajo publicado. Esta información se pedirá en la hoja final donde se solicita a los autores sus datos, afiliaciones, aportaciones de los autores, redes sociales y agradecimientos. En la lista de autores firmantes deben figurar únicamente aquellas personas que han contribuido intelectualmente al desarrollo del trabajo. En general, para figurar como autor se deben cumplir los siguientes requisitos: a) haber participado en la concepción y realización del trabajo que ha dado como resultado el artículo en cuestión; b) haber participado en la redacción del texto y en las posibles revisiones del mismo; c) haber aprobado la versión que finalmente va a ser publicada. El equipo editorial de *Cultura, Ciencia y Deporte* rehúsa cualquier responsabilidad sobre posibles conflictos derivados de la autoría de los trabajos que se publican en la revista.

El autor firmante como autor de correspondencia será el encargado de actuar como mediador entre la revista y los demás autores y debe mantener informados a todos los coautores e involucrarlos en las decisiones importantes sobre la publicación. Posteriormente a la aceptación del artículo no se admitirán cambios en el mismo (salvo erratas), por lo que se recomienda contar con el visto bueno de todos los coautores antes de remitir las revisiones a la revista.

7. REGISTRO DE LA FUENTE DE FINANCIACIÓN DE LOS ARTÍCULOS PUBLICADOS

Los autores deberán declarar si el trabajo ha tenido algún tipo de financiación para realizar la investigación que se pretende publicar, así como los proyectos de investigación o contratos financiados de la que es resultado. Esta información se deberá incluir en los metadatos de la revista a la hora de cargar el artículo en la plataforma. Además, se volverá a pedir esta información en la hoja final donde se solicita a los autores sus datos, filiaciones, aportaciones, redes sociales y agradecimientos.

8. ABONO EN CONCEPTO DE FINANCIACIÓN PARCIAL DE LA PUBLICACIÓN

Las normas de este apartado entran en vigor para los envíos y revisiones realizadas a partir del 29 de octubre de 2019.

De acuerdo con la filosofía de *Open Access* de la revista y con el fin de sufragar parte de los gastos de la publicación en aras de mejorar la calidad de la misma, la visibilidad y la repercusión de la publicación, CCD fija una tarifa de publicación de 120 € (IVA incluido). Este pago deberá hacerse efectivo tras la comunicación de la aceptación del artículo.

Para ello tras la aceptación del artículo se debe enviar a gjimenez@ucam.edu el resguardo de la transferencia realizada al nº de cuenta ES02 0081 5089 3800 0109 4420 (CODIGO BIC-SWIFT: BSABESBB), cuyo titular es la "FUNDACIÓN UNIVERSITARIA SAN ANTONIO", indicando en el concepto "Revista CCD + nº del artículo".

Por otra parte, los revisores de artículos CCD tendrán derecho a una publicación sin coste por cada tres artículos que hayan revisado en el tiempo y la forma solicitada por los editores. A tal fin, deben indicar los artículos revisados si quieren beneficiarse de la exención de pago cuando se les solicite el mismo. Los editores están exentos de pago.

9. ACTUALIZACIÓN IMPORTANTE EN LA NORMATIVA DE ENVÍO QUE ENTRARÁ EN VIGOR PARA TODOS LOS ARTÍCULOS ENVIADOS A PARTIR DEL 1 DE ENERO DEL 2021.

Todos los autores que realicen un envío a partir de dicha fecha (en un idioma diferente al inglés), y cuyo artículo finalmente sea aceptado, también deberán remitir la versión definitiva en inglés. En la versión en inglés deberá aparecer el nombre completo del traductor y su email. La intención de este cambio es aumentar la difusión de los artículos publicados en nuestra revista.

10. PROPUESTA DE PUBLICACIÓN DE MONOGRÁFICOS EN *CULTURA, CIENCIA Y DEPORTE.*

Las personas interesadas en proponer la publicación de un monográfico en la *Revista Cultura, Ciencia y Deporte,* deben enviar una descripción de 500-600 palabras (incluidas referencias) a la dirección email de la revista (ccd@ucam.edu). En dicho email, el coordinador o coordinadores del mismo (máximo 3 personas) deben realizar una aproximación a la temática y contenido del monográfico propuesto, así como sus CV.

Una vez aceptada la propuesta de monográfico, se establecerá un período de llamada de artículos *"Call for papers"* y una fecha límite de envíos "*Deadline"* cuya duración será determinada por el coordinador del mismo. El equipo editorial de la *Revista Cultura, Ciencia y Deporte* propondrá la fecha prevista de publicación del monográfico en función de su disponibilidad.

Las funciones del coordinador del monográfico serán, redactar el editorial del mismo, y aportar un listado de posibles revisores que serán seleccionados por el equipo editorial para llevar a cabo las revisiones por pares de los artículos del monográfico. Para que el monográfico sea publicado serán necesarios un mínimo de 10 artículos aceptados. El coordinador del monográfico tendrá la posibilidad de invitar autores para que colaboren con sus manuscritos. La decisión final de aceptación para que un artículo forme parte del monográfico será del equipo editorial, no del coordinador del monográfico. Todos los manuscritos aceptados para publicación, incluido el editorial, contarán con DOI.

11. PUBLICACIÓN DE ARTÍCULOS EN UN MONOGRÁFICO

Los manuscritos deben presentarse a través de la web *Cultura, Ciencia y Deporte* (https://ccd.ucam.edu), registrándose e iniciando sesión. Durante el proceso de envío, se seleccionará la pestaña con el nombre del monográfico donde se pretende publicar. Se invita a presentar artículos de investigación y de revisión. Los trabajos aceptados se

publicarán en la página web de la *Revista Cultura, Ciencia y Deporte*, y contarán con su correspondiente DOI.

Los manuscritos que se presenten no deben haber sido publicados anteriormente, ni estar en consideración para su publicación en otro lugar. Todos los manuscritos se someten a un riguroso proceso de revisión por pares a ciegas. Los manuscritos deben redactarse de acuerdo a las directrices generales de la revista: **https://ccd.ucam.edu/index.php/revista/about/submissions#authorGuidelines** y siguiendo las directrices del template de la revista (https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true).

El coste de procesamiento de artículos para los autores en números especiales (monográficos) de acceso abierto es de 250 euros por artículo (IVA incluido). El coordinador del monográfico no debe abonar ninguna tasa por la edición del editorial y tendrá un artículo gratuito en dicho monográfico. Los artículos presentados deben tener el formato correcto de acuerdo a las normas de publicación de la revista, de lo contrario no serán aceptados. Los envíos pueden realizarse en idioma español o inglés, siendo necesario en caso de que se hayan enviado en español su traducción al inglés por parte de los autores una vez que el artículo haya sido aceptado.

CHECKLIST FORMATO PARA ARTÍCULOS EN *CCD*

- *Texto*: adaptado al template disponible en la página web y en las normas de publicación de la revista.
- *Alineación del texto:* a izquierda y derecha (justificada).
- *Extensión:* no debe sobrepasar las 7500 palabras incluyendo Figuras, Tablas, y Referencias.
- *Primera página:* debe contener los siguientes elementos del trabajo: título del artículo en español y en inglés en minúscula, un resumen del trabajo en español y en inglés, más las palabras claves en español y en inglés. Por este orden, o el contrario si el artículo está escrito en inglés.
- *Segunda página*: se iniciará con el texto completo del artículo. El cuerpo de texto del trabajo deberá empezar en página independiente de la anterior de los resúmenes.
- Indicación clara de los apartados o secciones de que consta, así como con una clara jerarquización de los posibles sub-apartados (primer nivel irá en negrita y sin tabular, segundo irá en cursiva y sin tabular, tercero irá en cursiva y con una tabulación). Todos ellos en minúscula.
- *Título*: Se recomiendan 10-12 palabras.
- *Resumen:* La longitud no debe sobrepasar las 200 palabras.
- *Palabras clave*: 4 ó 5 palabras que reflejen claramente cuál es el contenido específico del trabajo.
- No repetidas del título.
- *Figuras y Tablas*: introducidas en el archivo "Tablas y Figuras", con su numeración correlativa.
- *Figuras y Tablas*: leyenda de las Figuras en su parte inferior y la leyenda de las Tablas en su parte superior.
- *Figuras y Tablas*: Mantener las tablas simples sin líneas verticales.
- *Figuras y Tablas*: El tamaño de la fuente en las tablas podrá variar en función de la cantidad de datos que incluya, pudiéndose reducir hasta 8 cpi máximo.
- *Citas y referencias:* Deben seguir formato APA 7th edición.
- *Agradecimientos:* se colocan al final del artículo, tras las referencias.
- *Envío*: se incluyen dos manuscritos, uno con el nombre de "**artículo con autores**" y el otro "**artículo anónimo**"; un documento con "**5 potenciales revisores"**; y un documento de "**Tablas y Figuras**".

En Murcia, a 19 de Agosto de 2022

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CULTURA, CIENCIA Y DEPORTE MANUSCRIPTS SUBMISSION GUIDELINESS

Cultura, Ciencia y Deporte will consider research studies related to the different areas of Physical Activity and Sport Sciences, which are scientifically based. Given the specialized nature of the journal, popular articles will not be accepted, nor will those limited to exposing opinions without conclusions based on academic investigation. Papers should be sent electronically through our website: http://ccd.ucam.edu, where the author must register as an author and proceed as indicated by the tool.

1. CCD TEMPLATE

THE JOURNAL CULTURA, CIENCIA Y DEPORTE HAS A TEMPLATE THAT MUST BE USED FOR THE SUBMISSION OF NEW ARTICLES. YOU CAN FIND IT AT THE FOLLOWING LINK: https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true

You should not edit the document on the web page. You must click on "Archivo/File", click on "Descargar/Download" and select "Microsoft Word". Once you have the template downloaded to your device you will be able to edit it.

This Template will NOT include tables and figures. These should be included in a separate file titled "Tables and Figures". You can find it in the following link: https://docs.google.com/document/d/1tHreE-78C9pbLmWWhFYSa-lRyVb5B4HP/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true

2. CONDITIONS

All manuscripts received will be examined by the Editorial Board of *Cultura, Ciencia y Deporte*. If the manuscript adequately fulfills the conditions defined by the Editorial Board, it will be sent on for the anonymous peer review process by at least two external reviewers, who are members of the Advisory Committee. The manuscripts rejected in this first evaluation will be returned to the author with an explanation of the motives for which the paper was not admitted. Likewise, the authors of those manuscripts that having passed this first filtering process may be subsequently required to alter any corrections needed in their manuscript as quickly as possible. Acceptance of the article for publication in Cultura, Ciencia y Deporte, will require the positive judgment of the two reviewers, and where appropriate, of a third review. Throughout this process, the manuscript will continue to be in possession of the journal, though the author may request that his/her paper be returned if so desired. The publication of articles does not entitle any remuneration. Editing rights belong to the journal and permission is required for any reproduction. The acceptance of an article for publication in the *Cultura, Ciencia y* Deporte implies the author's transfer of copyright to the editor, to allow the paper to be reproduced or published in part or the entire article. Within four months the outcomes from any paper submitted will be communicated to the author.

3. SUBMISSION

3.1 General guideliness

Manuscripts must be submitted via http://ccd.ucam.edu/index.php/revista/login. All text should be written according to the guidelines in the **journal template** (https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/t?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true), without modifying the font or size of the text. If your article is accepted for publication, it will present the layout of the final template, therefore, please review it carefully before submitting it. The maximum recommended length should not exceed 7500 words including Figures, Tables and Reference List.

Each submission will consist of **FOUR DOCUMENTS**. The first one will be called "**anonymous article**" in which the title of the paper, the abstract, the keywords, the text of the paper and the references will be included, **WITHOUT ANY INDICATION THAT ALLOWS THE REVIEWERS TO IDENTIFY THE AUTHORS OF THE MANUSCRIPT**. **THE "ANONYMOUS ARTICLE" MUST BE ATTACHED ON THE PLATFORM IN THE "ARTICLE TEXT" OPTION**. The second will be called "**article with authors**" and will include in the manuscript the name of all authors who are part of the paper, as well as their affiliations, author of correspondence, committee codes (e.g., ethics committee), linked research projects, acknowledgements and funding. **THE "ARTICLE WITH AUTHORS" MUST BE ATTACHED IN THE PLATFORM UNDER THE "OTHER" OPTION**. The third document will be called "**potential reviewers for the manuscript**" and should include 5 potential reviewers (name, surname, institution and email) who have not been coauthors of the authors of the manuscript in the last three years and who do not belong to the same institution. **THE DOCUMENT OF "POSSIBLE REVIEWERS FOR THE MANUSCRIPT" MUST BE ATTACHED IN THE PLATFORM IN THE "OTHER" OPTION.** And the fourth document will be called "**Tables and Figures**" and should include all the tables and figures of the manuscript. In the "anonymous article" and in the "article with authors" the place where each Table and/or Figure should be inserted must be clearly specified, indicating "Table x here". **THE "TABLES AND FIGURES" DOCUMENT MUST BE ATTACHED IN THE PLATFORM IN THE "OTHER" OPTION.**

- On the **first page** of the article, the following elements should be presented (in this order, or the opposite order if the text of the article is in English). It is important not to include the names of the authors or their affiliation in the document entitled "**anonymous article**", but this should be done in "**article with authors**".

  - **Title** in Spanish and English (both in lowercase, without full stop). 10 – 12 words are recommended. Since it will be shown on the index information, the title should be informative itself and call the attention of potential readers. The title must be concise and avoid being over long.

  - **Abstract** of the work in Spanish and English.

  a. Should reflect the content and purpose of the manuscript.

  b. If the paper is reproducing another author´s work, it should be acknowledged.

c. The length of the abstract should not exceed **200 words**.

d. The abstract should include: the problem, if possible in one sentence; participants, identifying the main variables (number, age, gender, etc.); methodology (design, equipment, procedure data collection, full names of tests, etc.); results (including levels of statistical significance); conclusions and implications or applications. The summary should not be unstructured and **should be written in a single paragraph**.

- **Key words** in Spanish and English**.** 4 or 5 words that reflect the specific content of the work (in italics and not included in the title). Only the first word is written with a capital letter. Words should be separated with commas, and a full stop at the end of a sentence. plus the key words in Spanish and English, in this order, or the opposite if the item is in English. A full stop should not be included at the end of the title.

- On the **second page** of the article, will start the **full text** of the article. Full text of the article should begin on separate page to the abstracts with a clear indication of the paragraphs or sections and with a clear hierarchy of possible sub-paragraphs: .
  - The first level should be in bold, without tabs and lowercase.
  - The second should be without bold, tabs and lowercase.
  - The third should be in italics, without tabs and lowercase.
- After the full text, a section on **Acknowledgments** will be included, for people who have contributed with ideas or readings, or who have participated in the fieldwork, etc.; and a **Financing** section, indicating the project in which the research is included and declaring the entities that support it.
- After the Acknowledgments and Funding sections, a **References** section must be included. Citations and references in the text and in the specific section must be made in **APA 7th ed** regulations. Below is a summary of it:
  - References through the text.
  - References of three or more authors only the first author should appear followed by "et al." For example: Fernandez et al. (2019).
  - The literal references will be made in the text, after being reference in parentheses, the author's last name, coma, the year of the cited work, coma and page where the text: (Sanchez, 1995, 143).
  - If you want to make a generic reference in the text, i.e. without specifying the page of the book or article, it should be cited as follows: the author's name, comma and year of publication in parentheses: (Ferro, 2015).
  - References cited in the text should appear in the reference list.
  - The references included in the same parentheses should be in alphabetical order.
  - Whenever the reference is included in parentheses: the "&" will be used. When the reference is not included in parentheses, "and" should always will be used. The references of two authors are linked by "and" or "&", and references from various authors end up in a coma plus "and" or "&". For example: Fernandez and Ruiz (2008) or Moreno, Ferro, and Diaz (2007).
  - When citing two authors with the same name, the initials of the relevant names must precede them.
  - When the same author published two or more pieces of work in the same year, their work should add in the lowercase letters a, b, c. For example: Ferro (1994a, 1994b).
  - At the end of the manuscript – References list
  - Authors are listed in alphabetical order, independently of the number. When various authors are listed, the alphabetical order should be determined in each work by the first author, then the second, then the third successively.
  - The DOI (Digital Object Identifier) must be used in the bibliographic citations of articles and electronic publications:
  - Muñoz, V., Gargallo, P., Juesas, Á., Flández, J., Calatayud, J., & Colado, J. (2019). Influence of the different types and parameters of the physical exercise on seminal quality: a systematic review of the literature. *Cultura, Ciencia y Deporte*, *14(40), 25-42*. http://dx.doi.org/10.12800/ccd.v14i40.1223
  - References of various authors will be separated by a comma and "&". Some examples as follows:

    Author, A. A.; Author, B. B., & Author, C. C. (2020). Title. *Journal, xx*(x), xxx-xxx. http://dx.doi.org/xxxxxx

    Author, A. A. (2020). *Title*. Publisher.

    Author, A. A., & Author, B. B. (2020). Title. In A. Editor, B. Editor, & C. Editor. (Eds.),

    Book title (pp. xxx-xxx). Publisher.

    Author, A. A.; Author, B. B., & Author, C. C. (in press). Title. *Journal*

- In addition, for correct referencing:
  - If there are two authors, add a comma before "&".
  - After a ":" (colon) a capital letter should be used.
  - Just type the uppercase for the first letter of the first word of the title for a Book reference. However, titles of journal references are capitalized, using the first letter of each word.

3.2 Type of papers that can be submitted for evaluation in CCD

3.2.1 Original research

These are articles that account for an empirical study set in original parts that reflect the steps taken in the investigation. The full text must have the following structure:

3.2.1.1 Introduction. State the problem of the investigation and the aim and hypothesis of the work. The research problem should be substantiated theoretically, describing the experimental approach to the problem. In the last paragraph, the aim of the work should be established clearly.

Use **italics** to show relevant information. Underline, bold or capital letters are not allowed. The use of abbreviations should be as minimum as possible. See the International System of Units for general style guidelines International System of Units.

3.2.1.2 Method. Description of the methodology used in the research process. This section should be detailed enough to allow the reader to understand all aspects regarding what and how the research has been developed. Well known techniques used within the study should be abbreviated. Information about the participants must be displayed to describe their basic characteristics and criteria used for the distribution of participants in any group. The experiment must be reproducible by others and methods, devices, procedures and variables must be detailed. Methods used by other authors should include a reference. All statistical procedures must be described. Numbers lower than ten should be in the form of text, if the numbers are equal to or greater than 10, they should be expressed numerically.

The method is usually divided into subsections:

- *Participants.* The sample´s characteristics (number, sex, age and other relevant characteristics in each case) and selection process. Studies involving humans or animals must cite the ethical committee that approved the study. When describing experiments that have been performed with human beings, it should be noted that in addition to the institutional or regional ethical committee, the study agrees with the World Medical Association and the Helsinki Declaration. No names, initials or numbers should be used to identify the participants.
- *Instruments.* Specify technical characteristics.
- *Procedure.* Summarize each step carried out in the research: instructions to the participants, groups, and specific experimental manipulations. If the study involves more than one experiment, describe the method and results of each of them separately. Numbered, Study 1, Study 2, etc.

Results. The results must be presented as accurately as possible. The discussion should be minimal and reserved for the Discussion section. The results may be presented as text, tables or figures.

To report statistical data, abbreviations should be in italics, as well as when using the *p*-value (which should always be in lowercase). For example: *p, F, gl, SD, SEM, SRD, ICC, ICC*. It is necessary to include a space before and after the equal sign (=). A space must be included also between the number and the unit of measure (not 7Kg but 7 Kg), conversely the space between the number and the percentage sign should not be included (7% and 7% do not). Decimals will be preceded by points (9.1 and not 9,1).

Do not include the same information in the text as used in the tables or figures. Figures and Tables should not be called by any other name. The Figures and Tables should be included in a separate document (Tables and Figures) and the place where they should appear in the text of the article should be indicated, with their correlative numbering, placing the legend of the Figures at the bottom and the legend of the Tables at the top.

Tables are an organized summary of words or figures in lines or lines. All tables must follow the APA format, including: a) their numbering in Arabic numerals, b) a title, c) only horizontal lines above the heading, below it and at the end of the table, without vertical lines, and d) background of white table. Decimals within tables must be separated by dock (.). All abbreviations or symbols used in it should be included at the bottom of the table. The font size in the tables may vary depending on the amount of data that is included, and can be illustrated up to 8 cpi as a maximum.

Table 1. Example Table 1 to include articles sent to CCD

	P5	POT	SDT	SDS	SDI	EQG	SDT	ENF	CA	EH	ES	Esuc	F	MT	ED
MT	9.1	21.2	9.1	6.1	92.0	63.6	9.0	33.3	3.0	30.3	15.5	12.1	0.0	82.1	35.5
ED	33.3	13.3	16.7	6.7	23.0	70.0	16.6	26.7	21.1	63.3	0.0	30	10.0	13.3	96.0

Note: P5=Write the meaning of abbreviations.

Table 2. Example Table 2 to include articles sent to CCD

Name 1	Item 1. Explanation of the characteristics of the item 1 Item 2. Explanation of the characteristics of the item 2 Item 3. Explanation of the characteristics of the item 3
Name 2	Item 1. Explanation of the characteristics of the item 1 Item 2. Explanation of the characteristics of the item 2 Item 3. Explanation of the characteristics of the item 3

The Figures are exposures of data in a non-linear way by means of iconic resources of any genre. If photographs are included, they must be carefully selected, ensuring that they have a quality of at least 300 pixels / inch and 8 cm wide. If photographs are reproduced, subjects should not be identified. In any case, the authors must have obtained the informed consent for the realization of these images, authorizing their publication, reproduction and dissemination in CCD. Figures should be included in the text, including: a) their numbering in Arabic numerals, b) a title.

3.2.1.4. Discussion. The discussion is an interpretation of the results and their implications. This section should relate the results of the study to theory, and or, previous research with references and discuss the significance of what has been achieved. A general review of the problem must not be included. The discussion will be focused on the most important results of the study and avoid repeating the results shown in the previous paragraph. Avoid controversy, triviality and comparisons theoretical surface. Speculation is appropriate if it appears as such and is closely related to the theory and empirical data. Identify theoretical and practical implications of the study. Suggest improvements in the investigation or further investigation, but briefly.

3.2.1.5. Conclusions. Summarize the most important findings of the work for future research. Only conclusions supported by the results of the study and discussion must be presented. The significance of the work, its limitations and advantages, the application of results and future lines of investigation should be presented.

3.2.2. Review articles.

Historical review articles should use the following the same sections and style from original research. Reviews on the status of an issue should be systematic.

3.2.3. Essays.

This section of *Cultura, Ciencia y Deporte* will admit essays, properly structured and sufficiently justified, grounded, we argue and with logical coherence, on issues related to sport, that have a deep philosophical or anthropological background that promotes the advance in the compression of sport as a phenomenon genuinely human. It aims to be a dynamic, current section that marks the editorial line and the philosophy of the sport that underlies the journal. You do not need to follow the original research scheme, but the same format.

3.3. Relevant information from the journal

3.3.1. The journal *Cultura, Ciencia y Deporte* adheres to the "Code of Conduct and the Best Practices Guidelines for Journals Editors of the Committee on Publication Ethics - COPE" and the recommendations of the "International Committee of Medical Journal Editors - ICJME". There is a commitment by the journal to detect plagiarism and other types of fraud in the writing and submission of articles to *Cultura, Ciencia y Deporte.*

3.3.2. The journal's editorial policy promotes the use of inclusive language in scientific articles. Please take note of this guideline and review your document before submitting it to the journal.

4. TREATMENT OF PERSONAL DATA

In virtue of what was established in article 17 of the Royal Decree 994/1999, in which the Regulation for Security Measures Pertaining to Automated Files That Contain Personal Data was approved, as well as the Constitutional Law 15/1999 for Personal Data Protection, and Law Organic Law 3/2018, of 5 December, on the Protection of Personal Data and guarantee of digital rights, the editorial committee of *Cultura, Ciencia y Deporte* guarantees adequate treatment of personal data.

5. INFORMATION REGARDING PROOFS AFTER ACCEPTANCE OF THE ARTICLE

In case of acceptance, the author appointed as correspondent will receive a style report (with formatting aspects to be modified, if necessary) together with a document requesting the names and surnames of all authors together with their affiliation (for the head of the article), the contribution of each of the authors, the authors' social networks and acknowledgements. These documents will be returned complete within a maximum of three days. You will then receive a proof of the article in PDF format by email. The proof will be reviewed and any errors marked with the Adobe Acrobat notes option, and the corrected proofs will be returned to the journal's editorial staff within a maximum of 48 hours. If these proofs are not received by the deadline, the journal's Editorial Committee may decide to publish the article in its original state, with no changes made after publication and the journal will not be responsible for any errors or omissions that may be published; or delay publication to a later issue. At this stage of editing the manuscript, corrections made should be kept to a minimum. The editorial team reserves the right to admit or not the corrections made by the author in the proof print.

6. INFORMATION ON THE CONTRIBUTION OF ALL SIGNATORIES TO THE ARTICLE

Authors must inform about the criteria chosen to decide the order of signature and about the specific contribution made by each one of them in the published work. This information will be requested on the final sheet where the authors are asked for their details, affiliations, contributions from the authors, social networks and acknowledgements. Only those persons who have contributed intellectually to the development of the work should appear on the list of signatory authors. In general, in order to appear as an author, the following requirements must be met: a) to have participated in the conception and execution of the work that has resulted in the article in question; b) to have participated in the drafting of the text and possible revisions of the same; c) to have approved the version that is finally going to be published. The editorial team of *Cultura, Ciencia y Deporte* refuses any responsibility for possible conflicts derived from the authorship of the works published in the journal.

The author who signs as a correspondent will be responsible for acting as a mediator between the journal and the

other authors and must keep all co-authors informed and involved in important decisions about the publication. After the article has been accepted, no changes will be made to it, and it is therefore recommended that all co-authors give their approval before revisions are sent to the journal.

7. SOURCE OF FUNDING FOR PUBLISHED PAPERS

Authors must declare whether the work has had any funding to carry out the research to be published, as well as the research projects or contracts funded as a result. This information must be included in the journal's metadata when the article is uploaded to the platform. In addition, this information will be requested again in the final page where authors are asked for their data, affiliations, contributions, social networks and acknowledgements.

8. PAYMENT IN CONCEPT OF PARTIAL FINANCING OF PUBLICATION

The rules in this section are effective for submissions and revisions send from 29 October, 2019. In accordance with the Open Access philosophy of the journal and in order to cover part of the expenses of the publication in to improve its quality, visibility and impact of the publication, CCD sets a publication fee of €120 (VAT included). This payment must be done after the notification of acceptance of the article.

To do this, after acceptance of the article, the receipt of the transfer made to "FUNDACIÓN UNIVERSITARIA SAN ANTONIO" in the account number ES02 0081 5089 3800 0109 4420 (BIC-SWIFT CODE: BSABESBB) must be sent to gjimenez@ucam.edu, indicating in the concept of the transfer "CCD journal + article number".

Furthermore, reviewers of CCD articles will be entitled to a free publication for every three articles they have reviewed in time and in the form requested by the editors. To this end, they must indicate the reviewed articles if they want to benefit from the exemption of payment when requested. Editors are exempt from payment.

9. IMPORTANT UPDATE IN THE SENDING REGULATIONS AS OF JANUARY 1, 2021.

All authors who submit an article after this date (in a language other than English), and whose article is finally accepted, must also submit the final version in English. The full name of the translator and his/her e-mail address must appear on the English version. The intention of this change is to increase the circulation of articles published in our journal.

10. PROPOSAL FOR THE PUBLICATION OF MONOGRAPHS ON *CULTURA, CIENCIA Y DEPORTE*

Those interested in proposing the publication of a monograph in the journal Cultura, Ciencia y Deporte should send a 500-600 word description (including references) to the journal's email address (ccd@ucam.edu). In this email, the coordinator or coordinators (maximum 3 people) must provide an approximation of the subject matter and content of the proposed monograph, as well as their CVs.

Once the monograph proposal has been accepted, a "Call for papers" period and a "Deadline" for submissions will be established, the duration of which will be determined by the coordinator of the monograph. The editorial team of the Journal Cultura, Ciencia y Deporte will propose a date for the publication of the monograph according to its availability.

The functions of the coordinator of the monograph will be to write the editorial of the monograph, and to provide a list of possible reviewers who will be selected by the editorial team to carry out the peer reviews of the articles in the monograph. A minimum of 10 accepted articles will be required for the monograph to be published. The coordinator of the monograph will have the possibility to invite authors to collaborate with their manuscripts. The final decision as to whether an article is accepted for inclusion in the monograph will be made by the editorial team, not by the monograph coordinator. All manuscripts accepted for publication, including the editorial, will have a DOI.

11. PUBLICATION OF ARTICLES IN A MONOGRAPH

Manuscripts must be submitted through the Cultura, Ciencia y Deporte website (https://ccd.ucam.edu), by registering and logging in. During the submission process, select the tab with the name of the monograph where you intend to publish. Research and review articles are invited. Accepted papers will be published on the website of the Journal Cultura, Ciencia y Deporte, and will have their corresponding DOI.

Manuscripts submitted must not have been previously published, nor be under consideration for publication elsewhere. All manuscripts undergo a rigorous blind peer review process. Manuscripts should be written according to the general guidelines of the journal:

https://ccd.ucam.edu/index.php/revista/about/submissions#authorGuidelines and following the guidelines of the journal's template (https://docs.google.com/document/d/1jCGV_xVUqsxpQ2WYkOy9nFiC-Q2w3Vu3/edit?usp=sharing&ouid=109045219128359206476&rtpof=true&sd=true).

The article processing fee for authors in open access special issues (monographs) is 250 euros per article (including VAT). The coordinator of the monograph is not required to pay any editorial editing fee and will have a free article in the monograph. Articles submitted must be in the correct format according to the journal's publication guidelines, otherwise they will not be accepted. Submissions can be made in Spanish or English, and if the article is submitted in Spanish, it must be translated into English by the authors once the article has been accepted.

CHECKLIST FORMAT FOR ARTICLES IN CCD

- Text: adapted to the template available on the website and in the journal's publication guidelines.
- Text alignment: left and right (justified).
- Length: should not exceed 7500 words including figures, tables, and references.
- First page: should contain the following items of the work: title in Spanish and English in lowercase, a summary of the work in Spanish and English, plus the key words in Spanish and English. By this order, or the opposite if the article is written in English.

- Second page: start with the text. The main document should be in a new page (after abstract).
- Clear indication of paragraphs or sections that comprise, and with a clear hierarchy of
- possible sub-sections (first level will be without tabulating in bold type, second will be in italic without tabulating, and the third will be in italics and with tabulation). All in lowercase letter.
- Title: Recommended 10 to 12 words.
- Abstract: The length of the abstracts should not exceed 200 words.
- Keywords: 4 or 5 words that clearly reflect what the specific content of the work. Do not
- repeat the title. Only the first word is written with capital. Words separated with commas, and point at the end.
- Figures and Tables: In the "Tables and Figures" document, with consecutive numbering.
- Figures and Tables: Figures caption in the bottom and Tables caption at the top.
- Figures and Tables: Maintain simple tables without vertical lines.
- Figures and Tables: The font size in the tables may vary depending on the amount of data that includes, and can be cut up to 8 cpi.
- References: They must follow the APA 7th edition format.
- Acknowledgements: They must be placed in the application in the space defined for this purpose.
- Submission: two manuscripts are included, one with the name "**article with authors**" and the other "**anonymous article**"; a "**5 potential reviewers**" document; and a "**Tables and Figures**" document.

Murcia,19th August 2021

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MANUAL DE AYUDA PARA LOS REVISORES EN EL PROCESO DE REVISIÓN DE ARTÍCULOS EN CCD*

Estimado revisor, su labor es inestimable. Le estamos extraordinariamente agradecidos. Sin su aportación rigurosa, la calidad de los trabajos que se publican en CCD, no sería tal. Es por ello por lo que estamos completamente abiertos a tantas recomendaciones y aportaciones que sirvan para mejorar el ya de por sí complejo proceso de revisión. En esta nueva etapa de CCD tenemos una premisa: agilidad, eficiencia y rigor de los procesos de revisión. Por ello le pedimos que, por favor, plantee valoraciones sólidas y las argumente de forma constructiva con un objetivo principal: mejorar la calidad del artículo (siempre que sea posible). Además, le recomendamos que tenga en cuenta las premisas para los revisores que marca la *Declaración de Ética y Negligencia de la Publicación* que puede ver en el pie de página.

A continuación se presenta un manual, en el que los revisores de la revista CCD podrán seguir paso a paso todas y cada una de las tareas que deben acometer para realizar un proceso de revisión riguroso y que se ajuste a las características de la plataforma de revisión (OJS) y de la filosofía de la revista. Cualquier duda que le surja, por favor, no dude en contactar con los editores de la revista (rvaquero@ucam.edu y labenza@ucam.edu). Todas y cada una de las fases se describen a continuación:

1. El revisor recibe el e-mail de CCD con la solicitud de revisión de un artículo. Debe decidir si acepta (o no) la petición del editor de sección. Para ello, debe clicar sobre el título del artículo dentro de "Envíos activos".

2. Una vez hecho esto, aparecerá una pantalla como la siguien- te, en la que el revisor debe seleccionar si hará (o no) la revisión. Si se acepta (o no), aparecerá una ventana automática con una plantilla de correo al editor de sección para comunicarle su decisión. Independientemente de su decisión, el revisor debe enviar este correo electrónico. Una vez la revisión es aceptada el revisor debe cumplir las indicaciones que aparecen en la pantalla siguiente.

3. A continuación debe primero abrir y descargar el fichero del manuscrito; y segundo, abrir y descargar la hoja de evaluación de CCD que puede encontrar en el apartado "Normas de revisor" (parte inferior en el epígrafe 1). La revisión y todos los comentarios que el revisor realice deberán plasmarse en esta hoja de evaluación (nunca en el texto completo a modo de comentarios o utilizando el control de cambios). Con ambos documentos descargados se procederá a la revisión propiamente dicha. Es muy importante que el revisor conozca las normas de publicación de CCD, para proceder de forma exhaustiva. Si bien los editores en fases previas del proceso de revisión han dado visto/bueno al formato del artículo, es importante que se conozcan las normas a nivel general para poder evaluar el artículo con mayor rigurosidad.

4. Una vez completada la revisión y rellenada la hoja de evaluación puede escribir algunos comentarios de revisión para el autor y/o para el editor. El comité editorial de CCD recomienda no introducir comentarios específicos en estos apartados. De utilizarse (pues no es obligatorio) se recomienda que hagan una valoración global del artículo, en la que se utilice un lenguaje formal.

5. A continuación debe subir el fichero con la hoja de evaluación del manuscrito actualizada. En este apartado únicamente se debe subir un archivo con la correspondiente evaluación del artículo. No se olvide de clicar en "Subir" o de lo contrario, a pesar de haber sido seleccionado, no se subirá el archivo, y el editor de sección no podrá acceder a él.

6. Por último, se debe tomar una decisión sobre el manuscrito revisado y enviarla al editor. Para ello debe pulsar el botón de enviar el correo, ya que de no ser así el correo no será enviado. Las diferentes opciones de decisión que la plataforma ofrece son las que puede ver en la pantalla. En el caso de considerar que "se necesitan revisiones" o "reenviar para revisión" llegado el momento, el editor se volverá a poner en contacto con usted y le solicitará empezar con la segunda (o siguientes rondas de revisión), que deberá aceptar y volver a empezar el proceso tal y como se explica en el presente manual. Caso de aceptar o rechazar el manuscrito, el trabajo del revisor habrá terminado cuando informe al editor de sección de esta decisión, tal como se ha indicado anteriormente (correo al editor mediante la plataforma).

En la segunda y siguientes rondas de revisión, el revisor se encontrará con dos archivos: uno con el texto completo del manuscrito, en el que el autor ha modificado con otro color distinto al negro en función de las aportaciones sugeridas; y otro fichero adicional con la planilla de evaluación, en la que el autor ha res- pondido punto por punto en un color distinto al negro, a todas las aportaciones que usted le hizo. Por favor, compruebe que todo está correctamente modificado. Caso de no producirse, responda en la misma hoja de evaluación con tantos comentarios considere, para que el autor pueda "afinar más" y realizar las modificaciones de forma satisfactoria y rigurosa. Este proceso se repetirá tantas veces como los editores de sección consideren oportuno.

Una vez completada la segunda (o siguientes rondas de revisión) del manuscrito, se volverá a tomar una decisión sobre el mismo, y se procederá de la misma manera que en la primera ronda. Una vez se da por finalizada la revisión doble-ciego del manuscrito, desaparecerá de su perfil de revisor, en el que encontrará 0 activos.

Equipo editorial de Cultura, Ciencia y Deporte.
(ccd@ucam.edu)

RESPONSABILIDADES DE LOS REVISORES

1) Los revisores deben mantener toda la información relativa a los documentos confidenciales y tratarlos como información privilegiada.
2) Las revisiones deben realizarse objetivamente, sin crítica personal del autor.
3) Los revisores deben expresar sus puntos de vista con claridad, con argumentos de apoyo.
4) Los revisores deben identificar el trabajo publicado relevante que no haya sido citado por los autores.
5) Los revisores también deben llamar la atención del Editor-jefe acerca de cualquier similitud sustancial o superposición entre el manuscrito en cuestión y cualquier otro documento publicado de los que tengan conocimiento.
6) Los revisores no deben revisar los manuscritos en los que tienen conflictos de interés que resulte de la competencia, colaboración u otras relaciones o conexiones con alguno de los autores, empresas o instituciones en relación a los manuscritos.

INFO FOR REVIEWERS IN THE REVIEW PROCESS FOR ARTICLES IN CCD*

Dear reviewer, your work is essential. We are remarkably grateful. Without your rigorous contribution, the qua-lity of the papers published in CCD would not be the same. That is why we are completely open to recommendations and contributions that can open the already complex process of revision. In this new stage of CDD we have a premise: agility, efficiency and the exactitude of the revision process. Thus, we please ask you solid ratings, and argue constructively with one main objective: to improve the quality of the article. In addition, we recommend you to consider the premises that denotes the Statement of Ethics and Publication Malpractice that can be ob-served in the footer.

Below a manual is presented, where the CCD journal reviewers are going to be able to follow step by step the process in order to perform a rigorous review process that fits the characteristics of the review platform (OJS) and the philosophy of the journal. Any questions that may raise, please do not hesitate to contact the publishers of the journal (rvaquero@ucam.edu y labenza@ucam. edu). Each and every one of the steps are described here:

1. The reviewer receives the e-mail of CCD with the request for revision of an article. You must decide whether to accept (or not) the request of the "Section Editor". For this, you must click on the title of the article under "Active Submissions".
2. Once this is done, a screen like the following one is going to appear in which the reviewer must select whether will (or not) review the article. If accepted (or not) an automatic window ap-pears with a template email to the Section Editor to communi-cate its decision. Regardless its decision, the reviewer must send this email. Once the revision is accepted, the reviewer should fo-llow the directions that appear on the screen below.
3. The next step is to open and download the file of the ma-nuscript; and second, open and download the evaluation sheet that can be found under the "Reviewer Guidelines" (in the sec-tion 1). The review and any comments that the reviewer makes, should be written in the evaluation sheet (not in the full text as a comment). It is very important that the reviewers knows the CCD publishing standards in order to proceed exhaustively. When the editors accept the format of the article, it is crucial that the re-viewers know the general rules, to assess more rigorously the article.
4. After completing the revision and filled the evaluation sheet, you can write some review comments to the author and/or publisher. The CCD editorial committee recommends not to introduce specific comments on these sections. If it needs to be used (not required) make an overall assessment of the article, using a formal language.
5. The next step consists of uploading the manuscript evalua-tion sheet updated. Here, you only need to upload a file with the corresponding evaluation of the article. Make sure you first click on "select file" and then on "upload".
6. Eventually, a decision on the manuscript must be taken and send it to the Editor. Thus, it is needed to press the button to send the email because if not it will not be sent. The different op-tions that can be chosen appear in the screen below. In the case of considering "revisions required" or "resubmit for review", the editor will get in touch with you and ask you to start with the second round (or further rounds), having to accept and start the same process that has been explained. If the manuscript is accepted or declined, the reviewer´s job will be over, informing the Section Editor by email.

In the second and subsequent rounds of review, the reviewer will find two files: one with the full text of the manuscript in which the author has modified with another colour different to black depending on the contributions suggested, and another additional file with the evaluation form, where the author has responded point by point in a different colour to black all contri-butions that the reviewer made. Please, check that everything is correctly modified. If not, answer the same evaluation sheet with the considered comments, so that the author can "refine" and make the changes in a satisfactory and rigorous way. This process will be repeated as many times as the Section Editors consider appropriate.

Once the second (or subsequent rounds of revision) of the ma-nuscript is completed, a new decision will be made, and proceed in the same way as in the first round. Once ends the double-blind review of the manuscript, it will di-sappear from your reviewer profile, where you will find none "Active Submissions".

Equipo editorial de Cultura, Ciencia y Deporte.
(ccd@ucam.edu)

RESPONSIBILITIES OF THE REVIEWERS

1) Reviewers should keep all information relating to confidential documents and treat them as privileged.
2) The revisions must be made objectively, without personal criticism of the author.
3) Reviewers should express their views clearly with supporting arguments.
4) Reviewers should identify relevant published work that has not been mentioned by the authors.
5) Reviewers also should draw the attention of Editor-in-chief about any substantial similarity or overlap between the manuscript in question and any other document of which they are aware.
6) Reviewers should not review manuscripts in which they have conflicts of interest resulting from competitive, collaborative, or other relationships or connections with any of the authors, companies, or institutions connected to the manuscripts.

BOLETÍN DE SUSCRIPCIÓN
SERVICIO DE PUBLICACIONES CIENTÍFICAS

CULTURA, CIENCIA Y DEPORTE
REVISTA DE LA FACULTAD DE DEPORTE

SUSCRIPCIÓN ANUAL
(Incluye 4 números en papel: marzo, junio, septiembre y diciembre)

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