motricidade

ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.34668

The effect of balance on the real and perceived motor competence of 7 –and 8-year-old children

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ABSTRACT

The aims of the present study were to observe the values of balance, Motor Competence (MC) and Perceived Motor Competence (PMC) in pupils between 7 and 8 years of age, as well as to find out the effect of a program focused on balance work over MC, PMC and balance itself, and the differences according to sex. The sample consisted of 10 boys and 7 girls, belonging to the second year of Primary Education (*Mage*= 7.6 years; *SD*= .24). A pre-experimental repeated measures study design was used. The instruments used were the Test of Gross Motor Development (TGMD-3) to analyse actual motor competence, the Pictographic Scale of Perceived Motor Skills Competence (PMSC) to analyse their perceived motor competence, and the Stability Skills test for balance. A 10-session programme, in which balance was the main aim, was implemented. The results indicated improvements in all dimensions, with differences according to the gender of the participants. Therefore, it can be concluded that specific balance work can improve not only balance but also real and perceived motor competence, although more studies are needed on sex differences.

KEYWORDS: balance; motor competence; object control; locomotion skills.

INTRODUCTION

Motor competence (MC) has been defined as an individual's degree of competence in an array of movement capabilities, as well as their motor coordination, motor control, and movement quality while performing activities (Gabbard, 2008). By contrast, low MC describes children who have not reached age-appropriate levels for motor skill development, usually because of low stimulation and experience, practice, and instruction (Tamplain & Cairney, 2024). According to Gallahue et al. (2012), MC is an essential prerequisite to performing daily life activities, as well as to practising healthy physical activity during childhood, adolescence, and adulthood. These authors understand MC as a diversified set of motor skills organised into three main categories: locomotion, object control, and balance. They hold the hypothesis that children must acquire basic balance skills before progressing to locomotion skills and that they must develop basic capabilities in these two areas to move forward to object control (Gallahue et al., 2012). Azuero-Azuero and Aldas (2023) pointed out that effective balance development and improvement requires planning, frequency and dedicated time, and the activities must match the context characteristics.

Thus, as balance control improves with learning, it is possible to increase the amount of movement and to engage other body segments, allowing for the acquisition of more complex skills (Croselj et al., 2019). Likewise, these fundamental movement capabilities help develop more specialised skills, which are essential to successfully playing games or sports, dancing and doing other physical activities (Gallahue et al., 2012). Additionally, it was found that, by improving balance, children showed greater confidence when performing these activities (Azuero-Azuero & Aldas, 2023).

Motor development improved during childhood, especially between the ages of 6 and 9, with MC playing a relevant role in the process (Cenizo et al., 2015). In this period, locomotion and balance skills grow. Furthermore, relying on the increase in strength, motor coordination, and balance, eye-hand and eye-foot coordination improve and, as

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Conflict of interests: nothing to declare. Funding: nothing to declare.
Received: 02/15/2024. Accepted: 06/19/2024.

a consequence, object control skills start to develop as well (Fort-Vanmeerhaeghe et al., 2017).

In the present study, MC was assessed based on three types of skills: locomotion, object control and stability. Locomotion skills refer to displacements in space, and they require coordinated movements of the limbs in order to move the body's centre of mass (e.g. running, jumping, or galloping) (Stodden et al., 2009). Object control skills refer to object handling, and they include all types of throwing, catching, and kicking. By contrast, stability skills are those based on balance, and they are considered to underlie the previous ones (Gallahue et al., 2012). They are needed to develop the ability to perceive a change in the relative position between body segments, as well as the ability to quickly and accurately adapt to those changes.

Balance is developed during the first life stages, maturing gradually from age 7 (Puta et al., 2022). It is divided into static balance, the ability to sustain a stable single-leg or narrow double-leg stance (Condon & Cremin, 2014), and dynamic balance, the ability to control our moving body (Ruiz, 2021).

This ability depends on our senses as well as on our vestibular and motor control systems, which are essential for social interaction, cognitive improvement, and the acquisition and development of more complex motor skills (Wälchli et al., 2017). Balance is usually described as a complex movement capability and is often introduced as postural control (Croselj et al., 2019). The coordination of several systems, such as visual, proprioceptive, kinaesthetic, and vestibular, is needed to keep posture and orientation in space. Consequently, balance is influenced by the development and interaction among these systems. These relationships will determine what a child is able to do regarding their motor skills e.g. a 5-year-old child should be able to stay still with their feet together in parallel, without stepping or falling (Ruiz, 2021).

As stated in the literature, the ability to keep balance allows one to effectively and efficiently perform a variety of motor skills and daily-life activities such as walking, running, or sitting with good body posture (Conner et al., 2019; Puta et al., 2022) and is important to the performance of many movement skills (Estevan et al., 2021). Stability skills help not only to maintain stability in a specific space, but also to adjust and adapt our own body to the changes that happen in the context in an agile, fast, and accurate manner (Ruiz, 2021), which is paramount in a sports practice setting.

In the past years, multiple studies have established that MC requires perception skills, emotional regulation, knowledge, and understanding of the task to be executed (Rudd et al., 2020), which are related to perceived motor competence (PMC) in healthy children, adolescents, and adults, as well as to their self-concept and physical activity practice (De Meester et al., 2020). These relationships explain the associations among low MC, low PMC and little adherence to physical activity (Robinson et al., 2015), which may affect children's complete development.

Actual motor competence (AMC) is important for schoolchildren's development, and so is PMC. Although there is some controversy over the terms used to refer to it, physical self-concept, perceived sports competence, and perceived physical confidence (Estevan & Barnett, 2018), PMC can be defined as an individual's perception, awareness, and beliefs about their actual movement capabilities (Robinson et al., 2015). Stodden et al. (2008) identified it as one determining factor in children's motor and MC development, since it may encourage them to practice until mastering a skill, which can, in turn, generate adherence to physical activity practice. For that reason, PMC can be considered as a predictor of physical activity levels, as well as a mediating factor between physical activity and AMC (Babic et al., 2014),

Considering all the above, the present study aimed to assess balance, AMC and PMC in Year-2 (primary school) children, to measure the effect of a balance-centered program on AMC, PMC, and balance, and to determine whether there are sex differences in these variables. The hypotheses proposed are that working on balance leads to an improvement not only in balance but also in the AMC and PMC of Year-2 school children and that there are no differences between boys and girls.

METHOD

Study design

This research design was quasi-experimental, also known as pre-experimental, whose objective is to test a hypothesis, manipulating at least one independent variable (IV) (Fernández et al., 2014). It is causal research since the purpose of the study was to determine the effects of a balancing programme (VI) on the dependent variables, AMC, PMC and balance. To this end, a repeated measures design was applied, with pre- and post-test measures.

Participants

The sample selection method was non-probabilistic, based on convenience and accessibility to the participating subjects. The participating children belonged to a private, co-educational, secular school in a Spanish autonomous community with a medium-high socioeconomic level, where five hours of Physical Education are taught per week. There was only one group, called the intervention group, made up of 17 students in the second year of Primary Education (*Mage*= 7.6 years; *SD*= 0.24), of whom 58.8% were boys and 41.2% were girls. For organisational reasons, it was not possible to have a control group.

Measures

For the assessment of motor competence.

The instrument used was the Test of Gross Motor Development, Third Edition (TGMD-3, Ulrich, 2019). This test has excellent reliability in children from different cultures, including the Spanish context (Estevan & Barnett, 2018). It is composed of thirteen tests that assess fundamental motor skills, divided into two subscales. The first is composed of six tasks that measure locomotion skills, which require a coordinated and fluid movement of the child's body in motion (running, galloping, hopping, skipping, skipping, horizontal jumping and lateral movement), while the second is composed of seven tasks, serves to assess object control skills, that is, to measure the gross motor skills involved in throwing, catching and hitting movements (batting, racket hitting, bouncing, catching, kicking and throwing).

The test, whose evaluation is process-oriented and is carried out by an expert observer, contemplates three to five performance criteria for each skill, scoring 1 if the participant shows the criterion in the performance of the activity or 0 if he/she does not show the criterion, making two attempts for each skill, in addition to a pre-test after the explanation of the task to be performed. For each of the subscales, a score is obtained, which is the result of the sum of the values of each of the criteria. The range of scores for the locomotion subscale is between 0 and 46 points, for the object control subscale between 0 and 54, and for the gross motor development scale, which is called AMC in this study, between 0 and 100, calculated from the sum of the two previous ones. In addition, the test has a manual containing normative values for each subscale and for the total, depending on the age and gender of the participant. Also, the test manual for the gross motor index contains a series of descriptors associated with the different scores (impaired or delayed, borderline impaired or delayed, below average, average, above average, superior, and gifted or advanced) that indicate where the participant stands motor performance in relation to their chronological age, taking into account their date of birth and the time of measurement. Data collection was carried out by direct observation, and participants were assessed individually, spending between 15 and 20 minutes per participant.

For the assessment of the balance

The instrument used was the Stability Skills Test, a process-oriented test developed by Rudd et al. (2015). It has three postural control tasks: rocking, rolling, and static back stability (own translation of rock, log roll, and back support), each of which provides three to five criteria for skill performance. The participant has two attempts per skill, scoring each criterion 1 (successful completion) or 0 (unsuccessful completion) depending on the performance outcome. Finally, the scores for each skill are added up separately, and then all the scores are added together, with the total value indicating the participant's balance. The scores that can be obtained for each subscale are as follows: roll between 0 and 8 points, roll between 0 and 6 points, static back stability between 0 and 10 points, and total balance between 0 and 24 points. The interpretation of the results indicates that the higher the score, the better the balance. Data collection was carried out by direct observation, and participants were assessed individually, spending between 5 and 7 minutes for each one.

For the assessment of perceived motor competence

Based on the Pictographic Perception of Motor Skills Competence Scale for Young Children (PMSC; Barnett et al., 2015), the Spanish version of Estevan et al. (2019) was used. This scale consists of 13 items, divided into two subscales, aligned with the skills assessed in the TGMD-3 battery (Ulrich, 2019). This instrument is designed for children between 4 and 9 years of age. The six items of the first subscale assess locomotor patterns and the seven items of the second subscale measure object control. The sum of the scores obtained in each subscale indicates the PMC of the participant being assessed. The instrument is implemented. The participant is shown two pictograms of a child performing a motor skill and has to choose the image that most resembles how he or she performs the skill. With this scoring method, four possible skill levels are obtained for each skill. The scores of the locomotion subtest, with a range of scores between 6 and 24 points; those of the object control subtest, with possible values between 6 and 28 points; and finally, the score of the thirteen skills, with a range between 12 and 52 points, are added together. The PMC is determined according to the points obtained, so the higher the score, the higher the participant's PMC. The following designations have been used to refer to each of the dimensions of this instrument: PMC, perceived locomotion, and perceived object control.

Programme

The balance-focused programme consisted of 10 45-minute sessions over four weeks. The balance development activities were designed to be playful and based on games, cooperative challenges, circuits, and individual trampoline jumping work. The sessions were structured as follows: 5-7 minutes of games and activation tasks and 38-40 minutes of balance work. The sessions were carried out during physical education hours, and the spaces used were the gymnasium and the outdoor football pitch.

Procedure

Before the beginning of data recording, the school was informed about the study aims, and authorisation was obtained in order to proceed with the research. Families were asked to sign an informed consent to authorise their children to participate in the study. The research and the tests were explained in this consent, and information about voluntary participation and data confidentiality was provided. Should they wish to do so, participants were free to withdraw their participation in the study at any time.

Pre-test data gathering began after all families provided informed consent. The first test was the TGMD-3, which was given over five 45-minute sessions on an outdoor football field. It was carried out in small groups of about five students; task explanation and demonstration were given in groups, but the assessment was done individually. Simultaneously, and thanks to the involvement of the teaching staff, the remaining pupils attended the equivalent Physical Education session as scheduled by the yearly educational program.

Additionally, the data collection for PMSC was conducted in two 45-minute sessions, in this case, during Spanish Language class. One by one, participants were asked to leave the classroom and perform the test in an adjacent one, which was empty and free from distracting elements that could interrupt them or influence their answers.

The Stability Skill Test was conducted in two 45-minute sessions in the sports hall during Physical Education class. Every participant was asked to perform the three testing skills while the rest engaged in Physical Education class.

It took two weeks to collect all pre-test data, and the designed programme was then implemented for four weeks. It must be noted that while the original intervention design included 16 practice sessions, the final programme had to be reduced to 10 sessions due to school organisational reasons.

After the intervention programme, the post-test was conducted using the same instruments as in the pre-test. In this case, four 45-minute sessions on the outdoor football field were needed for TMGD-3, one 45-minute session in the sports hall was used for the Stability Skill Test, and two 45-minute sessions were needed for PMSC.

Data analysis

The statistical software used to analyse the collected data was the Statistical Package for Social Sciences (SPSS version 29). A descriptive study of the scales obtained in the TGMD-3 (Ulrich, 2019) and in the Stability Skills Test (Rudd et al., 2015), both before and after the intervention, was carried out to assess the scores obtained by the participants at baseline and to study possible improvements after the application of the programme.

From the scores obtained in the TGMD-3, the corresponding scalars and AMC descriptors were calculated. A table of absolute frequencies and percentages was produced to show the differences in the values obtained pre- and post-intervention for each of the subscales, locomotion and object control skills, as well as for the AMC.

For the inferential analysis, the values obtained from the difference between pre- and post-test scores were considered using the scores of the subscales locomotion skills, object control and gross motor development (AMC). Non-parametric statistics were used due to the sample size, following Pardo and Ruiz (2005), who recommend using this type of test with samples of less than 30 participants.

Also, the Wilcoxon signed-rank test was used to determine the effectiveness of the within-subject programme. Effect size was considered using the R statistic ($R= Z/\sqrt{N}$; N= number of measurements) and was interpreted as small (.1 to .3), medium (.3 to .5) or strong (≥ .5) (Cohen, 1998). The Mann-Whitney U-test was used to study the intergroup difference between boys and girls before and after the intervention.

However, to determine the degree of relationship between variables, Spearman's correlation coefficient was used, both at baseline and after the program, using the final scores of the two subscales and the total score of the instruments used. The size of the correlation coefficients was interpreted according to Hopkins et al. (2009): trivial (< .1), low (.1 to .3), moderate (.3 to .5), high (.5 to .7), very high (.7 to .9), and near perfect (> .9).

RESULTS

The present study aimed to assess balance, AMC and PMC in Year-2 (primary school) children, to measure the effect of a balance-centred programme on AMC, PMC and balance, and to determine whether there are sex differences in the previous results.

Table 1 shows the means and standard deviations of the baseline scores for balance, AMC, PMC and their sub-scales. Despite mean scores being higher in boys than in girls in all dimensions analysed, the Mann-Whitney U test did not reveal significant differences between sexes. Even so, the *p-value* for the dimension total balance was close to significant.

Concerning relationships between variables at baseline among girls, very high correlations were found between AMC and log roll (r= .84, p< .05), between log roll and total balance (r= .82, p< .05) and between log roll and actual locomotion (r= .79, p< .05). A larger number of correlations were detected in the case of boys, so they are displayed in Table 2. Very high correlations can be observed between back support and perceived locomotion, between actual locomotion and both rock and total balance and between AMC and both rock and total balance.

The descriptive statistics about AMC, stability skills and PMC scales obtained after the intervention programme are shown in Table 3.

For the whole sample, improvements were found in all dimension means after the programme, all of them being significant and with large effect sizes (p< .05, R> .5), except for rock. In the case of girls, a significant increase with a large effect size (R between .51 and .90) was observed in

Table 1. Descriptives of the scales of Actual Motor Competence, Stability Skills and Perceived Motor Competence at baseline and gender differences.

Dimension	Total sample	Girls	Boys	*U*	*p*-value
	M (SD)	*M (SD)*	*M (SD)*		
TGDM-3					
Locomotion	33.24 (4.68)	31.86 (5.34)	34.20 (4.18)	25.00	.32
Object control	36.29 (5.06)	35.57 (4.35)	36.80 (5.67)	32.00	.77
AMC	69.53 (7.42)	67.43 (7.11)	71.00 (7.63)	27.00	.43
StabilitySkills					
Rock	4.00 (1.54)	3.43 (1.81)	4.40 (1.26)	24.00	.27
Log Roll	2.06 (1.56)	1.71 (2.06)	2.30 (1.16)	26.00	.37
Back Support	4.12 (1.50)	3.43 (1.90)	4.60 (0.97)	21.00	.16
Total Balance	10.18 (2.77)	8.57 (2.82)	11.30 (2.21)	15.50	.05
Perceived Competence					
PMC Locomotion	18.65 (1.46)	18.00 (1.29)	19.10 (1.45)	20.00	.13
PMC Obj. Control	20.65 (2.21)	20.14 (2.41)	21.00 (2.11)	29.00	.55
PMC	39.35 (2.67)	38.14 (2.73)	40.20 (2.39)	19.50	.13

AMC: Actual Motor Competence; PMC: Perceived Motor Competence; PMC Obj. Control: Perceived Motor Competence Object Control; *M*: Mean; *SD*: Standard Deviation; *U*: U Mann-Whitney.

Table 2. Relation between variables before the programme in boys.

Dimension	1	2	3	4	5	6	7	8	9	10
1. Locomotion	-	.22	.64*	.94**	.25	.21	.76*	.02	-.61	-.32
2. Object control		-	.83**	.44	.13	.59	.50	.21	-.02	.25
3. AMC			-	.78**	.09	.62	.72*	.23	-.40	-.01
4. Rock				-	.18	.28	.74*	-.04	-.48	-.21
5. Log Roll					-	-.08	.67*	-.49	-.19	-.53
6. Back Support						-	.46	.71*	-.11	.42
7. Total balance							-	-.43	-.04	-.32
8. PMC Locomotion								-	.04	.68*
9. PMC Object control									-	.70*
10. PMC										-

AMC: Actual Motor Competece; PMC: Perceived Motor Competence; *p< .05; **p< .01

5 out of the 10 dimensions analysed: actual object control, AMC, back support, total balance and PMC. In the case of boys, a significant increase with a large effect size (*R* between .68 and .90) was detected in 8 out of the 10 dimensions analysed, i.e. all except actual locomotion and rock.

The table with the Mann-Whitney U test results for the post-test is not included since it only yielded significant differences between boys and girls in actual object control (p= .03), where the mean was 43.71 (*SD*= 4.12) for girls and 45.40 (*SD*= 3.84) for boys.

Table 4 shows AMC descriptors in the pre- and post-tests, with absolute frequencies and percentages for each of them. As can be seen, before the programme implementation, 2 girls and 4 boys were below the average value for children of their age, while the rest of the participants presented average values. Nevertheless, in the post-test, both girls and boys scored average or above-average values in the TGMD-3.

Table 3. Descriptives of the scale of Actual Motor Competence, Stability Skills and Perceived Motor Competence.

Dimension	Total Sample				Girls				Boys			
	Pre-test	Post-test	*p*-value	*R*	Pre-test	Post-test	*p*-value	*R*	Pre-test	Post-test	*p*-value	*R*
	M (SD)	*M (SD)*			*M (SD)*	*M (SD)*			*M(SD)*	*M (SD)*		
TGDM-3												
Locomotion	33.24 (4.68)	35.53 (4.29)	.03*	.52	31.86 (5.34)	35.14 (4.18)	.12	.59	34.20 (4.18)	36.10 (4.38)	.15	.45
Object control	36.29 (5.06)	43.71 (4.12)	< .001**	.88	35.57 (4.35)	41.29 (3.40)	.02*	.89	36.80 (5.67)	45.40 (3.84)	.005**	.89
AMC	69.53 (7.42)	78.88 (6.53)	< .001**	.87	67.43 (7.11)	75.57 (5.62)	.03*	.83	71.00 (7.63)	81.50 (6.19)	.005**	.89
Stability Skills												
Rock	4.00 (1.54)	4.82 (1.24)	.11	.39	3.43 (1.81)	4.86 (1.57)	.18	.51	4.40 (1.26)	4.80 (1.03)	.34	.30
Log Roll	2.06 (1.56)	3.47 (1.28)	< .001**	.80	1.71 (2.06)	2.86 (1.21)	.05	.74	2.30 (1.16)	3.90 (1.20)	.008**	.83
Back Support	4.12 (1.50)	5.59 (1.97)	.002**	.75	3.43 (1.90)	5.14 (2.27)	.03*	.84	4.60 (0.97)	5.90 (1.79)	.03*	.70
Total Balance	10.18 (2.77)	13.88 (3.35)	< .001**	.88	8.57 (2.82)	12.86 (4.14)	.02*	.90	11.30 (2.21)	14.60 (2.67)	.005**	.90
Perceived Competence												
PMC Loco.	18.65 (1.46)	19.82 (1.74)	.006**	.67	18.00 (1.29)	19.00 (0.82)	.07	.70	19.10 (1.45)	20.40 (2.01)	.03*	.68
PMC Obj.	20.65 (2.21)	21.82 (2.51)	.008**	.65	20.14 (2.41)	20.86 (3.02)	.16	.53	21.00 (2.11)	22.50 (1.96)	.03*	.70
PMC	39.35 (2.67)	41.65 (2.96)	< .001**	.84	38.14 (2.73)	39.86 (2.97)	.04*	.77	40.20 (2.39)	42.90 (2.33)	.005**	.90

AMC: Actual Motor Competence; PMC Loco.: Perceived Motor Competence Locomotion; PMC Obj.: Perceived Motor Competence Object Control; *M*: Mean; *SD*: Standar Deviation; $^{*}p< .05$; $^{**}p< .01$; R: effect size.

Table 4. Actual Motor Competence descriptors by gender and in the whole sample.

Descriptive term	Girls				Boys				Total sample			
	Pre-test		*Post-test*		*Pre-test*		*Post-test*		*Pre-test*		*Post-test*	
	f	%	f	%	f	%	f	%	f	%	f	%
Impaired or delayed	-	-	-	-	-	-	-	-	-	-	-	-
Borderline impaired or delayed	-	-	-	-	-	-	-	-	-	-	-	-
Below average	2	28.6	-	-	4	40.0	-	-	6	35.3	-	-
Average	5	71.4	6	85.7	6	60.0	8	80.0	11	64.7	14	82.4
Above average	-	-	1	14.3	-	-	2	20.0	-	-	3	17.6
Superior	-	-	-	-	-	-	-	-	-	-	-	-
Gifted or very advanced	-	-	-	-	-	-	-	-	-	-	-	-
Total	7		7		10		10		17		17	

f: Absolute frecuency.

After the intervention, very significant correlations were found in girls between actual and perceived locomotion (r= .86, p< .05) and between actual object control and rock (r= .90, p< .05). In the case of boys, high significant correlations were observed between back support and actual object control (r= .69, p< .05) and between back support and AMC (r= .68, p< .05).

DISCUSSION

The aims of the present study were to assess participants' balance, AMC and PMC, to measure the effect of a balance-centred programme on these variables, and to determine potential sex-related differences.

When looking at the baseline AMC descriptors, it was observed that more than half of the boys and girls presented 'average' values, in contrast to the results reported by Bolger et al. (2021), who concluded that children between 6 and 10 years old scored 'below average' in the TMGD-2 (Ulrich, 2019). Furthermore, after the programme implementation, the students obtained 'average' and 'above-average' scores, suggesting that the intervention had helped them achieve an appropriate AMC level. Reaching this level by age 7 is important to successfully engage in physical activities requiring more specialised skills, such as sports or dancing (Gallahue et al., 2012).

Significant improvements were observed in AMC, PMC and balance. In light of the results, thanks to the balance-centred work, the participants showed an improvement in AMC, which can be explained by the relationship between balance and motor competence, a relationship that has also been found between balance perception and motor competence in other studies (Estevan et al., 2021). In line with this, Conner et al. (2019) stated that good balance allows one to effectively and efficiently move and perform activities, agreeing with other studies that highlighted that proper balance development is necessary for the successful performance of daily-life activities (De Oliveira et al., 2017; Melo et al., 2020).

Other intervention studies reported improvements in the participants' total MC. They aimed to assess the changes in movement capabilities and physical activity after implementing a motor skill programme (Palmer et al., 2019) and to determine the effects of another programme on motor skill performance and self-regulation in pre-schoolers (Robinson et al., 2015). Palmer et al. (2019) conducted a five-week intervention on motor skills based on the achievement goal theory, after which the experimental group students showed greater improvements in motor skills compared to those in the control group. Likewise, Robinson et al. (2015) applied another intervention based on the same theory and with a similar duration. In this case, instead of allowing students to play freely during the break, they were asked to follow a motor skill programme. The results revealed that the experimental group members who participated in the motor skill programme showed higher motor skill performance than those in the control group. Similarly, Azuero-Azuero and Aldas (2023) reported that the implementation of recreational activities in Physical Education class for 12 weeks contributed to enhancing static and dynamic balance.

When analysing the relationships among variables in girls, very high positive correlations can be observed at baseline between log roll and AMC and between log roll and actual locomotion. This can be due to the fact that, as explained by Rudd et al. (2015), the log roll seemed to be a complex ability for children and, according to Gallahue et al. (2012), it is essential to master balance skills to move forward to locomotion skill development. This may also justify, in the case of boys, the very high positive correlations found between actual locomotion and both rock and total balance, as well as between the latter two variables and AMC.

With regard to the post-test, very high positive correlations were detected between actual object control and rock in girls and between back support and both actual object control and AMC in boys. This also aligns with the notion that improving balance helps improve other, more complex skills (Fort-Vanmeerhaeghe et al., 2017), such as object control.

However, the results revealed a lack of correlation between AMC and PMC, in contrast to Lopes et al. (2018), who obtained weak to moderate associations between these variables in Portuguese children aged 5 to 9 years old. De Meester et al. (2020) conducted a meta-analysis to examine, analyse, and summarise the scientific evidence regarding the relationship between AMC and PMC in children, adolescents, and young adults. As a result, they concluded that the association between these variables was weak to moderate. Moreover, they observed that the strength of this association did not change based on participants' age or sex. Nonetheless, this research highlighted a lack of clarity in the relationship between AMC and PMC and the need for studies where other variables are taken into account.

In light of the results, it can be stated that boys obtained higher scores than girls in all dimensions analysed, not only at baseline but also in the post-test, where boys showed significant improvements in eight out of ten dimensions. Boys scored higher than girls in balance, as opposed to other studies' findings (Djordjević, 2021; Rodríguez-Negro et al., 2021).

There was also a significant difference in object control between boys and girls, in agreement with the studies by Djordjević (2021) and Rodríguez-Negro et al. (2021). These authors hypothesised that this could be explained by the fact that males had greater opportunity to engage in activities that require object control. Additionally, boys showed significant improvements in both PMC and its sub-scales (perceived locomotion and perceived object control), while girls only presented significant improvements in PMC. This reveals sex-related differences in how they perceive themselves, in line with the results obtained by Gutiérrez et al. (2020), who analysed the differences in AMC and PMC between boys and girls aged 12 to 15 years old, concluding that boys perceived themselves as more competent than girls. The difference between boys and girls in perceived object control, with boys scoring higher, agrees with the studies by De Meester et al. (2020) and Rodríguez-Negro et al. (2021). These disparities can be explained by the fact that boys have greater possibilities to participate in physical activities that require object handling, whereas girls typically engage in personalised and stereotyped activities such as dancing (Gutiérrez et al., 2020).

CONCLUSION

In view of the results obtained in this study, it can be concluded that a balance-based intervention leads to improvements in this skill, as well as in locomotion and object control skills, both actual (AMC) and perceived (PMC) in the sample study. When looking at the results by sex, it can be stated that boys scored higher than girls both at baseline and in the post-test.

The first limitation of this study is related to the sample, which was very small, selected through a non-probability method, and did not include a control group. Secondly, children should have been filmed while performing the TGMD-3 to be able to analyse them afterwards, but the school did not allow it due to data protection reasons. However, help was provided by the physical education teacher during observation and data collection. Thirdly, the original intervention included 16 sessions, but only 10 were finally implemented due to school organisational reasons. Lastly, to the best of our knowledge, no previous research had included the Stability Skill Test as a measuring instrument. Moreover, a strong point of this test is that it measures not only static balance but also dynamic balance and postural control. Additionally, advice was provided by one of its authors.

Future research could examine parents' perception of their children's AMC, which can be assessed through the DCDQ-ES (Montes-Montes et al., 2020), and compare it to the data already collected. In addition, a larger sample could be randomly selected, including a control group, and the number of program sessions could be increased.

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