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COMPARATIVE DYNAMICS OF PHYSICAL ACTIVITY IN CHILDREN AGED 11–13: WEEKDAYS VS WEEKENDS

USPOREDNA DINAMIKA TJELESNE AKTIVNOSTI KOD DJECE U DOBI OD 11 DO 13 GODINA: RADNIM DANIMA VS. VIKENDOM

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ABSTRACT

Introduction: Physical activity is essential for children's health and quality of life. However, less than 20% of children worldwide meet the WHO's physical activity recommendations, and activity levels often decrease during weekends. In Bulgaria, students are generally inactive during the school week and spend weekends in sedentary screen-related behaviors. This study aims to assess the duration and type of physical activity among Bulgarian students aged 10 to 13, with a focus on differences between weekdays and weekends. **Methods:** The study involved 387 students (221 girls, 166 boys) from grades 5 to 7. Physical activity was measured using Axivity AX3 motion sensors worn continuously for 7 consecutive days. Data were excluded if wear time was less than 6 hours per day. Parents also provided information regarding their children's extracurricular activities. **Results and discussion:** Fifth-grade students exhibited slightly more sedentary behavior on weekends compared to weekdays, although the difference was not statistically significant. In contrast, sixth- and seventh-grade students showed a marked increase in sedentary time on weekends, especially boys, who spent up to 60.5 minutes more sitting. High-intensity physical activity declined significantly across all grades during weekends. **Conclusion:** As children age, their overall physical activity decreases—most noticeably on weekends and among boys. To counter this trend, it is essential to implement school-based initiatives, promote

SAŽETAK

Uvod i cilj: Tjelesna aktivnost ključna je za zdravlje i kvalitetu života djece. Međutim, manje od 20% djece diljem svijeta zadovoljava preporuke WHO-a o tjelesnoj aktivnosti, a razina aktivnosti često se smanjuje tijekom vikenda. U Bugarskoj su učenici općenito neaktivni tijekom školskog tjedna i vikende provode u sjedilačkim ponašanjima povezanim s ekranima. Cilj ove studije je procijeniti trajanje i vrstu tjelesne aktivnosti među bugarskim učenicima u dobi od 10 do 13 godina, s naglaskom na razlike između radnih dana i vikenda. **Materijali i metode:** U studiji je sudjelovalo 387 učenika (221 djevojčica, 166 dječaka) od 5. do 7. razreda. Tjelesna aktivnost mjerena je pomoću senzora pokreta Axivity AX3 koji su se kontinuirano nosili 7 uzastopnih dana. Podaci su isključeni ako je vrijeme nošenja bilo kraće od 6 sati dnevno. Roditelji su također dali informacije o izvannastavnim aktivnostima svoje djece. **Rezultati:** Učenici petog razreda pokazali su nešto više sjedilačkog ponašanja vikendom u usporedbi s radnim danima, iako razlika nije bila statistički značajna. Nasuprot tome, učenici šestog i sedmog razreda pokazali su značajno povećanje vremena provedenog u sjedenju vikendom, posebno dječaci, koji su provodili do 60,5 minuta više sjedeći. Tjelesna aktivnost visokog intenziteta značajno se smanjila u svim razredima tijekom vikenda. **Zaključak:** Kako djeca stare, njihova ukupna tjelesna aktivnost se smanjuje - najuočljivije vikendom i među dječacima. Kako bi se suprotstavilo ovom trendu, bitno je provoditi

active breaks, and launch educational campaigns targeting families and communities.

Keywords: *age groups, movement intensity, physical activity, school environment, students*

školske inicijative, promovirati aktivne odmore i pokretati obrazovne kampanje usmjerene na obitelji i zajednice.

Ključne riječi: *dobne skupine, intenzitet kretanja, tjelesna aktivnost, školsko okruženje, učenici*

INTRODUCTION

The development of motor skills in children is essential for their overall health and quality of life. Well-developed motor skills not only enable participation in various physical activities but also support social and emotional well-being (15). Physical activity, in both quantitative and qualitative aspects, is a key determinant of physical health (21), psychological stability, and future working capacity, which ultimately influences a country's economic development (26). In childhood, adequate physical activity supports academic performance and engagement (25), and its expression varies across cultures and traditions (11).

A global decline in physical activity has been observed, influenced by factors such as increased screen time and digital entertainment (18). According to the World Health Organization, children and adolescents aged 5–17 should engage in at least 60 minutes of moderate to vigorous physical activity per day for optimal health benefits (4). However, less than 20% of children worldwide meet this recommendation, and the proportion is steadily decreasing (10, 13).

Physical fitness plays a vital role in supporting children's growth and development. Nevertheless, levels of fitness among school-age children continue to decline, leading to earlier onset of health problems, reduced quality of life, and increased financial burden on healthcare systems (9). While the school curriculum in Bulgaria includes 180 minutes of structured physical activity per week, studies show that physical activity levels are often lower on weekends, when extracurricular sports are parent-organized and less structured (2).

In Bulgaria, educational stages are regulated by national law, with lower secondary education typically including students in grades 5 to 7, aged 11 to 13. The structure of a typical school day fills a large portion of children's time, often limiting opportunities for spontaneous movement (20). During weekends, children have greater autonomy and often engage in more sedentary behaviors, such as prolonged screen use (1). While school-day activities are consistent and structured, weekends offer a broader, less regulated range of options—many of which involve reduced physical activity, as confirmed by accelerometer-based studies (3).

Despite a growing body of international research on children's declining physical activity, there is a lack of region-specific data for Bulgaria, particularly regarding variations in physical activity between weekdays and weekends among students aged 11 to 13. Most existing studies focus on general trends or single time points, without accounting for differences in structured versus unstructured daily routines. This gap limits the ability to design targeted interventions that reflect the local educational framework and cultural context.

Understanding when and how children's activity levels decline—especially during less structured periods like weekends—is crucial for developing effective strategies to increase movement and reduce sedentary behaviors. Given the rise in screen-based entertainment and the limited duration of physical education during school hours, there is an urgent need to identify the most vulnerable time periods and groups.

The purpose of this study is to assess and compare the duration and intensity of physical activity between weekdays and weekends among Bulgarian children aged 11 to 13, using objective accelerometer data. The findings aim to inform school policies, parental practices, and public health recommendations aimed at improving youth physical activity patterns.

SUBJECTS AND METHODS

Participants: The study involved 387 children from grades 5 to 7, aged between 10 and 13 years (221 girls and 166 boys). The average age was 12.7 ± 0.8 years, average height 161.7 ± 8.7 cm, average weight 50.6 ± 12.0 kg, and average BMI 19.2 ± 3.6. Participants were recruited using convenience sampling from three urban schools in Bulgaria.

Research Design: This is a quantitative, observational, cross-sectional study aiming to assess physical activity patterns in school-aged children.

Instrumentation: Physical activity was objectively measured using Axivity AX3 inertial measurement units (IMU), which are validated triaxial accelerometers widely used in pediatric physical activity research (reference). The devices recorded the duration and intensity of movement. Additionally, a brief parent-completed questionnaire was used to collect information about children's participation in extracurricular sports activities. The questionnaire consisted of three items: participation status, frequency per week, and average duration of activities. The questionnaire was reviewed for face validity by experts in physical education. The Axivity AX3 accelerometer has been validated in previous studies for accurately measuring physical activity

in children and adolescents (5). It provides reliable data on movement intensity and duration, making it suitable for this type of research.

Procedures: During physical education classes, participants were fitted with the Axivity AX3 devices and had their height and weight measured. Parents provided written informed consent for their children's participation in accordance with the Helsinki Declaration. Children wore the devices continuously for seven consecutive days, with the requirement not to remove them for more than six hours per day. After the monitoring period, devices were collected, and data were downloaded and processed according to standardized protocols. Participants who wore the device for less than 720 minutes (6 hours) per day on average were excluded from analysis.

Statistical Analysis: Data were analyzed using descriptive statistics (means, standard deviations) and inferential statistics. Paired t-tests were conducted to compare physical activity levels between weekdays and weekends. Statistical significance was set at $p < 0.05$. Data processing was performed using [SPSS].

Scope and Limitations: This study's limitations include the use of convenience sampling, which may limit generalizability. The reliance on parent-reported questionnaires for extracurricular activities introduces potential recall and social desirability biases. Furthermore, physical activity was monitored over a single week, which may not represent habitual activity patterns.

RESULTS AND DISCUSSION

When analyzing the results, we found that 5th-grade students were more active on weekdays than on weekend days.

The results in Figure 1 illustrate a factual difference that is statistically not significant: 27.56 minutes more at P = 0.08 for boys for a time in a sitting position over the weekend compared to days at school, as much as girls are more than for girls -Malk (23.64 minutes at p = 0.12), but again, not essential.

The average time spent in low activity in boys is 84.6 minutes during school days and 6.89 minutes less on weekends (P = 0.003), which shows a statistically significant difference. For girls, these values are 97.1 during the school days and 3.19 minutes less on weekend days at p = .021.

When the intensity increases with average activity, the difference between school and weekends is statistically significant in both sexes (for boys, it is 6 minutes at P = 0.043, and for girls, it is 11.63 minutes at P = 0.011).

The highest activity duration differs by 9.64 minutes in boys, at a level of significance of P = 0.00, and 4.82 minutes

Table 1. Frequency and distribution of the examined persons
Tablica 1. Frekvencije i distribucija ispitanika

Age ⇩	Investigated persons ⇩	Girls ⇩	Boys ⇩	Height ⇩ (cm)	Weight ⇩ (kg)
V - grade	150	Data 7	76	158.3	47.6
VI - grade	143	Data 8	49	161.2	50.1
VII - grade	94	Data 9	41	167.1	55.6

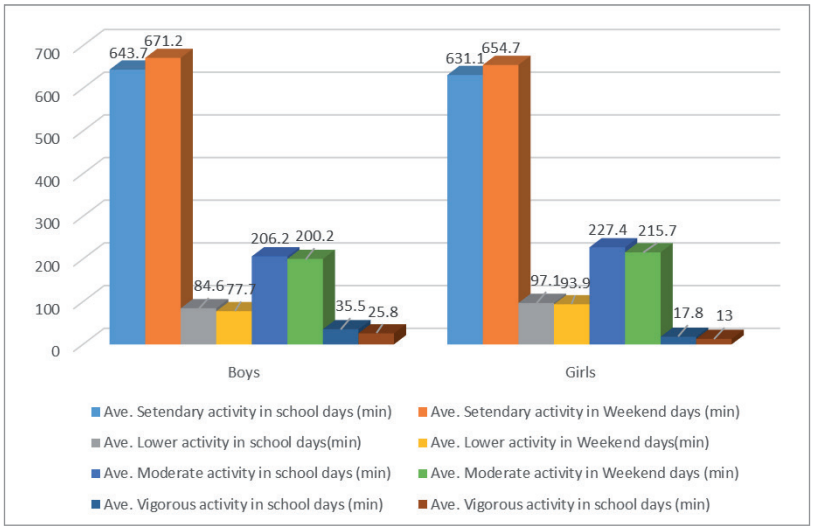


Figure 1. Average activity times, school vs. weekend day of boys and girls in the 5th grade
Slika 1. Prosječno vrijeme aktivnosti, školski dani u odnosu na vikend kod dječaka i djevojčica u 5. razredu

in girls, at a level of significance of P = 0.00, indicating a statistically significant difference in favor of school days.

In summary, children from the 5th grade (boys and girls) spend 4% more time sitting over the weekends than during school. With 6% less time, they spend less on low activity, 4% less on medium activity, and 27% less on high activity.

Figure 2 presents the results of the data obtained by 6th-grade students, the difference for sitting time being an average of 59.86 minutes more at P = 0.00 in the boys on the weekend compared to the days at school, as far as at school. For the girls, this difference is 41.29 minutes at p = 0.00. Here, we notice a larger and, at the same time, statistically significant difference between the two ages.

The average time spent in low activity in boys is 81.96 minutes during school days and 8.10 minutes less on weekends at P = 0.00. For girls, these values are 89.40 during school days and 4.95 minutes less on weekends at p = 0.03. Here, we observe the same pattern with younger students as with those who have low activity.

When the intensity increases in average activity, the difference between school and holidays in boys is 36.02 minutes at P = 0.1.24 minutes at P = 0.00; both differences are statistically significant.

The highest activity has a difference of 14.18 minutes in boys at P = 0.00 and 4.82 minutes in girls with a level of importance p = 0.00, which are again statistically significant.

The 6th-grade children (boys and girls) spend an average of 6% more time sitting on weekends than during the school week. With 5% less time, they spend less on low activity, 13% less on medium activity, and 35% less on high activity.

Figure 3 illustrates the results of the physical activity of 7th-grade students. The results show a significantly lower sitting position in boys, with 60.51 minutes at P = 0.00 during school days compared to the holidays. At the same

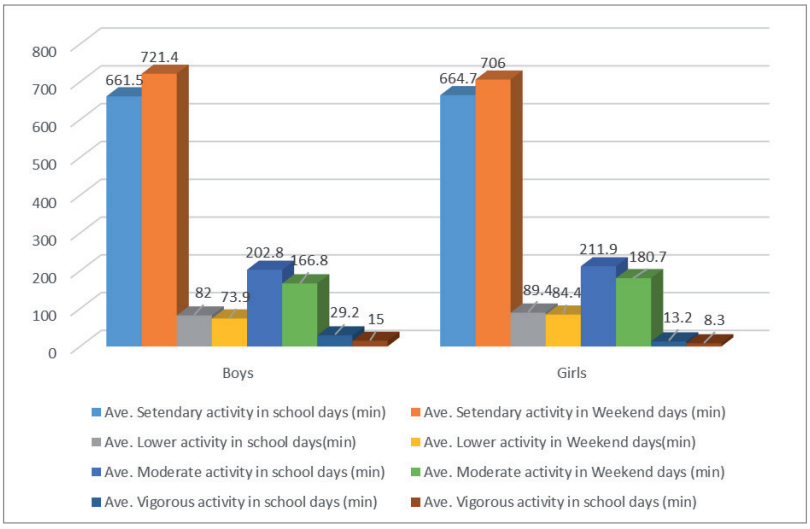


Figure 2. Average activity times, school vs. weekend day of boys and girls in the 6th grade

Slika 2. Prosječno vrijeme aktivnosti, školski dani u odnosu na vikend kod dječaka i djevojčica u 6. razredu

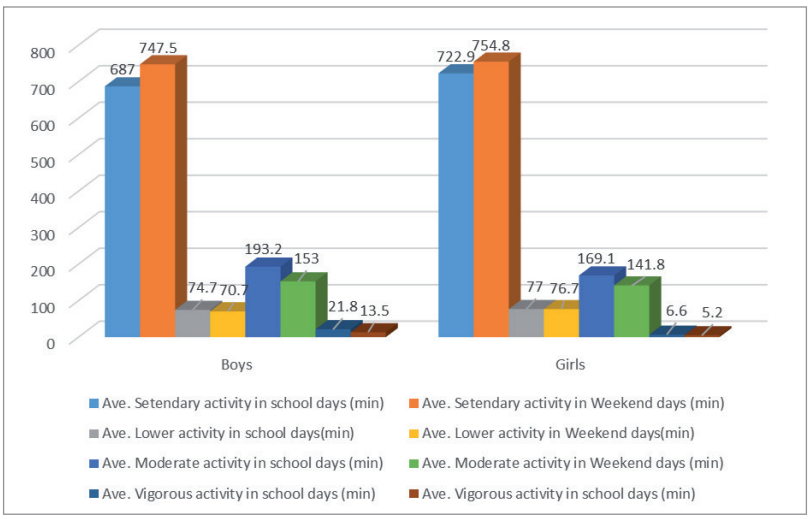


Figure 3. Average activity times, school vs. weekend day of boys and girls in the 7th grade

Slika 3. Prosječno vrijeme aktivnosti, školski dani u odnosu na vikend kod dječaka i djevojčica u 7. razredu

time, the difference in girls is 31.92 minutes at P = 0.00, again in favor of the school days, but it is also statistically significant. With low activity, 7th-grade boys spend 4 minutes less time in it during the weekends, whereas girls spend only 0.3 minutes less.

As the intensity increases, the boys perform 193.2 minutes of medium-intensity activities during school days, with 40.22 minutes less at P = 0.00 on non-teaching days. For girls, this difference is 27.25 minutes at P = 0.00, with less time spent on weekends. The differences in both sexes are statistically significant.

In high activity, boys have significantly more time performing such activities on school days and in the non-teaching ones than the girls, namely 21.8 minutes for the boys and 6.6 minutes for the girls. The difference between school and holidays in the boys in this activity is 8.27 minutes at P = 0.00, and for girls, it is only 1.43 minutes at P = 0.18. Another difference is that this difference is significant in boys, unlike in girls, as can be seen from the odds.

Physical activity decreases when children transition from childhood to adolescence (17, 23, 19). Similar age studies show that as age increases, the duration of motor activity decreases more on weekends than on weekdays (17).

The analysis is confirmed above as the most significant change is on weekends when there is a significant increase in the time spent sitting by an average of 10.5% in boys and 4.8% in girls. All other motor activities reduce their duration, especially those with medium intensity, resulting in them being most tangible again on weekends, namely 31.4% in boys and 21.8% in girls. This emphasizes the importance of promoting physical activity over the weekend, especially when children grow up and total levels of activity decrease. In social determinants of health, adult control over how children spend their time inevitably changes with their growth (7).

In Figure 4, we have looked at the differences in activity between the 5th and 6th grades and the 6th and 7th grades during weekdays. The graph shows a significant increase in sitting time in the boys between 5th and 6th grades, with 36.3 minutes on school days and almost twice as much on weekends, 60.4 minutes, insofar as the differences between 6th and 7th grades are 19.6 min on school days and 16.5 minutes on non-teaching ones.

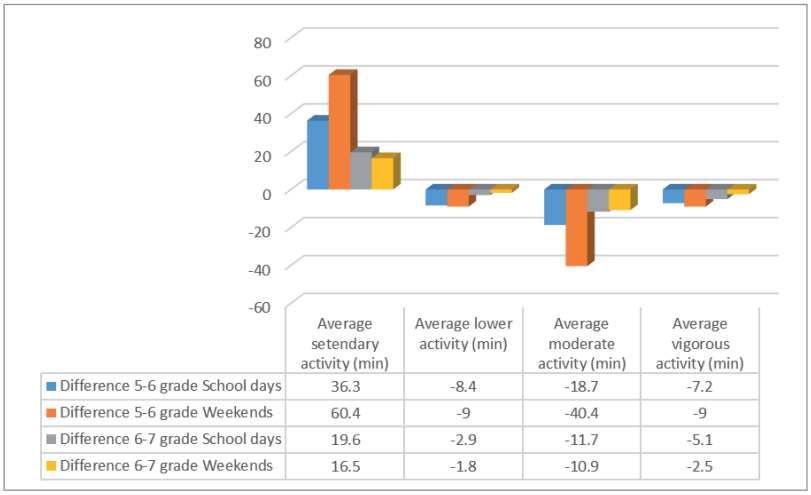
Significant differences are also observed when the boys perform average activity, specifically an 18.7-minute difference in 6th grade compared to 5th grade. Between 6th and 7th grade, this difference increases and becomes an average of 40.4 minutes less for students in 7th grade. On the weekend, the days with reduced motor activity are relatively equal across ages, with 11.7 minutes between the 5th and 6th grades and 10.9 minutes between the 6th and 7th grades.

Unlike boys, girls have many more minor differences (Figure 5) in the same age group. During the sitting position between 5th and 6th grades, there is a growth of 16.6 minutes on weekdays and 34.2 minutes on weekends, and this time is reduced by 6.7 minutes in 7th grade. This is due to the increase in time spent in high intensity, which has increased by 8.2 minutes for school days and by 6.1 minutes for weekends in 7th grade.

The analysis confirms that as children age, physical activity levels tend to decline—particularly among boys, who show increased sedentary behavior and reduced moderate-intensity activity. This decline is most evident between 5th and 6th grades and continues into 7th grade. Although similar trends are reported by Kallio et al. (12), in this study, girls demonstrate a slightly different pattern, with high-intensity activity even increasing in 7th grade—echoing findings from Gavarry (8).

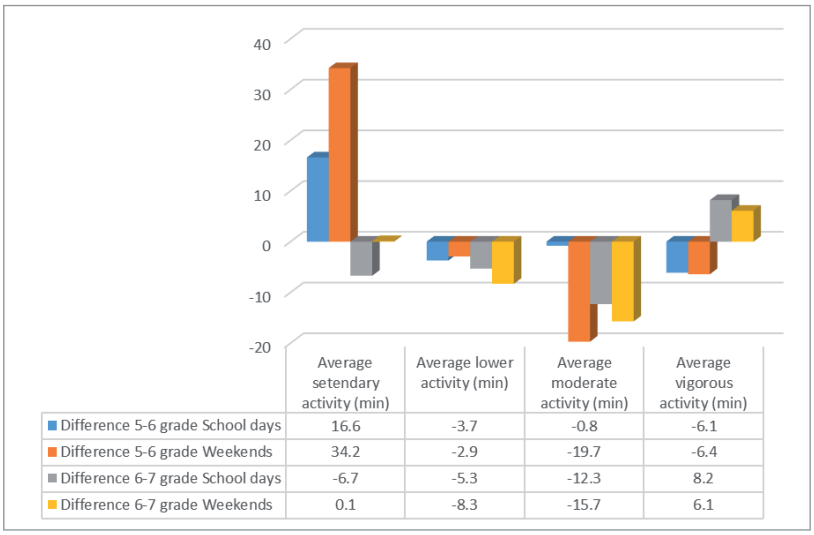
The most substantial reduction in activity is observed on weekends, with sitting time increasing by an average of 10.5% in boys and 4.8% in girls. This is consistent with prior research (16, 14), though conflicting results exist (27, 24, 6, 22).

These findings suggest an urgent need for targeted interventions to maintain physical activity levels during



	Average setendary activity (min)	Average lower activity (min)	Average moderate activity (min)	Average vigorous activity (min)
Difference 5-6 grade School days	36.3	-8.4	-18.7	-7.2
Difference 5-6 grade Weekends	60.4	-9	-40.4	-9
Difference 6-7 grade School days	19.6	-2.9	-11.7	-5.1
Difference 6-7 grade Weekends	16.5	-1.8	-10.9	-2.5

Figure 4. Average difference for boys' activity in school and on weekend days at different ages
Slika 4. Prosječna razlika za aktivnost dječaka u školi i vikendom u različitim dobnim skupinama



	Average setendary activity (min)	Average lower activity (min)	Average moderate activity (min)	Average vigorous activity (min)
Difference 5-6 grade School days	16.6	-3.7	-0.8	-6.1
Difference 5-6 grade Weekends	34.2	-2.9	-19.7	-6.4
Difference 6-7 grade School days	-6.7	-5.3	-12.3	8.2
Difference 6-7 grade Weekends	0.1	-8.3	-15.7	6.1

Figure 5. Average difference for girls' activity in school and on weekend days at different ages
Slika 5. Prosječna razlika za aktivnost djevojčica u školi i vikendom u različitim dobnim skupinama

weekends and transitional age periods, particularly for boys. The study contributes new data on physical activity patterns in Bulgarian children, objectively measured through motion sensors—a relatively underexplored population and method.

However, limitations include the short duration of observation (7 days), reliance on parent-reported extracurricular activity data, and potential seasonal effects. Future research should explore more extended tracking periods and include qualitative insights from children and parents. Additionally, school and community-based strategies should be designed to promote weekend activity and reduce sedentary time.

CONCLUSION

Boys are generally more active than girls on school and weekend days. However, girls' participation in high-intensity activities is less than that of boys.

Various initiatives, both within and outside the school, are necessary to promote physical activity among students. In the learning environment, this can be done by introducing active inter-hours, including physical games or short exercises. In addition, organizing sports hours and clubs that offer moderate and high-intensity activities is a good way to engage students, especially boys.

Outside school, movement can be stimulated by promoting participation in sports competitions, group training, or local sports clubs. Also, organizing initiatives such as sports holidays or special "Days without devices" can motivate children to spend their free time actively.

To raise awareness of the importance of movement, educational programs must be developed to inform students and their parents about the benefits of regular physical activity for health and development. These programs should also prepare students to incorporate movement into their daily lives, such as going to school or participating in active games instead of using digital devices.

The school environment must also be adapted to promote movement. This includes the provision of sports facilities and the separation of activities for activity in the schoolyard. It is also important to offer a variety of sports so that more students with different interests are attracted.

The personalized approach to boys and girls is also key. Boys must offer dynamic and engaging activities that compensate for the decline in physical activity. Girls should encourage the preservation and increase of high physical activity through appropriate activities such as games, dances, and other engaging activities. It is recommended that training at this age (puberty) of both sexes should be carried out in separate groups due to the increasingly clear sexual differences that would lead to problematic communication between them, caused by the physical and mental specificity of age (29).

The above recommendations help limit the sedentary lifestyle and stimulate healthy physical activity among students.

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