

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.



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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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