Physical Activity in Children
ISSN: 2783-5391

Original Article

Comparing the Anthropometric Characteristics and Physical Fitness of the School-Students with High and Low Levels of Physical Activity

Safaa A. Ismaeel *

Professor, Department of Sport Sciences, University of Diyala, Diyala, Iraq.

*Corresponding Author: Safaa A. Ismaeel. Professor, Department of Sport Sciences, University of Diyala, Diyala, Iraq. Email: sc_safaaismaeel@uodiyala.edu.iq

Received: 30 June, 2024; **Revised:** 23 July, 2024; **Accepted:** 23 August, 2024; **Published**: 01 September 2024.

Abstract

Introduction: It is crucial to examine the impact of low or high engagement in physical activity (PA) on the development of anthropometric characteristics and physical fitness (PF) components in children.
Objective: Consequently, this study aims to assess and compare the anthropometric characteristics and PF components among children with low and high levels of PA.
Methods: In the present study, a descriptive-comparative method was employed. The statistical population for this research comprised all secondary school children enrolled in a regular school in Tehran in 2023. Through a convenience sampling technique, a total of 258 children (125 girls) aged between 10 and 14 were chosen as the participants of this study. Data was collected using standard questionnaires. The data was analyzed by SPSS-26 using t-test.
Results: 58% of the children did not engage in PA during the week. No significant differences were between children with high and low PA in terms of anthropometric features (including arm length, leg length, and trunk length) (all P>0.05). However, children with high levels of PA had significantly higher levels of PF than those with lower levels of PA (P<0.001).
Conclusions: This study underscore the significance of higher PA for children. Consequently, it is recommended for physical educators to integrate programs into their curricula that aim to enhance children's PA.

Keywords: Exercise, Anthropometry, Fitness, Child, School

How to Cite: A. Ismaeel S, Comparing the Anthropometric Characteristics and Physical Fitness of the School-Students with High and Low Levels of Physical Activity. Phys. Act. Child. 2024;1(1):52-57. doi: 10.61186/pach.2024.465559.1014

1. Introduction

Industrial development, increased tendency to urbanization and mechanization of life have created major effects on people's lifestyles and have brought sedentary lifestyles to societies (1). Non-communicable diseases, especially cardiovascular diseases, are a health problem in developed and developing countries, and are a major cause of death (2). Among the 10 risk factors related to deaths in the world, six factors are related to diet and physical activity (PA) (3). Approximately 80% of non-communicable diseases occur in developing countries (4). Research has shown the prevalence of obesity (23.1%), overweight (40%), high blood pressure (29.2%), blood lipid disorder (23.6% with high total cholesterol) and diabetes (5.4%) in adults (5). Prevention of non-communicable diseases depends on the control of risk factors such as low PA. In fact, the amount of PA of people plays a role as an effective independent factor in the occurrence of various chronic diseases (6,7). Global estimates have shown that the cause of 22% of heart attacks and about 10-16% of cancers such as breast, colon, pancreas and rectum is the low PA of people. However, it has been reported that more than 60% of children do not have enough PA. The low level of PA is especially related to the incidence of obesity, which is one of the important factors of many chronic diseases (8,9).

Physical fitness (PF) is the body's ability for effective and efficient activity (10,11). PF refers to a person's ability to work effectively, enjoy free time, be healthy, and face extraordinary situations throughout life (12-14). Leisure and ability to face unforeseen emergencies. Research has shown that laying the groundwork for PF and skill development during the early years of life is essential for long-term PF and overall health. The stage of childhood holds significant importance due to the numerous physiological and behavioral changes that take place, such as alterations in body composition, attitudes towards PF, levels of PA, sedentary behavior, and dietary habits (15-17). Consequently, it is crucial to collect epidemiological data specific to each country regarding the rates of over- and underweight, body composition, as well as PF aspects such as cardiorespiratory fitness and muscular strength in children. This data is vital for creating effective public health strategies and designing appropriate PA interventions (18-20).

Irrespective of their age, individuals tend to become less physically active as they grow (21-23). The decline in PA may be linked to the different timing of sexual maturation and the growth spurt that is related to age and gender (22,24). The development of

secondary sexual characteristics in girls may lead to feelings of discomfort and lower self-esteem, which in turn may discourage them from engaging in PA (25). The rise in body fat levels and hormonal fluctuations, often experienced during this period, may also contribute to a decrease in PA (26). In the majority of PAs, anthropometric characteristics such as height, weight, limb length, etc., along with the physical and mental abilities of individuals, play a significant role in determining the type of sports activity they engage in (27-31). Studies have indicated that body composition and anthropometric characteristics are linked to physical and mental health, well-being, and the execution of physical movements and activities (32-34). By focusing on the physical condition of individuals, it becomes evident that diverse types of PA are essential for overall growth and development. Hence, it is crucial to examine the impact of low or high engagement in PA on the development of anthropometric characteristics and PF components in children. Consequently, this study aims to assess and compare the anthropometric characteristics and PF components among children with low and high levels of PA.

2. Methods

2.1. Design and participants

In the present study, a descriptive-comparative method was employed to investigate the anthropometric characteristics and PF components of children with varying levels of PA. Prior to their involvement, written consent was acquired from the parents of the children. The study adhered to the guidelines outlined in the Declaration of Helsinki. The statistical population for this research comprised all secondary school children enrolled in a regular school in Tehran in 2023. Through a convenience sampling technique, a total of 258 children (125 girls) aged between 10 and 14 were chosen as the participants of this study.

2.2. Measures

The assessment of PA and exercise participation was conducted using the Physical Activity Questionnaire for Children (PAQ-C) (35). This questionnaire comprises eight questions that participants rated on a 5-point Likert scale. The structure of the questionnaire was validated through confirmatory factor analysis, demonstrating a high loading rate exceeding 0.4. Furthermore, the reliability of the questionnaire was established with a Cronbach's alpha coefficient of 0.86. In the present study, the reliability of PAQ-C was confirmed to be 0.92 using Cronbach's alpha. It should be noted that children who had a score of less than 2.5 were considered as low PA group and those who had a score of higher than 2.5 were considered as high PA group.

Standard instruments such as meter and balance were utilized for the assessment of anthropometric features like body mass index (BMI), arm length, leg length, and trunk length.

Fitness in children was assessed through two different tests: the "Shuttle Run 4*9 test" and the "Stork Balance Stand test". The Shuttle Run 4*9 test focused on measuring agility. Participants had to walk a 9.15-meter track four times while carrying sticks or legs to the other side and placing them on the ground. The test began with the participant standing behind the starting line and running upon hearing the "go" signal. After reaching the end of the track, the participant retrieved a stick, returned to the starting line, and placed it on the ground behind the line. This process was repeated a second time, but without the requirement of placing the stick on the ground, allowing the individual to cross the line at the same pace. On the other hand, the Stork Balance Stand test aimed to evaluate static balance. Participants stood on a foam surface with eyes open, lifted one leg, and placed the sole of the foot under the knee of the opposite leg. The test continued until the person placed the sole of the foot on the ground, with the time being recorded by a stopwatch. This test assessed the stability of the standing posture by measuring the duration (in seconds) that the person could maintain the one-legged standing position.

2.3. Data analysis

The data was analyzed utilizing SPSS software version 26. Descriptive statistics employed the mean and standard deviation (SD). Gender differences were assessed using an independent t-test. To compare the anthropometric characteristics and PF components among children with low and high levels of PA, the independent t test was employed. The p-value was set at $p<0.05$.

3. Results

The participants' demographic data revealed that the average age was 11.48 years old. Within the research group, 49% were female and 51% were male. Additionally, the participants had an average BMI of 17.25, which falls within the normal range (Table 1).

Table 1. Demographic Data Across Gender.

	Gender	No.	Mean±SD	P-Value
Age (Year)	Boys	133	11.41±1.67	0.77
	Girls	125	11.53±1.84	
Height (M)	Boys	133	1.36±0.08	0.85
	Girls	125	1.32±0.04	
Weight (Kg)	Boys	133	32.17±4.14	0.54
	Girls	125	30.28±3.39	
Body Mass Index (Kg/m^2)	Boys	133	17.31±1.78	0.79
	Girls	125	17.22±1.93	

Out of the total of 258 participants in the study, 109 children (42%) participated in PA. The data reveals that 58% of the children did not engage in PA during the week. Furthermore, the initial results show that children generally have moderate to low PA. Table 2 displays the mean and SD of descriptive findings by gender, with boys showing significantly higher PA ($P<0.001$). Additionally, 43% of the participants had PA

scores above the average, indicating high PA levels. On the other hand, 57% of the children had PA scores below the average, suggesting low PA levels.

In addition, the participants exhibited normal range of anthropometric features (including BMI, arm length, leg length, and trunk length) and PF (Table 2). Notably, there were no significant gender difference in terms of anthropometric features (including arm length, leg length, and trunk length) (all P>0.05). However, boys had significantly better PF than girls (p<0.001). When comparing the anthropometric features (including BMI, arm length, leg length, and trunk length) and PF of children with high and low levels of PA, the findings demonstrated that children with higher PA had significantly lower BMI (P<0.001), however, there were no significant differences between children with high and low PA in terms of anthropometric features (including arm length, leg length, and trunk length) (all P>0.05, Table 2 and Figure 1, 2, 3, and 4). Furthermore, the results showed that children with high levels of PA had significantly higher levels of PF than those with lower levels of PA (Table 2 and Figure 5 and 6).

Table 2. Comparison of Research Variables between High and Low Physical Activity.

		BMI	Arm Length	Leg Length	Trunk Length	Shuttle Run	Stork Balance
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
High Physical Activity	Boys	16.67±1.28	50.39±3.47	71.68±8.49	62.78±5.27	12.08±2.17	14.47±2.60
	Girls	16.82±1.39	50.36±3.50	70.39±7.16	61.54±4.23	13.11±3.20	13.58±2.11
Low Physical Activity	Boys	17.96±1.28	49.71±3.22	69.94±7.19	61.43±4.87	15.97±3.64	10.20±2.55
	Girls	17.87±1.46	49.02±3.09	69.52±8.47	60.55±3.67	16.97±3.27	9.67±2.41
Comparison	Boys	t=8.64, P<0.001	t=0.27, P=0.79	t=0.09, P=0.96	t=0.17, P=0.86	t=9.94, P<0.001	t=8.12, P<0.001
	Girls	t=7.18, P<0.001	t=0.13, P=0.85	t=0.12, P=0.88	t=0.12, P=0.90	t=8.99, P<0.001	t=7.85 0.94, P<0.001

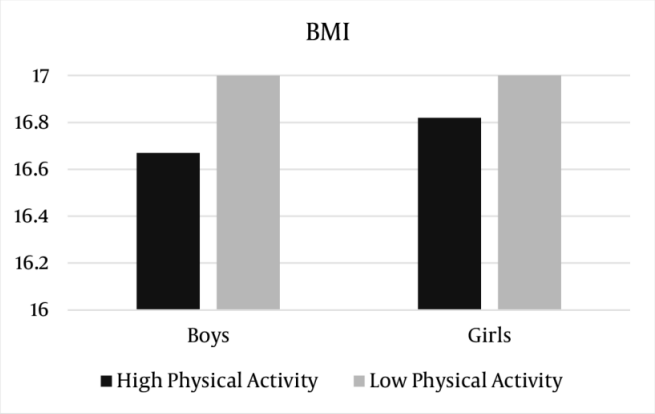

Figure 1. Mean of BMI Scores among Gender and Physical Activity Level.

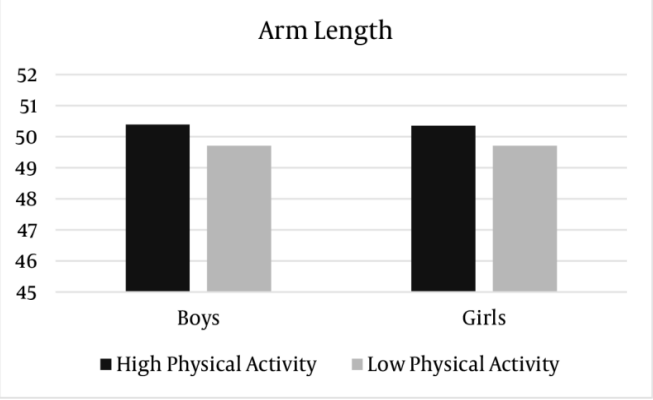

Figure 2. Mean of Arm Length Scores among Gender and Physical Activity Level.

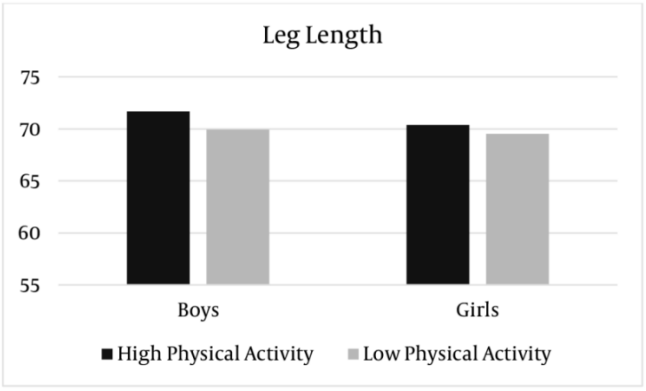

Figure 3. Mean of Arm Length Scores among Gender and Physical Activity Level.

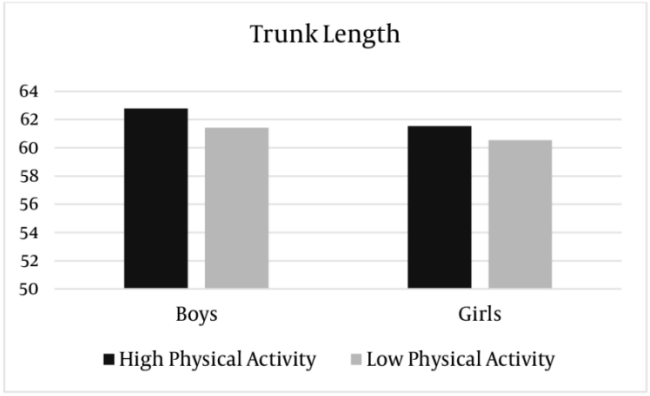

Figure 4. Mean of Trunk Length Scores among Gender and Physical Activity Level

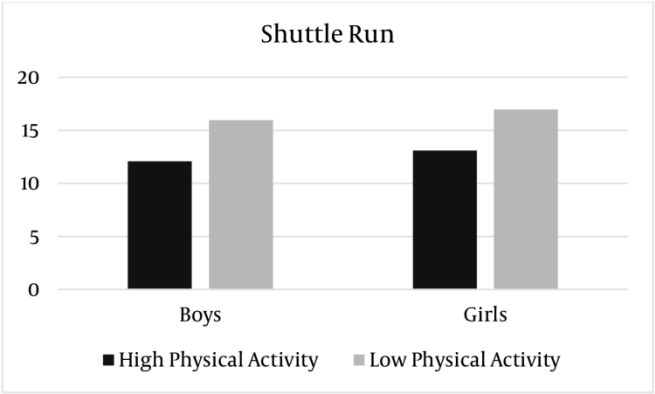

Figure 5. Mean of Shuttle Run Scores among Gender and Physical Activity Level.

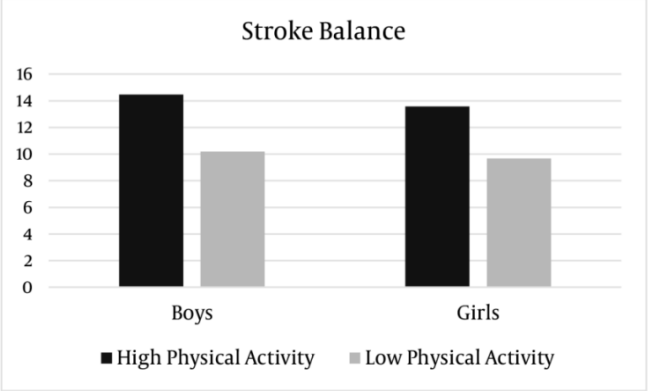

Figure 6. Mean of Stroke Balance Scores among Gender and Physical Activity Level.

4. Discussion

It is crucial to examine the impact of low or high engagement in PA on the development of anthropometric characteristics and PF components in children. Consequently, this study aims to assess and compare the anthropometric characteristics and PF components among children with low and high levels of PA. The initial results of the research show that children generally have moderate to low PA, where boys showing significantly higher PA. Additionally, 43% of the participants had PA scores above the average, indicating high PA levels. These findings are consistent with previous studies (2,4,5,7,8), which also reported low PA among children. Due to the fact that PA plays a crucial role in maintaining the vitality the human health system, and is considered a fundamental requirement for the well-being of children, it is necessary to promote PA among children. Encouraging participation in sports activities not only promotes vitality but also aligns their behavior, interests, and needs with valuable and defined objectives. Therefore, meticulous and comprehensive planning is essential to ensure PA, and the more detailed and precise the planning, the more sustainable the progress and motivation for sports participation will be (1,4,7,9).

Additionally, the findings indicated that children with high PA exhibited notably enhanced PF compared to those with lower PA, that emphasized the positive influence of sports participation on overall PF. These findings are consistent with previous studies (10,11,14,16,18-20). To interpret these findings, it can be stated that regular participation in PA is responsible for the elevated levels of fitness observed. This involvement in PA promotes improved joint mobility, muscle growth, and flexibility in ligaments and tendons. Additionally, engaging in consistent PA leads to enhancements in respiratory function. These improvements manifest as stronger respiratory muscles, improved thoracic compliance, increased endurance of the upper respiratory system, and enhanced respiratory elasticity (12,14). On the other hand, children who do not engage in sports and games experience stiffer joints and a decreased resistance in the respiratory system (17,19).

In addition, the findings demonstrated no significant differences between children with high and low PA in terms of anthropometric features (including arm length, leg length, and trunk length), however, children with higher PA had significantly lower BMI than those with lower PA. These findings are consistent with previous studies (28-30,32,33). In order to explain these results, it can be stated that the anthropometric indicators such as arm length, leg length, and trunk length are items that are less affected by external factors such as PA. These indicators were mainly related to the length of organs, which are related to skeletal growth (30,32,33). Skeletal growth is mainly influenced by heredity and nutritional factors in early childhood, and therefore it is conceivable that external factors such as exercise and PA may not have a significant impact on them. However, several studies have shown that active participation in PA can improve some anthropometric indicators such as fat mass and muscle tissue, which directly affect BMI. This may be the reason why children with higher PA had significantly lower BMI than those with lower PA. Further studies are needed to provide more comprehensive view regarding the effects of PA on different aspects of anthropometric features in children (30,31,34).

In line with prior research (36,37), this study discovered that boys exhibited higher PF than girls. Factors such as social and cultural constraints on PA for girls beyond the home and school environment could be a significant contributor to their lower PF than boys (38,39).

The current study was limited by its cross-sectional design, preventing the examination of contributing factors. Additionally, the use of a questionnaire to measure PA was another limitation, as it may introduce bias and produce less precise data compared to device-measured tools.

4.1. Conclusion

Current study has indicated that children generally participate in minimal PA. It has been noted that girls tend to exhibit lower PF in comparison to boys. In light of the results of this research, which demonstrated that increased PA improved PF, it is imperative to promote PA, especially among girls. Interestingly, while higher PA did not affect skeletal-related anthropometric features, it did have a positive impact on reducing BMI. These findings underscore the significance of higher PA for children. Consequently, it is recommended for physical educators to integrate programs that aim to increase children's PA.

Acknowledgments

The author is grateful to all the participants who participated in this research.

Footnotes

Authors' Contribution: This study was carried out solely by the corresponding author.

Conflict of Interests: The researcher confirms that there is no conflict of interests in this study with any participant.

Data Availability: The data that support the findings of this study are openly available upon request from the corresponding author.

Ethical Approval: Approval for this study was obtained from the university. The author confirms that all steps and requirements of this study comply with ethical guidelines. Participants were informed about the characteristics of the study and gave written informed consent.

Funding/Support: This research received no external funding.

Informed Consent: Informed written consent was obtained from all participants.

Supplementary information accompanies this paper at doi: 10.61186/pach.2024.465559.1014

ORCID iD

Safaa A. Ismaeel https://orcid.org/0000-0003-2116-6061

References

1. Rawal LB, Smith BJ, Quach H, Renzaho AMN. Physical Activity among Adults with Low Socioeconomic Status Living in Industrialized Countries: A Meta-Ethnographic Approach to Understanding Socioecological Complexities. J Environ Public Health. 2020;**2020**:4283027. [PubMed ID: 32322283]. [PubMed Central ID: PMC7152945]. https://doi.org/10.1155/2020/4283027
2. Lee YS, Chia M, Komar J. A Systematic Review of Physical Activity Intervention Programs in ASEAN Countries: Efficacy and Future Directions. Int J Environ Res Public Health. 2022;**19**(9):5357. [PubMed ID: 35564751]. [PubMed Central ID: PMC9103551]. https://doi.org/10.3390/ijerph19095357
3. Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. Am J Prev Med. 1998;**15**(4):379-97. [PubMed ID: 9838979]. https://doi.org/10.1016/s0749-3797(98)00076-2
4. Bauman A, Bull F, Chey T, Craig CL, Ainsworth BE, Sallis JF, Bowles HR, Hagstromer M, Sjostrom M, Pratt M; IPS Group. The International Prevalence Study on Physical Activity: results from 20 countries. Int J Behav Nutr Phys Act. 2009;**6**:21. [PubMed ID: 19335883]. [PubMed Central ID: PMC2674408]. https://doi.org/10.1186/1479-5868-6-21
5. Day K. Physical Environment Correlates of Physical Activity in Developing Countries: A Review. J Phys Act Health. 2018;**15**(4):303-314. Epub 2017 Dec 26. [PubMed ID: 29278043]. https://doi.org/10.1123/jpah.2017-0184
6. Ranasinghe PD, Pokhrel S, Anokye NK. Economics of physical activity in low-income and middle- income countries: a systematic review. BMJ Open. 2021;**11**(1):e037784. [PubMed ID: 33452186]. [PubMed Central ID: PMC7813307]. https://doi.org/10.1136/bmjopen-2020-037784
7. Ammar A, Trabelsi K, Hermassi S, Kolahi AA, Mansournia MA, Jahrami H, Boukhris O, Boujelbane MA, Glenn JM, Clark CCT, Nejadghaderi A, Puce L, Safiri S, Chtourou H, Schöllhorn WI, Zmijewski P, Bragazzi NL. Global disease burden attributed to low physical activity in 204 countries and territories from 1990 to 2019: Insights from the Global Burden of Disease 2019 Study. Biol Sport. 2023;**40**(3):835-855. [PubMed ID: 37398951]. [PubMed Central ID: PMC10286621]. https://doi.org/10.5114/biolsport.2023.121322
8. Blair SN, Booth M, Gyarfas I, Iwane H, Marti B, Matsudo V, Morrow MS, Noakes T, Shephard R. Development of public policy and physical activity initiatives internationally. Sports Med. 1996;**21**(3):157-63. [PubMed ID: 8776006]. https://doi.org/10.2165/00007256-199621030-00001
9. Matsudo V, Matsudo S, Andrade D, Araujo T, Andrade E, de Oliveira LC, Braggion G. Promotion of physical activity in a developing country: the Agita São Paulo experience. Public Health Nutr. 2002;**5**(1A):253-61. [PubMed ID: 12027292]. https://doi.org/10.1079/phn2001301
10. Malina RM. Physical fitness of children and adolescents in the United States: status and secular change. Med Sport Sci. 2007;**50**:67-90. [PubMed ID: 17387252]. https://doi.org/10.1159/000101076
11. Boreham C, Riddoch C. The physical activity, fitness and health of children. J Sports Sci. 2001;**19**(12):915-29. [PubMed ID: 11820686]. https://doi.org/10.1080/026404101317108426
12. Sallis JF. Epidemiology of physical activity and fitness in children and adolescents. Crit Rev Food Sci Nutr. 1993;**33**(4-5):403-8. [PubMed ID: 8357503]. https://doi.org/10.1080/10408399309527639
13. Landry BW, Driscoll SW. Physical activity in children and adolescents. PM R. 2012;**4**(11):826-32. [PubMed ID: 23174545]. https://doi.org/10.1016/j.pmrj.2012.09.585
14. Wouters M, Evenhuis HM, Hilgenkamp TIM. Physical fitness of children and adolescents with moderate to severe intellectual disabilities. Disabil Rehabil. 2020;**42**(18):2542-2552. [PubMed ID: 30973765]. https://doi.org/10.1080/09638288.2019.1573932
15. Riddoch CJ, Boreham CA. The health-related physical activity of children. Sports Med. 1995;**19**(2):86-102. [PubMed ID: 7747006]. https://doi.org/10.2165/00007256-199519020-00002
16. Michel J, Bernier A, Thompson LA. Physical Activity in Children. JAMA Pediatr. 2022;**176**(6):622. [PubMed ID: 35467714]. https://doi.org/10.1001/jamapediatrics.2022.0477
17. Sacchetti R, Ceciliani A, Garulli A, Masotti A, Poletti G, Beltrami P, Leoni E. Physical fitness of primary school children in relation to overweight prevalence and physical activity habits. J Sports Sci. 2012;**30**(7):633-40. [PubMed ID: 22348275]. https://doi.org/10.1080/02640414.2012.661070
18. Riddoch CJ, Boreham CA. The health-related physical activity of children. Sports Med. 1995;**19**(2):86-102. [PubMed ID: 7747006]. https://doi.org/10.2165/00007256-199519020-00002
19. Ganley KJ, Paterno MV, Miles C, Stout J, Brawner L, Girolami G, Warren M. Health-related fitness in children and adolescents. Pediatr Phys Ther. 2011;**23**(3):208-20. [PubMed ID: 21829112]. https://doi.org/10.1097/pep.0b013e318227b3fc
20. Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. Int J Obes (Lond). 2008;**32**(1):1-11. [PubMed ID: 18043605]. https://doi.org/10.1038/sj.ijo.0803774
21. Collins AM, Molina-Hidalgo C, Aghjayan SL, Fanning J, Erlenbach ED, Gothe NP, Velazquez-Diaz D, Erickson KI. Differentiating the influence of sedentary behavior and physical activity on brain health in late adulthood. Exp Gerontol. 2023;**180**:112246. [PubMed ID: 37356467]. https://doi.org/10.1016/j.exger.2023.112246
22. Pate RR, Dowda M, Dishman RK, Gorab J, Bucko A, Saunders RP. Longitudinal association of biological maturation with physical activity behaviors in girls transitioning from 5th to 7th grade. Am J Hum Biol. 2022;34(7):e23737. [PubMed ID: 35213763]. [PubMed Central ID: PMC9253076]. https://doi.org/10.1002/ajhb.23737
23. Bacil ED, Mazzardo Júnior O, Rech CR, Legnani RF, de Campos W. Atividade física e maturação biológica: uma revisão sistemática [Physical activity and biological maturation: a systematic review]. Rev Paul Pediatr. 2015;**33**(1):114-21. [PubMed ID: 25583624]. [PubMed Central ID: PMC4436963]. https://doi.org/10.1016/j.rpped.2014.11.003
24. Sherar LB, Cumming SP, Eisenmann JC, Baxter-Jones AD, Malina RM. Adolescent biological maturity and physical activity: biology meets behavior. Pediatr Exerc Sci. 2010;**22**(3):332-49. [PubMed ID: 20814031]. https://doi.org/10.1123/pes.22.3.332
25. Campos CG, Carlos FM, Muniz LA, Bila WC, Damasceno VO, Romano MCC, Lamounier JA. Physical activity and adolescent sexual maturity: a systematic review. Cien Saude Colet. 2021;**26**(5):1823-1832. Portuguese, English. [PubMed ID: 34076123]. https://doi.org/10.1590/1413-81232021265.17622019
26. Fairclough SJ, Ridgers ND. Relationships between maturity status, physical activity, and physical self-perceptions in primary school children. J Sports Sci. 2010;**28**(1):1-9. [PubMed ID: 20013460]. https://doi.org/10.1080/02640410903334780
27. Andaki AC, Tinôco AL, Mendes EL, Andaki Júnior R, Hills AP, Amorim PR. Anthropometry and physical activity level in the prediction of metabolic syndrome in children. Public Health Nutr. 2014;**17**(10):2287-94. [PubMed ID: 24063585]. [PubMed Central ID: PMC10282609]. https://doi.org/10.1017/s136898001300253x
28. Godoy-Cumillaf A, Farías-Valenzuela C, Duclos-Bastías D, Giakoni-Ramírez F, Vásquez-Gómez J, Bruneau-Chávez J, Bizzozero-Peroni B. Effects of physical activity interventions on anthropometric indicators and health indices in Chilean children and adolescents: A protocol for systematic review and/or meta-analysis. Medicine (Baltimore). 2023;**102**(21):e33894. [PubMed ID: 37233401]. [PubMed Central ID: PMC10219749]. https://doi.org/10.1097/md.0000000000033894
29. Reid RER, Fillon A, Thivel D, Henderson M, Barnett TA, Bigras JL, Mathieu ME. Can anthropometry and physical fitness testing explain physical activity levels in children and adolescents with obesity? J Sci Med Sport. 2020;**23**(6):580-585. [PubMed ID: 31926870]. https://doi.org/10.1016/j.jsams.2019.12.005
30. Ahmad Bahathig A, Abu Saad H, Md Yusop NB, Mohd Shukri NH, El-Din MME. Relationship between Physical Activity, Sedentary Behavior, and Anthropometric Measurements among Saudi Female Adolescents: A Cross-Sectional Study. Int J Environ Res Public Health. 2021;**18**(16):8461. [PubMed ID: 34444210]. [PubMed Central ID: PMC8392146]. https://doi.org/10.3390/ijerph18168461
31. Contreras-Osorio F, Guzmán-Guzmán IP, Cerda-Vega E, Chirosa-Ríos L, Ramírez-Campillo R, Campos-Jara C. Anthropometric Parameters, Physical Activity, Physical Fitness, and Executive Functions among Primary School Children. Int J Environ Res Public Health. 2022;**19**(5):3045. [PubMed ID: 35270736]. [PubMed Central ID: PMC8910200]. https://doi.org/10.3390/ijerph19053045
32. Bénéfice E. Physical activity and anthropometric and functional characteristics of mildly malnourished Senegalese children. Ann Trop Paediatr. 1992;**12**(1):55-66. [PubMed ID: 1376588]. https://doi.org/10.1080/02724936.1992.11747547
33. Pysz K, Leszczyńska T, Kopeć A. Anthropometric assessment of the nutritional status of children and adolescents residing in selected Polish orphanages based on their energy intake and physical activity level. Rocz Panstw Zakl Hig. 2015;**66**(1):77-83. [PubMed ID: 25813077].
34. Contreras-Osorio F, Guzmán-Guzmán IP, Cerda-Vega E, Chirosa-Ríos L, Ramírez-Campillo R, Campos-Jara C. Anthropometric Parameters, Physical Activity, Physical Fitness, and Executive Functions among Primary School Children. Int J Environ Res Public Health. 2022;**19**(5):3045. [PubMed ID: 35270736]. [PubMed Central ID: PMC8910200]. https://doi.org/10.3390/ijerph19053045
35. Sirajudeen MS, Waly M, Manzar MD, Alqahtani M, Alzhrani M, Alanazi A, Unnikrishnan R, Muthusamy H, Saibannavar R, Alrubaia W. Physical activity questionnaire for older children (PAQ-C): Arabic translation, cross-cultural adaptation, and psychometric validation in school-aged children in Saudi Arabia. PeerJ. 2022;**10**:e13237. [PubMed ID: 35433134]. [PubMed Central ID: PMC9012174]. https://doi.org/10.7717/peerj.13237
36. Ishii K, Shibata A, Adachi M, Nonoue K, Oka K. Gender and grade differences in objectively measured physical activity and sedentary behavior patterns among Japanese children and adolescents: a cross-sectional study. BMC Public Health. 2015;**15**:1254. [PubMed ID: 26679503]. [PubMed Central ID: PMC4683705]. https://doi.org/10.1186/s12889-015-2607-3
37. Trost SG, Pate RR, Sallis JF, Freedson PS, Taylor WC, Dowda M, et al. Age and gender differences in objectively measured physical activity in youth. Med Sci Sports Exerc. 2002;**34**(2):350-5. [PubMed ID: 11828247]. https://doi.org/10.1097/00005768-200202000-00025
38. Saller FVI, Khaled SM. Potential psychosocial influences on gender differences in physical activity among Qatari adolescents: A first insight through descriptive observation. International Journal of Adolescence and Youth. 2019;**24**(2):234-251. http://dx.doi.org/10.1080/02673843.2018.1515087
39. Lenhart CM, Hanlon A, Kang Y, Daly BP, Brown MD, Patterson F. Gender disparity in structured physical activity and overall activity level in adolescence: Evaluation of youth risk behavior surveillance data. ISRN Public Health. 2012;**2012**:674936. https://doi.org/10.5402/2012/674936