

## Breakdown of motor skills in primary school children: weight status and gender

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### Abstract

The Primary Education phase marks the beginning of formalized and systematic instruction for many children. In the field of Physical Education, one of its fundamental purposes is to promote the development of basic motor skills. The objectives of this study were, on the one hand, to analyze gender differences in basic motor skills among a group of primary school children, and on the other hand, to examine the relationship of weight status with these same motor skills. We analyzed a sample of 145 girls and 142 boys, aged between 8 and 12 years. A scale of assessment of basic motor skills was used to evaluate their motor skills. Anthropometric measurements were collected to ascertain their weight status. The girls and boys showed similar competence in locomotor skills and turn and rolling skills. The girls had the lowest levels in object control competence with a significant difference regarding boys ( $p \leq .05$ ). The intra-gender analysis indicated that overweight boys perform worse than boys with normal weight in motor competence for locomotor activities and turning, showing significant differences. Conversely, among girls, these differences are observed in motor competence related to object control. These findings underscore the importance of addressing gender differences and weight status when designing interventions to enhance motor skills in the childhood population.

**Key Words:** motor competence, children, overweight, motor ability.

### Introduction

The Primary Education phase marks the beginning of formalized and systematic instruction for many children. During this educational period, the aim is to enhance the cognitive, social, affective, and motor development of students (Herazo and Domínguez, 2010; Más et al., 2018). In the field of Physical Education, one of its fundamental purposes is to promote the development of basic motor skills. These basic motor skills are shared by all individuals and serve as a foundation for acquiring more specific motor skills (Hulteen et al., 2018). The evolution of motor skills constitutes a procedure that requires the accumulation of experiences and the maturation of the central nervous system, as indicated by Schmidt and Lee (2019). This development takes place through the motor phases that make it up, namely, the initial, elementary, and mature stages. Therefore, it is crucial that children could participate in practices and explore various forms of movement in a logical and systematic way (Stodden et al., 2014). If these practical opportunities are lacking, motor skills may not reach the maturity stage, which is related to possible complications in motor coordination (Schmidt and Lee, 2019). Various factors directly influence motor development, including physical and neurological maturation, genetics, quality and diversity of experiences, environmental conditions, quality of life, balanced diet, and hygiene (Hulteen et al., 2018; Payne and Isaacs, 2017; Schmidt and Lee, 2019).

One factor associated with low levels of basic motor skills is a sedentary lifestyle (Macmillan et al., 2023; Trecroci et al., 2021). In recent decades, social evolution has changed human behavior, with home technology replacing physical activities. Industrialized food production, rich in fats and carbohydrates, along with environmental factors such as sedentary lifestyle is associated with an increase in overweight and obesity (Ahrens et al., 2014; Kushner et al., 2019; Marcelin et al., 2019; Reid et al., 2020; Thivel et al., 2016). Various research suggests that children who are overweight or obese exhibit lower levels of fundamental motor skills (Macmillan et al., 2023; Trecroci et al., 2021).

On the other hand, by examining the significance of gender identity as a cultural element in motor development, it becomes evident that it wields a significant impact. This is interpreted as the set of beliefs, values, and societal norms that are prevalent and accepted, reflecting the designated roles for men and women shaped by specific historical, cultural, and social contexts, influencing individual behaviors (De Juan and Pérez-cañavera, 2007). Motor skills cultivated in certain sports often carry a pronounced cultural aspect aligned with gender stereotypes. The data indicates that girls typically engage in sports activities with an aesthetic emphasis, whereas boys tend to gravitate towards contact sports (Wellard, 2017). Based on this, girls and boys face the decision between two extremes. If girls choose predominantly male sports, they run the risk of being perceived as athletes with a masculine identity, sometimes negatively labeled by society. In this context, girls tend to choose activities that do not compromise their feminine identity (Masanovic, 2019). In recent decades, the

evolution of physical activity has detached some activities from gender stereotypes, creating a common space between the masculine and the feminine (Masanovic, 2019).

In recent years, children's games have become more similar (Wellard, 2017). Despite this, studies continue to indicate that girls participate less in sports activities (Masanovic, 2019; Monforteand Úbeda-Colomer, 2019). Differences persist in the type of physical activity preferred and participated in; boys lean towards ball sports, while girls tend to gravitate towards more artistic activities such as dance, rhythmic gymnastics, and skating (Field and Temple, 2017; Temple, 2016). Furthermore, it is known that there are some differences in the level of motor competence between genders, with object control being more developed in boys than in girls (Field and Temple, 2019).

Understanding how gender and weight status impact motor development may be key to designing interventions and programs that effectively address the specific needs of different groups of individuals, thereby promoting healthy and equitable motor development.

The objectives of this study were, on the one hand, to analyze gender differences in basic motor skills among a group of primary school children, and on the other hand, to examine the relationship of weight status with these same motor skills.

## Material & methods

### Sample

This study has a descriptive and quantitative cross-cutting design, including 287 children (145 girls and 142 boys) from 8 to 12 years old (mean 9.97,  $\pm$  1.305), belonging to three educational establishments in a province of Spain. The selection of educational centers was made based on convenience and availability. Informed consent was obtained from both the parents of the students following the guidelines of the data protection law and the approval of the Ethics Committee of the University of Alicante (UA-2020-09-01).

### Instruments

To measure motor competence, the Basic Motor Skills Assessment Scale (Fernández et al., 2007) was utilized. It assesses three basic skills: Locomotor Skills (12 tasks), Object Control (10 Tasks), and turning and rolling (12 Taks). This scale is a dichotomous list of motor tasks that assumes each task can be evaluated with two alternatives, either appropriate or not, to determine the level of difficulty in execution based on the subject's age. The reliability of the instrument was determined using Cronbach's alpha, with the following results: locomotor skills alpha 0.81, rolling alpha 0.84, and object control alpha 0.86.

To determine the levels of motor competence of the students, the values obtained were compared with the classification provided by the evaluation scale. Classifying motor competence levels into five: low, low average, medium, medium high and high

The assessment of weight and height for calculating the Body Mass Index (BMI) was conducted using an electronic scale and a stadiometer. To determine obesity and overweight levels in the sample, the BMI values were compared with a reference distribution from the Orbegozo Foundation (Fernández et al., 2011). This research defines obesity as  $\geq$  97th percentile and overweight as  $\geq$  85th percentile.

To know sports habits, three questions were asked about the practice of extracurricular physical activity, frequency, and type.

### Procedure

Upon obtaining parental consent for their children's participation the researcher assessed the basic motor skills scale, as well as weight and height and sports habits questions. The data collection protocol was as follows:

The students were informed about the assessments to be conducted.

- Weight and height measurements were taken with the children wearing shorts, a T-shirt, and barefoot.
- Each task on the basic motor skills assessment scale was explained to ensure understanding by the subjects.
- Tasks were presented in the same order as the prepared task list, with a score of 1 recorded for successful completion and 0 otherwise.
- A second attempt was allowed if the first one failed.
- If a subject failed another 2 consecutive tasks after failing one, the test was suspended for that subject.

### Data Analysis:

IBM SPSS 28.0 software for Windows was utilized for data analysis, employing descriptive statistics.

Variable comparisons were conducted using the chi-square test (X<sup>2</sup>), t-test, and one-way analysis of variance (ANOVA) with Scheffer post hoc analysis. A significance level of  $p < 0.05$  was set.

## Results.

The findings from our study reveal that 24.6% of children are overweight, with 14.1% experiencing obesity. Among girls, 26.9% have overweight tendencies, while 9% are classified as obese. No significant differences were observed between genders. When segregating the sample by age and gender, only one significant difference was found between genders at the age of 8. (Table 2).

Table 2. Classification of the sample according to gender, age, and BMI.

Aged	Normopeso		Sobrepeso		Obeso		Chi <sup>2</sup>	p
	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)	Boys n (%)	Girls n (%)		
8	16(53.3)	16(26.7)	8(26.7)	1(5.9)	6(20)	0(0.0)	8.499	.014
9	16(57.1)	18(51.4)	6(21.4)	14(40.0)	6(21.4)	3(8.6)	3.584	.167
10	27(71.1)	19(54.3)	6(15.8)	9(25.7)	5(13.2)	7(20.0)	2.205	.332
11	17(65.4)	23(67.6)	8(30.8)	9(26.5)	1(3.8)	2(5.9)	.230	.892
12	11(55.0)	17(70.8)	7(35.0)	6(25.0)	2(10.0)	1(4.2)	1.343	.511

The results on sports habits indicate that 22.8% of girls do not participate in any sports activity, in contrast to 6.4% of boys. Additionally, the daily practice of physical activity revealed that girls engaged in less physical activity, and significant differences were observed compared to boys ( $t=3.626$ ,  $p=.004$ ). Regarding the types of sports practiced by students, it was observed that boys primarily lean towards team sports, while girls show a preference for individual sports. These findings suggest an association between gender and the type of sport ( $\chi^2(2)=64.090$ ,  $p=.001$ ).

The level of motor movement skills (running) of the students does not show significant differences between genders. Both groups reached similar levels in this motor skill (figure 1).

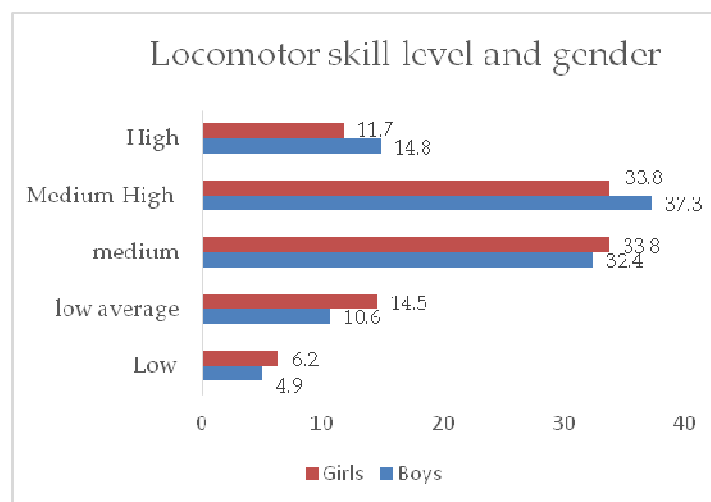


Figure 1. Locomotor skill level according to gender.

Now, when analyzing the relationship of BMI on the level of motor competence of intragender locomotion skills, we observed that boys and girls with normal weight obtain better results than children who are overweight or obese. The ANOVA analysis of variance did not show significant differences between the groups of girls, but significant differences were found between children with normal weight and overweight and children with normal weight and obesity (Table 3). Boys with normal weight are the ones who obtain greater motor competence.

Table 3. Significant intragender differences in the level of displacement between BMI groups.

Dependent Variable	(I)BMI	(J) BMI	Mean difference (I-J)	Typical Error	p
Locomotor skills level (boys)	Normal	overweight	.724	0.191	0.001*
		obesity	.982	0.236	0.001*
	overweight	normal	-.724	0.191	0.001*
		obesity	0.257	0.267	0.629
	obesity	normal	-.982	0.236	0.001*
Locomotor skills level (girls)	Normal	overweight	0.131	0.201	0.809
		obesity	0.541	0.312	0.225
	overweight	normal	-0.131	0.201	0.809
		obesity	0.410	0.337	0.478
	obesity	normal	-0.541	0.312	0.225
		overweight	-0.410	0.337	0.478

\* Difference mean is significant at  $p \leq 0.05$ .

The results obtained in this study on the level of control of objects show that girls obtain the worst results (Fig. 2). The  $\chi^2$  test showed a significant association between gender and object control ( $\chi^2(4) = 17.730, p = .001$ ).

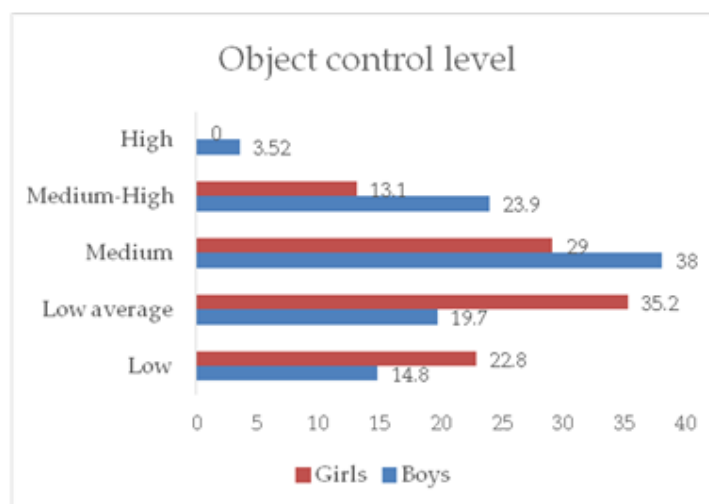


Figure 2. Object control level according to gender.

The intragender and BMI analysis showed that girls with obesity mostly have very low levels in this motor competence. The ANOVA analysis of variance showed a significant difference between girls with normal weight and girls with obesity. On the other hand, no significant differences were found between the groups of boys and BMI (Table 4).

Table 4. Significant intragender differences in the level of object control between BMI groups.

Dependent Variable	(I)BMI	(J) BMI	Mean difference (I-J)	Typical Error	<i>p</i>
Object Control level (boys)	Normal	overweight	0.463	0.198	0.068
		obesity	0.577	0.245	0.066
	overweight	obesity	-0.463	0.198	0.068
		normal	0.114	0.277	0.918
	obesity	normal	-0.577	0.245	0.066
Object Control level (girls)	Normal	overweight	-0.114	0.277	0.918
		obesity	0.257	0.181	0.368
	overweight	obesity	0.770	0.281	0.026*
		normal	-0.257	0.181	0.368
	obesity	normal	0.513	0.304	0.245
	obesity	overweight	-0.770	0.281	0.026*
		obesity	-0.513	0.304	0.245

\* Difference mean is significant at  $p \leq 0.05$ .

The analysis of the results of the level of the motor skill of turning shows that boys and girls have a low overall level (fig. 3), with no significant association between both gender groups after applying the  $\chi^2$  test.

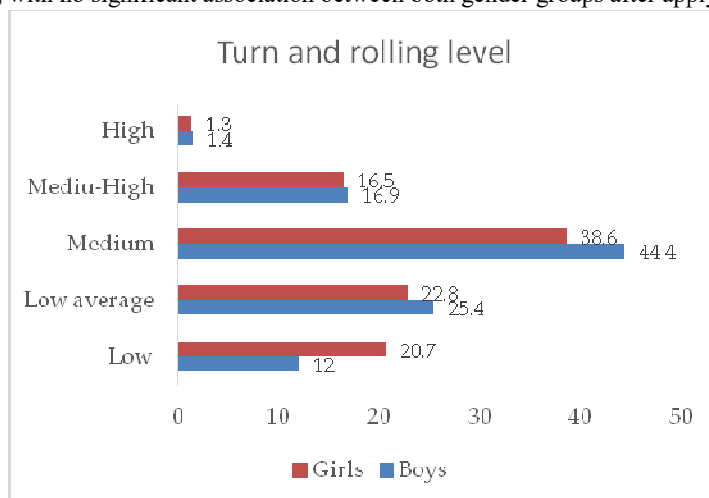


Figure 3. Turn and rolling level according to gender.

We also noticed that both girls and boys with obesity performed worse than their overweight and normal weight peers.

The intra-gender ANOVA analysis of variance showed that there was no significant difference for girls. On the contrary, there was a significant difference between boys with overweight and obesity and between boys with normal weight and obesity (table 5).

Table 5. Significant intragender differences in the level of turning and rolling between BMI groups.

Dependent Variable	(I) BMI	(J) BMI	Mean difference (I-J)	Typical Error	<i>p</i>
Turning and rolling level (boys)	Normal	overweight	-0.139	0.176	0.735
		obesity	.647	0.218	0.014*
	overweight	normal	0.139	0.176	0.735
		obesity	.786	0.247	0.008
Turning and rolling level (girls)	Normal	overweight	-0.647	0.218	0.014*
		obesity	-.786	0.247	0.008
	overweight	normal	0.049	0.191	0.968
		obesity	0.690	0.297	0.070
obesity	normal	-0.049	0.191	0.968	
	obesity	-0.641	0.321	0.140	
	normal	obesity	-0.690	0.297	0.070
	obesity	overweight	-0.641	0.321	0.140

\* Difference mean is significant at  $p \leq 0.05$ .

## Discussion

This research aimed to examine gender and weight status differences in fundamental motor skills among a cohort of elementary school children.

Basic motor skills are evolutionarily shared actions among all individuals that have played a significant role in human survival. These skills encompass the ability to move, jump, turn, receive, and throw, serving as the foundation for the development of more specialized abilities (Hardy et al., 2012; Hulteen et al., 2018; Schmidt and Lee, 2019). These basic motor patterns evolve as individuals grow older, progressing from simpler to more structured and intricate forms, with environmental factors playing a crucial role in their advancement (Herazo et al., 2009; Payne and Isaacs, 2017; Schmidt et al., 2019).

In this study, boys showed better levels in the development of basic motor skills than girls; these data are corroborated by other studies (Cenizo-benjumea, 2018; Hulteen et al., 2018; Martínez et al., 2016; Montesdeoca et al., 2018), that boys also present better levels of motor competence. This may be related to the fact that girls perform less sports activity than boys, data that is also corroborated by other research (Guthold et al., 2020; Martínez et al., 2016). Furthermore, there is a significant difference in the motor skill of object control between gender, a conclusion that agrees with Bardid et al. (2015) and Cenizo-Benjumea et al. (2018), where boys performed better than girls. Studies carried out by Ruiz and Graupera (2003; 2005) show that there are differences related to gender in the United States, Spain, and Japan where boys have a greater ability to throw and catch a ball, a fact that also reflects a study carried out with Australian schoolchildren (Bardid et al., 2015) and the United States (Temple, 2016). Therefore, it is imperative to examine the persisting gender disparities in physical activity and sports. Our findings indicate that boys predominantly engage in team sports, whereas girls are more inclined towards individual sports. In team sports, such as football, basketball or volleyball, the game involves the constant use of a ball that is shared between players. On the contrary, many individual sports, which do not necessarily require any equipment, such as balls. We concur with Kirk and Oliver (2014), who emphasized the need for more in-depth research on the motivations, interests, and perceptions of different genders in physical activity to enhance the relationship of children and youth with it.

On the other hand, a child's level of daily physical activity may be restricted by their weight status, as these may influence the structural and functional limitations due to excess weight (Duncan et al., 2013; Macmillan et al., 2023). The results obtained in this work show that there are some significant differences in motor competence according to weight status, showing lower levels of motor skills in overweight and obese students, data that is corroborated by other studies (Van Rhee, 2012). Our findings indicate that children with obesity encountered challenges when performing tasks that involved orienting their foot placement or widening their stride. Excess weight can impact locomotor activities and lead to biomechanical issues in the legs, hindering movement during displacements (Chan and Chen, 2018; Gentier et al., 2013). Our data also showed that children in our study who were overweight or obese faced challenges in tasks that involved decision-making, such as choosing how to overcome obstacles through movement. A study suggests that overweight children are less effective in motor planning to overcome obstacles and exhibit reduced knee flexion (Gill and Hung, 2014). This may be linked to the attempt to enhance joint stability by maintaining inflexibility in the articulation (Stodden et al., 2014; Gill et al., 2014).

Regarding object control, our data show that girls in general have a low level of motor competence. Obese girls showing worse levels. Low levels of this competence to a possible lack of physical activity experiences to support timely motor development. This motor skill requires eye-manual coordination,

encompassing precision when throwing, strength, and correct direction (Jiménez et al., 2016; Trecroci et al., 2021).

The examination of the capacity for turning and rolling indicated that both boys and girls do not have a high level in this skill. The students with overweight and obese displayed reduced proficiency, possibly stemming from the necessity for enhanced body control in this skill. There is a lack of studies connecting the motor competence of turning to BMI. Nevertheless, these diminished levels of motor competence might be associated with biomechanical factors like knee flexion to lower the center of gravity and achieving the optimal body position for executing the roll.

### Conclusions

Through the BMI values of the sample, we found that both overweight and obesity have a high prevalence, without significant differences between genders.

We also confirmed that there are gender differences in the type and frequency of sports practice, with boys being the ones who practice physical activity the most. Girls have lower levels in motor tasks, with a significant difference in mobile handling.

Finally, there is a significant relationship between BMI and the level of basic object control motor skills for girls. In the case of children, these significant differences occur in the motor skills of movement and turning in obese and overweight children.

**Conflicts of interest.** the author have any conflicts of interest to declare.

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