



The Impact of Regular Physical Activity on Lipid Profile and Cardiovascular Health in Adolescents : A Literature Review

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Abstract: This literature review delves into the impact of regular physical activity on lipid profiles and cardiovascular health in adolescents, addressing the growing concern of sedentary lifestyles and unhealthy habits contributing to increased cardiovascular disease risks among teenagers. By systematically searching academic databases and scientific journals using relevant keywords, a selection of 8 articles was chosen for review after rigorous screening and eligibility assessment. The findings of the review underscore the significant relationship between physical activity, metabolic parameters, and cardiovascular risk factors in adolescents. Studies consistently highlight the benefits of regular physical activity in improving lipid profiles, insulin sensitivity, and overall cardiovascular parameters in this population. For instance, adolescents engaging in moderate to high-intensity physical activity demonstrated reduced risks of metabolic syndrome and improved insulin sensitivity. Lifestyle modifications encompassing increased physical activity and dietary changes were associated with positive alterations in lipid and glycemic profiles, particularly in high-risk pediatric individuals. Notably, regular vigorous-intensity physical activity was found to yield favorable cardiometabolic outcomes in adolescents with type 2 diabetes. In conclusion, the review emphasizes the critical role of regular physical activity in maintaining cardiovascular health and managing metabolic risk factors among adolescents. Participation in physical activity, particularly at moderate to high intensity, holds promise for significant improvements in lipid profiles and cardiovascular parameters. These findings underscore the importance of promoting active lifestyles among teenagers to prevent cardiovascular disease and enhance overall health outcomes.

Keywords: Adolescents; Cardiovascular; Lipid Profile; Regular Physical Activity

Introduction

In the modern era filled with technological advancements and comfort, lifestyle tends to lead to lack of physical activity and a tendency to spend time in an excessive sitting position (Akulwar-tajane et al., 2020; Aziz et al., 2021; Ramalho & Petrica, 2023). This phenomenon contributes significantly to the increasing prevalence of cardiovascular disease and metabolic health problems, even among adolescents (Grabia et al., 2021; Negrea et al., 2021; Petek et al., 2022). Today's teenagers are facing increasingly complex health challenges, they are not only confronted with academic and social pressures, but also with health risks

associated with unhealthy lifestyles (Choudhury et al., 2020; Horta & Tang, 2023). Unbalanced diets, lack of physical activity, and excessive use of technology are increasingly becoming a hallmark of the daily lives of modern adolescents (Gantenbein & Kanaka-Gantenbein, 2021; Jasbi et al., 2022; Poteko, 2024). The impact of this lifestyle is not only seen in the increased prevalence of obesity in adolescents, but also in the increased risk of cardiovascular disease and metabolic health problems (Caprio et al., 2020; Drozd et al., 2021; Nicolucci & Maffei, 2022).

Then, one factor that has been extensively researched in relation to cardiovascular health is physical activity. Doing regular physical activity is very

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important for teenagers because it can help improve their physical and mental health significantly (Andermo et al., 2020; Okuyama et al., 2021). By doing at least 60 minutes of moderately intense physical activity every day, they can improve heart, lung, muscle and bone strength, as well as weight control (Harrington & Henson, 2021; Ito et al., 2021; Xu et al., 2022). This routine can also improve mood, reduce stress, and improve the quality of their sleep (Briguglio et al., 2020; Johnston et al., 2021). By making exercise a regular part of daily life, adolescents can maintain optimal physical health, improve physical fitness, and reduce the risk of chronic diseases such as heart disease and diabetes.

Through a consistent physical activity routine, such as brisk walking, jogging, or other cardiovascular exercises, it can increase High-Density Lipoprotein (HDL) cholesterol or (good cholesterol) levels in the body (Ahn & Kim, 2020; Franczyk et al., 2023). HDL cholesterol helps transport bad cholesterol or Low-Density Lipoprotein (LDL) from artery walls to the liver for removal from the body, which can help prevent arterial plaque buildup and reduce the risk of heart disease (Cho, 2022; Poznyak et al., 2022; Rais et al., 2024). In addition, physical activity can also help control weight and reduce triglyceride levels, which is another type of blood fat that can increase the risk of cardiovascular disease (Poznyak et al., 2022). Thus, doing regular physical activity can contribute to a healthier lipid profile and reduce the risk of heart disease. A lipid profile is a set of measurements that describe the levels of fats and lipids in a person's blood, including total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides (Hossain et al., 2021). Then, low HDL cholesterol is often associated with an increased risk of heart disease (Duran et al., 2020; Hedayatnia et al., 2020).

So the importance of lipid profiles in adolescents should not be overlooked, although cardiovascular disease usually develops in old age. The development of atherosclerotic plaques can begin in adolescence, especially if risk factors such as poor eating habits, lack of physical activity, or obesity are present (Daniels et al., 2011; Oliveira et al., 2010). Given the prevalence of obesity and unhealthy lifestyles in today's adolescents, it is important to pay attention to their lipid profile and take the necessary preventive measures to maintain their heart health in the future. Educating adolescents about the importance of maintaining a healthy lipid profile and encouraging them to adopt a healthy lifestyle is an important step in the prevention of cardiovascular disease in this population. By understanding the importance of physical activity in influencing the lipid profile and cardiovascular health of adolescents, we can take concrete steps to promote more active and healthy lifestyles among the adolescent population. Thus,

further research in this field is not only relevant but also urgent to support efforts to prevent cardiovascular disease and improve the health of future generations. Therefore, we would like to relate and discuss in depth the effect of regular physical activity and vascular health through literature review.

Method

Research methods for a literature review on the impact of regular physical activity on lipid profiles and cardiovascular health in adolescents began with the identification of relevant sources of information. The initial step is to conduct a systematic search through academic databases and scientific journals using keywords that correspond to the research topic. Article selection is based on predefined inclusion and exclusion criteria, such as relevance to the topic, year of publication, and trustworthiness of the source. After that, articles are selected based on topic suitability and some keywords used in journal searches in the Science Direct, Proquest, and Google Scholar databases. Some of the keywords used are "Physical Activity", "Lipid Profile", "Cardiovascular Health", and "Adolescents". The analysis is carried out by taking into account the research methodology, results, and conclusions drawn by the author of the article. After getting several journals/articles, they were selected according to the research theme. There were 210 journal articles found and 10 articles that met the inclusion criteria for review. Articles with the same title were thus issued. At the eligibility stage, 121 articles were found with titles and abstracts that were not in accordance with the research topic, were not available in full text form, and were not in accordance with the scope of research, so they were excluded. At the determination stage, 10 journal articles were determined for review.

In addition, this literature review research will also look for consistency and differences between findings from various relevant studies (Firmansyah & Dede, 2022). With this approach, it is expected to provide a comprehensive understanding of the relationship between physical activity, lipid profiles, and cardiovascular health in adolescents based on the evidence available in the scientific literature. For more details can be seen in the Prisma Diagram below.

Result and Discussion

There are 8 journal articles that will be further analyzed in this literature review. Journal articles are grouped based on the scope of discussion so that articles are obtained that discuss impact of physical activity on lipid profile and cardiovascular health in adolescents:

Table 1. Summary of data description

Author	Topic	Objective	Method	Results	Conclusion
(Grabitz et al., 2023)	Cardiovascular health and potential cardiovascular risk factors in young athletes.	The study aimed to investigate early markers and driving factors of cardiovascular disease in young athletes pursuing careers in competitive sports.	One hundred and five athletes were characterized through a variety of measurements including body impedance, blood pressure, pulse wave velocity, echocardiography, and blood tests. Athletes come from a variety of competitive sports disciplines and are grouped by dynamic or static components.	High systolic blood pressure, increased pulse wave velocity, and higher left ventricular mass are found in some athletes. Higher pulse wave velocity is associated with higher systolic blood pressure, which correlates with hemoglobin levels. Increased left ventricular mass is linked to a lower resting heart rate, higher metabolic equivalent clocks, certain exercise disciplines, and higher systolic blood pressure.	Despite regular physical exercise, high levels of cardiovascular risk factors are found in young athletes, indicating the need for thorough medical examinations in this population
(T. O. Silva et al., 2023)	Association of physical activity and sitting with metabolic syndrome and hyperglycemic clamp parameters in adolescents – BRAMS pediatric study	The study analyzed PA and sitting time effects on MetS and metabolic parameters in 448 Brazilian adolescents. Those sitting over 8 hours had higher MetS odds, while active individuals didn't. Insulin sensitivity correlated positively with moderate-to-high PA, suggesting a link with metabolic health..	The study used a cross-sectional design within BRAMS-P to examine physical activity and sitting time's association with MetS in adolescents, using questionnaires, anthropometric measures, blood samples, and statistical analyses like Mann-Whitney and chi-squared tests.	The sample comprised 448 adolescents, with 57 undergoing hyperglycemic clamp. MetS was more frequent in males, smokers, and medication users, showing worse parameters. In the hyperglycemic clamp subsample, MetS adolescents had lower ISI and DI. Odds for MetS were higher with >8 hours sitting, affecting BMI, waist circumference, body fat percentage, and lipid profile. ISI correlated positively with moderate-to-high PA, suggesting PA's potential benefit on insulin sensitivity.	The study emphasizes PA and sedentary behavior's impact on MetS in adolescents. Increased sitting time raises MetS risk, while PA improves insulin sensitivity. Promoting PA and reducing sedentary time are crucial for managing MetS.
(Arnaiz et al., 2023)	Intervention effects and long-term changes in physical activity and cardiometabolic outcomes among children at risk of noncommunicable diseases in South Africa: a cluster-randomized controlled trial and	The study evaluated cardiometabolic risk changes in KaziKidz program children, comparing at-risk to healthy peers and intervention effects on movement and health parameters. It aimed to fill evidence gaps on school-based interventions' effectiveness and sustained impact on high-risk children's health in South Africa.	A trial assessed KaziKidz intervention's impact on cardiometabolic risk in South African children. Data from low-income schools included baseline, intervention, and post-intervention measurements, with follow-up concluding in Oct 2021.	A trial assessed KaziKidz intervention's impact on cardiometabolic risk in South African children. Data from low-income schools included baseline, 20-week intervention, and post-intervention measurements. The study followed at-risk children for two years, ending Oct 2021.	The intervention boosted high-intensity activity, aiding less active kids, yet long-term effects on at-risk children declined, signaling tailored interventions' necessity. COVID-19 disruptions emphasized resilient frameworks' importance, highlighting essential school structural changes.

	follow-up analysis				
(Giussani et al., 2022)	Impact of Lifestyle Modifications on Alterations in Lipid and Glycemic Profiles and Uric Acid Values in a Pediatric Population	The study aimed to assess lifestyle modifications, particularly dietary-behavioral treatment, on lipid, glycemic profiles, and uric acid in high-risk pediatric individuals. Focused on children referred to a cardiovascular risk clinic, it examined lifestyle's impact on cardiometabolic risk factors.	The study used longitudinal observation to assess lifestyle modifications' effect on lipid, glycemic profiles, and uric acid in high-risk pediatric individuals. Biochemical parameters were measured post 12-hour fasting with commercial kits. Compliance monitored via periodic visits.	Pediatric lifestyle changes led to notable enhancements in lipid, glycemic profiles, and uric acid levels over 14.7 months. Reduced BMI z-score correlated with improved LDL cholesterol, triglycerides, HOMA index, and uric acid. Post-intervention, normal weight children rose, while obesity declined. Lower initial metabolic values predicted superior improvement..	Pediatric lifestyle changes over 14.7 months improved lipid, glycemic profiles, and uric acid. Reduced BMI z-score correlated with better LDL cholesterol, triglycerides, HOMA index, and uric acid. Increased normal weight, decreased obesity. Lower baseline values predicted better improvement.
(Lin et al., 2022)	Multilevel Understanding of the Impact of Individual- and School-Level Determinants on Lipid Profiles in Adolescents: The Cross-Level Interaction of Food Environment and Body Mass Index	The study examined individual and school determinants on adolescent lipid profiles. It assessed how personal dietary patterns, physical parameters, and school context influence lipid levels. It aimed to explore the contributions of school context and individual factors on adolescent lipid levels.	The study used a multilevel approach to analyze adolescent lipid profiles, considering individual and school determinants. Data on diet, physical parameters, and lipids were collected from 36 schools across three economic areas in Taiwan. Lipid levels were enzymatically quantified, and multilevel linear regression models assessed individual and school contributions to lipid profiles.	Individual factors like low physical activity, high BMI, and SSB intake correlated with elevated TG, LDL-C, and TC in adolescents. School factors such as health programs and nearby food outlets also influenced lipid profiles. BMI positively correlated with TG, LDL-C, and TC, and negatively with HDL-C. The study underscores the multilevel impact on adolescent lipid profiles.	The study stressed the multilevel impact of individual diet, physical activity, BMI, school health programs, and nearby food outlets on adolescent lipid profiles. School context had a stronger effect on TG levels in high-BMI adolescents. Preventive strategies should address both individual and school levels to promote adolescent lipid health, especially for high-BMI students in areas with dense food outlets.
(Slaght et al., 2021)	Physical activity and cardiometabolic health in adolescents with type 2 diabetes: a cross-sectional study	The study investigated how vigorous-intensity physical activity (PA) impacts cardiovascular risk factors in adolescents with type 2 diabetes. Results showed lower HbA1c, diastolic blood pressure, and odds of albuminuria in active adolescents. The study supports guidelines promoting vigorous	The cross-sectional study compared CVD risk factors in adolescents with type 2 diabetes based on vigorous-intensity PA participation. Participants aged 10-18 were recruited from the iCARE cohort study. Data collection followed guidelines, including	Adolescents with type 2 diabetes engaging in regular vigorous-intensity physical activity exhibited favorable outcomes: nearly double weekly activity dose, lower diastolic blood pressure, load, and mean arterial pressure. They had lower odds of albuminuria and hemoglobin A1c levels. Despite blood pressure differences, hypertension	Regular vigorous-intensity physical activity benefits cardiometabolic health in adolescents with type 2 diabetes, unlike lower-intensity or organized sports. Confirmation through randomized trials or robust cohort

		PA to manage cardiometabolic risks in this population.	PA quantification and outcomes like HbA1c and blood pressure. Statistical analysis adjusted for variables such as diabetes duration, BMI Z-score, sex, and smoking.	odds didn't vary. Vigorous PA linked to better cardiometabolic health.	studies is vital to understand physical activity's impact on this population's health.
(G. C. R. da Silva et al., 2023)	Association of Early Sports Practice with Cardiovascular Risk Factors in Community-Dwelling Adults: A Retrospective Epidemiological Study	The study aimed to analyze early sports practice's association with cardiovascular risk factors in adults. It focused on childhood and adolescent sports participation's relationship with obesity, diabetes, dyslipidemia, and hypertension in adulthood. The research explored if early sports engagement could independently protect against hypertension, considering sex, age, socioeconomic status, and habitual physical activity.	The study employed a retrospective epidemiological design with 265 adults from a municipality. It analyzed cardiovascular risk factors and early sports practice, self-reported. Total physical activity levels were objectively measured. Logistic regression, adjusting for variables including sex, age, socioeconomic status, and MVPA, assessed associations.	Participants reporting early sports practice in childhood and adolescence had lower prevalence and significant odds ratios for dyslipidemia, diabetes, and hypertension in adulthood. Even after adjusting for confounders, the association with dyslipidemia remained significant for childhood sports. Associations had small effect sizes, indicating modest but meaningful impact on hypertension risk.	Early sports practice inversely linked to adult hypertension, even after adjusting for sex, age, socioeconomic status, and moderate-to-vigorous physical activity. Encouraging sports practice from a young age is crucial for combating cardiovascular risk factors effectively.
(D'Ascenzi et al., 2019)	Cardiovascular risk profile in Olympic athletes: an unexpected and underestimated risk scenario	The study aimed to assess CV risk factor prevalence in Olympic athletes, exploring associations with age, body size, and sport type. It aimed to identify lifestyle factors and risk profiles, highlighting modifiable risks like dyslipidemia and hypertension. Promoting healthy habits, including exercise and smoking cessation, among athletes was emphasized.	A cross-sectional analysis on 1058 Olympic athletes (656 males, 402 females) between 2014-2016 assessed CV risk factors. Medical evaluations included history, physical exams, blood tests, and cardiac assessments. Parameters like BMI, body fat, and blood pressure identified CV risks. SPSS software and logistic regression were used for analysis, revealing age, BMI, and body fat as significant predictors.	Dyslipidemia (32%) was the most common CV risk among Olympic athletes, followed by increased waist circumference (25%), positive family history (18%), smoking habit (8%), hypertension (3.8%), and hyperglycemia (0.3%). A large subset (40%) had none or one risk factor, with endurance athletes (34%) most represented. Age correlated with lipid levels. Various sports disciplines showed differences in physical characteristics. Age, BMI, and body fat predicted increased CV risk.	Elite athletes face CV risk factors like dyslipidemia and increased waist circumference (32% and 25%). Lifestyle choices influence CV risk. Monitoring BMI, body fat, waist circumference, and lipids is crucial. Addressing modifiable factors optimizes athlete health. Comprehensive CV risk assessment is essential.

This literature review provides a comprehensive overview of the importance of regular physical activity to lipid profiles and cardiovascular health in adolescents. From ten journal articles analyzed, important findings were revealed regarding the relationship between physical activity, metabolic parameters, and cardiovascular risk factors. One of the main findings is from Silva et al (2023), who found that adolescents with more than 8 hours of sitting time have a higher chance of MetS, while those who engage in

moderate-high physical activity show improved insulin sensitivity. This highlights the importance of physical activity in reducing metabolic health risks in adolescents. Another finding comes from Arnaiz et al (2023), who observed that interventions such as the KaziKidz program increase high-intensity physical activity in at-risk children, but their long-term effects on cardiometabolic risk worsen, suggesting the need for tailored interventions and structural changes in the school environment. This suggests that to reduce the risk of cardiovascular disease in the future, it is important to understand the impact of physical activity on lipid profiles and cardiovascular health in adolescents.

The studies also highlight the important role of physical activity in shaping adolescent health. For example, Giussani et al., (2022) found that lifestyle modification over nearly 15 months resulted in significant improvements in lipid and glycemic profiles in high-risk pediatric individuals. It emphasizes the importance of behavioral interventions in managing cardiovascular risk factors in the adolescent population. In addition, Slaght et al., (2021) showed that regular high-intensity physical activity is associated with favorable outcomes in adolescents with type 2 diabetes, highlighting the importance of promoting high-intensity physical activity to manage cardiometabolic risk in this population. Therefore, understanding the impact of physical activity on adolescent cardiovascular health is crucial in efforts to prevent heart disease and improve public health. However, these studies also have limitations and challenges. Some studies rely on self-measurements of physical activity and lifestyle behaviors, which can introduce biases and inaccuracies. In addition, the generalizability of findings may be limited by the specific population and context studied in each study. Therefore, future research should use longitudinal designs to better understand the long-term effects of physical activity interventions on cardiovascular health outcomes in adolescents. As such, the study provides valuable insight into the importance of physical activity in maintaining adolescent cardiovascular health. By leveraging these findings to inform targeted interventions and policy initiatives, stakeholders can make significant progress in improving next-generation health outcomes. However, more research is needed to address existing limitations and improve our understanding of the complex relationship between physical activity, lipid profiles, and cardiovascular health in adolescents.

Conclusion

In conclusion, this literature review underscores the importance of regular physical activity in maintaining

cardiovascular health and managing metabolic risk factors in adolescents. The studies analyzed suggest that participation in moderate to high-intensity physical activity can result in significant improvements in lipid profiles, insulin sensitivity, and cardiovascular parameters in the adolescent population. These findings illustrate the great potential of behavioral interventions in preventing heart disease and improving adolescent general health. However, there are also limitations to be aware of. Some studies rely on self-measurements regarding physical activity, which can introduce biases and inaccuracies. In addition, the generalizability of findings may be limited by the specific population and context studied in each study. Therefore, future research should use longitudinal design and more sophisticated methodologies to overcome these limitations and deepen understanding of the relationship between physical activity, lipid profiles, and cardiovascular health in adolescents.

With a better understanding of the importance of physical activity in preventing heart disease and improving adolescent health, health stakeholders can develop more effective interventions and strengthen public health policies focused on promoting healthy lifestyles. Thus, this literature review provides a solid foundation for efforts to prevent heart disease and improve the health of future generations through the promotion of sustained and purposeful physical activity.

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Conflict of Interest

The content of this article does not create a conflict of interest

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