EFFECTS OF A PHYSICAL EDUCATION PROGRAMME BASED ON KIN BALL ON BODY MASS INDEX AND BASIC PHYSICAL SKILLS IN STUDENTS WITH DOWN SYNDROME

EFECTOS DE UN PROGRAMA DE EDUCACIÓN FÍSICA BASADO EN KIN BALL SOBRE EL ÍNDICE DE MASA CORPORAL Y LAS HABILIDADES FÍSICAS BÁSICAS EN ALUMNOS CON SÍNDROME DE DOWN

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Effects on kin Ball on Students With Down's Syndrome

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Abstract

Currently, scientific literature establishes that people with special educational needs show high levels of sedentary lifestyles. Likewise, alternative sports are known for the numerous benefits they provide. This research aims to test whether a Kin ball sport initiation programme improves the effect of basic physical qualities on body mass index and coordination. A quasi-experimental study has been developed with a pre-test-pos-test group design. The sample consists of 47 participants with Down syndrome. A bioimpedance scale was used to collect body mass index. To assess data related to strength, flexibility, endurance, speed and coordination, the Eurofit battery adapted for people with intellectual disabilities was used. The results indicate that the intervention programme has improved the effect of speed, coordination, endurance and flexibility on coordination and body mass index. In conclusion, this study indicates that Kin Ball is a sport that helps to improve the motor development of students with special educational needs.

Keywords: Special educational needs, basic physical qualities, alternative sports, body mass index, physical education.

Resumen

Actualmente, la literatura científica establece que las personas con necesidades educativas especiales evidencian elevados niveles de sedentarismo. Asimismo, los deportes alternativos son conocidos por los numerosos beneficios que aportan. Esta investigación muestra el objetivo comprobar si un programa de iniciación deportiva del Kin ball mejora el efecto de las cualidades físicas básicas sobre el índice de masa corporal y la coordinación. Se ha desarrollado un estudio cuasi experimental con un diseño de un grupo pre-test-pos-test. La muestra está formada por 47 participantes con síndrome de Down. Para recoger el índice de masa corporal se usó una balanza de bioimpedancia. Para evaluar los datos relacionados con la fuerza, flexibilidad, resistencia, velocidad y coordinación se ha utilizado la batería Eurofit adaptada para personas con discapacidad intelectual. Los resultados indican que el programa de intervención ha mejorado el efecto de la velocidad, coordinación, resistencia y flexibilidad sobre la coordinación y el índice de masa corporal. Como conclusión este estudio señala que el Kin Ball es un deporte que ayuda a mejorar el desarrollo motor de estudiantes con necesidades educativas especiales.

Palabras clave: Necesidades educativas especiales, cualidades físicas básicas, deportes alternativos, índice de masa corporal, educación física.

Introduction

Today, most societies are aware of the benefits of regular physical activity on physical and mental health (Kujala et al., 2022). Research has pointed to the benefits of regular physical activity (Kujala et al., 2022) in helping to maintain fitness and fat burning (Ptomey et al., 2021). It has also been shown that physical sports practice helps to improve the basic physical abilities of people who for some reason are impaired under a mental, sensory or physical impairment (Ptomey et al., 2021).

Decree 102/2023 of 9 May establishing the organisation and curriculum of the Compulsory Secondary Education stage in the Autonomous Community of Andalusia in its article four aims to offer personalised attention to students and their learning needs, encourage participation and coexistence, prevent learning difficulties and apply measures to cater for diversity, as well as alternative methodologies or other appropriate actions as soon as the need is identified (Decree 102/2023).

Within the current regulations, the concept of Specific Educational Support Needs (Decree 102/2023) stands out. This term refers to all learners with special educational needs, those with high intellectual abilities, those facing specific learning difficulties and those requiring compensatory interventions (Simon et al., 2021). Students with special educational needs refer to those who need specific support and attention due to various physical, mental, cognitive or sensory abilities, as well as severe behavioural disorders (Simon et al., 2021). It focuses not only on the learner, but also on the educational response required, including the supports, aids and adaptations needed to achieve maximum development in an inclusive school model (Simon et al., 2021).

The population with specific educational needs shows several characteristics including low balance (which can lead to falls in later life), problems with coordination of upper and lower body segments, high levels of obesity and low motor competence (Dustine et al., 2012). Melville et al. (2015) found that people with an impairment are less likely to engage in physical activity, leading to sedentary behaviour and causing health problems that can result in a shorter life expectancy.

The psychomotor development of young people with Down syndrome is characterised by the late development of gross motor skills (Silva-Ortiz et al., 2020). This motor development increases in complexity due to ligamentous laxity and hypotonia (Benavides-Pando et al., 2023), highlighting the length of the lower and upper limbs in relation to the trunk (Benavides-Pando et al., 2023). Another reason for this lack of motor skills acquisition is related to medical problems related to intestinal problems, heart and respiratory conditions (Benavides-Pando et al., 2023). All the alterations affect their quality of life (Benavides-Pando et al., 2023).

Regarding the recommendations for physical activity in the population with Down syndrome, it is recommended that the activities should offer a recreational, intermittent and varied profile (Silva-Ortiz et al., 2020). In addition, activities should be designed according to their physical and psychological characteristics (Silva-Ortiz et al., 2020). Increased weekly physical activity time has a favourable impact on the health of people with special educational needs (Yang et al., 2021). The most prominent benefits of regular physical activity include reduction of cardiovascular disease, prevention of developing type 2 diabetes and osteoporosis along with improvements in cardiorespiratory fitness and increased life expectancy (Chastin et al., 2015).

Body mass index is one of the factors conditioning the motor and physical development of young people (Capellán-Caraballo et al., 2023). Young people who show an imbalance in body mass index have been found to have very poor development of basic physical qualities during youth and adolescence (Capellán-Caraballo et al., 2023). Poor or late development of basic physical qualities leads to a delay in the acquisition of motor skills (Castillo-Retamal et al., 2024). This leads to difficulty in performing different tasks of daily life (Castillo-Retamal et al., 2024). Previous studies have found that the use of alternative sports is effective for motor development and for improving the quality of life of students with special educational needs (Ramírez-Granizo et al., 2020; Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024).

The study by Ramírez-Granizo et al. (2020) reported improvements in the quality of life of students with special educational needs by applying an alternative sport. Specifically, this study applied the System of Oriental Wrestling in Competition (SLOC) (Vílchez-Polo et al., 2019). Findings showed improvements in coordination, balance and other health indicators (Ramírez-Granizo et al., 2020). In addition, numerous studies that have been carried out with accelerometers in young people have highlighted the improvement in physical fitness, however, no improvements in the cognitive domain of young people are reported (Lobenius-Palmer et al., 2018).

A very useful sport for physical and cognitive work is the alternative sport known as Kin-Ball (Zurita-Ortega et al., 2020). The conclusions obtained by Zurita-Ortega et al. (2024) and Zurita-Ortega et al. (2020) highlight the high degree of applica-

bility of Kin ball for motor development in populations with intellectual disabilities. These studies have highlighted improvements in speed, endurance, strength, coordination and balance (Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024). These results are mainly due to the work on strength, endurance and speed, these qualities being present in the Kin ball (Zurita-Ortega et al., 2020). In addition, working on these qualities has reported benefits such as muscle toning, reduction of body fat percentage and improvements in the cardiovascular system (Silva-Ortiz et al., 2020).

The sport is notable for its emphasis on teamwork and cooperation (Hall et al., 2016). Regarding the experiences carried out with Kin-Ball, the one carried out by Hastie et al. (2011) highlights that this alternative sport keeps participants more committed from a motor point of view compared to other sports modalities.

Finally, the aim of this research is: To check if a Kin ball sport initiation programme improves the effect of basic physical qualities on body mass index and coordination.

Materials and Methods

Design and Participants

A quasi-experimental design was carried out with a one-group pre-test-post-test design. In terms of gender distribution, 46.8% are male and 53.2% are female (*M* = 15.85; *DT* = 0.41). The sample belongs to a special education centre, which is composed of thirteen primary school classes and four classes belonging to the work insertion programme for adult life.

The sample had Down's syndrome. In terms of motor development, the students were not severely delayed. Young people showed a good mastery of activities involving basic motor skills. Instead, they showed a higher degree of complexity in the performance of activities involving the combination of two basic motor skills.

Instruments

To calculate the body mass index, the Kern MPS-PM BMI bioimpedance scale was used. The WHO (2022) recommendations were followed to classify BMI in participants aged 6-18 years. This classification was carried out following the parameters established by de Onis and Lobstein (2010): underweight (< 2 standard deviation), overweight (BMI > 1 standard deviation) and obese (> 2 standard deviation). For the adult population, the criteria established by the WHO (2022) were also followed following the following cut-offs: underweight (< 18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2) and obesity (≥ 30 kg/m^2).

The European Fitness Battery for people with intellectual disabilities (Eurofit) was used to collect data related to flexibility, strength, endurance and speed (Skowroński et al., 2009). Endurance was measured through The Six-Minute Walk Test (Nasuti et al., 2013). To collect data related to speed, the test of running 50 metres in the shortest possible time was used (Skowroński et al., 2009). This test has been used in other research in samples with intellectual disabilities (Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024). Strength was assessed using a JAMAR SP5030J1 hydraulic dynamometer. Due to the characteristics of the study population, the adaptations recommended by Boer and Moss (2016) were applied. To collect data related to flexibility, the sit and reach test (Skowroński et al., 2009) was used. To assess flexibility, the recommendations of Cuesta-Vargas et al. (2011) were followed. Finally, coordination was collected according to the criteria established by Skowroński et al. (2009).

Procedure

The intervention programme was implemented in such a way that the basic learning objectives of this alternative sport were maintained (Hastie et al., 2011). The researchers had previously taken a course to be able to teach this sport to people with intellectual disabilities. To carry out the programme, the school provided medical reports to the researchers to find out if any participants had health problems or musculoskeletal problems.

The first session focused on familiarising the pupils and the school's support monitors with this alternative sport. At the end of the session, a small meeting was set up to address the doubts raised by the support monitors and to receive feedback on issues that could be improved. This meeting helped the researchers to clarify ideas, as well as to prepare new activities that were better adapted to the needs of the participants. Subsequently, a new adaptation was carried out where the programme was extended to twelve weeks to allow for greater familiarity with the content to be covered. Regarding the time of each session, participants arrived twenty minutes before the start and left after sixty minutes of the activity.

During the first sessions an adaptation of the proposed exercises was carried out, and in the following sessions a progressive sequencing of exercises of this sport modality was carried out (Mullor et al., 2017). The adaptations were carried out due to the individual needs of the participants, considering the different learning paces and motor execution rhythms. Adaptations were carried out due to the individual needs of the participants. These were made according to the different learning and motor execution rhythms. The adaptations were supervised by the medical staff of the centre and the researchers. Table 1 presents the different activities that finally formed the intervention programme.

Table 1
Time Distribution and Explanation of the Exercises

	Sessions					
	1-2	**3-4**	**5-6**	**7-8**	**9-10**	**11-12**
Temporal Distribution	P-P	P-P	MUR	P-P	MUR	MUR
	CR	GOL	BALL	CR	JUN	P-P
	GS	JUN	GS	ROC	TRI	ROC
	JUN	CR	TRI	GOL	GOL	GOL
	TRI	PRT	PRT	PRT	PRT	PRT
Explanation of tasks	Play Tag (P-P): Participants must avoid being touched by the ball. Relay Racing (CR): It consists of carrying the ball in pairs. Worms (GS): Students pass the ball lying on the ground. Together (JUN): At the signal 'together' the pupils have to touch the ball Trio (TRI): In teams of three, the youngsters have to pass the ball to each other. Striking (GOL): It consists of striking the ball with both hands. Match (PRT): Kin Ball Match. The Wall (MUR): A pupil has to prevent other participants from passing by touching them with the ball. If they are touched, they join in to help catch with the partner. The Rock (ROC): A pupil within a circle of players has to avoid being touched by the ball.					

The pre- and post-tests were carried out individually in a sports hall in the same order. In addition, subjects were always assessed by the same researchers in both the pre-test and post-test. The research team consisted of physiotherapists, nurses and physical education teachers. For data collection, the following sequencing was used: bioimpedance balance, dynamometry, flexibility, coordination, speed and endurance. Due to the physical condition of most of the participants, a break was taken between the tests.

The intervention programme lasted 12 weeks (three months), with one session per week. All subjects participated on the same day, however, they were divided into three groups according to age. Two groups consisted of 16 participants and one of 15. These groups were defined by the school where the intervention took place. Standardised instructions were not given due to the characteristics of the communicative process of each participant, and the researchers were guided to explain the exercises through imitation. All members of the research group had previous experience in working with people with disabilities.

Finally, this research has been approved by an ethics committee belonging to the University of Granada (2966/CEIH/2022). The different ethical principles set out in the Declaration of Helsinki have been considered.

Statistical Analysis

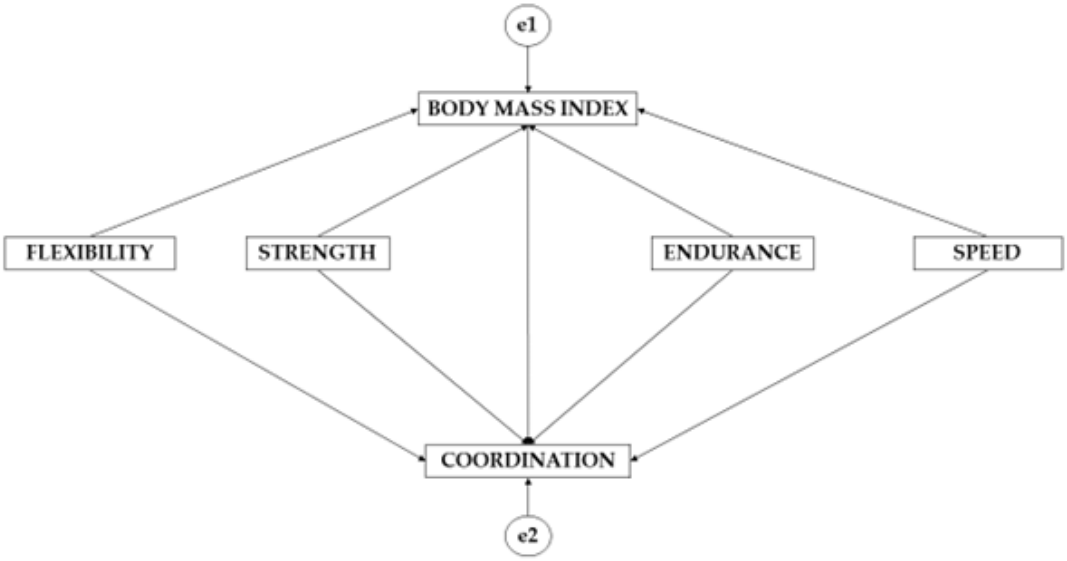
To create the structural equation models, the IBM SPSS Amos 23.0 programme (IBM Corp, Armonk, NY, USA) was used, so that this software allows the causal relationships of the variables that make up the theoretical model to be established (Figure 1). Based on the objectives and the research hypothesis, two models have been developed. The first model is based on the results obtained in the pre-test, while the second model is based on the results obtained after the end of the intervention programme.

Each model consists of six variables, of which two are endogenous and four are exogenous. For the endogenous variables, a causal explanation has been made between the indicators and the reliability of the measurement. Measurement error arising from the measurement of the results has also been included in the models. These results can be interpreted as multivariate regression coefficients. Regarding the unidirectional direction of the arrows, they symbolise the lines of influence and are interpreted from the regression coefficients. To study the significance of the effects of the proposed models, the Pearson Chi-Square test was used, establishing two levels of significance, one for $p \leq .05$ and the other for $p \leq .001$.

To assess the model fit, the criteria established by Maydeu-Olivares (2017) and Kyriazos (2018) have been followed. For the goodness of fit, the values of the Chi-Square test should be taken into consideration, with data showing a non-significant level indicating a good result. Adjustment indices should also be considered, with scores above .900 showing good fit (Loehlin & Beaujean, 2017). Root Mean Square Approximation (RMSEA) should also be estimated, with scores below .100.

The structural equation model proposed for the pretest obtained a good fit for the different fit indices. The Chi-Square test analysis showed a significant value ($X^2 = 3.596$; $df = 6$; $pI = .731$). For CFI, NFI and IFI values of .998, .959 and .923 were obtained respectively. Due to the size of the sample and the influence of susceptibility, other standardised fit indices were studied (Tenenbaum and Eklund, 2007). The Tucker Lewis Index (TLI) value was analysed, obtaining a value of .972. Finally, the RMSEA obtained a value of .039.

Figure 1
Theoretical Model



Results

Table 2 presents the standardised regression weights before and after applying the intervention programme. It is observed that the Kin Ball-based intervention programme has significantly decreased the negative effect of flexibility on body mass index (β = − .327; β = − .239; $p \leq .05$). There is also a significant decrease in body mass index resistance (β = − .281; β = − .235; $p \leq .05$). after implementing the intervention programme. A decrease in the causal relationship of body mass index on coordination is noted (β = .292; β = .209; $p \leq .001$). The intervention programme has significantly increased the effect of flexibility on coordination (β = .483; β = .499; $p \leq .001$).

Table 2
Analysis of Causal Relationships Before and After Implementation of the Intervention Programme

Direction of causal relationships Estimation		Regression Weights				Standardised regression weights
		Estimation error	Critical Radio	*p*	β	
Pre	Flexibility ⇨ Body Mass Index	− 0.358	0.144	− 2.494	≤ .05	− .327
Post	Flexibility ⇨ Body Mass Index	− 0.216	0.126	− 1.722		− .239
Pre	Strength ⇨ Body Mass Index	− 0.073	0.098	− 0.743	> .05	− .098
Post	Strength ⇨ Body Mass Index	− 0.027	0.103	− 0.264		− .037
Pre	Resistance ⇨ Body Mass Index	− 0.017	0.008	− 2.142	≤ .05	− .281
Post	Resistance ⇨ Body Mass Index	− 0.014	0.008	− 1.693		− .235
Pre	Speed ⇨ Body Mass Index	− 0.231	0.285	− 0.810	> .05	− .106
Post	Speed ⇨ Body Mass Index	0.004	0.289	0.015		.002
Pre	Flexibility ⇨ Coordination	2.228	0.625	3.566	≤ .001	.483
Post	Flexibility ⇨ Coordination	2.012	0.503	3.997		.499
Pre	Strength ⇨ Coordination	0.518	0.403	1.285	> .05	.164
Post	Strength ⇨ Coordination	0.277	0.400	0.693		.084
Pre	Resistance ⇨ Coordination	0.056	0.033	1.677	≤ .05	.223
Post	Resistance ⇨ Coordination	0.080	0.034	2.366		.295
Pre	Speed ⇨ Coordination	− 0.118	1.173	− 0.101	> .05	− .013
Post	Speed ⇨ Coordination	− 1.325	1.123	− 1.180		− .143
Pre	Body Mass Index ⇨ Coordination	1.233	0.602	2.046	≤ .001	.292
Post	Body Mass Index ⇨ Coordination	0.931	0.931	1.625		.209

There has also been a decrease in the negative impact of the strength (β = − .098; β = − .037) and speed (β = − .106; β = .002) on body mass index. Finally, there is a decrease in the effect of the strength (β = .164; β = .084) and speed (β = − .013; β = − .143) on coordination.

Discussion

The present research shows the results of an intervention programme based on Kin-Ball on the effect of basic physical qualities on body mass index and coordination. The structural equation models denote significant results, therefore, this discussion aims to compare the data obtained with those of other studies already carried out. Other studies already carried out have shown similar results to those obtained by this research, demonstrating a positive development in terms of motor development (Bürgi et al., 2011).

Studies focusing on the motor analysis of young people with Down syndrome highlight poor motor regulation, low coordination ability and low levels of balance (Alesi & Battaglia, 2019). In addition, the low physical inactivity in this population is based on physical, family and social factors (Alesi & Battaglia, 2019). Low levels of physical activity in this population are due to social barriers that are detrimental to their health (Alesi & Battaglia, 2019).

The proposed intervention programme has been effective in improving the effect of the different basic physical qualities on body mass index. Kin ball is a sport that involves strength, endurance and speed (Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024). In addition, when hitting the Omnikin, the coordination of the lower and upper limbs is required (Hastie et al., 2011; Zurita-Ortega et al., 2024).

Working on the different basic physical qualities is positively related to fat loss (Rosu et al., 2024). A major risk factor in the Down's syndrome population lies in the presence of high abdominal fat (Ballenger et al., 2023). Strength and endurance work are effective strategies for changing body composition (Ballenger et al., 2023). These results show that prolonged Kin-Ball practice helps to prevent the onset of cardiovascular diseases, overweight and obesity (Zurita-Ortega et al., 2020). Similar results have also been obtained by Hall et al. (2016) establishing that Kin Ball is a sport that favours a higher energy expenditure compared to other sports.

Regarding the effect of basic physical qualities, this study shows an improvement in the effect of flexibility and endurance on coordination. On the contrary, a worsening of the effect of strength and speed on coordination is observed. The study by Díaz-Amate et al. (2015) states that Kin Ball is a sport that requires high levels of endurance. Similarly, it has been observed that resistance work significantly improves different aspects of motor skills in students with special educational needs (Zurita-Ortega et al., 2024). Improvements in palmar muscle strength, endurance and coordination-balance have been found (Rosu et al., 2024). This results in an improvement of the physical condition of the practitioners (Zurita-Ortega et al., 2020).

Educational centres and centres specialised in the treatment of people with intellectual disabilities are not obliged to carry out physical exercise sessions to improve the quality of these people (Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024). In view of the low levels of motor competence of these people, it would be appropriate to promote, from the school curriculum, the hours of physical exercise carried out during school hours (Zurita-Ortega et al., 2020; Zurita-Ortega et al., 2024).

Despite having carried out the study, this research has a number of limitations. The first relates to the total sample. Only 47 people with Down's syndrome participated. Also, very important factors such as the socio-economic level of the families were not considered.

With regard to future perspectives, it is proposed to study the effect of other alternative sports and evaluate which of these are more effective for working on the variables addressed in this study. In addition, it would also be interesting to study the differences according to sex, since, during puberty, the differences in development are more accentuated.

Conclusions

It is evident that an intervention programme based on Kin Ball helps to improve the effect of basic physical qualities on coordination and body mass index in a population with special educational needs. Therefore, it can be affirmed that alternative sports are effective tools to improve the physical development of young people with special educational needs.

Ethics Committee Statement

The study has been supervised by the following ethics committee: 2966/CEIH/2022

Conflict of Interest Statement

None of the authors have any conflict of interest

Authors' Contribution

Conceptualization GGV, EMI & JLUJ; Methodology FZO, JMAV & EMI; Software EMI & JMAV; Validation GGV & FZO; Formal Analysis EMI & JLUJ; Investigation FZO, GGV & JLUJ; Resources JLUJ; Data Curation EMI & FZO; Writing – Original Draft JLUJ &

EMI; Writing – Review & Editing JLUJ & EMI; Visualization JLUJ & FZO; Supervision FZO; Project Administration FZO; Funding Acquisition EMI. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data are available upon contact with the authors.

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