# Influence of physical activity on balance in children: a cross-sectional study

*Influencia de la actividad física en el equilibrio en niños: un estudio transversal*


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## Abstract

Objective: The objective of this work is to evaluate differences in the balance of children who perform physical activity compared to those who do not.
Methodology: A cross-sectional observational study was conducted in a child population (N=130). Two study groups were established: non-physical activity group (n=68) and physical activity group (n=62). Outcome measures were Romberg test (with eyes open and eyes closed), one-legged support test (with eyes open and eyes closed) and unstable surface test (with eyes open and eyes closed). The ability and the time that they held in balance were valued. A 95% confidence interval (95% CI) was employed, and all values with a p-value lower than 0.05 were considered to be statistically significant.
Results: T-Student test revealed statistically significant results in favor of the group of children who performed physical activity for measures of the ability to perform the Romberg test with eyes closed (p<0.001); unstable surface ability with eyes open and eyes closed (p=0.03 and p<0.001 respectively); ability for the one-leg stand test with eyes open and with eyes closed (p<0.002 and p<0.001, respectively); and time in one-legged support with eyes closed (p<0.004).
Conclusions: Children who perform physical activity have a better ability to maintain balance compared to children who do not perform physical activity.



## Keywords

Balance; childhood; physical activity; sports.



## Resumen

Objetivo: El objetivo de este trabajo es evaluar las diferencias en el equilibrio de los niños que realizan actividad física en comparación con los que no la realizan.
Metodología: Se realizó un estudio observacional transversal en población infantil (N=130). Se establecieron dos grupos de estudio: grupo sin actividad física (n=68) y grupo con actividad física (n=62). Las medidas de resultado fueron la prueba de Romberg (con los ojos abiertos y cerrados), la prueba de apoyo con una sola pierna (con los ojos abiertos y cerrados) y la prueba de superficie inestable (con los ojos abiertos y cerrados). Se valoró la habilidad y el tiempo que mantenían el equilibrio. Se empleó un intervalo de confianza del 95% (IC 95%), y todos los valores con un valor p inferior a 0,05 se consideraron estadísticamente significativos.
Resultados: La prueba t-Student reveló resultados estadísticamente significativos a favor del grupo de niños que realizaron actividad física para las medidas de la habilidad para realizar el test de Romberg con los ojos cerrados (p<0,001); habilidad para la superficie inestable con los ojos abiertos y con los ojos cerrados (p=0,03 y p<0,001 respectivamente); habilidad para el test de mantenerse en equilibrio con una pierna con los ojos abiertos y con los ojos cerrados (p<0,002 y p<0,001, respectivamente); y tiempo en apoyo con una pierna con los ojos cerrados (p<0,004).
Conclusiones: Los niños que realizan actividad física tienen una mejor capacidad para mantener el equilibrio en comparación con los niños que no realizan actividad física.



## Palabras clave

Actividad física; deportes; equilibrio; niñez.

## Introduction

Postural control is defined as “the ability to maintain balance and orientation in a gravitational environment” (Horak et al., 1992). This definition includes the terms equilibrium, orientation, and environment. The first two refer to the individual himself and the third refers to the context in which the individual must perform a certain task. Therefore, postural control emerges from the interaction of the individual with the task and the environment (Cano-de-la-Cuerda et al., 2015).

The human body is continuously subjected to destabilizing forces, both internal and external, which must be compensated through muscular responses called postural adjustments (Cyr et al., 2019). The ability to control our body in space emerges from a complex interaction of the musculoskeletal system and the nervous system, collectively referred to as the "postural control system”. The components of the nervous system, essential for postural control, include sensory-perceptual processes, cognitive processes, and motor processes (Læssøe, 2007).

Motor development during childhood is a multifactorial process, conditioned by maturational and physiological changes which are coordinated by the central nervous system (CNS), integrating sensorimotor functions and responses, during a phase of life of intense neuroplasticity and acquisition of skills (Ismail et al., 2017; Wick et al., 2022). These responses influence and are influenced by involvement in physical and sports activities at this stage of life (Tjernström et al., 2002; Jaakkola et al., 2019).

The diversity of movements experienced in these activities, with regard to balance and postural control, promote a combination of information that helps to develop the vestibular, visual and proprioceptive systems (Ojie & Saatchi, 2021; Wick et al., 2022). It is worth noting that, in addition to neurophysiological aspects, sexual differences will also act to modulate the learning of motor skills, due to hormonal variations and different maturational stages between boys and girls (Barnett et al., 2016; García-Liñeira et al., 2021).

Physical activity is a fundamental aspect in the development and well-being of children (Jaakkola et al., 2019; Lermanda et al., 2022). In addition to its effects on cardiovascular health and weight control, regular physical activity has been shown to have a positive impact on balance in children and adolescents (Dapp et al., 2021). Despite the importance of this issue, there is still a need to further investigate how physical activity influences balance in children. Balance is a fundamental skill that allows children to perform a variety of everyday activities, such as walking, running, jumping, and playing, without injury (Téllez Tinjacá et al., 2024).

Balance has been shown to be influenced by a variety of factors, including age, gender, body mass index, and physical activity. Previous studies have shown that physical activity can improve balance in children. For example, longitudinal studies conducted found that physical activity was positively related to the development of motor skills, including static and dynamic balance (Bürgi et al., 2011; Lima et al., 2019). In this way, the fact that children practice sports on a regular basis can translate into an improvement in balance and if this habit is maintained throughout life, they could have a lower risk of falling in situations of imbalance in daily life. According to the results of the 2017 Spanish National Health Survey, it has been shown that around 61% of children and adolescents between the ages of 5 and 17 did not meet the recommendation of at least 60 minutes of physical activity. moderate to vigorous daily (Ministerio de Sanidad, Consumo y Bienestar Social - Portal Estadístico del SNS, 2018).

For this investigation, the practice of physical activity requires body stability and thus, the need to maintain and improve balance and postural control. The objective of this work is to evaluate if there are differences in the balance of children who perform physical activity compared to children who do not perform physical activity. Our hypothesis is that children who practice sports that help develop displacement, stabilization and manipulation skills show greater development of fundamental stabilizing skills.

## Method

This study was a cross-sectional study conducted according to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

### *Participants*

The required sample size for this study was calculated using G*Power software (version 3.1.9.7). An a priori analysis was conducted for an independent sample t-test, aiming to detect a medium effect size (Cohen's d = 0.55) with a significance level (α) of 0.05 and a statistical power (1-β) of 0.80. The specific parameters used in the calculation were as follows: type of analysis, independent samples t-test; expected effect size, Cohen's d of 0.55; significance level, 0.05; statistical power, 0.80; and allocation ratio, 1, assuming similar group sizes. The calculation result indicated that approximately 60 participants per group were required to detect a medium effect with 80% power and a 5% significance level (120 in total). Considering the possible dropout of participants during the study, the sample size was increased by 10%, resulting in a total of 66 participants per group.

Our study sample finally comprised 130 children from different primary schools in the Autonomous Community of Madrid recruited from a local support group through advertisements and informative presentations in the facilities of the Rey Juan Carlos University, in the year 2018. In accordance with the Declaration of Helsinki, and all participants provided written informed consent before participating including the consent of their parents and legal guardians. The previous two years history of physical-sports activity was taken into account. The inclusion criteria for present study were: (1) children aged 10 to 13 years. The exclusion criteria were: (1) Children who presented any type of neurological disease; (2) Children who presented an injury that affected the musculoskeletal system (such as fractures, sprains or severe cases of scoliosis); (3) medical diagnosis of a disease that causes balance problems; (4) medical diagnosis of a vision problem that affects both eyes. Once the selection criteria were met, the participants were assigned to one group or another depending on whether or not they performed at least 1 hour of physical activity on 3 days per week during the last year, this information was self-reported by the children's parents or guardians. In this way, a total of 62 children were assigned to the physical activity group that performed physical activity regularly and a total of 68 children were assigned to the non-physical activity group, which did not perform physical activity regularly. Table 1 shows the flow of participants during the study.

Table 1. Flow of participants during the study

| Study Stage | Group 1 (n) | Group 2 (n) | Total (N) |
|---|---|---|---|
| Enrollment | | | 143 |
| Inclusion and exclusion criteria | | | 5 |
| Allocated to intervention | 69 | 69 | 138 |
| Drop out during follow-up | 1 | 7 | 8 |
| Completed the study | 68 | 62 | 130 |

Dropped out due to personal reasons.

### *Outcome measures*

#### *Sociodemographic characteristics*

Data that can influence postural control such as age, gender, weight and waist circumference were taken. Age and gender were recorded on a questionnaire. The weight was measured using a scale (Model TANITA BC-420 MA balance) to measure body weight (the result was expressed in kg). Height was measured using the SECA 213 stadiometer and the data were expressed in cm. Waist circumference was measured using a tape measure (the result was expressed in cm).

#### *Romberg test*

During the Romberg Test (Romberg, 1846), applied in both children and adults in other recent studies (Friello et al., 2022; Jung et al., 2017), the participant is positioned barefoot with feet together, body erect, arms relaxed along the body and gaze forward. 3 tests of 30 seconds were carried out in which they had to remain as stable as possible during the measurements. Subjects received information prior to the first trial of each condition. The test was performed with eyes open (first condition) and with eyes closed (second condition). The imbalance was assessed in those 30 seconds and we also controlled the moment of fall if it occurred. The fall was also counted if one of the feet moved, or if they leaned on some side or if they opened their eyes in the case of closed eyes. The time they stood without falling was recorded and the imbalance was also scored based on the following score: 0 minimal sway; 1 slight sway; 2 moderate sway; and 3 fall. It was considered a fall when the subject moved one foot, did not adopt the correct position of the arms (extended along the body) or opened their eyes in the second condition (Test Romberg Eyes Closed).

*Single leg support*

Using the Single Leg Stance Test (Springer et al., 2007), subjects were instructed to stand barefoot on the ground, supporting only the non-dominant leg. The other leg had to maintain hip flexion and knee flexion of 90º respectively. The arms must have been resting on the hips (jar shape). Look straight ahead, maintaining a position as stable as possible. It was performed with eyes open (first condition) and with eyes closed (second condition). 3 tests of 10 seconds were carried out in which they had to remain as stable as possible during the measurements. The time they stood without falling was recorded and the imbalance was also scored based on the following score: 0 minimal sway; 1 slight sway; 2 moderate sway; and 3 fall.

*Unstable surface*

Based on the Modified Clinical Test of Sensory Interaction in Balance (mCTSIB), a modified version of the test developed by Shumway-Cook & Horak (1986) and based on protocols from other studies (Boonsinsukh et al., 2020), the subjects were positioned with their feet together, on an unstable surface and barefoot. Looking straight ahead, arms relaxed along your body, maintaining as stable a position as possible. The unstable surface consisted of a soft base that sinks when a force is applied, it has dimensions of 46 cm on each side, 13 centimeters thick with a firmness of the IFD (force used to compress it by % of its height, it would be 25% about 23.77 Newton and for 65% about 56.77 Newton. It was performed with eyes open (first condition) and with eyes closed (second condition). 3 tests of 10 seconds were carried out in which they had to remain as stable as possible during the measurements. The time they stood without falling was recorded and the imbalance was also scored based on the following score: 0 minimal sway; 1 slight sway; 2 moderate sway; and 3 fall.

### *Data analysis*

The data analysis was performed with the Statistics Package for Social Science (SPSS 25.00, IBM Chicago, IL, USA). A 95% confidence interval (95% CI) was employed, and all values with a p-value lower than 0.05 were considered to be statistically significant. The Chi-square test was used to compare the differences between nominal variables (such as profession or marital status). Normality tests were performed and no statistical differences were found that would determine an abnormal distribution (The Shapiro–Wilk and Kolmogorov–Smirnov tests were used). Stu- dent's t-test for independent samples was used as a statistical test to compare continuous variables between groups. The effect size (Cohen's d) was then calculated to compare the study variables. According to Cohen's method, the effect was considered very small (0.00-0.19), small (0.20–0.49), medium (0.50-0.79), or large (>0.8). The correlation between age, weight and height variables and the measurement variables (Romberg test, unstable surface and single-leg support with eyes open and closed) variables was examined using the Pearson correlation coefficient. A correlation coefficient >0.60 indicated a strong correlation; a coefficient between 0.30 and 0.60 indicated a moderate correlation and a coefficient <0.30 indicated a low correlation. A secondary analysis of subgroups by sex was also carried out between boys who carry out physical activity and boys who do not carry out physical activity and another analysis by sex between girls who carry out physical activity and girls who do not carry out physical activity. For statistical analysis, the significance level for all tests was $p < 0.05$.

All children were tested twice before recording the measurements so that they could become accustomed to them and avoid learning bias.

## Results

The 130 children, male and females, were collected, among them 68 were physically inactive and 62 physically active. The active children were basketball players (n=11), ping pong (n=10), tennis (n=14), volleyball (n=9), dance (n=8), or taekwondo (n=10). Table 2 shows the characteristics of the study sample. The physical activity group showed an average age of 11.80±0.49, an average weight of 45.65±10.01 and a height of 152±8.83. The physical inactivity group had an average age of 11.37±0.48, an average weight of 40.91±8.26 and a height of 147.46±7.08. Significant differences were found in age (p=0.004), weight (p=0.002) and height (p=0.001).

Table 2. Characteristics of the study sample

| Variable | Physically Inactive (n=68) | Physically Active (n=62) | p-value |
|---|---|---|---|
| Age (years) | 11,37±0,49 | 11,60±0,49 | 0.09 |
| Weight (kg) | 40,91±8,27 | 45,66±10,01 | 0.002* |
| Height (cm) | 147,46±7,09 | 152,68±8,84 | 0.001* |
| Body Mass Index (kg/m$^2$) | 18,86±3,85 | 19,65±4,46 | 0.46 |

Data are presented as mean±SD.

Significant differences between inactive and active participants were found for Romberg test eyes closed (0,69±0,57 vs. 0,4±0,44, p = 0,001, d=0.44). Single leg support eyes open (1,43±0,95 vs. 0,93±0,98, p= 0,002, d=0.51), eyes closed (2,45±0,7 vs. 1,75±0,87, p = 0,001, d=0.89), and time of eyes closed (7,84±2,13 vs. 8,89±1,89, p=0,004, d=-0.51). The unstable surface eyes open (0,84±0,71 vs. 0,61±0,69, p=0,03, d=-0.2), and eyes closed (2,02±0,63 vs. 1,59±0,83, p=0,001, d=-0.1). Table 3 shows comparison of balance in inactive and active children.

Table 3. Comparison of balance in inactive and active children

| Variable | Physically Inactive (n=68) | Physically Active (n=62) | p-value | Cohen's d |
|---|---|---|---|---|
| Romberg test | | | | |
| Eyes open | 0.11±0.24 | 0.02±0.1 | | |
| Time - eyes open | 30 | 30 | | |
| Eyes closed | 0.69±0.57 | 0.4±0.44 | <0.001 | 0.44 |
| Time - eyes closed | 30 | 30 | | |
| Single leg support | | | | |
| Eyes open | 1.43±0.95 | 0.93±0.98 | <0.01 | 0.51 |
| Time - eyes open | 10.29±3.39 | 9.83±0.94 | | |
| Eyes closed | 2.45±0.7 | 1.75±0.87 | <0.001 | 0.89 |
| Time - eyes closed | 7.84±2.13 | 8.89±1.89 | <0.01 | -0.51 |
| Unstable surface | | | | |
| Eyes open | 0.84±0.71 | 0.61±0.69 | <0.05 | -0.2 |
| Time - eyes open | 29.71±1.16 | 29.89±0.53 | | |
| Eyes closed | 2.02±0.63 | 1.59±0.83 | <0.001 | -0.1 |
| Time - eyes closed | 25.5±4.95 | 26.5±4.95 | | |

Data are presented as mean±SD.

In the physically inactive group, a moderate correlation was found between age and the skill variable on the unstable surface with eyes open (0.32) and eyes closed (0.32); moderate correlation between age and skill variable single leg support eyes open (0.39) and eyes closed (0.34) and moderate correlation between height and time variable in single leg support eyes open (0.34). The rest of the correlations between variables were low and can be found in Table 4.

Table 4. Age, weight, and height correlations with balance in the physically inactive group

| Variable | Age | Weight | Height |
|---|---|---|---|
| Romberg EO score | -0.06 | -0.06 | -0.06 |
| Romberg EC score | 0.29 | -0.18 | -0.05 |
| Unstable surface EO score | 0.32* | -0.06 | -0.18 |
| Unstable surface EC score | 0.32* | -0.06 | -0.1 |
| Unstable surface EO time | -0.08 | -0.12 | 0.06 |
| Unstable surface EC time | -0.26 | 0.21 | 0.26 |
| Single leg EO score | 0.39* | -0.15 | -0.1 |
| Single leg EC score | 0.35* | -0.08 | -0.19 |
| Single leg EO time | 0.04 | -0.11 | 0.34* |
| Single leg EC time | 0.22 | 0.2 | 0.19 |

In the physically active group, a moderate inverse correlation was found between height and the variable foam skill with eyes open (-0.32) and also between height and skill in single-leg support with eyes open (-0.30). The rest of the correlations between variables were low and can be found in Table 5.

Table 5. Age, weight, and height correlations with balance in the physically active group

| Variable | Age | Weight | Height |
|---|---|---|---|
| Romberg EO score | -0.2 | -0.05 | -0.12 |
| Romberg EC score | -0.1 | -0.19 | -0.35* |
| Unstable surface EO score | -0.18 | -0.15 | -0.32* |
| Unstable surface EC score | -0.01 | -0.22 | -0.18 |
| Unstable surface EO time | 0.08 | 0.10 | 0.13 |
| Unstable surface EC time | -0.04 | 0.11 | 0.01 |
| Single leg EO score | -0.11 | -0.26 | -0.31* |
| Single leg EC score | -0.04 | -0.18 | -0.21 |
| Single leg EO time | 0.2 | -0.12 | 0.08 |
| Single leg EC time | 0.02 | 0.18 | 0.07 |

According to sex, significant differences between inactive and active girls (table 6) were found for Romberg test eyes closed (0.89±0.5 vs. 0.54±0.45, p=0.05, d=0.72); and for single leg support eyes open (1.77±0.922 vs. 1.28±0.99, p=0.03, d=0.50), eyes closed (2.45±0.7 vs. 1.75±0.87, p=0.02, d=0.80) and time of eyes closed (7.84±2.13 vs. 8.89±1.89, p=0.02, d=-0.58). In inactive and active boys (table 7), significant differences were found for Romberg test eyes open (0.11±0.25 vs. 0.01±0.07, p=0.01, d=0.53) and eyes closed (0.53±0.59 vs. 0.32±0.42, p=0.03, d=0.42); for single leg support eyes open (1.15±0.89 vs. 0.71±0.92, p=0.02, d=0.47), eyes closed (2.33±0.81 vs. 1.60±0.78, p<0.001, d=0.92) and time of eyes closed (8.25±2 vs. 9.07±1.80, p=0.04, d=0.43); and for unstable surface eyes closed (1.94±0.57 vs. 1.44±0.82, p=0.002, d=0.69).

Table 6. Differences between inactive and active girls

| Variable | Physically Inactive (n=31) | Physically Active (n=24) | p-value | Cohen's d |
|---|---|---|---|---|
| Romberg test | | | | |
| Eyes open | 0.1±0.24 | 0.04±0.1 | 0.12 | 0,31 |
| Time - eyes open | 30 | 30 | | |
| Eyes closed | 0.89±0.5 | 0.54±0.45 | 0.05* | 0.72 |
| Time - eyes closed | 30 | 30 | | |
| Single leg support | | | | |
| Eyes open | 1.77±0.92 | 1.28±0.99 | 0.03* | 0.5 |
| Time - eyes open | 10.78±4.94 | 9.83±0.94 | 0.14 | 0.35 |
| Eyes closed | 2.45±0.7 | 1.75±0.87 | 0.02* | 0.8 |
| Time - eyes closed | 7.84±2.13 | 8.89±1.89 | 0.02* | -0.58 |
| Unstable surface | | | | |
| Eyes open | 0.99±0.72 | 0.8±0.7 | 0.17 | 0.26 |
| Time - eyes open | 29.74±1.02 | 29.75±0.81 | 0.46 | -0.01 |
| Eyes closed | 2.12±0.67 | 1.83±0.8 | 0.07 | 0.40 |
| Time - eyes closed | 25.06±5.19 | 25.71±5.35 | 0.33 | -0.12 |

Data are presented as mean±SD.

Table 7. Differences between inactive and active boys

| Variable | Physically Inactive (n=37) | Physically Active (n=38) | p-value | Cohen's d |
|---|---|---|---|---|
| Romberg test | | | | |
| Eyes open | 0.11±0.25 | 0.01±0.07 | 0.01* | 0,53 |
| Time - eyes open | 30 | 30 | | |
| Eyes closed | 0.53±0.59 | 0.32±0.42 | 0.03* | 0.42 |
| Time - eyes closed | 30 | 30 | | |
| Single leg support | | | | |
| Eyes open | 1.15±0.89 | 0.71±0.92 | 0.02 | 0.47 |
| Time - eyes open | 9.87±0.55 | 10±0 | 0.10 | -0.32 |
| Eyes closed | 2.33±0.81 | 1.60±0.78 | <0.001* | 0.92 |
| Time - eyes closed | 8.25±2 | 9.07±1.80 | 0.04* | -0.43 |
| Unstable surface | | | | |
| Eyes open | 0.71±0.68 | 0.49±0.66 | 0.07 | 0.33 |
| Time - eyes open | 29.68±1.29 | 30±0 | 0.09 | -0.33 |
| Eyes closed | 1.94±0.57 | 1.44±0.82 | 0.002* | 0.69 |
| Time - eyes closed | 26.18±5.83 | 0.11±0.25 | 0.25 | -0.17 |

Data are presented as mean±SD.

According to level of physical activity, significant differences between inactive girls and inactive boys (table 8) were found for Romberg test eyes closed (0.89±0.5 vs. 0.53±0.59, p=0.006, d=0.55); for single leg support eyes open (1.77±0.922 vs. 1.15±0.89, p=0.003, d=0.90); and for unstable surface eyes open (0.99±0.72 vs. 0.71±0.68, p=0.05, d=0.70). In active girls and active boys (table 9), significant differences were found for Romberg test eyes closed (0.54±0.45 vs. 0.32±0.42, p=0.03, d=0.43); for single leg support eyes open (1.28±0.99 vs. 0.71±0.92. p=0.01, d=0.95) and eyes closed (1.75±0.87 vs. 1.60±0.78, p=0.04, d=0.85); and for unstable surface eyes open (0.80±0.70 vs.0.49±0.66, p=0.04. d=0.68), time of eyes open (29.75±0.81 vs. 30±0, p=0.05, d=0.52) and eyes closed (1.83±0.80 vs. 1.44±0.82, p=0.03, d=0.81).

Table 8. Differences between inactive girls and inactive boys

| Variable | Inactive girls (n=31) | Inactive boys (n=37) | p-value | Cohen's d |
|---|---|---|---|---|
| Romberg test | | | | |
| Eyes open | 0.1±0.24 | 0.04±0.1 | 0.43 | 0.24 |
| Time - eyes open | 30 | 30 | | |
| Eyes closed | 0.89±0.5 | 0.53±0.59 | 0.006* | 0.55 |
| Time - eyes closed | 30 | 30 | | |
| Single leg support | | | | |
| Eyes open | 1.77±0.92 | 1.15±0.89 | 0.003* | 0.9 |
| Time - eyes open | 10.78±4.94 | 9.87±0.55 | 0.15 | 3.33 |
| Eyes closed | 2.45±0.7 | 2.33±0.81 | 0.07 | 0.69 |
| Time - eyes closed | 7.84±2.13 | 8.25±2 | 0.06 | 2.11 |
| Unstable surface | | | | |
| Eyes open | 0.99±0.72 | 0.71±0.68 | 0.05* | 0.70 |
| Time - eyes open | 29.74±1.02 | 29.68±1.29 | 0.45 | 1.17 |
| Eyes closed | 2.12±0.67 | 1.94±0.57 | 0.11 | 0.63 |
| Time - eyes closed | 25.06±5.19 | 26.18±5..83 | 0.22 | 5.54 |

Data are presented as mean±SD.

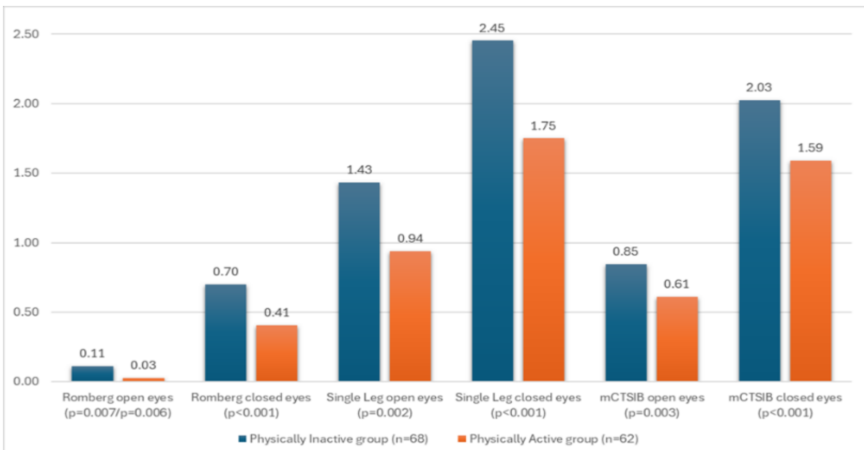
Table 9. Differences between active girls and active boys

| Variable | Active girls (n=24) | Active boys (n=38) | p-value | Cohen's d |
|---|---|---|---|---|
| Romberg test | | | | |
| Eyes open | 0.04±0.1 | 0.01±0.07 | 0,2 | 0,1 |
| Time - eyes open | 30 | 30 | | |
| Eyes closed | 0.54±0.45 | 0.32±0.42 | 0.03* | 0.43 |
| Time - eyes closed | 30 | 30 | | |
| Single leg support | | | | |
| Eyes open | 1.28±0.99 | 0.71±0.92 | 0.01* | 0.95 |
| Time - eyes open | 9.83±0.94 | 10±0 | 0.07 | 0.93 |
| Eyes closed | 1.75±0.87 | 1.6±0.78 | 0.04* | 0.85 |
| Time - eyes closed | 8.89±1.89 | 9.07±1.8 | 0.2 | 1.9 |
| Unstable surface | | | | |
| Eyes open | 0.80±0.7 | 0.49±0.66 | 0.04* | 0.68 |
| Time - eyes open | 29.75±0.81 | 30±0 | 0.05* | 0.52 |
| Eyes closed | 1.83±0.8 | 1.44±0.82 | 0.03* | 0.81 |
| Time - eyes closed | 25.71±5.35 | 0.11±0.25 | 0.16 | 4.95 |

Data are presented as mean±SD.

Figure 1 shows the average results on the three ability balance tests with their p-values.

Figure 1. Average results on the 3 ability balance tests with their p-values.



## Discussion

The primary objective of this study was to determine whether children who engage in sports exhibit better balance compared to those who do not participate in physical activities. With regard to the total sample, 52.31% of the children showed low levels of physical activity, which is in line with the global trend currently observed, in which children and adolescents show increasing numbers and a high prevalence of physical inactivity and risk of obesity and other conditions (Hu et al., 2021). This is the opposite of what is recommended by the American College of Sports Medicine - ACSM in agreement with the World Health Organization - WHO, in which children should be physically active for at least 300 minutes a week, with a predominance of aerobic activities and moderate or vigorous intensities (Bayles, 2023).

In the early stages of life, physical activity is directly related to and generates benefits in motor skills such as strength, flexibility and balance (Chambonnière et al., 2023). A longitudinal study that followed 150 children after the pandemic found that they had worse results in terms of physical activity and levels of balance, stability and postural control, inferring that the variables measured by the researchers are influenced by the level of physical activity (Martínez-Córcoles et al., 2022).

In the study by Górna et al. (2023) with 2,913 children and adolescents aged between 6 and 17, it was observed that levels of physical activity decreased over the years. In contrast, García-soidán et al. (2020) found that 60.9% of 64 boys with an average age of 10 were physically active. Sex differences will also generate different effects in children on the ability to balance and postural control, García-Liñeira et al. (2021) demonstrated in their study that while girls use visual and vestibular information more to maintain balance, boys are guided by somatoaesthetic information.

The level of physical activity and body composition play an important role when addressing issues related to postural control and balance in childhood, as indicated by Tsiros et al. (2019), where children with higher body adiposity (less active) had worse postural control compared to more active children, in tests with dominant and non-dominant feet, eyes open and eyes closed. In addition, the review by Han et al. (2018) showed that children and adolescents who are overweight or obese have lower levels of motor skills such as motor coordination and balance, recommending the incorporation of physical activities and sports into their daily lives.

There was a statistically significant difference in this investigation in the components of the Romberg test (which assesses changes in balance) with eyes closed ($p<0.001$), skill on an unstable surface ($p<0.001$), skill in unipodal support with eyes open ($p<0.002$) and eyes closed ($p<0.001$) and time in unipodal support with eyes closed ($p<0.004$). In the sense that the most physically active children, who practiced sports, were better than those classified as inactive in the tests mentioned. The physically active group were children who practiced various sports, such as basketball, ping pong, tennis, ballet, volleyball and taekwondo.

This is in line with Bhati et al. (2022) who investigated the relationship between sports participation and postural control and anthropometric variables in childhood, highlighting that practicing sports (e.g. dance, martial arts) at this stage is positively related to stability and balance. This is in line with the experimental analysis carried out over twelve weeks with children aged 9 to 12 involved in sports (soccer, artistic gymnastics), which showed, with a significant difference, that the group that practiced sports obtained better results in terms of balance, global stability, anteroposterior and medial-lateral stability with eyes open compared to the control group (Wilczynska et al., 2021).

Low levels of physical activity can lead to deviations and a reduction in the quality of posture and balance. A study of 133 children aged between 9 and 12 divided into two groups, 76 active and 57 competing in combat sports - karate, showed that those with a higher level of physical activity, who were more regular and were accompanied by a professional trainer, were less likely to have problems with postural control and balance (Brzek et al., 2022).

In children affected by some pathology, the level of physical activity shows the same trend. The review with meta-analysis of 847 participants conducted by Merino-Andrés et al. (2022) showed that strength training and higher levels of physical activity had a positive impact on balance, muscle strength and gross motor function in children with cerebral palsy. Another study of children with ADHD compared groups who practiced sports with those who didn't, showing that regular physical activity promotes gains in cognitive, motor and executive function aspects, making it an important alternative for non-pharmacological treatment (Ziereis & Jansen, 2015).

In addition, Brzek et al. (2019), when investigating children with asthma and allergies, found that the most active children who participated in sports such as soccer, basketball and swimming had better body posture scores. This agrees with the findings of this study and proves that physical activity, regardless of the child's health condition, is a strong ally in improving the balance and postural function of this population.

When it comes to balance and postural control, there are several valid and certified ways of measuring this physical capacity in young people, from the different perspectives and specificities in which it manifests itself and which we intend to analyze; with eyes open and closed, dynamically and statically, on a stable and unstable surface, different bases of support on the ground (Forbes et al., 2023). A randomized clinical trial evaluated the effects of balance training in childhood with 39 volunteers over eight weeks using the Lower Quarter Y-Balance test (YBT-LQ), which measures dynamic balance over three attempts (Muehlbauer & Schedler, 2022).

The impact of yoga classes on balance, strength and flexibility in children aged 10 to 12 was verified in an 8-week experimental study, with a weekly frequency of 1-3 classes, using the sit and stand test, the 90/90 hamstring flexibility test and the Bruininks-Oseretsky motor proficiency test second edition - BOT-2 (Donahoe-Fillmore & Grant, 2019).

While Brzek et al. (2019) used the scoliometer, plumb line and digital inclinometer to analyze postural quality. In order to monitor the development of postural control from childhood to young adulthood, Kiefer et al. (2021) measured static balance in conditions of oscillations with eyes open and closed and an enlarged and reduced base of support.

It is worth noting that not all physical activity promotes improvements in balance and postural control in children, since an intervention with Pilates (an activity similar to a stretching session, some gymnastics, calisthenics) did not find (Hornsby & Johnston, 2024) an influence on postural control in children. And Hammami et al. (2024) showed that the specific level of difficulty and intensity of certain physical activities, sports disciplines and exercise programs, with balance in mind, alter the possible positive effects on this physical capacity to a greater or lesser extent.

In the era that contemporary society is going through, marked by high levels of sedentary behavior and overweight in children, it is becoming increasingly imperative for parents, teachers, schools and professionals to promote practical measures and interventions (e.g. sports, games and play) that increase engagement and physical activity levels in order to provide healthy psychomotor development in young people (Brzek et al., 2022).

This involves adequate postural balance and appropriate stimuli in terms of frequency, intensity and volume throughout childhood, preferably accompanied and prescribed by competent professionals in their respective areas of knowledge, having a positive impact on children and future adolescents and adults with good biomechanics and range of movement in the tasks and demands of everyday life and the elderly with lower risks of falls and a higher quality of life (Guzman-Muñoz et al., 2023; Ramos et al., 2021).

The findings of this study shed light on practical implications in the school and public health spheres, aiming at a healthy growth and development of children, it reinforces the importance of promoting programs and interventions in physical activities and various sports modalities, through the public authorities or partnerships with private initiatives, accessible and structured to the realities of schools and environments with this function. In the field of public health, encouraging the creation of awareness campaigns with the participation of parents and teachers, which stimulate in young people the engagement and pleasure in practicing physical activities that optimize the motor and cognitive repertoire, the ability to maintain balance and body posture, reflecting positively in the following phases of life.

This study has some limitations: the researchers were not blinded and there was no sex-stratified analysis. One limitation to be considered is the time frame of the study (cross-sectional), which makes it impossible to establish causal relationships due to the dynamics of the physiological changes inherent to the stage of life of this investigated sample. Another limitation is about data collection, as it was in a single moment, the participants who presented certain characteristics at that time of the study may not be representative of the general population, which may distort the results. And another limitation to be considered may be that, due to the small sample of each type of sport, balance has not been measured in terms of this.

There is a need for more and larger studies, especially longitudinal ones, which delve deeper into the relationships between the level of physical activity and the practice of different sports with the balance variables discussed in this study and other correlated variables, stratified by age and gender. We would also like to extrapolate the present sample profile by evaluating these associations in children with different conditions, such as those with some kind of disability, who suffer from various types of illness; cognitive, cardiorespiratory and neurological.

## Conclusions

It can be concluded that there is a direct relationship between the level of physical activity and balance in children, in the sense that higher levels of physical activity promote a better ability to maintain balance in different visual conditions and on different surfaces. It should be noted that the most physically active children were those involved in sports with the most varied characteristics and body demands. It is therefore necessary to reinforce the importance of practicing sports at this stage of human development as a powerful strategy for improving and maintaining balance, which is an essential physical ability at all stages of life.

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