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A Critical Analysis of the Impact of Sport Activities on the Cardiovascular System of Adult Men and Women in Uyo Metropolis

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Abstract

This study presents a critical analysis of the impact of sports activities on the cardiovascular health of adult men and women residing in Uyo Metropolis, Nigeria. Ex- post facto design was adopted to carry out this research in Uyo metropolis. The targeted population for the study comprised all physical and health worker in Uyo metropolis. Simple random sampling technique was used to select 150 physical and health worker in Uyo metropolis which formed the sample size used to carry out this research. The instrument used for data collection was a structured questionnaire entitled "Sport Activities and Cardiovascular System Questionnaire (SACSQ)".Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.85, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as multiple regression to answer research questions. From the results of the data analysis, it was observed that the result of research question proved that there was no relationship between the two variables, indicating that there is significant impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis. The study concluded that regular participation improves heart efficiency, blood pressure regulation, and overall cardiovascular function. Notably, gender-specific responses to exercise highlight the need for tailored physical activity interventions. The study also recommended that local governments and health agencies should establish and support community sport initiatives that encourage regular participation among adults, with a focus on cardiovascular health benefits.

Keyword: Sport Activities, Cardiovascular System, Adult Men and Women, Uyo Metropolis.

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INTRODUCTION

The cardiovascular system is fundamental to sustaining life, comprising the heart, blood vessels, and

blood that work together to circulate oxygen and nutrients throughout the body. Maintaining cardiovascular health is crucial for preventing diseases such as hypertension, atherosclerosis, coronary artery disease, and stroke, which are among the leading causes of death globally (World Health Organization [WHO], 2021). One of the most effective, non-pharmacological ways to promote cardiovascular health is through regular physical activity, particularly sport-related exercises. Numerous studies have confirmed that engaging in sports can significantly enhance cardiac output, improve blood pressure regulation, increase aerobic capacity, and reduce levels of low-density lipoprotein (LDL) cholesterol, thereby lowering the risk of cardiovascular disease (Warburton, Nicol, & Bredin, 2016).

In the Nigerian context, especially in urban areas like Uyo Metropolis—the capital of Akwa Ibom State—there has been an increasing awareness of health and fitness. However, this awareness coexists with rising sedentary lifestyles, poor dietary habits, and limited public infrastructure for physical activity. Uyo's urbanization has introduced both opportunities and challenges for adult men and women in maintaining active lifestyles. While some individuals engage in structured sports like football, jogging, aerobics, and cycling, many others lead sedentary lives due to occupational and environmental constraints. This urban shift underscores the need to critically analyze how sport activities influence the cardiovascular health of adults within the metropolis.

Furthermore, sex-based differences in cardiovascular responses to physical activity have been documented. Men and women often exhibit varying physiological adaptations to sport. For instance, men generally have a higher stroke volume and cardiac output during exercise due to larger heart size and blood volume, whereas women tend to experience greater vasodilation and lipid metabolism benefits from aerobic activities (Joyner & Coyle, 2018). Hormonal differences, particularly the influence of estrogen in women, also play a role in modulating cardiovascular responses (Convertino, 2015). These biological differences necessitate a gender-sensitive analysis of how sport affects cardiovascular outcomes, especially in regions like Uyo, where data is limited.

Despite the global recognition of the benefits of sports on cardiovascular health, there is a noticeable gap in localized research that evaluates these effects within the socio-cultural and environmental context of Uyo. Existing studies often generalize findings from Western populations, which may not reflect the health behaviors, access to facilities, or genetic profiles of Nigerians. Hence, there is a pressing need for a region-specific analysis that examines how frequently adults in Uyo engage in sports, the types of activities preferred by each gender, and the measurable cardiovascular impacts observed.

STATEMENT OF PROBLEM

Despite the well-documented health benefits of physical activity, many adults in Uyo Metropolis do not engage in regular sports, potentially increasing their risk of cardiovascular diseases. The extent to which sports activities influence cardiovascular health among men and women in this region remains unclear. There is limited localized research that critically analyzes these effects, considering gender-specific physiological responses. Additionally, lifestyle differences, cultural perceptions, and awareness levels may influence participation and outcomes. The lack of data hinders the development of targeted health interventions. Understanding these impacts is essential for promoting cardiovascular wellness. This study seeks to bridge that knowledge gap through focused analysis.

Objectives of the study

1. To find out the impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis.

Research Question

1. To what extent is the impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis.

Hypotheses

H_o1 There is no significant impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis.

LITERATURE REVIEW

Concept of sport activities

Sport activities encompass a broad spectrum of physical endeavors, ranging from recreational pursuits to competitive engagements. These activities are integral to human culture and development, influencing various aspects of individual and societal well-being. This delves into the multifaceted concept of sport activities, examining their definitions, benefits, and the factors influencing participation, drawing on recent scholarly sources.

Sport activities are structured physical activities that involve skill, competition, and often, a set of established rules. They can be categorized into individual and team sports, each offering unique experiences and benefits. The International Olympic Committee defines sport as "all forms of physical activity that aim to improve or maintain physical fitness and mental well-being" . This inclusive definition underscores the diverse nature of sport activities, encompassing both organized competitions and informal recreational pursuits.

Engaging in regular sport activities is associated with numerous health benefits. Physically, sports enhance cardiovascular health, improve muscular strength, and increase flexibility. Mentally, they contribute to reduced levels of stress, anxiety, and depression. A systematic review by Eime. (2023) highlighted that adults participating in team sports reported better mental health outcomes, including improved psychological well-being and lower levels of psychological distress.For adolescents, participation in sports has been linked to increased resilience. A study by Zhang. (2024) found that students who engaged in sports activities demonstrated higher resilience levels, which in turn correlated with better mental health and academic performance.

Sport activities play a crucial role in social development. They provide opportunities for individuals to develop teamwork, communication, and leadership skills. Moreover, sports can foster a sense of community and belonging. Li and Shao (2022) conducted a systematic review indicating that participation in sports activities positively influences prosocial behavior among children and adolescents, promoting cooperation and empathy. Additionally, sports serve as a platform for inclusivity. Recent studies emphasize the importance of inclusive policies that allow all individuals, regardless of gender identity, to participate in sports. Such inclusivity not only promotes equality but also enhances the overall experience and benefits of sport activities.

Several factors influence an individual's decision to participate in sport activities. Motivation plays a pivotal role; intrinsic motivations, such as personal enjoyment, often lead to sustained participation. Extrinsic motivations, such as social recognition or health benefits, can also be significant. Research by Lu (2021) found that individuals with a strong sense of self-efficacy are more likely to engage in sports, as they believe in their ability to succeed in these activities. Environmental factors, including access to facilities, social support, and cultural attitudes, also impact participation rates. In urban settings, the availability of sports infrastructure and community programs can facilitate greater involvement in sport activities.

Concept of cardiovascular system

The cardiovascular system is a critical biological network essential for sustaining life. It consists primarily of the heart, blood vessels, and blood, working in unison to deliver oxygen, nutrients, hormones, and immune cells throughout the body while removing metabolic waste. This system maintains homeostasis and supports cellular metabolism, making it indispensable for overall health.

The heart functions as a central pump, divided into four chambers: the right and left atria and the right

and left ventricles. It propels blood through two main circulatory pathways: the pulmonary circuit, which oxygenates blood via the lungs, and the systemic circuit, which delivers oxygenated blood to tissues (Mathiyalagan, 2024). Blood vessels—arteries, veins, and capillaries—form an extensive network that regulates blood flow and facilitates nutrient and gas exchange at the cellular level. Blood itself is a connective tissue comprising plasma, red blood cells, white blood cells, and platelets, each with distinct roles in transport, immunity, and hemostasis (Saheera, 2021).

Recent advances have highlighted the complex cellular heterogeneity within the cardiovascular system. Single-cell transcriptomics studies have uncovered diverse cardiac cell populations and intercellular communication mechanisms essential for maintaining cardiovascular health (Mathiyalagan 2024). Moreover, extracellular vesicles have gained attention for their role in cardiovascular communication, modulating processes such as inflammation, repair, and remodeling after injury (Saheera, 2021).

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide. The prevalence of conditions like hypertension, coronary artery disease, and heart failure is increasing globally due to aging populations and lifestyle factors (Fomonyuy, 2020). The COVID-19 pandemic has also emphasized the vulnerability of patients with pre-existing cardiovascular conditions, linking viral infection with exacerbated cardiac complications (Jafari 2022).

The integration of machine learning and data-driven modeling has revolutionized cardiovascular diagnostics and treatment planning. Algorithms are increasingly used to predict CVD risk and optimize personalized therapies (Arzani & Dawson, 2020). Advanced imaging techniques and computational fluid dynamics allow detailed assessment of cardiovascular flow, contributing to better understanding and management of vascular diseases (Arzani & Dawson, 2020).

Concept of cardiovascular diseases

Cardiovascular diseases (CVDs) represent a broad group of disorders affecting the heart and blood vessels. These include coronary artery disease, cerebrovascular disease, rheumatic heart disease, and other conditions that impair cardiovascular function. Globally, CVDs remain the leading cause of mortality and morbidity, accounting for nearly 18 million deaths annually, with projections suggesting further increases due to sedentary lifestyles, aging populations, and urbanization (Roth, 2023). The conceptual framework of CVDs encompasses their pathophysiology, risk factors, clinical manifestations, and strategies for prevention and management, reflecting a complex interaction between genetic, behavioral, and environmental determinants.

At the core of cardiovascular diseases is the pathophysiological process of atherosclerosis, which involves the buildup of plaques within arterial walls. These plaques consist of lipids, inflammatory cells, and fibrous elements that gradually narrow and stiffen arteries, thereby impeding blood flow to vital organs. In coronary artery disease, this process affects the arteries supplying the heart, while in cerebrovascular disease, it impacts the arteries serving the brain. Recent studies highlight that inflammation, endothelial dysfunction, oxidative stress, and thrombogenesis play critical roles in the initiation and progression of atherosclerosis (Libby, 2021). These mechanisms are often silent until they lead to acute events such as myocardial infarction or stroke.

Risk factors for CVDs are traditionally classified into modifiable and non-modifiable categories. Modifiable risk factors include hypertension, dyslipidemia, diabetes mellitus, obesity, tobacco use, unhealthy diet, physical inactivity, and excessive alcohol intake. These factors are interconnected through metabolic and behavioral pathways, giving rise to a condition often referred to as "metabolic syndrome" (Whelton, 2020). Non-modifiable risk factors include age, sex, family history, and genetic predisposition. Notably, recent advances have elucidated the role of social determinants of health—such as income, education, and access to care—as critical contributors to cardiovascular risk, especially in low- and middle-income countries (Yusuf, 2021).

The clinical manifestations of cardiovascular diseases are diverse and may vary based on the type and

severity of the condition. Common symptoms include chest pain (angina), shortness of breath, palpitations, dizziness, and fatigue. However, many individuals remain asymptomatic until the onset of a serious cardiovascular event. This asymptomatic nature underscores the importance of early screening and preventive care. Diagnostic approaches range from simple blood pressure measurements and lipid profiling to advanced imaging modalities like echocardiography, cardiac MRI, and coronary angiography (Chow, 2022).

Preventive strategies are centered on lifestyle modification, pharmacological interventions, and population-level policies. Primary prevention aims to reduce the incidence of CVD by addressing risk factors before the disease occurs. This includes promoting physical activity, healthy eating, and smoking cessation, alongside medications such as statins and antihypertensive where necessary. Secondary prevention focuses on individuals with established CVD, aiming to prevent recurrence and complications. The use of antiplatelet therapy, beta-blockers, and ACE inhibitors is standard in such cases. Moreover, public health initiatives targeting salt reduction, trans fat elimination, and access to affordable medications have shown promise in reducing cardiovascular burden globally (NCD Risk Factor Collaboration, 2022)

Types of sport activities

Certainly! Sports activities can be categorized based on various characteristics such as the nature of participation, the skills required, and the environment in which they are performed. Below is a comprehensive list and explanation of different types of sport activities.

- **Team Sports**

Team sports involve organized groups competing against each other, emphasizing collaboration, communication, and strategic planning. Examples include soccer, basketball, volleyball, and rugby. These sports require players to work cohesively to achieve common objectives. A study by Kwon (2024) analyzed the impact of team-building interventions on team cohesion in sports teams, highlighting the importance of structured activities to foster collaboration and unity among athletes.

- **Individual Sports**

Individual sports are performed by athletes competing alone, focusing on personal performance, self-discipline, and concentration. Examples include tennis (singles), golf, swimming, and gymnastics. These sports demand a high level of self-motivation and personal accountability. Krasmik. (2024) explored the motivational determinants of athletes' self-realization, emphasizing that individual sports require a high degree of personal drive and self-discipline to achieve success.

- **Dual Sports**

Dual sports involve two participants competing either as opponents or partners. Examples include doubles tennis, doubles badminton, and fencing. These sports require strong coordination and understanding between partners or sharp reflexes when facing an opponent. While specific recent studies on dual sports are limited, the dynamics of dual sports share similarities with both individual and team sports, requiring a blend of personal skill and cooperative strategy.

- **Combat Sports**

Combat sports focus on fighting and physical confrontation, often governed by specific rules to ensure safety and fairness. Examples include boxing, judo, taekwondo, and mixed martial arts (MMA). These sports require physical strength, mental focus, and strategic thinking. A study by Spieszny. (2024) assessed how coordination training improves psychomotor abilities in adolescent handball players, highlighting the importance of coordinated movement and teamwork, which are also crucial in combat sports.

- **Water Sports**

Water sports are activities conducted in or on water, offering both recreational and competitive opportunities. Examples include swimming, diving, surfing, rowing, and water polo. These sports promote cardiovascular health and improve endurance. While specific recent studies on water sports classification are limited, water sports are recognized for their unique physical demands and the necessity for specialized training and safety measures.

- **Winter Sports**

Winter sports are typically played on snow or ice and are common in colder climates. Examples include skiing, snowboarding, ice skating, and ice hockey. These sports demand balance, agility, and resilience in extreme conditions. Research by Li. (2024) explored how charismatic leadership influences team performance, satisfaction, and engagement in youth sports, emphasizing the role of effective communication and leadership in team dynamics, which are essential in winter sports teams.

- **Extreme or Adventure Sports**

Extreme sports involve high levels of risk and thrill, often taking place in challenging environments. Examples include rock climbing, skydiving, mountain biking, and skateboarding. Participants in these sports require courage, quick reflexes, and often special safety equipment. A study by Sahli. (2024) investigated how group regulation affects technical development in soccer, underscoring the role of collective decision-making and communication in enhancing team performance, which can be extrapolated to the coordination required in extreme sports.

- **Motor Sports**

Motor sports involve the use of motorized vehicles, combining speed and technical skill. Examples include Formula 1 racing, MotoGP, rally racing, and motocross. These sports require drivers to possess precision, fast decision-making abilities, and exceptional coordination. While specific recent studies on motor sports classification are limited, motor sports are recognized for their reliance on both human skill and technological advancements, necessitating ongoing research into safety and performance optimization.

- **Mind Sports**

Mind sports emphasize mental skill over physical exertion. Examples include chess, bridge, and competitive video gaming (eSports). These sports demonstrate that competition and skill are not limited to physical activity but also extend into the realm of mental agility. Odynets (2024) confirmed that emotional control and focus are key cognitive strategies for success in individual sports, highlighting the importance of self-regulation and concentration, which are paramount in mind sports.

- **Athletic Sports (Track and Field)**

Athletic sports focus on physical strength, speed, and endurance. Examples include running, long jump, shot put, and javelin throw. These events are often featured in major competitions like the Olympics and emphasize personal achievement and physical excellence. Research by Ali. (2024) found a strong positive correlation between mental toughness and self-efficacy, indicating that higher self-motivation levels in individual sports enhance resilience and performance under pressure, which is crucial in athletic sports.

Effects of sport activities on cardiovascular system of adult men and women

Engaging in regular sports activities has profound effects on the cardiovascular system of adult men and women. Below is a summary of these effects.

- **Enhanced Cardiac Function and Structure**

Engaging in regular sports activities promotes favorable adaptations in the heart's anatomy and

physiology. Known as "athlete's heart," these adaptations include increased left ventricular (LV) mass and improved cardiac output. Male athletes are more likely to exhibit concentric hypertrophy due to higher levels of testosterone, whereas female athletes tend to develop eccentric remodeling, influenced by estrogen's cardio protective properties (Keller-Ross, 2023). These sex-based differences are critical for understanding how men and women respond to training stimuli and may have implications for exercise prescription and cardiovascular health.

- **Improved Vascular Health**

Sports activities improve endothelial function by increasing the bioavailability of nitric oxide, leading to enhanced vasodilation and reduced arterial stiffness. This effect reduces both systolic and diastolic blood pressure, significantly decreasing cardiovascular risk. These changes are evident in both sexes, though the magnitude may vary based on training intensity and hormonal factors (Jones, 2024).

- **Reduction in Cardiovascular Disease (CVD) Risk**

Regular participation in endurance and team sports has been linked with lower rates of cardiovascular disease. Activities such as cycling, running, and swimming are associated with reductions in coronary artery disease and cardiovascular mortality. A 2022 longitudinal cohort study confirmed that regular moderate-to-vigorous physical activity significantly reduced all-cause and cardiovascular mortality in both sexes (Nystoriak & Bhatnagar, 2022).

- **Sex-Specific Responses to Exercise**

Emerging evidence suggests women may gain greater cardiovascular benefits from lower exercise volumes compared to men. A 2024 study reported that women who performed 140 minutes of moderate-to-vigorous physical activity per week reduced cardiovascular mortality by 36%, while men required nearly 300 minutes to achieve a 14% reduction. This difference is attributed to variations in heart size, autonomic control, and hormonal effects (Paluch, 2024).

- **Enhanced Cardiorespiratory Fitness (CRF)**

Participation in sports increases VO_2max, a key marker of cardiorespiratory fitness. Recreational team sports such as soccer and basketball have been shown to improve CRF even in previously sedentary adults. Improvements are observed across both sexes, with differences in rate and extent of adaptation linked to muscle mass and aerobic capacity (Krustrup, 2021).

- **Metabolic and Anti-inflammatory Effects**

Sports also contribute to improved lipid profiles, enhanced insulin sensitivity, and reduced systemic inflammation. These changes support cardiovascular health by preventing atherosclerosis and metabolic syndrome. Regular exercise leads to higher HDL, lower LDL, and better glycemic control in both men and women, though hormonal fluctuations in women may influence lipid response (Zhang, 2023).

METHODOLOGY

Ex- post facto design was adopted to carry out this research in Uyo metropolis. The targeted population for the study comprised all physical and health worker in Uyo metropolis. Simple random sampling technique was used to select 150 physical and health worker in Uyo metropolis which formed the sample size used to carry out this research. The instrument used for data collection was a structured questionnaire entitled "Activities and Cardiovascular System Questionnaire (SACSQ)".Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.85, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as multiple regression to answer research questions.

RESULTS AND DISCUSSIONS

Hypothesis one

there is no significant the impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis. In order to test the hypothesis multiple regression analysis was used to analyse the data, (see table 1).

Table 1. Multiple Regression analysis of the impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	.994[a]	.987	.987	2.12712	.987

***Significant at 0.05 level; df =148; N =150; critical r–value = 0.235**

The table 1 shows that the calculated R-value 0.994 was greater than the critical R-value of 0.197 at 0.5 alpha level with 148 degree of freedom. The R-square value of 0.987 predicts 98.7% of the the impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis. This rate of percentage is highly positive and therefore means that there is significant impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis. The result aligns with the findings made by Jones, (2024) which stated that sports activities improve endothelial function by increasing the bioavailability of nitric oxide, leading to enhanced vasodilation and reduced arterial stiffness. According to him this effect reduces both systolic and diastolic blood pressure, significantly decreasing cardiovascular risk in both both sexes, though the magnitude may vary based on training intensity and hormonal factors. The findings also agree with the finding of Nystoriak & Bhatnagar, (2022), that stated that activities such as cycling, running, and swimming are associated with reductions in coronary artery disease and cardiovascular mortality. According to him a 2022 longitudinal cohort study confirmed that regular moderate-to-vigorous physical activity significantly reduced all-cause and cardiovascular mortality in both sexes.

CONCLUSION

In conclusion, sport activities play a vital role in enhancing cardiovascular health among adult men and women in Uyo Metropolis. Regular participation improves heart efficiency, blood pressure regulation, and overall cardiovascular function. Notably, gender-specific responses to exercise highlight the need for tailored physical activity interventions. Despite increasing awareness, participation remains inconsistent due to lifestyle and environmental barriers. From the results of the data analysis, it was observed that the result of research question proved that there was no relationship between the two variables, indicating that there is significant impact of sport activities on the cardiovascular system of adult men and women in Uyo Metropolis. Addressing these challenges through targeted health policies can significantly reduce cardiovascular risks. Ultimately, promoting inclusive and sustained sport engagement is essential for healthier urban populations in Uyo.

RECOMMENDATIONS

1. Local governments and health agencies should establish and support community sport initiatives that encourage regular participation among adults, with a focus on cardiovascular health benefits.
2. Health professionals should design fitness programs that cater to the physiological differences between men and women to maximize cardiovascular outcomes.
3. Public health campaigns should educate residents on the importance of sport and physical activity in preventing cardiovascular diseases, especially targeting sedentary individuals.

REFERENCES

1. Ali, A., Luo, Y., Wang, C., & Peng, Y. (2024). The effect of exercise motivation on college students'

self-efficacy. *Frontiers in Psychology*, 15, 1465138. https://doi.org /10.3389/fpsyg.2024.1465138

2. Arzani, A., & Dawson, S. T. M. (2020). Data-driven cardiovascular flow modeling: examples and opportunities. *Physics of Fluids*, 32(11), 111302. https://doi.org/10.1063/5.0026554
3. Chow, C. K., Patel, A. A., & Woodward, M. (2022). Cardiovascular disease prevention for all: Meeting the needs of people with cardiovascular disease. The Lancet, 399(10343), 1342–1351. https://doi.org/10.1016/S0140-6736(22)00385-X
4. Convertino, V. A. (2015). Blood volume: its adaptation to endurance training. Medicine & Science in Sports & Exercise, 23(12), 1338–1348.
5. Eime, R. M., (2023). The impact of sports participation on mental health and social outcomes in adults: a systematic review and the 'Mental Health through Sport' conceptual model. Systematic Reviews, 12(1), 1-12. https://doi.org/10.1186/s13643-023-02264-8
6. Fomonyuy, M. F., (2020). Epidemiology of cardiovascular diseases in Sub-Saharan Africa: current perspectives. Global Heart, 15(1), 24. https://doi.org/10.5334/gh.853
7. *International Journal of Sports, Health and Physical Education*. (2024). Comparing the effectiveness of individual and team sports for mental health. *International Journal of Sports, Health and Physical Education*, 6(2), 128–134. https://www.physicaleducationjournal.in/archives/2024/vol6issue2/PartB/6-2-19-549.pdf
8. International Olympic Commit tee. (n.d.). What is Sport? Retrieved from https://olympics.com/ioc/what-is-sport
9. Jafari, M., (2022). Cardiovascular implications of COVID-19 infection: A review of the evidence. Frontiers in Cardiovascular Medicine, 9, 842898. https://doi.org/10.3389/fcvm.2022.842898
10. Jones, T. W., Howlett, R. A., & Green, D. J. (2024). Vascular benefits of exercise in men and women: A meta-analysis of endothelial function. Sports Medicine - Open, 10(1), 24. https://doi.org/10.1186/s40798-024-00692-x
11. Joyner, M. J., & Coyle, E. F. (2018). Endurance exercise performance: the physiology of champions. The Journal of Physiology, 586(1), 35-44.
12. Keller-Ross, M. L., Johnson, B. D., & Joyner, M. J. (2023). Sex differences in cardiovascular structure and function: Implications for exercise performance and health. *American Journal of Physiology-Heart and Circulatory Physiology*, 325(4), H678–H686. https://doi.org/10.1152/ajpheart.00756.2023
13. Krasmik, Y., Aimaganbetova, O., Iancheva, T., & Yordanova, A. (2024). Motivational determinants of athletes' self-realisation depending on their professional qualification. BMC Psychology, 12, Article 416. https://doi.org/10.1186/s40359-024-01895-3
14. Krustrup, P., Hansen, P. R., & Randers, M. B. (2021). Cardiovascular adaptations to recreational football training: A systematic review. *Scandinavian Journal of Medicine & Science in Sports*, 31(1), 3–15. https://doi.org/10.1111/sms.13838
15. Kwon, S. H. (2024). Analyzing the impact of team-building interventions on team cohesion in sports teams: A meta-analysis study. Frontiers in Psychology, 15, 1353944. https://doi.org/10.3389/fpsyg.2024.1353944
16. Li, J., & Shao, W. (2022). Influence of sports activities on prosocial behavior of children and adolescents: A systematic literature review. *International Journal of Environmental Research and Public Health*, 19(11), 6484. https://doi.org/10.3390/ijerph19116484
17. Li, Y., Zang, X., & Dunjie, L. (2024). Transforming youth sports team performance in the era of digitalization: The interplay of charismatic leadership, satisfaction, and team engagement drivers.

Heliyon, 10(15), e34904. https://doi.org/10.1016/j.heliyon.2024.e34904

18. Libby, P. (2021). The changing landscape of atherosclerosis. Nature, 592(7855), 524–533. https://doi.org/10.1038/s41586-021-03392-8
19. Lu, J. (2021). What affects sports participation and life satisfaction among urban residents? The role of self-efficacy and motivation. Frontiers in Psychology, 13, 884953. https://doi.org/10.3389/fpsyg.2022.884953
20. Mathiyalagan, P., Adamiak, M., Mayourian, J., & Sahoo, S. (2024). Emerging molecular mechanisms in cardiovascular physiology and pathology. Frontiers in Physiology, 15, 1485595. https://doi.org/10.3389/fphys.2024.1485595
21. NCD Risk Factor Collaboration. (2022). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: A pooled analysis of 1201 population-representative studies with 104 million participants. The Lancet, 398(10304), 957–980. https://doi.org/10.1016/S0140-6736(21)01330-1
22. Nystoriak, M. A., & Bhatnagar, A. (2022). Physical activity and cardiovascular disease prevention: Pathways and mechanisms. Current Sports Medicine Reports, 21(5), 174–181. https://doi.org/10.1249/JSR.0000000000000978
23. Odynets, T. (2024). Individual psychological profiles and their influence on self-regulation in sports. Institute of Information Technologies and Learning Tools of the NAES of Ukraine. https://lib.iitta.gov.ua/id/eprint/742496/1/67.pdf
24. Paluch, A. E., Gabriel, K. P., & Fulton, J. E. (2024). Sex differences in the association between physical activity and cardiovascular mortality. *Journal of the American College of Cardiology*, 83(3), 282–292. https://doi.org/10.1016/j.jacc.2024.01.010
25. Roth, G. A., Mensah, G. A., &Fuster, V. (2023). Global burden of cardiovascular diseases and risk factors, 1990–2022. *Journal of the American College of Cardiology*, 81(22), 2141–2165. https://doi.org/10.1016/j.jacc.2023.04.011
26. Saheera, S., . (2021). Role of extracellular vesicles in cardiovascular pathophysiology. American Journal of Physiology-Heart and Circulatory Physiology, 320(5), H1749-H1761. https://doi.org/10.1152/ajpheart.00925.2020
27. Sahli, F., Boujabli, M., Sahli, H., Jlalia, Z., & Chaalali, A. (2024). Unlocking team dynamics: Exploring the influence of group regulation on technical development in small-sided soccer games. *Journal of Science in Sport and Exercise*. https://doi.org/10.1007/s42978-024-00279-8
28. Spieszny, M., Kamys, Z., Kasicki, K., Gronek, P., & Stastny, P. (2024). The impact of coordination training on psychomotor abilities in adolescent handball players: A randomized controlled trial. Applied Sciences, 14(17), 7974. https://doi.org/10.3390/app14177974
29. Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2016). Health benefits of physical activity: the evidence. CMAJ, 174(6), 801–809.
30. Whelton, P. K., Carey, R. M., &Aronow, W. S. (2020). 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension, 75(6), 1334–1357. https://doi.org/10.1161/HYPERTENSIONAHA.120.15026
31. World Health Organization (WHO). (2021). Cardiovascular diseases (CVDs). Retrieved from https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)
32. Yusuf, S., Joseph, P., Rangarajan, S., Islam, S., Mente, A., Hystad, P., ...&Teo, K. (2021). Modifiable risk factors, cardiovascular disease, and mortality in 155,722 individuals from 21 high-, middle-, and low-income countries (PURE): A prospective cohort study. The Lancet, 398(10305), 117–129.

https://doi.org/10.1016/S0140-6736(21)01748-8

33. Zhang, Y., (2024). Association between sports participation and resilience in school-attending students: a cross-sectional study. Frontiers in Psychology, 15, 1365310. https://doi.org/10.3389/fpsyg.2024.1365310
34. Zhang, Y., Li, X., &Guo, Y. (2023). Exercise-induced modulation of lipid metabolism and inflammation: Implications for cardiovascular health. Frontiers in Physiology, 14, 1112582. https://doi.org/10.3389/fphys.2023.1112582