Indonesian Journal of Sport

Revealing Sex-Based Patterns and Fitness Component Gaps among Youth Volleyball Players through the TKJI Assessment

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Received: August 05, 2025 | Revised Sept 25, 2025 | Accepted: Okt 11, 2025

ABSTRACT

Background: Physical fitness plays a vital role in supporting performance and preventing injuries among young volleyball players. In many Indonesian schools, however, training sessions still tend to emphasize technical drills rather than comprehensive physical preparation.

Aims: This study was designed to describe the physical fitness condition of students who joined volleyball extracurricular activities, while also identifying possible differences between male and female participants across the main TKJI components.

Methods: A total of 44 high-school students (24 boys and 20 girls) aged between 15 and 17 years participated in this descriptive study. Each participant completed the Indonesian Physical Fitness Test (TKJI), which measures five elements of fitness: speed, strength, power, endurance, and flexibility. The collected data were processed using descriptive statistics and simple comparisons to outline patterns between groups.

Results: Overall, the students were classified within the moderate fitness category. Boys generally showed better performance in tests involving strength and explosive power, whereas girls achieved more balanced scores in endurance and flexibility. Both groups, however, tended to show lower results in aerobic endurance, suggesting limited exposure to continuous cardiovascular training.

Conclusion: Findings from this study indicate that school-based volleyball activities contribute positively to students' fitness but have yet to develop all components evenly. The results underline the importance of integrating specific endurance and conditioning exercises into volleyball training programs to foster more balanced physical development among young athletes.

Keyword: Physical fitness; School-based training; Sex differences; TKJI assessment; Youth volleyball

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INTRODUCTION

The importance of physical fitness among adolescents is becoming a growing concern, particularly as modern lifestyles continue to reduce opportunities for regular exercise (Hanifah et al., 2023; Sluijs et al., 2021). Increasing digital engagement and sedentary habits among students have significantly influenced their physical well-being (Matos Fialho et al., 2025; Reyes-Molina et al., 2022). Schools, as central institutions for youth development, hold a strategic role in restoring balanced patterns of movement and health. Volleyball, one of the most favored school sports in Indonesia, offers a platform for students to remain active while learning teamwork and discipline. Yet, participation alone does not always guarantee the development of comprehensive physical fitness. Many extracurricular activities still focus heavily on technical mastery instead of physical conditioning. This imbalance makes it essential to evaluate the fitness condition of student-athletes objectively. Therefore, a structured investigation is necessary to understand whether volleyball programs truly enhance the physical health of adolescents.

Physical fitness is not merely the ability to move efficiently but also an indicator of physiological readiness to perform daily and athletic tasks (Guthrie et al., 2023; Kvist & Silbernagel, 2022). In the context of volleyball, fitness determines the player's capability to sustain long matches, respond rapidly to opponents' movements, and execute explosive skills such as jumping and spiking. The sport demands a well-developed combination of strength, endurance, agility, power, and flexibility. Each component contributes differently to performance, and the absence of one may compromise the effectiveness of others. Adolescence is a critical phase for cultivating these physical abilities through guided and consistent training. When young athletes engage in organized programs, they build not only athletic skills but also lifelong health habits. Consequently, assessing physical fitness among volleyball students becomes a key step toward improving both performance and educational outcomes.

In Indonesia, volleyball has been integrated into many school programs as part of extracurricular activities designed to nurture both physical competence and social character. These programs aim to complement academic learning by fostering teamwork, responsibility, and perseverance (Schmalenbach et al., 2022; Shvets et al., 2024; Zainuri & Huda, 2023). However, the quality and structure of such programs vary widely among institutions. Some schools prioritize competition over long-term physical development, while others face limitations in facilities and coaching resources. As a result, many students acquire technical skills but lack endurance or muscular strength to sustain consistent performance. The imbalance between skill acquisition and physical preparation may affect not only match outcomes but also the sustainability of student health. This condition highlights the need for systematic assessments to guide better program design and training balance.

The Tes Kebugaran Jasmani Indonesia (TKJI) provides a standardized and culturally appropriate method for evaluating adolescent fitness (Aprilo et al., 2023) . The test measures multiple components—speed, strength, power, endurance, and flexibility—that align with volleyball's physical demands (Cereda, 2025; Martin et al., 2024). Because of its simplicity and reliability, TKJI is widely used in schools to monitor student performance objectively. Despite its extensive application, limited studies have focused specifically on volleyball extracurricular participants. Many investigations still examine general student populations or elite athletes, leaving a knowledge gap about the intermediate group trained within school contexts. Applying the TKJI to volleyball students thus

offers a meaningful approach to map their fitness distribution and identify areas requiring targeted training. Moreover, it provides empirical data that educators can use to adjust their teaching and coaching strategies.

Adolescence is often described as a formative stage in physical development where rapid changes in body composition and hormonal balance occur (Norris et al., 2022; Rusek et al., 2021). During this period, appropriate exercise can enhance coordination, muscular growth, and cardiovascular endurance (Dransmann et al., 2021; Spiering et al., 2021). Conversely, inadequate training or prolonged inactivity can hinder growth and lead to unhealthy lifestyles later in life. Volleyball, as a dynamic and non-contact sport, has the potential to support this developmental process through rhythmic and coordinated movement. However, without structured conditioning routines, students may not achieve balanced progress across all fitness components. The consequences can include poor endurance, limited flexibility, or uneven muscle development. Assessing physical fitness at this age is therefore vital for both preventive health and future athletic preparation.

Gender has long been recognized as an important factor influencing physical performance outcomes (Durau et al., 2022; Hunter, 2021). Biological and physiological distinctions between males and females shape their responses to training loads, recovery patterns, and muscular adaptation (Egan & Sharples, 2023; Landen et al., 2023). In most school settings, however, training is conducted uniformly for both groups without considering these inherent differences. This practice may lead to unequal progress, where certain exercises favor one gender more than the other. Prior research indicates that males generally outperform females in speed and strength-related tests, while females exhibit higher flexibility and endurance consistency. Nonetheless, these patterns can differ across sports, ages, and cultural contexts. Analyzing gender-related variations in volleyball extracurricular participants is therefore essential to ensure inclusive and effective training design.

Beyond physical performance, understanding students' fitness levels contributes to the broader goals of physical education and school-based health promotion (Bentsen et al., 2022; Cale, 2023). When teachers and coaches possess accurate data, they can design training plans that align with students' abilities and limitations (Glover et al., 2023; Lindsay & Spittle, 2024). Regular monitoring also fosters motivation, as students can observe their own progress over time. Such awareness cultivates a sense of responsibility for personal health, which is increasingly relevant amid modern sedentary lifestyles. Moreover, by applying standardized tools like TKJI, schools can align their local programs with national benchmarks. These data not only benefit individual students but also provide valuable insight for policymakers seeking to enhance youth fitness standards. Therefore, systematic assessment should be seen as an educational instrument, not merely a measurement task.

Finally, this study is significant because it bridges practical needs in school sports with empirical research on youth fitness (Almeida et al., 2025; Tanveer et al., 2024). Indonesia continues to face challenges in promoting physical activity amid urbanization and digital lifestyles. By focusing on volleyball extracurricular students, this study provides a contextual understanding of how existing school programs shape physical health outcomes. The findings are expected to inform educators, coaches, and policymakers about the strengths and shortcomings of current practices. More importantly, they can serve as a foundation for designing training models that emphasize balance between skill development and fitness conditioning. Through this effort, schools can contribute to building a generation that is not only academically competent but also physically resilient. Hence, this

research responds to both a scientific and social necessity to revitalize adolescent fitness within educational settings.

Several scholars have underlined how school-based sports programs contribute to students' overall development. Watkins et al. (2025) highlighted that physical education should integrate psychological and social growth, not only focus on performance outcomes. Wu et al. (2024) supported this view by showing that schools' capacity and motivation strongly shape the quality of physical activity implementation. Calle et al. (2025) observed that structured teaching models and digital monitoring tools can refine physical training and optimize learning outcomes. Similarly, Wan et al. (2025) discovered that gender differences influence how students engage and bond within team sports. In Indonesia, Aldapit et al. (2025) found that identifying and nurturing young talents through school programs can elevate long-term athletic potential, while Ortega-Zayas et al. (2025) showed that simple games like table tennis effectively enhance coordination and health awareness. Ningrum et al. (2025) confirmed that structured exercise routines significantly improve students' body composition and endurance, and Meregi et al. (2025) demonstrated that even improvised teaching in rural schools can yield positive physical benefits. Pereira et al. (2025) revealed that recreational training among young padel players boosts agility and stamina, and Heiestad et al. (2025) introduced an educational model combining fitness and academic growth to build well-rounded youth athletes. Altogether, these studies emphasize that planned, school-based training supported by tools such as TKJI can ensure balanced physical development and healthier student performance, particularly for those active in volleyball programs.

Many studies have discussed the physical fitness of adolescents, yet most of them tend to concentrate on students in general physical education classes or professional athletes in sports clubs. Little is known about how extracurricular volleyball programs in schools contribute to the overall fitness of young players. In many cases, research stops at describing teaching methods or motivational aspects without exploring how far these programs shape measurable physical outcomes. Differences between male and female students are also often overlooked, even though these differences may influence how each group develops speed, power, endurance, and flexibility. In addition, school programs frequently prioritize game techniques such as passing or serving, leaving limited attention to physical conditioning. As a result, it is unclear whether volleyball extracurriculars actually build balanced fitness among students. This situation shows a gap that needs to be filled through direct measurement and systematic analysis using reliable instruments like the TKJI to portray students' real fitness levels.

Evaluating the physical fitness of volleyball extracurricular participants is important to ensure that school-based training achieves its objectives. Schools are expected not only to develop students' technical abilities but also to strengthen their physical capacity for better performance and health. By applying TKJI as a structured fitness assessment, teachers and coaches can clearly identify which aspects of fitness are well-developed and which need further improvement. The data obtained can serve as the basis for designing more effective and balanced training sessions. This study was carried out to provide a clearer picture of students' actual fitness conditions and to align school practices with the intended goals of physical education. The findings are also expected to help educators redesign training programs so that skill enhancement goes hand in hand with comprehensive body conditioning. Through this approach, schools can foster students who are not only skillful in volleyball but also physically fit, healthy, and confident in their abilities.

The purpose of this study is to describe and analyze the physical fitness profiles of high-school students who take part in volleyball extracurricular activities through the Tes Kebugaran Jasmani Indonesia (TKJI). The research aims to determine how students perform in the main components of physical fitness—speed, strength, power, endurance, and flexibility—and to explore differences between male and female participants. It is expected that male students will show better performance in aspects related to strength, speed, and power, while female students may demonstrate advantages in flexibility and endurance. By identifying these differences, the study hopes to reveal how extracurricular volleyball activities contribute to each student's physical development. The results are anticipated to guide teachers, coaches, and schools in improving their training patterns, so that physical education can truly fulfill its role in supporting balanced growth and overall well-being among adolescents.

METHOD

Research Design

This study used a quantitative descriptive approach intended to describe the actual level of physical fitness among students participating in volleyball extracurricular activities. The design was selected because it allows for an objective portrayal of existing conditions without manipulating any variables. Through this approach, the research focused on mapping students' fitness levels and observing gender-related tendencies within each component of the test. The study was carried out in the natural school environment, allowing students to perform in familiar conditions during their regular practice sessions. This approach was considered suitable because the goal of the research was not to test a specific treatment but to present an accurate and realistic picture of students' physical fitness profiles.

Participant

The participants of this study were 44 high-school students who were actively involved in the volleyball extracurricular program at a public school. The group comprised 24 male and 20 female students, all aged between 15 and 17 years. Each participant had been consistently attending volleyball practice at least twice a week for the previous semester. Before the data collection began, all students were given an explanation about the purpose and procedures of the study to ensure informed and voluntary participation. Only students in good health and willing to complete the entire testing process were included. This sample was considered adequate to represent the general characteristics of adolescent volleyball players in school-based settings.

Instrument

The primary tool used in this research was the Tes Kebugaran Jasmani Indonesia (TKJI), a standardized national test developed to assess the physical fitness of Indonesian adolescents. The TKJI measures five fundamental components of fitness—speed, strength, power, endurance, and flexibility—through a series of physical performance tasks. Each participant completed the full set of tests under the supervision of trained assessors following the national testing guidelines. The data were recorded immediately after each test using standard measuring instruments such as stopwatches, measuring tapes, and official score sheets. The TKJI was selected because it is simple to administer, suitable for the school environment, and capable of producing comprehensive data about students' physical condition in relation to their sporting activities.

Data Analysis

All collected results from the TKJI were analyzed using descriptive statistics. Each participant's score was classified according to the national TKJI grading system, which categorizes physical fitness into very good, good, moderate, poor, and very poor. Mean values and standard deviations were calculated for every fitness component to show the general tendency and variation among participants. Comparative analysis between male and female students was carried out to reveal performance differences in each aspect of fitness. The outcomes were then presented in tables and diagrams to illustrate the findings clearly. The analysis aimed to offer a factual overview of students' current fitness conditions and to provide insight that can be applied to improve school training programs in the future.

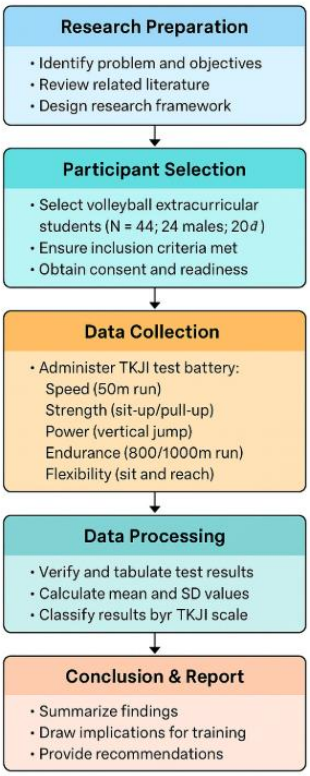

Figure 1. Research Procedure Flowchart

RESULTS AND DISCUSSION

Result

The analysis of students' performance through the Tes Kebugaran Jasmani Indonesia (TKJI) revealed that the volleyball extracurricular group showed varied levels of physical fitness. In general, most students reached the moderate category, suggesting that their physical condition was adequate to support sports participation, although there remains considerable room for improvement. Out of the 44 students who took part in the test, about 52% achieved a moderate level, 25% were classified as

good, 18% were placed in the poor category, and only 5% demonstrated very good fitness. None of the students fell into the very poor category, which indicates that the group maintained a reasonably active physical lifestyle. When comparing male and female students, a consistent pattern emerged. The male participants achieved higher scores in speed, strength, and power, while the female participants performed better in endurance and flexibility. This difference reflects both biological characteristics and training tendencies observed during their volleyball sessions. Male players tended to excel in explosive and short-burst movements, whereas females showed steadier results in tests requiring flexibility and stamina.

Table 1. Summary of TKJI Test Results by Component and Gender

Fitness Component	Male (n=24)	Female (n=20)	Combined Mean	Classification
Speed (50 m run)	7.8 sec	8.5 sec	8.1 sec	Moderate
Strength (sit-up/pull-up)	22 reps	19 reps	21 reps	Moderate
Power (vertical jump)	45 cm	39 cm	42 cm	Good
Endurance (800/1000 m run)	3.45 min	4.05 min	3.53 min	Fair
Flexibility (sit and reach)	25 cm	29 cm	27 cm	Good

The summary in Table 1 illustrates that endurance was the lowest-performing component for both male and female students. This result suggests that aerobic capacity was not sufficiently developed through the existing training routines. On the other hand, flexibility and power scored higher, likely because volleyball naturally involves dynamic movement and frequent jumping that stimulate those components.

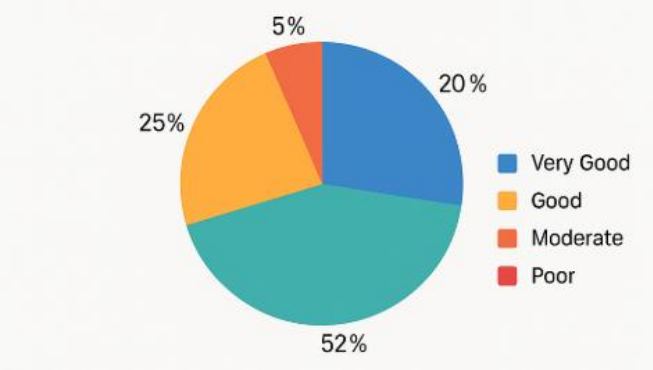

Figure 2. Distribution of Students' Overall Physical Fitness Levels

Figure 2 shows the percentage distribution of students' overall physical fitness levels. The majority (52%) fall into the moderate category, followed by good (25%), poor (18%), and a small portion (5%) categorized as very good. This indicates that while students possess adequate fitness, further improvement is still required to achieve optimal results.

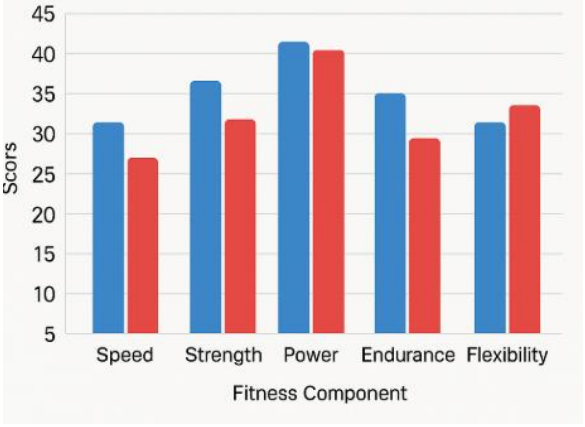

Figure 3. Comparison of TKJI Component Scores Between Male and Female Students

Figure 3 compares the average scores between male and female students across the five TKJI components. Male participants demonstrated higher results in speed, strength, and power, whereas female participants showed better scores in endurance and flexibility. These findings suggest natural variations in performance based on physiological and training differences.

The analysis also revealed that endurance was the lowest-performing component for both male and female students, indicating a lack of aerobic conditioning in their regular training sessions. In contrast, power and flexibility emerged as the strongest components, likely due to frequent jumping, dynamic movements, and stretching activities typical of volleyball training. This pattern highlights the need for schools to incorporate more endurance-focused exercises within volleyball extracurricular programs to achieve a balanced development of all fitness components.

Discussion

The results of this study show that volleyball extracurricular activities have a positive effect on students' physical fitness, though the overall level remains in the moderate category. This finding suggests that school-based sports can maintain students' activity levels but have not yet reached optimal outcomes. Watkins et al. (2025) emphasized that physical education in schools should nurture not only technical ability but also holistic development, including mental and social well-being. In this research, students who trained regularly demonstrated good coordination and stamina, though endurance and consistency still needed improvement. Limited training frequency may have restricted their progress toward higher fitness categories. Wu et al. (2025) highlighted that the strength of institutional support and motivation greatly influences how well schools implement their physical programs. When activities are less structured, their impact often becomes uneven. Therefore, schools must ensure that extracurricular sports are systematically organized to sustain student progress over time. Gender differences also emerged clearly in this study, aligning with previous literature on adolescent physical development. Male students performed better in speed, power, and strength tests, while female students excelled in endurance and flexibility. These variations confirm the argument by Calle et al. (2025) that different physical loads and instructional approaches produce varying outcomes depending on the learner's biological profile. This variation reflects natural physiological traits, such as greater muscle density in males and higher joint flexibility in females. Wan et al. (2025) pointed out that gender-related factors can shape students' motivation

and engagement, influencing their performance outcomes. These insights suggest that training should be adjusted to match physiological and motivational differences rather than adopting a one-size-fits-all approach. When teachers recognize these differences, they can design fair and effective learning experiences. Consequently, training sessions become more inclusive and beneficial for both male and female students. One of the most significant observations from the findings is the weakness in aerobic endurance across both groups of students. This issue likely stems from the design of volleyball training sessions, which prioritize short, high-intensity movements over continuous aerobic activity. Aldapit et al. (2025) stressed the importance of developing students' physical potential through structured and progressive programs that include fitness fundamentals. Without endurance training, athletes may struggle with consistency and fatigue during competition. Ortega-Zayas et al. (2025) also demonstrated that regular, school-based sports activities could enhance both coordination and health when implemented consistently. In this study, endurance training was rarely incorporated into volleyball sessions, causing a gap in aerobic capacity. Schools can address this by integrating running drills or interval training alongside technical exercises. Such an approach would balance the students' physical development and increase their overall stamina. In contrast, the relatively strong performance in power and strength components suggests that volleyball's natural structure already supports muscular development. Frequent jumps, quick directional changes, and striking movements help build muscle mass and coordination. Ningrum et al. (2025) found that structured physical activity programs significantly improve body composition and overall strength in adolescents. However, improvement was not evenly distributed among participants, indicating possible inconsistencies in how training is conducted. Meregi et al. (2025) noted that in schools with limited resources, teachers often adapt training creatively, yet effectiveness depends largely on how consistently these methods are applied. This condition may also apply in the current study, where variations in instruction possibly influenced results. Establishing clearer training standards could help ensure uniform benefits across students. Well-designed routines combining strength conditioning and volleyball drills would produce more consistent outcomes in the future. Flexibility became one of the components where female students achieved noticeably higher scores, a finding that aligns with established physical trends. The sit-and-reach results demonstrate how stretching movements—often used in warm-ups—have been integrated effectively into volleyball practice. Pereira et al. (2025) observed that recreational participation in sports could improve coordination and flexibility even in non-professional settings. This reinforces the idea that consistent movement practice can maintain physical adaptability over time. However, flexibility improvements must be maintained through continuous stretching routines rather than relying solely on gameplay. Heiestad et al. (2025) proposed an educational approach combining physical and academic development to encourage lifelong engagement in fitness. Applying such a model in schools could motivate students to view exercise not only as a sport but as a habit of self-care. Thus, maintaining flexibility should be seen as part of a broader educational process that supports both physical and cognitive growth. The predominance of moderate results across all components highlights the importance of evaluating the effectiveness of current training programs. Even though participation rates are high, the frequency and structure of sessions may not be sufficient for optimal improvement. Watkins et al. (2025) suggested that educational institutions should adopt a holistic monitoring approach to evaluate both learning and physical outcomes. Without proper evaluation, teachers may not detect areas that require adjustment. Wu et al. (2025) further emphasized that school motivation and policy play a

crucial role in maintaining training consistency. In many cases, physical activities are still viewed as secondary to academic goals, limiting their time allocation. Regular assessment through TKJI could serve as a valuable tool to monitor student progress objectively. Continuous evaluation ensures that school programs remain relevant and aligned with the students' needs. The differences between male and female students should also be interpreted as a guide for improvement rather than a limitation. Calle et al. (2025) argued that teaching strategies should be adapted to individual capacities to achieve balanced development. Wan et al. (2025) confirmed that gender-specific approaches encourage better engagement and teamwork in school sports. This idea aligns with the findings of this study, where male and female students showed distinct strengths across fitness components. Teachers can use this information to design differentiated training sessions tailored to each group's characteristics. Doing so promotes fairness while maintaining the effectiveness of the program. The emphasis should be on providing equal opportunities for physical improvement, not identical exercises for all. When inclusivity becomes a focus, both performance and motivation levels rise simultaneously. The pattern of moderate performance found here echoes Aldapit et al. (2025), who discussed how structured guidance in early training stages contributes to long-term athletic growth. The TKJI test in this study served as a useful benchmark to identify which aspects of fitness require enhancement. Integrating assessment tools like TKJI regularly allows teachers to evaluate progress more objectively and adjust teaching strategies accordingly. Ortega-Zayas et al. (2025) concluded that even simple sports activities could create meaningful improvements in health when guided systematically. This aligns with the current findings, suggesting that effective planning and consistent assessment can transform extracurricular programs into powerful instruments for youth development. With adequate structure and commitment, schools can use such programs to nurture both athletic potential and lifelong healthy habits among students. The low endurance results also draw attention to the importance of designing creative and adaptable training strategies. Ningrum et al. (2025) showed that consistent aerobic routines contribute significantly to better physical performance among adolescents. However, endurance exercises often receive less attention in school settings due to time constraints and limited equipment. Teachers could incorporate short, engaging cardiovascular routines between technical drills to overcome this issue. Meregi et al. (2025) demonstrated that innovative teaching methods, even in schools with limited facilities, can lead to meaningful results when executed with creativity. Implementing flexible, context-appropriate strategies could help maintain student interest while improving endurance. This balanced approach would not only raise students' fitness levels but also enhance their enjoyment of physical activity. Over time, it could foster a stronger culture of health awareness among young learners. Flexibility and coordination improvements also align with broader educational objectives discussed by Pereira et al. (2025) and Heiestad et al. (2025). Their studies emphasized that integrating physical education with character and academic development yields the most sustainable outcomes. The findings of this research confirm that volleyball extracurricular programs can serve as effective media for both physical enhancement and behavioral growth. Regular participation promotes not only movement skills but also discipline, responsibility, and social cooperation. Such values complement the goals of holistic education, which seeks to balance intellectual and physical growth. Schools can maximize this potential by providing supportive environments and regular evaluations. When properly implemented, extracurricular sports like volleyball become a powerful foundation for healthy and well-rounded students. Overall, the discussion consolidates the insights of Watkins, Wu, Calle, Wan,

Aldapit, Ortega-Zayas, Ningrum, Meregi, Pereira, and Heiestad, who collectively emphasize that structured, inclusive, and continuously evaluated sports programs are vital for sustainable youth fitness development. The present findings contribute empirical evidence supporting these perspectives, particularly the need for endurance improvement and balanced program design. Schools must adopt a comprehensive view of physical education that integrates skill, fitness, and health outcomes. This alignment between academic goals and physical activity promotes lifelong benefits for students. With proper planning and evaluation, volleyball extracurricular programs can evolve into strategic instruments for developing both athletic competence and personal growth. Such integration reflects the essence of holistic education—forming individuals who are physically capable, mentally resilient, and socially responsible.

Implications

The findings from this research provide several important takeaways for teachers, coaches, and educational institutions. Volleyball extracurricular programs have proven to be valuable in maintaining and improving students' physical fitness, yet their design still requires refinement to achieve a more balanced outcome. Schools are encouraged to develop structured and consistent training schedules that incorporate endurance, strength, flexibility, and power within the same program. Coaches can adapt the intensity and focus of each session according to students' needs and gender differences so that both male and female athletes benefit equally. Regular evaluations using the TKJI can serve as a reference point to monitor progress and ensure that training methods remain effective. These results also emphasize that physical education should not stand alone but must be integrated into the broader educational mission of shaping healthy, disciplined, and resilient young people. When schools, families, and policymakers work together to support these initiatives, sports programs like volleyball can become powerful tools for cultivating lifelong fitness habits and positive character formation among students.

Limitations

Although this study offers meaningful insights, it is necessary to recognize certain constraints that might have influenced the findings. The research was conducted on a limited number of participants from one school, which narrows the generalizability of the conclusions to a broader population. The study also used a cross-sectional approach, making it difficult to capture long-term changes in students' fitness development over time. External factors such as weather conditions, motivation during testing, and individual differences in prior activity levels could also have affected performance outcomes. Furthermore, the study relied primarily on quantitative measures and did not include interviews or qualitative observations that might explain behavioral or psychological influences on student performance. The absence of comparisons with other sports programs also restricts the scope of interpretation. Future research should therefore expand participant diversity, include longitudinal follow-ups, and combine mixed methods to present a richer and more comprehensive understanding of student fitness in school settings.

Suggestions

Several practical and research-oriented recommendations emerge from this study. Schools should enhance the structure of volleyball extracurricular programs by balancing skill development with dedicated physical conditioning sessions, particularly those targeting endurance and cardiovascular strength. Coaches and physical education teachers are advised to use standardized assessment tools like TKJI periodically to measure improvement and guide training adjustments. Training methods

should also consider gender-specific physiological differences so that programs remain fair, inclusive, and effective. Collaboration among teachers, administrators, and health experts is essential to build a sustainable model of school-based sports that promotes holistic student well-being. For future studies, involving participants from multiple schools and comparing different sports activities could provide broader perspectives on adolescent fitness development. In the long run, adopting a data-driven and student-centered approach will help transform extracurricular sports into consistent, meaningful contributors to health education and personal growth.

CONCLUSIONS

This study concludes that volleyball extracurricular activities contribute meaningfully to the development of students' physical fitness, even though the overall level remains moderate. The results show that regular participation in such programs helps maintain a good balance of strength, power, and flexibility, while endurance still needs more focused improvement. The comparison between male and female participants revealed different areas of strength, where boys tended to excel in speed and power, and girls performed better in endurance and flexibility. These variations reflect both biological characteristics and the way training sessions are conducted at school. The findings suggest that the structure of current programs has been effective in sustaining students' activity levels but has not yet reached its full potential in enhancing overall fitness. To strengthen outcomes, schools should plan training more systematically, incorporating aerobic and conditioning exercises alongside technical volleyball drills. Periodic evaluation through standardized assessments such as the TKJI can help track progress and adjust methods as needed. In a broader sense, volleyball extracurricular activities have the potential to shape students' discipline, teamwork, and healthy lifestyle habits when implemented as part of an integrated educational effort.

AUTHOR'S CONTRIBUTION

This study was carried out by Reki Putra Pratama as the main author, with supervision and academic guidance from Palmizal, and Grafitte Decheline,. The author was responsible for conceptualizing the research, designing the methodology, collecting and analyzing the data, and preparing the manuscript draft.

Palmizal, contributed to the refinement of the research framework, validation of the analysis process, and critical evaluation of the discussion.

Grafitte Decheline, provided direction in interpreting the results, ensuring the accuracy of the data presentation, and improving the overall structure and clarity of the manuscript. All contributors reviewed, discussed, and approved the final version of the article prior to submission.

REFERENCES

Aldapit, E., Sulaiman, Rumini, & Hadi. (2025). Empowering Physical Education through Talent

Scouting: Enhancing Early Sports Talent Development in Lampung City Schools.

International Journal of Human Movement and Sports Sciences, *13*(4), 975–986. https://doi.org/10.13189/saj.2025.130433

Almeida, L., Dias, T., Corte-Real, N., Menezes, I., & Fonseca, A. (2025). Positive youth development through sport and physical education: A systematic review of empirical research conducted with grade 5 to 12 children and youth. *Physical Education and Sport Pedagogy*, *30*(3), 282–308. https://doi.org/10.1080/17408989.2023.2230208

Aprilo, I., Arfanda, P. E., Mappompo, M. A., Zainuddin, M. S., & Nurulita, R. F. (2023). SOCIALIZATION OF PHASE C INDONESIAN STUDENT FITNESS TEST (TES KEBUGARAN SISWA INDONESIA / TKSI). *J-ABDI: Jurnal Pengabdian Kepada Masyarakat*, *3*(6), 1317–1322. https://doi.org/10.53625/jabdi.v3i6.6852

Bentsen, P., Mygind, L., Elsborg, P., Nielsen, G., & Mygind, E. (2022). Education outside the classroom as upstream school health promotion: 'Adding-in' physical activity into children's everyday life and settings. *Scandinavian Journal of Public Health*, *50*(3), 303–311. https://doi.org/10.1177/1403494821993715

Cale, L. (2023). Physical Education: At the Centre of Physical Activity Promotion in Schools. *International Journal of Environmental Research and Public Health*, *20*(11), 6033. https://doi.org/10.3390/ijerph20116033

Calle, O., Antúnez, A., González-Espinosa, S., Ibáñez, S. J., & Feu, S. (2025). Monitoring the Impact of Two Pedagogical Models on Physical Load in an Alternative School Sport Using Inertial Devices. *Sensors*, *25*(18). https://doi.org/10.3390/s25185929

Cereda, F. (2025). Physical Fitness Profile of Elite Female Volleyball Players: An Observational Study Correlating Bioimpedance Vector Analysis (BIVA) with Field-Based Testing. *Journal of Science in Sport and Exercise*. https://doi.org/10.1007/s42978-025-00340-0

Dransmann, M., Koddebusch, M., Gröben, B., & Wicker, P. (2021). Functional High-Intensity Interval Training Lowers Body Mass and Improves Coordination, Strength, Muscular Endurance, and

Aerobic Endurance of Inmates in a German Prison. *Frontiers in Physiology*, *12*. https://doi.org/10.3389/fphys.2021.733774

Durau, J., Diehl, S., & Terlutter, R. (2022). Motivate me to exercise with you: The effects of social media fitness influencers on users' intentions to engage in physical activity and the role of user gender. *DIGITAL HEALTH*, *8*, 20552076221102769. https://doi.org/10.1177/20552076221102769

Egan, B., & Sharples, A. P. (2023). Molecular responses to acute exercise and their relevance for adaptations in skeletal muscle to exercise training. *Physiological Reviews*, *103*(3), 2057–2170. https://doi.org/10.1152/physrev.00054.2021

Glover, T. A., Reddy, L. A., & Crouse, K. (2023). Instructional coaching actions that predict teacher classroom practices and student achievement. *Journal of School Psychology*, *96*, 1–11. https://doi.org/10.1016/j.jsp.2022.10.006

Guthrie, B., Jagim, A. R., & Jones, M. T. (2023). Ready or Not, Here I Come: A Scoping Review of Methods Used to Assess Player Readiness Via Indicators of Neuromuscular Function in Football Code Athletes. *Strength & Conditioning Journal*, *45*(1), 93. https://doi.org/10.1519/SSC.0000000000000735

Hanifah, L., Nasrulloh, N., & Sufyan, D. L. (2023). Sedentary Behavior and Lack of Physical Activity among Children in Indonesia. *Children*, *10*(8), 1283. https://doi.org/10.3390/children10081283

Heiestad, H., Myklebust, G., Bahr, R., & Moseid, C. H. (2025). Making, not breaking the young, aspiring athlete: The development of Prep to be PRO (Nærmere Best) - A Norwegian school-based educational programme. *BMJ Open Sport and Exercise Medicine*, *11*(2). https://doi.org/10.1136/bmjsem-2024-002388

Hunter, J. (2021). An Intersection of Mathematics Educational Values and Cultural Values: Pāsifika Students' Understanding and Explanation of Their Mathematics Educational Values. *ECNU Review of Education*, *4*(2), 307–326. https://doi.org/10.1177/2096531120931106

Kvist, J., & Silbernagel, K. G. (2022). Fear of Movement and Reinjury in Sports Medicine: Relevance for Rehabilitation and Return to Sport. *Physical Therapy*, *102*(2), pzab272. https://doi.org/10.1093/ptj/pzab272

Landen, S., Hiam, D., Voisin, S., Jacques, M., Lamon, S., & Eynon, N. (2023). Physiological and molecular sex differences in human skeletal muscle in response to exercise training. *The Journal of Physiology*, *601*(3), 419–434. https://doi.org/10.1113/JP279499

Lindsay, R., & Spittle, M. (2024). The adaptable coach – a critical review of the practical implications for traditional and constraints-led approaches in sport coaching. *International Journal of Sports Science & Coaching*, *19*(3), 1240–1254. https://doi.org/10.1177/17479541241240853

Martin, S. N., Rifandi, R., Sari, S., Mukhni, & Rusyda, N. A. (2024). *Education for sustainable development in quadrilateral topic of grade VII*. *3024*(1). Scopus. https://doi.org/10.1063/5.0204443

Matos Fialho, P. M., Wenig, V., Heumann, E., Müller, M., Stock, C., & Pischke, C. R. (2025). Digital public health interventions for the promotion of mental well-being and health behaviors among university students: A rapid review. *BMC Public Health*, *25*(1), 2500. https://doi.org/10.1186/s12889-025-23669-1

Meregi, A. D., Mulibana, P. K., & Mukoma, G. G. (2025). "We Just Improvise": Exploring Teachers' Perspectives on Sport Participation for Learners with Intellectual Disabilities in Rural South Africa. *International Journal of Environmental Research and Public Health*, *22*(6). https://doi.org/10.3390/ijerph22060893

Ningrum, D. T. M., Hafizah, Setyawan, D. A., & Mahyudi, Y. V. (2025). Effect of structured physical activity programs on physical fitness and body compotition among junior high school: A randomized controlled trial. *Retos*, *68*, 249–257. https://doi.org/10.47197/retos.v68.111620

Norris, S. A., Frongillo, E. A., Black, M. M., Dong, Y., Fall, C., Lampl, M., Liese, A. D., Naguib, M., Prentice, A., Rochat, T., Stephensen, C. B., Tinago, C. B., Ward, K. A., Wrottesley, S. V., & Patton, G. C. (2022). Nutrition in adolescent growth and development. *The Lancet*, *399*(10320), 172–184. https://doi.org/10.1016/S0140-6736(21)01590-7

Ortega-Zayas, M. A., Cardona-Linares, A. J., Lecina, M., Ochiana, N., García-Giménez, A., & Pradas, F. (2025). Table Tennis as a Tool for Physical Education and Health Promotion in Primary Schools: A Systematic Review. *Sports*, *13*(8). https://doi.org/10.3390/sports13080251

Pereira, A., Leitão, L., Marques, D. L., Marinho, D. A., & Neiva, H. P. (2025). Comparative Study in Physical Fitness in Recreative Young Padel Players. *Journal of Functional Morphology and Kinesiology*, *10*(2). https://doi.org/10.3390/jfmk10020214

Reyes-Molina, D., Alonso-Cabrera, J., Nazar, G., Parra-Rizo, M. A., Zapata-Lamana, R., Sanhueza-Campos, C., & Cigarroa, I. (2022). Association between the Physical Activity Behavioral Profile and Sedentary Time with Subjective Well-Being and Mental Health in Chilean University Students during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, *19*(4), 2107. https://doi.org/10.3390/ijerph19042107

Rusek, W., Baran, J., Leszczak, J., Adamczyk, M., Baran, R., Weres, A., Inglot, G., Czenczek-Lewandowska, E., & Pop, T. (2021). Changes in Children's Body Composition and Posture during Puberty Growth. *Children*, *8*(4), 288. https://doi.org/10.3390/children8040288

Schmalenbach, C., Monterrosa, H., Cabrera Larín, A. R., & Jurkowski, S. (2022). The LIFE programme – University students learning leadership and teamwork through service learning in El

Salvador. *Intercultural Education*, *33*(4), 470–483. https://doi.org/10.1080/14675986.2022.2090689

Shvets, T., Shestakova, S., Kryvoshlykov, S., Lohvynenko, V., & Butrynovska, U. (2024). Enhancing students' social abilities via cooperative learning and project-based teaching methods: Pedagogical approaches and beneficial outcomes. *Multidisciplinary Reviews*, *7*, 2024spe022-2024spe022. https://doi.org/10.31893/multirev.2024spe022

Sluijs, E. M. F. van, Ekelund, U., Crochemore-Silva, I., Guthold, R., Ha, A., Lubans, D., Oyeyemi, A. L., Ding, D., & Katzmarzyk, P. T. (2021). Physical activity behaviours in adolescence: Current evidence and opportunities for intervention. *The Lancet*, *398*(10298), 429–442. https://doi.org/10.1016/S0140-6736(21)01259-9

Spiering, B. A., Mujika, I., Sharp, M. A., & Foulis, S. A. (2021). Maintaining Physical Performance: The Minimal Dose of Exercise Needed to Preserve Endurance and Strength Over Time. *The Journal of Strength & Conditioning Research*, *35*(5), 1449. https://doi.org/10.1519/JSC.0000000000003964

Tanveer, M., Asghar, E., Badicu, G., Tanveer, U., Roy, N., Zeba, A., Badri Al-Mhanna, S., & Batrakoulis, A. (2024). Associations of School-Level Factors and School Sport Facility Parameters with Overweight and Obesity among Children and Adolescents in Pakistan: An Empirical Cross-Sectional Study. *Sports*, *12*(9), 235. https://doi.org/10.3390/sports12090235

Wan, B., Huang, H., Sha, X., Zhong, C., & Shui, Y. (2025). Adolescent Athlete Engagement and Team Cohesion in Football: A Moderated Mediation Model with Gender-Based Insights. *Behavioral Sciences*, *15*(9). https://doi.org/10.3390/bs15091264

Watkins, J. M., Goss, J. M., Kercher, V. M. M., Coble, C. J., Werner, N. E., Weaver, R. G., & Kercher, K. A. (2025). Hoosier Sport Re-Social: A protocol for developing a biopsychosocial body satisfaction intervention in rural Indiana. *Pilot and Feasibility Studies*, *11*(1). https://doi.org/10.1186/s40814-025-01695-5

Wu, X., Rai, S. N., & Weber, G. F. (2024). Beyond mutations: Accounting for quantitative changes in the analysis of protein evolution. *Computational and Structural Biotechnology Journal*, *23*, 2637–2647. https://doi.org/10.1016/j.csbj.2024.06.017

Zainuri, A., & Huda, M. (2023). Empowering Cooperative Teamwork for Community Service Sustainability: Insights from Service Learning. *Sustainability*, *15*(5), 4551. https://doi.org/10.3390/su15054551