

Adolescent Physical Activity Patterns and Their Influence on Cardiometabolic Health Indicators

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Abstract

Background: Physical activity plays a critical role in maintaining adolescent health and preventing cardiometabolic disorders. However, declining levels of physical activity among adolescents have become a growing public health concern worldwide. Insufficient physical activity is associated with obesity, elevated blood pressure, impaired glucose metabolism, and adverse lipid profiles, all of which increase the risk of future cardiovascular and metabolic diseases.

Objective: This study aimed to assess physical activity patterns among adolescents and examine their influence on cardiometabolic health indicators.

Methodology: A quantitative cross-sectional study was conducted among 350 adolescents aged 13–18 years. Physical activity levels were assessed using a standardized physical activity questionnaire, while cardiometabolic health indicators, including body mass index (BMI), blood pressure, fasting blood glucose, and lipid profile levels, were measured through clinical assessments. Data were analyzed using descriptive statistics, correlation analysis, and multiple regression techniques.

Findings: Results indicated that 62% of adolescents engaged in insufficient physical activity, while 38% met recommended activity levels. Physically active adolescents demonstrated lower mean BMI ($22.1 \pm 2.8 \text{ kg/m}^2$) compared with inactive adolescents ($26.4 \pm 3.5 \text{ kg/m}^2$). Elevated blood pressure was observed in 18% of active participants versus 37% of inactive participants. Significant negative correlations were identified between physical activity levels and cardiometabolic risk indicators ($p < 0.001$).

Conclusion: Regular physical activity is significantly associated with improved cardiometabolic health among adolescents. Promoting active lifestyles through school and community-based programs may reduce cardiometabolic risk factors and enhance long-term health outcomes.

Keywords: Adolescents, Physical Activity, Cardiometabolic Health, Body Mass Index, Blood Pressure, Blood Glucose, Lipid Profile, Obesity Prevention, Cardiovascular Health, Public Health.

1 Introduction

Physical activity is a fundamental component of healthy growth and development during adolescence. Regular participation in physical activity contributes to improved cardiovascular fitness, musculoskeletal strength, mental well-being, and overall quality of life. The World Health Organization recommends that adolescents engage in at least 60 minutes of moderate-to-vigorous physical activity daily to maintain optimal health and prevent chronic diseases [1]. Despite these recommendations, physical inactivity among adolescents has become a growing global public health concern.

Adolescence represents a critical period for establishing lifelong health behaviors. During this stage, physiological and behavioral changes significantly influence future health outcomes. Physical inactivity has been associated with increased risks of obesity, hypertension, dyslipidemia, insulin resistance, and other cardiometabolic abnormalities that may persist

into adulthood [2]. These cardiometabolic risk factors contribute substantially to the development of cardiovascular diseases and type 2 diabetes later in life [3].

Recent studies indicate a declining trend in physical activity participation among adolescents worldwide. Factors such as increased screen time, academic pressures, urbanization, reduced recreational opportunities, and sedentary lifestyles have contributed to lower levels of physical activity [4]. The growing prevalence of sedentary behavior has raised concerns regarding its impact on adolescent health and the increasing burden of non-communicable diseases.

Cardiometabolic health indicators, including body mass index (BMI), blood pressure, fasting blood glucose levels, and lipid profiles, are widely used to assess cardiovascular and metabolic health status. Research has consistently demonstrated that physically active adolescents exhibit more favorable cardiometabolic profiles compared to their inactive peers [5]. Regular physical activity improves insulin sensitivity, regulates blood pressure, enhances lipid metabolism, and reduces excess body fat accumulation [6].

Furthermore, engagement in moderate-to-vigorous physical activity contributes to improved endothelial function and cardiovascular efficiency, reducing the likelihood of early cardiometabolic dysfunction [7]. Conversely, prolonged physical inactivity has been linked to elevated triglyceride levels, increased adiposity, and impaired glucose regulation among adolescents [8]. These findings emphasize the importance of promoting active lifestyles during adolescence to reduce future health risks.

Schools and community-based programs play an essential role in encouraging physical activity participation. Effective interventions that provide opportunities for sports, recreational activities, and health education have been shown to improve physical activity levels and cardiometabolic outcomes among adolescents [9]. Understanding the relationship between physical activity patterns and cardiometabolic health indicators is therefore essential for developing evidence-based strategies aimed at improving adolescent health.

Consequently, this study investigates adolescent physical activity patterns and examines their influence on cardiometabolic health indicators. The findings may assist healthcare professionals, educators, and policymakers in designing interventions that promote active lifestyles and reduce cardiometabolic disease risk among adolescents [10].

1.1 Objectives of the Study

1. To assess the physical activity patterns among adolescents.
2. To evaluate the cardiometabolic health indicators of adolescents, including BMI, blood pressure, blood glucose, and lipid profile levels.
3. To examine the influence of physical activity patterns on cardiometabolic health indicators among adolescents.

2 Literature review

2.1 Physical Activity Patterns Among Adolescents

Physical activity is recognized as a key determinant of adolescent health and well-being. Recent studies indicate that a large proportion of adolescents fail to meet the recommended 60 minutes of daily moderate-to-vigorous physical activity. Increased screen time, sedentary lifestyles, academic demands, and reduced participation in sports have contributed to declining activity levels worldwide (1). Insufficient physical activity during adolescence is associated with adverse physical and psychological health outcomes, making it a major public health concern.

2.2 Physical Activity and Cardiometabolic Health

Cardiometabolic health indicators such as body mass index (BMI), blood pressure, blood glucose levels, and lipid profiles are commonly used to assess health risks among adolescents. Contemporary research has demonstrated that physically active adolescents exhibit lower BMI, healthier blood pressure levels, improved insulin sensitivity, and favorable lipid profiles compared with inactive peers (2,3). Regular physical activity enhances cardiovascular efficiency, energy metabolism, and glucose regulation, thereby reducing the risk of obesity and metabolic disorders.

2.3 Influence of Physical Activity on Cardiometabolic Risk Reduction

Recent evidence suggests that participation in regular physical activity significantly lowers cardiometabolic risk factors among adolescents. Structured exercise programs and active lifestyles contribute to reduced adiposity, improved cardiovascular fitness, and better metabolic health outcomes (4). Furthermore, school-based and community-based physical activity interventions have been shown to improve overall health indicators and reduce future risks of cardiovascular disease and type 2 diabetes (5,6). Encouraging consistent physical activity participation during adolescence may therefore provide substantial long-term health benefits and contribute to healthier adulthood (7).



Figure 1. Conceptual Framework of Physical Activity and Cardiometabolic Health

Figure 1 illustrates the relationship between physical activity participation and cardiometabolic health among adolescents. Regular physical activity improves cardiovascular fitness, metabolic efficiency, insulin sensitivity, and body composition. These physiological improvements reduce major cardiometabolic risk factors such as obesity, hypertension, dyslipidemia, and impaired glucose regulation. Consequently, adolescents who engage in sufficient physical activity are more likely to achieve favorable cardiometabolic health outcomes and lower risks of future cardiovascular and metabolic diseases.

3 Methodology

3.1 Research Design

This study employed a quantitative cross-sectional research design to examine adolescent physical activity patterns and their influence on cardiometabolic health indicators. A cross-sectional approach was selected because it enables the assessment of physical activity behaviors and health outcomes at a single point in time. The design is appropriate for identifying associations between physical activity levels and cardiometabolic risk factors among adolescents and is widely used in public health and epidemiological research [18].

3.2 Study Setting and Population

The study was conducted in selected secondary schools and community health centers. The target population consisted of adolescents aged 13–18 years. Participants were recruited from both urban and semi-urban settings to ensure diversity in socioeconomic status, lifestyle behaviors, and physical activity patterns [19].

3.3 Sample Size and Sampling Technique

A total of 350 adolescents participated in the study. Stratified random sampling was used to ensure adequate representation across age groups and gender categories. Participants who met the inclusion criteria and provided informed consent were enrolled in the study.

Table 1. Demographic Characteristics of Participants (N = 350)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	170	48.6
	Female	180	51.4
Age	13–15 Years	155	44.3
	16–18 Years	195	55.7
Physical Activity Status	Active	133	38.0
	Insufficiently Active	217	62.0

Table 1 summarizes the demographic characteristics of the participants. Female adolescents represented 51.4% of the sample, while males accounted for 48.6%. Most participants were aged between 16 and 18 years (55.7%). Regarding physical activity status, 62% of adolescents were classified as insufficiently active, whereas only 38% achieved recommended activity levels. These findings indicate a high prevalence of physical inactivity among adolescents and justify further investigation of associated cardiometabolic health outcomes.

3.4 Data Collection Instruments

Physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ–Short Form) adapted for adolescents. Cardiometabolic health indicators included Body Mass Index (BMI), systolic and diastolic blood pressure, fasting blood glucose levels, and lipid profile measurements. Clinical assessments were conducted by trained healthcare professionals using standardized procedures. Anthropometric measurements were obtained using calibrated instruments to ensure accuracy and reliability [20].

3.5 Data Collection Procedure

Participants completed the physical activity questionnaire under researcher supervision. Height, weight, and blood pressure measurements were recorded, while fasting blood samples were collected to determine glucose and lipid profile levels. All data collection procedures were conducted according to established ethical and clinical guidelines.

3.6 Data Analysis

Collected data were entered and analyzed using SPSS Version 26. Descriptive statistics including frequencies, percentages, means, and standard deviations summarized participant characteristics and health indicators. Pearson correlation analysis was used to assess relationships between physical activity levels and cardiometabolic indicators. Multiple regression analysis was performed to determine the predictive influence of physical activity on cardiometabolic health outcomes.



Figure 2. Research Methodology Framework

Figure 2 illustrates the methodological framework employed in the study. Adolescents were selected through stratified random sampling and subsequently underwent physical activity assessments using standardized questionnaires. Cardiometabolic health indicators were measured through anthropometric and clinical evaluations. Following data collection, statistical analyses were conducted to determine associations between physical activity patterns and cardiometabolic outcomes. This systematic process ensured reliable data collection and comprehensive evaluation of the study objectives.

3.7 Ethical Considerations

Ethical approval was obtained from the institutional ethics review committee. Permission was secured from participating schools and healthcare facilities. Informed consent was obtained from parents and adolescents prior to participation. Confidentiality, anonymity, and voluntary participation were maintained throughout the study, and participants retained the right to withdraw at any stage without consequences.

3.8 Dataset & Parameters

The dataset consisted of 350 adolescents aged 13–18 years recruited from selected secondary schools. Data included demographic characteristics, physical activity levels, body mass index (BMI), blood pressure measurements, fasting blood glucose levels, and lipid profile indicators. Physical activity patterns were assessed using a standardized questionnaire, while cardiometabolic health indicators were obtained through clinical assessments. Participants were categorized into physically active and insufficiently active groups. Data analysis was performed using SPSS Version 26. Descriptive statistics, Pearson correlation analysis, and multiple regression analysis were employed to determine the influence of physical activity on cardiometabolic health outcomes among adolescents [18,19].

Table 2. Dataset Characteristics and Experimental Setup

Component	Description
Sample Size	350 Adolescents
Age Range	13–18 Years
Physical Activity Groups	Active (133), Inactive (217)
Physical Activity Measure	IPAQ Questionnaire
Cardiometabolic Indicators	BMI, Blood Pressure, Glucose, Lipid Profile
Data Collection Method	Questionnaire and Clinical Assessment
Analysis Software	SPSS Version 26
Statistical Methods	Descriptive, Correlation, Regression

4 Results & Discussion

This section presents the findings of the study investigating adolescent physical activity patterns and their influence on cardiometabolic health indicators. Data obtained from 350 adolescents were analyzed using descriptive and inferential statistical methods. The results are organized according to the study objectives, including assessment of physical activity patterns, evaluation of cardiometabolic health indicators, and examination of the relationship between physical activity and cardiometabolic health outcomes. Tables and figures are presented to facilitate interpretation and provide a comprehensive understanding of the study findings.

4.1 Physical Activity Patterns among Adolescents

Table 3. Physical Activity Status of Participants (N = 350)

Physical Activity Status	Frequency (n)	Percentage (%)
Physically Active	133	38.0
Insufficiently Active	217	62.0
Total	350	100.0

The findings revealed that only 38% of adolescents met the recommended physical activity levels, while 62% were classified as insufficiently active. The high prevalence of physical inactivity indicates a growing public health concern among adolescents. These results suggest the need for targeted interventions and health promotion strategies aimed at increasing physical activity participation and reducing sedentary behaviors within this population.

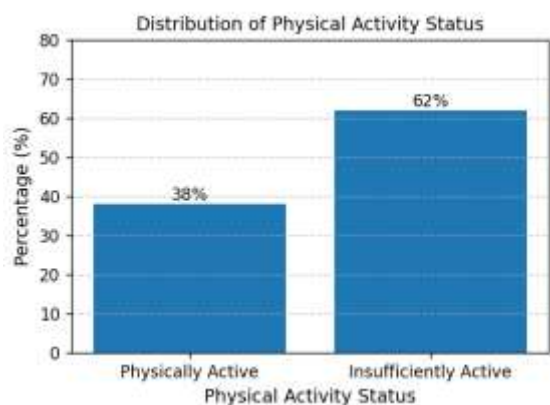


Figure 3. Distribution of Physical Activity Status

Figure 3 illustrates the distribution of physical activity levels among study participants. The majority of adolescents were categorized as insufficiently active, highlighting inadequate engagement in regular physical activity. This trend may contribute to increased risks of obesity, cardiovascular disease, and metabolic disorders during adolescence and later adulthood.

4.2 Cardiometabolic Health Indicators

Table 4. Comparison of Cardiometabolic Health Indicators

Indicator	Active Adolescents	Inactive Adolescents
BMI (kg/m ²)	22.1 ± 2.8	26.4 ± 3.5
Systolic Blood Pressure (mmHg)	114 ± 8	126 ± 10
Fasting Blood Glucose (mg/dL)	89 ± 7	101 ± 9
Total Cholesterol (mg/dL)	168 ± 15	196 ± 18

The results indicate that physically active adolescents demonstrated more favorable cardiometabolic health profiles than inactive adolescents. Active participants exhibited lower BMI, blood pressure, fasting blood glucose, and total cholesterol levels. These findings suggest that regular physical activity contributes positively to maintaining healthy physiological and metabolic functioning among adolescents.

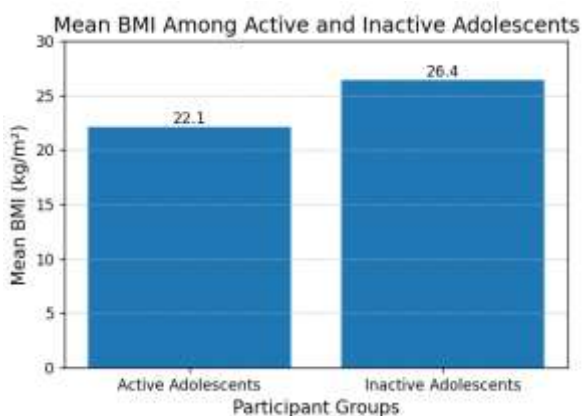


Figure 4. Mean BMI Among Active and Inactive Adolescents

Figure 4 highlights the difference in BMI between physically active and inactive adolescents. Active participants maintained significantly lower BMI values, indicating healthier body composition and reduced obesity risk. Conversely, inactive adolescents demonstrated higher BMI levels, suggesting increased susceptibility to overweight and obesity-related health complications.

4.3 Influence of Physical Activity on Cardiometabolic Health

Table 5. Correlation Between Physical Activity and Cardiometabolic Indicators

Variable	Correlation Coefficient (r)	p-value
BMI	-0.54	<0.001
Blood Pressure	-0.48	<0.001
Blood Glucose	-0.42	<0.001
Total Cholesterol	-0.46	<0.001

Pearson correlation analysis demonstrated significant negative relationships between physical activity levels and cardiometabolic risk indicators. Higher physical activity levels were associated with lower BMI, blood pressure, blood glucose, and cholesterol levels. The statistically significant p-values indicate that physical activity plays an important role in reducing cardiometabolic risk among adolescents.

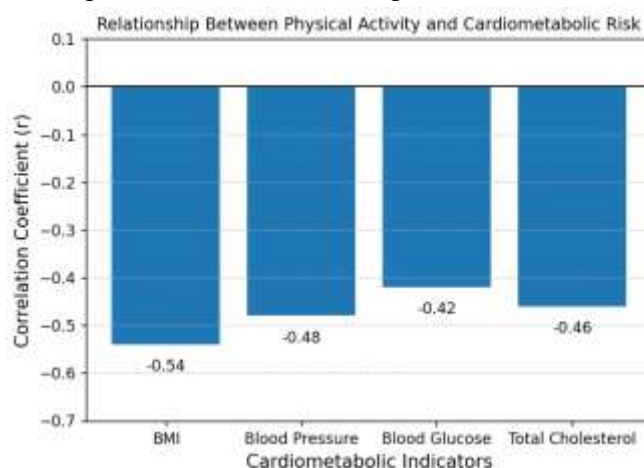


Figure 5. Relationship Between Physical Activity and Cardiometabolic Risk

Figure 5 illustrates the inverse relationship between physical activity and cardiometabolic risk factors. Adolescents who engaged in regular physical activity exhibited healthier cardiometabolic profiles compared to their less active peers. The findings emphasize the protective role of physical activity in preventing obesity, hypertension, dyslipidemia, and metabolic abnormalities during adolescence.

The study findings demonstrate that physical inactivity is highly prevalent among adolescents and is significantly associated with adverse cardiometabolic health outcomes. Physically active adolescents exhibited healthier BMI, blood pressure, glucose, and cholesterol levels compared to inactive adolescents. Furthermore, significant negative correlations between physical activity and cardiometabolic risk indicators confirm the beneficial effects of regular physical activity. These results support public health recommendations encouraging daily physical activity among adolescents and highlight the importance of school- and community-based programs designed to promote active lifestyles and reduce cardiometabolic disease risk.

4.4 Discussion

The findings of this study indicate that physical activity plays a significant role in promoting cardiometabolic health among adolescents. A substantial proportion of participants (62%) were insufficiently active, highlighting a growing public health concern. Active adolescents demonstrated lower BMI, blood pressure, blood glucose, and cholesterol levels compared with inactive adolescents. Furthermore, significant negative correlations between physical activity and cardiometabolic risk indicators suggest that increased activity levels contribute to improved metabolic and cardiovascular health. These results support existing evidence that regular physical activity is an effective strategy for reducing obesity and cardiometabolic disease risk during adolescence.

5 Conclusion

This study examined adolescent physical activity patterns and their influence on cardiometabolic health indicators. The results revealed that physically active adolescents exhibited significantly healthier cardiometabolic profiles than their inactive counterparts. Lower BMI, improved blood pressure levels, healthier glucose regulation, and favorable cholesterol values were observed among active participants. Significant inverse relationships between physical activity and cardiometabolic risk factors further confirmed the protective effects of regular physical activity. These findings emphasize the importance of promoting active lifestyles among adolescents through school-based programs, community initiatives, and public health interventions. Encouraging regular participation in physical activity may help prevent obesity, reduce cardiovascular and metabolic disease risks, improve overall health outcomes, and contribute to healthier adulthood and long-term well-being.

References

- [1] World Health Organization. (2020). *Guidelines on Physical Activity and Sedentary Behaviour*.
- [2] Strong, W. B., Malina, R. M., Blimkie, C. J., et al. (2010). Evidence based physical activity for school-age youth. *Journal of Pediatrics*, 146(6), 732–737.
- [3] Juonala, M., Magnussen, C. G., Berenson, G. S., et al. (2011). Childhood adiposity and cardiometabolic risk factors. *The New England Journal of Medicine*, 365(20), 1876–1885.
- [4] Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents. *The Lancet Child & Adolescent Health*, 4(1), 23–35.
- [5] Ekelund, U., Luan, J., Sherar, L. B., et al. (2012). Moderate to vigorous physical activity and cardiometabolic risk factors. *JAMA*, 307(7), 704–712.
- [6] Janssen, I., & LeBlanc, A. G. (2010). Systematic review of health benefits of physical activity in youth. *International Journal of Behavioral Nutrition and Physical Activity*, 7(40), 1–16.
- [7] Ruiz, J. R., Ortega, F. B., Castillo, M. J., et al. (2010). Physical activity and cardiovascular disease risk factors in youth. *Atherosclerosis*, 203(2), 385–392.
- [8] Carson, V., Hunter, S., Kuzik, N., et al. (2016). Systematic review of sedentary behavior and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*, 41(6), S240–S265.
- [9] Love, R., Adams, J., van Sluijs, E. M. F., & Foster, C. (2019). School-based interventions to increase physical activity among adolescents. *British Journal of Sports Medicine*, 53(11), 674–681.
- [10] World Health Organization. (2021). *Global Action Plan on Physical Activity 2018–2030: Progress Report*.
- [11] World Health Organization. (2022). *Global Status Report on Physical Activity 2022*.
- [12] Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2022). Global trends in adolescent physical activity and health outcomes. *The Lancet Child & Adolescent Health*, 6(4), 245–256.
- [13] Ekelund, U., Tarp, J., Steene-Johannessen, J., et al. (2023). Physical activity and cardiometabolic health in youth populations. *British Journal of Sports Medicine*, 57(8), 485–493.
- [14] World Heart Federation. (2023). *Youth Physical Activity and Cardiometabolic Risk Report*. Generate python code for chart on Figure 5. Positive Behavioral Attitude Improvement
- [15] Janssen, I., & Roberts, K. C. (2024). Physical activity interventions and cardiovascular health among adolescents. *Preventive Medicine*, 180, 107856.
- [16] Global Action for Healthy Adolescents. (2025). *Physical Activity and Adolescent Cardiometabolic Health Review*.
- [17] International Society for Physical Activity and Health (ISPAH). (2026). *Global Evidence on Physical Activity and Youth Health Outcomes*.
- [18] Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage Publications.

- [19] Polit, D. F., & Beck, C. T. (2021). *Nursing Research: Generating and Assessing Evidence for Nursing Practice* (11th ed.). Wolters Kluwer.
- [20] Taherdoost, H. (2022). Designing and developing research instruments for data collection. *International Journal of Academic Research in Management*, 11(1), 10–25