Sport Sciences for Health
https://doi.org/10.1007/s11332-023-01104-5

RESEARCH

Kin ball to promote the motor development of students with special educational needs: effects of an intervention programme

Félix Zurita-Ortega[1] · Manuel Ortiz-Franco[2] · José Luis Ubago-Jiménez[1] · Gabriel González-Valero[1] · José Manuel Alonso-Vargas[1] · Eduardo Melguizo-Ibáñez[1]

Received: 20 May 2023 / Accepted: 19 July 2023

Abstract

Background The scientific literature establishes that people with mental impairments show high levels of sedentary behaviour.
Aim This research has the objectives of (a) Studying the effect of the intervention programme on the effect of basic physical qualities, balance and coordination and (b) Comparing the results obtained before and after carrying out the intervention programme according to the sex of the participants through a structural equation model.
Methods A quasi-experimental study was carried out with a pre-test-post-test group design, with a sample of 47 participants (46.8% male and 53.2% female). Questionnaires adapted to the characteristics of the sample were carried out to collect the data.
Results It is observed that the intervention programme has helped to improve the effect of basic physical qualities on balance and coordination.
Conclusion It is concluded that Kin Ball is a sport that improves the quality of life of people with special educational needs and that gender is a key factor influencing the development of basic physical qualities.

Keywords Intellectual disability · Basic physical qualities · Kin ball · Coordination · Balance

Introduction

Scientific literature has now clearly demonstrated the benefits of physical-sports practice on people's physical and mental health [6]. Likewise, a process of integration and promotion of the practice of physical activity must be carried out in the area of school physical education so that, in future stages of development, this habit lasts [18, 20, 21]. From a scientific point of view, there is great concern, as the study carried out by Einarsson et al. [9] establishes that the population with special educational needs shows higher levels of sedentary lifestyles compared to other populations.

From an educational point of view, the concept of special educational needs is understood as any pupil who, during his or her period of schooling, requires specific educational support and attention due to disability or severe behavioural disorders [27]. Specifically, within the Spanish educational context, it has been observed that there are around four hundred thousand people who require educational support [40], the majority of these cases being caused by intellectual or motor disabilities [34]. The American Association on Mental Impairment [2] establishes three criteria to define a subject with mental impairment: IQ less than or equal to 70, deficit in adaptive behaviour and origin of the impairment before the age of 18.

Based on previous studies in this type of population, it has been observed that motor impairments are accentuated

✉ Gabriel González-Valero
ggvalero@ugr.es

Félix Zurita-Ortega
felixzo@ugr.es

Manuel Ortiz-Franco
manuelortizfranco@gmail.com

José Luis Ubago-Jiménez
jlubago@ugr.es

José Manuel Alonso-Vargas
josemalonsov@correo.ugr.es

Eduardo Melguizo-Ibáñez
emelguizo@ugr.es

[1] Departamento de Didáctica de la Expresión Musical, Plástica y Corporal, Universidad de Granada, Prof. Vicente Callao, 18011 Granada, Spain

[2] Centro de Magisterio La Inmaculada, 18013 Granada, Spain

Published online: 13 August 2023

and increase with increasing age, worsening the quality of life of these people [10, 38]. This is why a series of characteristics that belong to the population with educational needs can be emphasised, highlighting a low level of balance, problems derived from a lack of coordination, high levels of obesity and a reduced ability to maintain attention and concentration when carrying out an activity [36]. Increased levels of physical activity in this population have demonstrated numerous benefits at an organic level, including increased blood circulation, prevention of cardiovascular diseases, prevention of developing type-2 diabetes, reduction of blood pressure [14]. The research by Johnson [13] found that people with intellectual disabilities who are physically active prevent osteoporosis and osteoarthritis, leading to numerous improvements in basic physical qualities.

Numerous intervention programmes have already been carried out in the special educational needs population. The research conducted by Ramírez-Granizo et al. [26], designed and applied an intervention programme through alternative sport SLOC, concluding that alternative sports help people with impairments to improve their quality of life. Other studies that have been carried out with accelerometers in young people have highlighted improvements in physical fitness, however, no improvements in the cognitive domain of young people are reported [16].

In this case, the alternative sport known as Kin-Ball has demonstrated numerous benefits for people's physical development [40]. Research by Hastie et al. [11] highlights that this alternative sport keeps participants more engaged from a motor point of view compared to other sport modalities.

Gender has also been shown to be a key factor in physical activity and sport. In this case, research by Melguizo-Ibáñez et al. [20, 21] found that young men tend to engage in more physical activity per week than young women. Specifically, within the population in which this study was carried out, the research carried out by Abellán et al. [1] found that men with a mental impairment showed a more favourable attitude towards sports practice than women.

In the light of the above, the following research hypotheses have been developed for this study:

H.1. The implementation of the intervention programme will improve the basic physical qualities, coordination and balance of participants with special educational needs.

H.2. Male participants will show a greater improvement in the effect of the variables compared to female participants.

Finally, the research objectives presented are the following: (a) To study the effect of the intervention programme on the effect of basic physical qualities, balance and coordination and (b) To compare the results obtained before and after the intervention programme according to the sex of the participants through a structural equation model.

Material and methods

Participants and design

The design of this research is based on quasi-experimental research with a pre-test-post-test group design. In terms of study participants, the total sample consisted of 47 participants with special educational needs. The sample was divided into 22 male and 25 female participants. Regarding gender distribution, 46.8% belong to the male sex and 53.2% to the female sex (M = 29.85; SD = 10.41). Looking at the mean age of the two groups, the male sex had a mean age of M = 28.41 SD = 10.491, while the female sex had a mean age of M = 31.12 SD = 10.386. All participants belong to a special education centre which is specialised in working with people with special educational needs.

Most of the young people had Down syndrome and autism. About motor development, the youngsters were not severely delayed. It should be noted that the youngsters showed a good command of activities involving basic motor skills. On the other hand, they showed a higher degree of complexity when carrying out activities involving the combination of two basic motor skills.

Ethical criteria established for the collection of data

The rights of the participants were respected during data collection in this research. This research has been approved and supervised by an ethics committee belonging to the University of Granada (2966/CEIH/2022).

Firstly, contact was made with several educational centres in the province of Granada specialising in the treatment of people with special educational needs. In this first contact, the intention of the study was explained, as well as the objectives of the study. Because the programme was carried out at the end of 2021, the presence of COVID-19 prevented most schools from accepting the researchers' entry to the centre, with only one school accepting the proposal. Once a favourable response was obtained from the school management, the legal guardians of the children were informed of the nature of the study and its objectives. Subsequently, legal guardians were sent the informed consent to participate in the study, and a total of thirty-five minors were withdrawn. Finally, the final sample of this study comprised a total of 47 participants.

Intervention programme

The intervention programme carried out was based on Kin-Ball, maintaining the basic learning of this alternative sport [11]. In order to work in a satisfactory way the researchers were trained through a course on how to work most effectively with people with special educational needs. Prior to the programme, the school provided medical reports to the research team to find out if the participants had any health or musculoskeletal problems.

In terms of the distribution of the sessions, the first session focused on familiarising the monitors and students of the school with the sport. Once this session was over, a small meeting was set up to address possible doubts raised by the support monitors in order 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 of the session and left after sixty minutes of the activity.

During the first sessions, an adaptation of the proposed exercises was carried out, with a progressive sequencing of exercises of this sport modality being carried out in the following practices [22]. The adaptations were carried out due to the individual needs of the participants, taking into account the different learning paces and motor performance rates. The most significant adaptation was to carry out different explanations using pictograms. These adaptations were supervised by the medical staff of the centre and the researchers (Table 1).

Procedure

Data collection was carried out individually in a sports hall. Due to the characteristics of the population, it was always decided to follow the same order in both the pre-test and the post-test. For this research, the data collection team consisted of nurses, physiotherapists and physical education teachers. For the collection of data related to the basic physical qualities, the data were collected sequentially, starting with the easiest test and concluding with the most complex one. Also, due to the physical condition of the participants, it was decided to take a two-minute break between tests. The intervention programme was carried out over twelve weeks (3 months). During each of the weeks, one session was held. All participants took part on the same day, however, in order to work in a more comfortable way, it was decided to make three groups according to the age of the participants. In this case, two groups were made up of sixteen participants and the remaining one of fifteen. At no time were standardised instructions given due to the communicative process of each of the participants, which is why the researchers gave the explanations through pictograms and through imitation. Table 2 below shows characteristics about each intervention group.

Table 1 Time distribution and explanation of the exercises conducted

	Sessions					
	1–2	3–4	5–6	7–8	9–10	11–12
Time distribution of activities	TP	TP	WALL	TP	WALL	WALL
	RR	HT	BALL	RR	TGH	TP
	WR	TGH	WR	BALL	TRI	BALL
	TGH	RR	TRI	HT	HT	HT
	TRI	MCH	MCH	MCH	MCH	MCH
Explanation of activities	Trapping partners (TP): It consists of touching a teammate with the ball					
	Relay race (RR): It consists of handling the ball in pairs					
	Worm (WR): Team-mates pass the ball lying on the ground					
	Together (TGH): At a signal saying "together" the students have to touch the ball					
	Trio (TRI): In teams of 3, the students have to pass the ball to each other					
	Hitting (HT): It consists of hitting the ball with the hands					
	Match (MCH): It consists of simulating a Kin Ball match					
	The wall (WALL): A student has to prevent other students from passing by touching them with the ball					
	The ball (BALL): A student inside a circle of players who avoids being touched by the ball					

Table 2 Characteristics of the three working groups

	Participants number	Gender distribution	Average age	Characteristics
Group 1	16	6 Male	30.50 ± 14.937	9 Students with Down syndrome and 7 with Autism
		10 Female	29.60 ± 12.394	
Group 2	16	7 Male	24.14 ± 10.621	8 Students with Down syndrome and 8 with autism
		9 Female	26.33 ± 9.186	
Group 3	15	9 Male	30.33 ± 6.442	7 Students with Down syndrome and 8 with autism
		6 Female	36.00 ± 8.944	

Instruments and variables

This research has focused on the implementation of an intervention programme based on Kin-Ball and how this programme has affected the development of basic physical qualities, coordination, and balance.

For the collection of data related to basic physical skills, endurance was measured using The Six-Minute Walk Test, the version used being the one adapted by Nasuti et al. [23] for populations with intellectual disabilities. Likewise, to measure speed, the test used by Zurita-Ortega et al. [40] was used, which consists of covering 50 m in the shortest possible time. The JAMAR SP5030J1 hydraulic dynamometer was used to measure force. Due to the characteristics of the study population, the adaptations recommended by Boer and Moss [3] were applied. For the collection of data related to balance and coordination, the recommendations made by Skowrónski et al. [30] were followed. Finally, the recommendations established by Pérez-Cruzado et al. [25] were used to measure flexibility.

Data analysis and fitting of equation models

The IBM SPSS Amos 26.0 (IBM Corp, Armonk, NY, USA) statistical programme was used to develop the structural equation models, so that this type of analysis allows us to study the effect of the variables on each other before and after having intervened in the sample. In this case, the first two models are based on the state of the variables before the intervention, while the other two are based on the state of the variables after the programme has been implemented.

With regard to the characteristics of the models themselves, each model is made up of six variables under study. In this case, two of them play an endogenous role and four play the role of exogenous variables. For the first type of variables, it has been decided to run a causal explanation between the different indicators and the reliability of the degree of measurement. The error caused (e1 and e2) by the act of measurement has also been included, and these are interpreted as multivariate regression coefficients. For the significance study, the Pearson Chi-Square test was used, establishing two levels of significance. The first for $p \leq 0.05$ and the second for $p \leq 0.001$.

For the evaluation of the different models, the statements established by Kyriazos [15] and Maydeu-Olivares [19] have been followed. In terms of goodness of fit, the values obtained by the Chi-Square test should be reviewed, with the values indicating a non-significant level showing a good fit. Likewise, Loehlin and Beaujean [17] state that the values obtained in the fit indices should also be checked, showing a good fit when the scores are higher than 0.900. Similarly, the value obtained in the Root Mean Square Approximation (RMSEA) should also be reviewed, showing a good fit when the scores are lower than 0.100.

Results

The structural equation models proposed for the male and female pre-test sexes have shown good scores for each of their indices. For the model developed for the male sex the chi-square obtained a significant value ($X^2 = 5.397$; df = 8; pl = 0.525) occurring exactly the same for the model proposed for the female sex ($X^2 = 4.629$; df = 6; pl = 0.002). Following Tenenbaum and Eklund [31], it was decided to study other values such as the Tucker Lewis Index, due to the size and susceptibility of the sample. In this case for the CFI, NFI, IFI and TLI the scores were above 0.900 for each of the models while for the RMSEA a score below 0.100 was obtained for each model.

In this case it is observed that the female sex shows a better effect of flexibility on coordination ($\beta = 0.326$; $\beta = 0.274$). Likewise, a better effect is also observed for the female sex between flexibility and balance ($\beta = -0.082$; $\beta = -0.088$), strength and balance ($\beta = 0.084$; $\beta = -0.096$), endurance and balance ($\beta = -0.104$; $\beta = -0.301$) speed and balance ($\beta = -0.364$; $\beta = -0.463$ $p \leq 0.05$) and between coordination and balance ($\beta = 0.046$; $\beta = -0.004$). On the contrary, it is observed that the male sex shows a better effect between strength and coordination ($\beta = 0.261$; $\beta = 0.147$), endurance and coordination ($\beta = 0.296$; $\beta = -0.103$) and strength and

Table 3 Effects of variables for the male sex before implementing the intervention programme

Associations between variables	R.W				S.R.W
	Estimates	S.E	C.R	*p*	Estimates
COORD ←FLEXI	1.571	1.097	1.432	> 0.05	0.274
COORD ←STREN	0.851	0.623	1.368	> 0.05	0.261
COORD ←ENDU	0.079	0.051	1.550	> 0.05	0.296
COORD ←SPEED	0.326	2.048	0.159	> 0.05	0.030
BALAN ←FLEXI	− 0.458	0.976	−0.470	> 0.05	− 0.088
BALAN ←STREN	− 0.284	0.552	−0.514	> 0.05	− 0.096
BALAN ← ENDU	− 0.073	0.046	−1.587	> 0.05	− 0.301
BALAN ←SPEED	− 4.487	1.739	−2.580	≤ 0.05	− 0.463
BALAN ←COORD	− 0.004	0.185	− 0.021	> 0.05	− 0.004

STREN strength, *ENDU* endurance, *SPEED* speed, *FLEXI* flexibility, *COORD* coordination, *BALAN* balance

Table 4 Effects of variables for the female sex before implementing the intervention programme

Associations between variables	R.W				S.R.W
	Estimates	S.E	C.R	*p*	Estimates
COORD←FLEXI	1.222	0.685	1.785	> 0.05	0.326
COORD ←STREN	0.397	0.493	0.806	> 0.05	0.147
COORD ←ENDU	− 0.021	0.038	− 0.561	> 0.05	− 0.103
COORD ←SPEED	− 1.720	1.306	− 1.316	> 0.05	− 0.241
BALAN ←FLEXI	− 0.404	0.984	− 0.411	> 0.05	− 0.082
BALAN ←STREN	0.299	0.674	0.444	> 0.05	0.084
BALAN ← ENDU	− 0.029	0.052	− 0.554	> 0.05	− 0.104
BALAN ←SPEED	− 3.442	1.826	− 1.885	> 0.05	− 0.364
BALAN ←COORD	0.061	0.275	0.222	> 0.05	0.046

STREN strength, *ENDU* endurance, *SPEED* speed, *FLEXI* flexibility, *COORD* coordination, *BALAN* balance

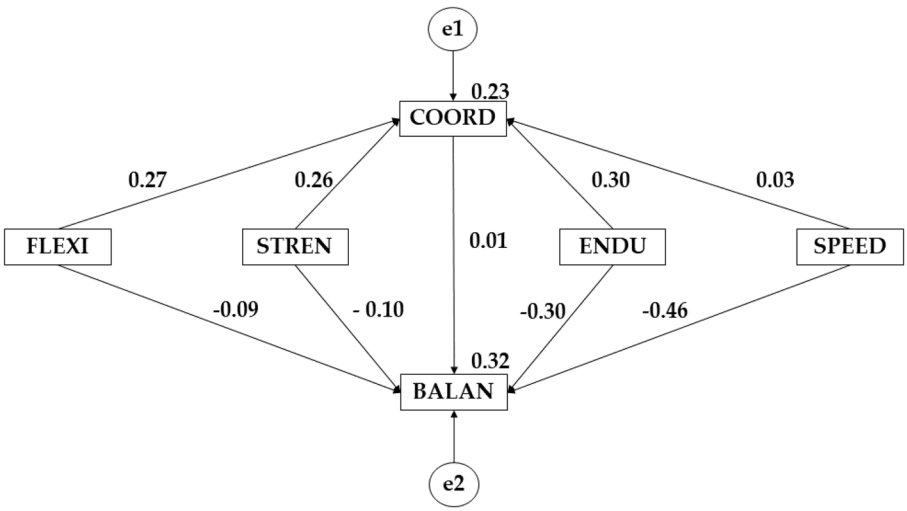

Fig. 1 Effects of variables for the male sex before implementing the intervention programme. Strenght (STREN); Endurance (ENDU); Speed (SPEED); Flexibility (FLEXI); Coordination (COORD); Balance (BALAN)

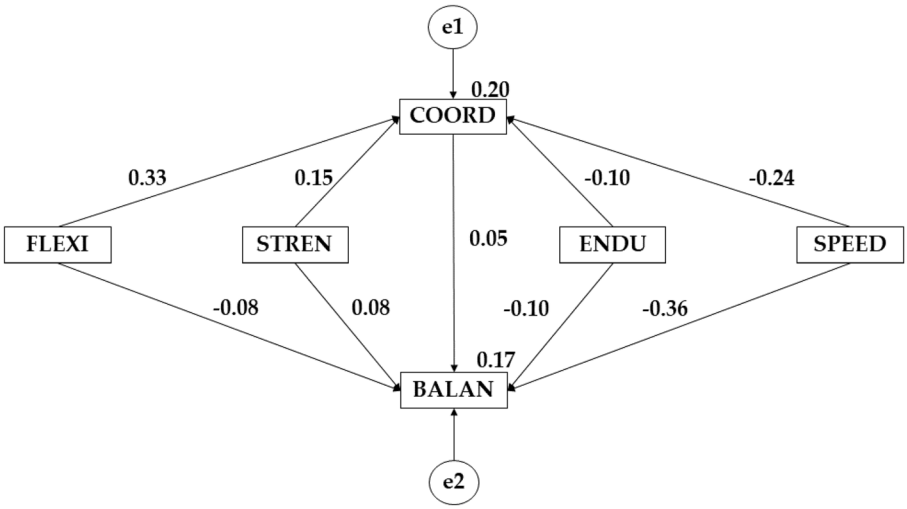

Fig. 2 Effects of variables for the female sex before implementing the intervention programme. Strenght (STREN); Endurance (ENDU); Speed (SPEED); Flexibility (FLEXI); Coordination (COORD); Balance (BALAN)

coordination (β = 0.030; β = −0.241) (Tables 3, 4; Figs. 1, 2).

The proposed structural equation models for the male and female sex of the post-test have shown good scores for each of their indices. For the model developed for the male sex, the chi-square obtained a significant value ($X^2 = 3.455$; df = 2; pl = 0.393) and exactly the same for the model proposed for the female sex ($X^2 = 6.987$; df = 1; pl = 0.005). In this case for the CFI, NFI, IFI and TLI the scores have been higher than 0.900 for each of the models while for the RMSEA a score lower than 0.100 has been obtained for each model.

After having carried out the intervention programme it is observed that the male sex shows a better effect between flexibility and coordination (β = 0.357 $p \leq 0.05$; β = 0.331), strength and coordination (β = 0.231; β = 0. 090), endurance and coordination (β = 0.373 $p \leq 0.05$; β = 0.016), strength and coordination (β = −0.039; β = −0.543 $p \leq 0.001$), speed and balance (β = −0.353 $p \leq 0.001$; β = −0.503) and coordination and balance (β = 0.106; β = −0.249). On the contrary, it is obtained that the female sex shows a better effect on the effect of flexibility and balance (β = 0.162; β = −0.040), strength and balance (β = 0.045; β = −0.191) and endurance and balance (β = 0.022; β = −0.522) (Tables 5, 6; Figs. 3, 4).

Looking at the effect of the programme for the male sex, an improvement in the effect of flexibility on coordination was observed (β = 0.274; β = 0.357). An improvement in the effect of resistance on coordination (β = 0.296; β = 0.373), flexibility and balance (β = −0.088; β = −0.040) and coordination on balance (β = −0.463; β = 0.106) is also observed. Regarding the effects observed for the female sex, improvements are observed in the effect of flexibility on coordination (β = 0.326; β = 0.331) and of resistance on coordination (β = −0.103; β = 0.016). Improvements are also observed in the effect of flexibility on balance (β = −0.082; β = 0.162) and of resistance on balance (β = −0.104; β = 0.022).

Table 5 Effects of the variables for the male sex after the implementation of the intervention programme

Associations between variables	R.W				S.R.W
	Estimates	S.E	C.R	*p*	Estimates
COORD ←FLEXI	1.741	0.877	1.985	≤0.05	0.357
COORD ←STREN	0.782	0.609	1.284	>0.05	0.231
COORD ←ENDU	0.106	0.051	2.077	≤0.05	0.373
COORD ←SPEED	−0.577	2.645	−0.218	>0.05	−0.039
BALAN ←FLEXI	−0.200	0.916	−0.218	>0.05	−0.040
BALAN ←STREN	−0.659	0.607	−1.087	≤0.05	−0.191
BALAN ← ENDU	−0.151	0.054	2.806	≤0.05	−0.522
BALAN ←SPEED	−5.279	2.538	−2.080	≤0.001	−0.353
BALAN ←COORD	0.107	0.209	0.514	>0.05	0.106

STREN strength, *ENDU* endurance, *SPEED* speed, *FLEXI* flexibility, *COORD* coordination, *BALAN* balance

Table 6 Effects of the variables for the female sex after the implementation of the intervention programme

Associations between variables	R.W				S.R.W
	Estimates	S.E	C.R	*p*	Estimates
COORD ←FLEXI	0.951	0.449	2.116	≤0.05	0.331
COORD ←STREN	0.226	0.394	0.574	>0.05	0.090
COORD ←ENDU	0.003	0.032	0.104	>0.05	0.016
COORD ←SPEED	−3.148	0.907	−3.471	≤0.001	−0.543
BALAN ←FLEXI	0.613	0.764	0.803	>0.05	0.162
BALAN ←STREN	0.150	0.619	0.242	>0.05	0.045
BALAN ← ENDU	0.006	0.049	0.121	>0.05	0.022
BALAN ←SPEED	−3.852	1.736	−2.219	≤0.05	−0.503
BALAN ←COORD	−0.329	0.319	−1.033	>0.05	−0.249

STREN strength, *ENDU* endurance, *SPEED* speed, *FLEXI* flexibility, *COORD* coordination, *BALAN* balance

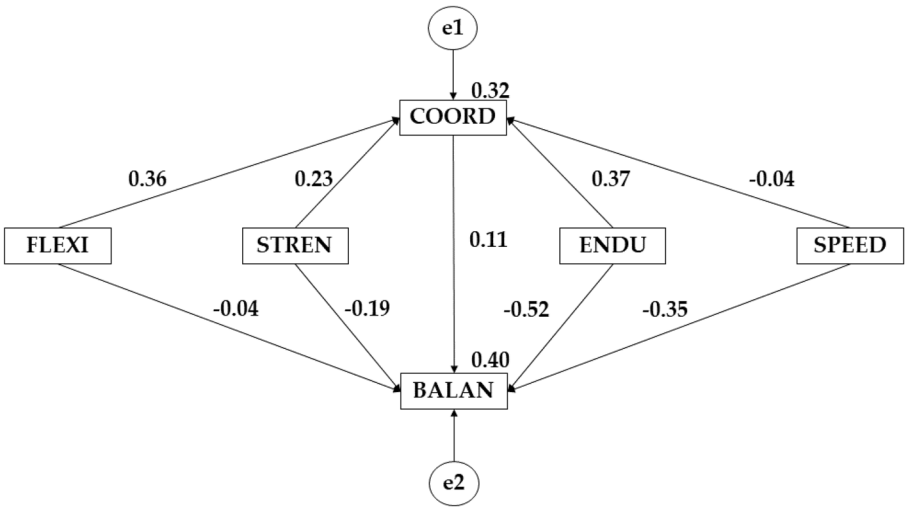

Fig. 3 Effects of the variables for the male sex after the implementation of the intervention programme. Strenght (STREN); Endurance (ENDU); Speed (SPEED); Flexibility (FLEXI); Coordination (COORD); Balance (BALAN)

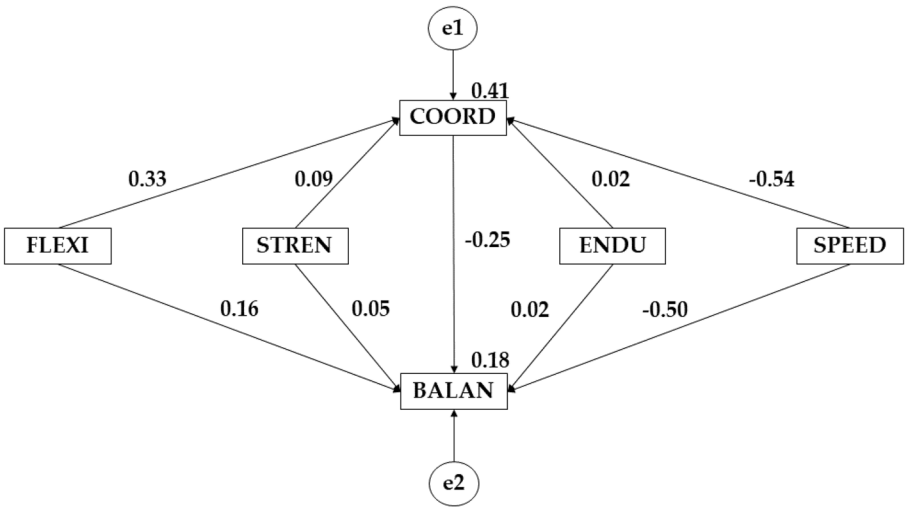

Fig. 4 Effects of the variables for the female sex after the implementation of the intervention programme. Strenght (STREN); Endurance (ENDU); Speed (SPEED); Flexibility (FLEXI); Coordination (COORD); Balance (BALAN)

Discusion

This study shows that a programme based on the use of alternative sport, namely Kin Ball, helps to improve the effect of basic physical qualities on coordination and balance. In this case, the originality of this research lies in studying the effect of the intervention programme according to the sex of the participants.

It was observed that before carrying out the intervention programme, the female sex obtained a better effect of the variables flexibility, strength, endurance, speed and coordination on balance. On the contrary, it was observed that the male sex obtained a better effect of the variables strength, endurance and speed on coordination. Studies have shown that people with mental and motor impairments show poorer development of coordination and balance and a poorer quality of life [37, 39]. Research by Vens et al. [35] states that a lack of physical activity has a negative impact on people's motor skills, showing poor motor control, poor motor regulation, poor coordination, low levels of balance, among others. Jacinto et al. [12], state that the low levels of physical inactivity in this population and specifically among the female sex are due to personal factors (linked to poor motor development), family factors (related to bullying behaviour) and social factors (few intervention programmes with this study sample). These statements establish that the low levels of physical activity in this population are due to social barriers which are detrimental to the health of these people [12].

After having carried out the intervention programme, it is observed that the male gender shows a better effect between flexibility and coordination, strength and coordination, endurance and coordination, strength and coordination, speed and balance and coordination and balance. In contrast, it is found that the female sex shows a better effect on the effect of flexibility and balance, strength and balance and endurance and balance. Van der Ploeg et al. [32] state that sport practice in people with intellectual and physical impairments helps to improve attitude and motivation towards sport. Participants with intellectual impairment who had some kind of physical or musculoskeletal problem have achieved improvements in physical fitness and in the development of basic motor skills. Therefore, this study is in line with that carried out by Van Schijndel-Speet et al. [33] and Ramírez-Granizo et al. [26] where it is stated that one hour a week of an alternative sport helps to improve the quality of people with intellectual impairments.

The intervention programme based on the Kin Ball has proved to be effective in improving the quality of life of people with special educational needs. Numerous intervention programmes have been developed for populations with special educational needs [4, 24, 29] however, only a single research study has been carried out focusing on Kin Ball [40]. This research shows that prolonged practice of an alternative sport such as Kin Ball helps people's physical development [7], with the practice of this sport being associated with a reduction in the probability of suffering from cardiovascular diseases, hypertension and other metabolic pathologies [8].

Finally, within the school curriculum, Calderón and Ayuso [5] point out the importance of alternative sports from a dual perspective. This type of sport helps to improve not only the physical condition of individuals, but also psychosocial factors such as leadership, confidence, safety, sportsmanship, cooperation, empathy and inclusion [5]. Even though this type of sport is an emerging trend, there is a need to carry out a greater number of interventions in the classroom that investigate the contributions that these sports can make to the integral development of individuals [28]. In this case, the aforementioned should be carried out leaving aside the current that accepts the alternative for the simple fact of being different from the established [28].

Limitations and future perspectives

The present research shows several limitations, which are important to point out. The first limitation is the fact that only 47 people participated in the study. In addition, very important factors such as the socio-economic level of the families have been overlooked. The sample under study belongs to a very specific area of the Spanish context, so generalizations cannot be made. It should be noted that the working groups were imposed by the school. This made it impossible for the groups to be organized according to the initial evaluation carried out by the research team. This meant that it was not possible to include an experimental design. The three working groups included students with Down syndrome and autism. It would have been interesting to have intervened according to the type of need. Also this research does not present a design based on a control group and an experimental group.

Regarding future perspectives, research is being developed to study the effect of other alternative sports and to evaluate which of these are more effective for working on the variables addressed in this study.

Conclusions

The conclusions obtained show that Kin Ball is a sport that improves the quality of life of people with special educational needs.

Depending on the sex, it is concluded that after having carried out the intervention programme, it is observed that

the male sex shows a better effect between flexibility and coordination, strength and coordination, resistance and coordination, strength and coordination, speed and balance and coordination and balance. For the female sex a better effect is evident in the effect of flexibility and balance, strength and balance and endurance and balance. This shows that gender is a key factor in the development of basic physical qualities.

From a gender-focused perspective, it is concluded that for the male gender, an improvement in the effect of flexibility on coordination is observed. An improvement in the effect of resistance on coordination, flexibility and balance and of coordination on balance is also observed. Regarding the effects observed for the female sex, improvements are observed in the effect of flexibility on coordination and endurance on coordination. Likewise, improvements are observed in the effect of flexibility on balance and endurance on balance.

Acknowledgements This study belongs to the project "Desarrollo de un programa de actividad física y educación emocional en personas con discapacidad para fomentar la inclusión con iguales" with code "INV-INC140-2021" directed and coordinated by Félix Zurita-Ortega

Author contributions Conceptualization: F.Z.O., J.L.U.J. and G.G.V; Methodology: E.M.I., J.M.A.V and M.O.F; software: E.M.I., F.Z.O and J.L.U.J; Validation: M.O.F and J.M.A.V; Formal Analysis: E.M.I and G.G.V; Investigation: F.Z.O; Data Curation: J.M.A.V. Writing-Orginal draft preparation: J.L.U.J and G.G.V; Writing-review and editing: J.M.A.V; M.O.F and F.Z.O; visualization: F.Z.O; Supervision: F.Z.O

Funding Funding for open access publishing: Universidad de Granada/CBUA.

Data Availability [M1] [EMi2] The data used to support the findings of current study are available from the corresponding author upon request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standars of the institutional research committee (2966/CEIH/2022) and with the 1964 Helsinki declaration.

Informent consent Informed consent was obtained fromm all participants who agreed to participate in the study.

References

1. Abellán J, Sáez-Gallego NM, Reina R (2017) Evaluation of attitudes towards disability in physical education: differential effect of sex, previous contact and skill and competence perception. Cuadernos de Psicología del Deporte 18(1):133–140
2. Asociación Americana para la Deficiencia Mental (1999) Discapacidad intelectual: Definición, clasificación y sistemas de apoyo. Psicología Alianza Editorial
3. Boer PH, Moss SJ (2016) Test–retest reliability andminimal detectable change scores of twelve functional fitness tests in adults with Down syndrome. Res Dev Disabil 48:176–185. https://doi.org/10.1016/j.ridd.2015.10.022
4. Burgi F, Meyer U, Granacher U, Schindler C, Marques-Vidal P, Kriemler S, Puder JJ (2011) Relationship of physical activity with motor skills, aerobic fitness and body fat in preschool children: a cross-sectional and longitudinal study Ballabeina. Int J Obes 35:937–944. https://doi.org/10.1038/ijo.2011.54
5. Calderón P, Ayuso JA (2022) Alternative sports as content for physical education in secondary education. Retos 46:1004–1014. https://doi.org/10.47197/retos.v46.94422
6. Conde-Pipó J, Melguizo-Ibáñez E, Marsical-Arcas M, Zurita-Ortega F, Ubago-Jiménez JL, Ramírez-Granizo I, González-Valero G (2021) Physical self-concept changes in adults and older adults: influence of emotional intelligence, intrinsic motivation and sports habits. Int J Environ Res Public Health 18(4):1711. https://doi.org/10.3390/ijerph18041711
7. Díaz-Amate R, Alcántara F, Torres G, Lara A (2015) Time and gestural structure of Kin-Ball. Apunts 1202:36–42. https://doi.org/10.5672/apunts.2014-0983.es.(2015/2).120.05
8. Dimmick D (2022) Evaluation of teaching games to understand how to improve the motivation levels of children with special needs. J Phys Educ Sport 22(4):879–883. https://doi.org/10.12968/ijtr.2018.25.1.20
9. Einarsson IT, Olafsson A, Hinriksdottir G, Hinriksdottir G, Johannsson E, Daly D, Arngrimsson SA (2015) Differences in physical activity among youth with and without intellectual disability. Med Sci Sports Exerc 47:411–418. https://doi.org/10.1249/mss.0000000000000412
10. González-Valero G, Vidal-Conti J, Zurita-Ortega F, Palou-Sampol P (2021) Active time in cooperative activities, quality of life and body mass index in individuals with intellectual disabilities. A model of structural equations. Sustainability 13(4):2341. https://doi.org/10.3390/su13042341
11. Hastie PA, Langevin F, Wadsworth D (2011) Effects of age and experience on physical activity accumulation during kin ball. Res Q Exerc Sport 821:140–144. https://doi.org/10.1080/02701367.2011.10599731
12. Jacinto M, Vitorino AS, Palmeira D, Antunes R, Matos R, Ferreira JP, Bento T (2021) Perceived barriers of physical activity participation in individuals with intellectual disability—a systematic review. Healthcare 9(11):1521. https://doi.org/10.3390/healthcare9111521
13. Johnson CC (2009) The benefits of physical activity for youth with developmental disabilities: a systematic review. Am J Health Promot 23(3):157–167. https://doi.org/10.4278/ajhp.070930103
14. Kim JY, Yi ES (2018) Analysis of the relationship between physical activity and metabolic syndrome risk factors in adults with intellectual disabilities. J Exerc Rehabil 14(4):592–597. https://doi.org/10.12965/jer.1836302.151
15. Kyriazos TA (2018) Applied psychometrics: sample size and sample power considerations in factor analysis (EFA, CFA) and SEM in general. Psychology (Irvine) 9(8):2207–2230. https://doi.org/10.4236/psych.2018.98126

16. Lobenius-Palmér K, Sjöqvist B, Hurtig-Wennlöf A, Olov Lundqvist L (2018) Accelerometer-assessed physical activity and sedentary time in youth with disabilities. Adapt Phys Activ Q 35:1–19. https://doi.org/10.1123/apaq.2015-0065
17. Loehlin JC, Beaujean AA (2017) Latent variable models: an introduction to factor, path, and structural equation analysis. Taylor and Francis, London
18. Manzano-Sánchez D (2022) Physical education classes and responsibility: the importance of being responsible in motivational and psychosocial variables. Int J Environ Res Public Health 19(16):10394. https://doi.org/10.3390/ijerph191610394
19. Maydeu-Olivares A (2017) Maximum likelihood estimation of structural equation models for continuous data: standard errors and goodness of fit. Struct Equ Model 24(3):383–394. https://doi.org/10.1080/10705511.2016.1269606
20. Melguizo-Ibáñez E, Zurita-Ortega F, Ubago-Jiménez JL, López-Gutiérrez CJ, González-Valero G (2022) An explanatory model of the relationships between sport motivation, anxiety and physical and social self-concept in educational sciences students. Curr Psychol. https://doi.org/10.1007/s12144-022-02778-9
21. Melguizo-Ibáñez E, Zurita-Ortega F, Ubago-Jiménez JL, Puertas-Molero P, González-Valero G (2022) Motivational climate, anxiety and physical self-concept in trainee physical education teachers—an explanatory model regarding physical activity practice time. Int J Environ Res Public Health 19(19):12812. https://doi.org/10.3390/ijerph191912812
22. Mullor D, Gallego J, Cangas AJ, Aguilar-Parra JM, Valenzuela L, Mateu JM, López-Pardo A (2017) Efectividad de un programa de actividad física en personas con trastorno mental grave. Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte (67):507–521. https://doi.org/10.15366/rimcafd2017.67.008
23. Nasuti G, Stuart-Hill L, Temple VA (2013) The six-minute walk testfor adults with intellectual disability: a study of validity and reliability. J Intellect Dev Disabil 381:31–38. https://doi.org/10.3109/13668250.2012.748885
24. Pérez CA, Carral JMC, Costas AA, Martínez SV, Martínez-Lemos RI (2018) Water-based exercise for adults with Down syndrome: findings from a preliminary study. Int J Ther Rehabil 25(1):20–28. https://doi.org/10.12968/ijtr.2018.25.1.20
25. Pérez-Cruzado D, Cuesta-Vargas AI (2016) Changes on quality of life, self-efficacy and social support for activities and physical fitness in people with intellectual disabilities through multimodal intervention. Eur J Spec Needs Educ 314:553–564. https://doi.org/10.1080/08856257.2016.1187876
26. Ramírez-Granizo I, Ubago-Jiménez JL, Zurita-Ortega F, Puertas-Molero P (2020) Effectiveness of an intervention program on basic physical and coordination skills and its relationship with BMI in individuals with intellectual disability. Arch Budo 16:235–243
27. Real Decreto 157/2022, de 1 de marzo, por el que se establecen la ordenación y las enseñanzas mínimas de la Educación Primaria. Boletín Oficial del Estado, 52, de 2 de marzo de 2022. https://www.boe.es/eli/es/rd/2022/03/01/157/con
28. Robles-Rodríguez J (2015) Tchoukball. A new team sport. Proposal for the implementation in Secondary. Retos 16:75–79. https://doi.org/10.47197/retos.v0i16.34979
29. Shin IS, Park EY (2012) Meta-analysis of the effect of exercise programs for individuals with intelectual disabilities. Res Dev Disabil 33(6):1937–1947. https://doi.org/10.1016/j.ridd.2012.05.019
30. Skowrónski W, Horvat M, Nocera J, Roswal G, Groce R (2009) Eurofit special: European fitness battery score variation among individuals with intellectual disabilities. Adapt Phys Activ Q 261:54–67. https://doi.org/10.1123/apaq.26.1.54
31. Tenembaun G, Eklund RC (2007) Handbook of sport psychology. Wiley, New York
32. Van Der Ploeg HP, Van Der Beek AJ, Van DerWoude LHV, Van Mechelen W (2004) Physical activity forpeople with a disability: a conceptual model. Sports Med 34:639–649. https://doi.org/10.2165/00007256-200434100-00002
33. Van Schijndel-Speet M, Evenhuis HM, Van Empelen P, VanWijck R, Echteld MA (2013) evelopment and evaluation of a structured programme for promoting physical activity among seniors with intellectual disabilities: a study protocol for a cluster randomized trial. BMC Public Health 13:746. https://doi.org/10.1186/1471-2458-13-746
34. Vázquez A, Jenaro C, Flores N, Bagnato MJ, Pérez MC, Cruz M (2018) E-health interventions for adult and aging population with intellectual disability: a review. Front Psychol 9:1–7. https://doi.org/10.3389/fpsyg.2018.02323
35. Vens N, Dewitte G, Van Waelvelde H, Bar-On L, De Roubaix A (2022) Developmental coordination disorder before the age of three: a longitudinal retrospective study in a Belgian Center for developmental disabilities. Children 9(3):334. https://doi.org/10.3390/children9030334
36. Wakimizu R, Fujioka H, Nishigaki K, Matsizawa A (2020) Quality of life and associated factors in siblings of children with severe motor and intellectual disabilities: a cross-sectional study. Nurs Health Sci 22(4):977–987. https://doi.org/10.1111/nhs.12755
37. Wang T, Qian Y, Zhong T, Qi J (2022) Associations between fundamental movement skills and moderate-to-vigorous intensity physical activity among chinese children and adolescents with intellectual disability. Int J Environ Res Public Health 19(20):13057. https://doi.org/10.3390/ijerph192013057
38. Wehmeyer ML (2020) The importance of self-determination to the quality of life of people with intellectual disability: a perspective. Int J Environ Res Public Health 17(19):7121. https://doi.org/10.3390/ijerph17197121
39. Wolan-Nieroda A, Dudziak J, Drużbicki M, Pniak B, Guzik A (2021) Effect of dog-assisted therapy on psychomotor development of children with intellectual disability. Children 8(1):13. https://doi.org/10.3390/children8010013
40. Zurita-Ortega F, Ubago-Jiménez JL, Puertas-Molero P, Ramírez-Granizo IA, Muros JJ, González-Valero G (2020) Effects of an alternative sports program using Kin-Ball in individuals with intellectual disabilities. Int J Environ Res Public Health 17(15):5296. https://doi.org/10.3390/ijerph17155296