15 (2) (2026) 1228-1235

Journal of Physical Education, Sport, Health and Recreations

http://journal.unnes.ac.id/journals/peshr

Periodized Core And Resistance-Based Strength Training Effects On Service Accuracy In Intermediate Tennis Players

Muhammad Dicky Saputra[1], Siti Baitul Mukarromah[2]*, Sugiarto[3]

[123]Faculty of Sports Science, Universitas Negeri Semarang, Semarang, Indonesia

Keywords

core stability, intermediate tennis players, periodized core training, resistance-based strength training, service accuracy, tennis

Abstract

The objective of this study is to evaluate the impact of periodized core training and resistance-based strength training on enhancing service accuracy, as well as to compare the efficacy of these two training modalities among intermediate tennis players. This study used an experimental method with a two-group pre-test and post-test design. There were 16 intermediate tennis players from Club TitikTemuTennis in the sample. They were split into two groups: the periodized core training group and the resistance-based strength training group. The training program took place over the course of one month, with three sessions per week for a total of 12 sessions. The research tools used a test to see how well people could serve tennis balls. Descriptive statistics, paired sample t-tests, and independent sample t-tests were used to look at the data. The findings indicated that both training methods significantly enhanced service accuracy. The periodized core training group gained an average of 10.50 points, while the resistance-based strength training group gained 7.75 points. The comparison test showed that periodized core training was better than resistance-based strength training at helping people serve better. So, systematic core stability training is a better way for intermediate tennis players to improve their serve accuracy.

✉ Corresponding author :
E-mail: sitibaitul@email.unnes.ac.id

p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Tennis is a globally recognized racket sport that requires a combination of technical proficiency, physical fitness, tactical intelligence, and psychological preparedness to achieve optimal performance. Success in tennis competition is determined not only by a player's mastery of stroke techniques but also by the ability to execute these techniques consistently under competitive pressure. Among the fundamental skills in tennis, the serve occupies a unique position because it is the only stroke entirely initiated and controlled by the player. Unlike other strokes that depend on the opponent's actions, the serve allows players to dictate the initial direction, speed, and placement of the ball. Consequently, service performance is frequently regarded as one of the most influential determinants of success in tennis matches (Pavlović, 2026). Service accuracy is a critical aspect of service performance. It refers to a player's ability to consistently place the ball into designated target areas within the service box according to tactical objectives. Accurate serves enable players to exploit opponents' weaknesses, create offensive opportunities, and gain immediate control over the rally. Conversely, inaccurate serves may result in service faults, reduced confidence, and increased pressure during match situations. Research has demonstrated that highly successful tennis players exhibit superior service accuracy compared with lower-performing players, highlighting the importance of this skill in competitive performance (Aprial, 2025). Therefore, improving service accuracy remains a primary objective for coaches and athletes seeking to enhance tennis performance.

The execution of an effective tennis serve involves a complex interaction between biomechanical, physiological, and neuromuscular factors. From a biomechanical perspective, the serve is characterized by a sequential transfer of force known as the kinetic chain. This mechanism begins with force generation from the lower extremities, followed by energy transfer through the trunk and finally to the upper limbs and racket. Efficient utilization of the kinetic chain allows players to generate greater racket-head velocity while maintaining directional control of the ball. Disruptions in any segment of this chain can negatively affect service effectiveness and accuracy (Nuannuan Deng, 2023). Consequently, physical conditioning programs aimed at optimizing force transfer and movement coordination have become increasingly important in tennis training. One physical component that plays a central role in the kinetic chain is core stability. The core consists of the muscles surrounding the abdomen, lower back, pelvis, and hips, which function collectively to stabilize the trunk and facilitate efficient movement between the upper and lower body. During the service motion, core muscles are responsible for maintaining balance, controlling trunk rotation, and transferring force generated by the legs to the upper extremities. Adequate core stability enables athletes to maintain proper posture and movement efficiency, thereby enhancing stroke precision and reducing unnecessary energy expenditure. Previous studies have consistently demonstrated positive effects of core training on tennis-specific performance variables. (Sohail, 2024) reported significant improvements in agility, strength performance, and tennis skills among young tennis players following a structured core training program. Similarly, (Deng, 2025) found that integrated core training interventions contributed to enhanced balance, coordination, and stroke performance in adolescent tennis athletes. Furthermore, (Bangari, 2022) reported that core stability training significantly improved stroke accuracy and spin control, emphasizing the importance of trunk stability in racket sports performance.

Core training programs are often implemented using a periodization approach. Periodization refers to the systematic organization of training variables such as volume, intensity, and exercise complexity over time to optimize physiological adaptation and prevent performance stagnation. Periodized core training allows athletes to progressively develop muscular endurance, stability, and neuromuscular control through structured phases of training. Research conducted by (Zhu, 2022) demonstrated that periodized core training significantly improved physical fitness components and movement efficiency among racket sport athletes. Similarly, (Koya, 2022) reported that six weeks of structured core training enhanced service performance and motor abilities in tennis players. These findings suggest that periodized core training may provide substantial benefits for improving technical

execution, particularly service accuracy, muscular strength is another physical factor strongly associated with tennis service performance. Strength contributes to the generation of force required for racket acceleration, ball velocity, and stroke consistency. Upper-body strength, particularly in the shoulders, arms, forearms, and wrists, plays a crucial role during ball impact and follow-through phases of the serve. Resistance-based strength training is widely recognized as an effective method for increasing muscular strength and power through the application of external loads. Previous investigations have shown that strength and conditioning interventions can positively influence tennis performance outcomes. (Muzaqir, 2025) reported that resistance training significantly improved fitness-related variables and tennis-specific skills among adolescent players. Furthermore, (Deng, 2025) concluded in their systematic review and meta-analysis that strength and conditioning programs contribute positively to service-related performance variables, particularly serve speed and overall stroke effectiveness.

The relationship between muscular strength and service accuracy has also been highlighted in previous studies. (Aprial, 2025) reported that hand-grip strength explained a substantial proportion of variance in service accuracy among competitive-level tennis players. (Kizilca, 2025) emphasized that neuromuscular and strength-oriented training programs improve sports performance and injury prevention among tennis athletes. These findings indicate that muscular strength not only enhances power production but also contributes to greater control during racket-ball contact, which is essential for accurate service placement. Although both core training and resistance-based strength training have demonstrated positive effects on tennis performance, their underlying mechanisms differ considerably. Core training primarily focuses on improving body stability, movement control, balance, and force transmission efficiency, whereas resistance-based strength training emphasizes muscular force production and power development. Consequently, the two training approaches may influence service accuracy through different physiological pathways. While several studies have examined the independent effects of core training or strength training on tennis performance, direct comparisons between these two methods remain limited, particularly among intermediate-level tennis players (Deng, 2025).

Intermediate-level tennis players represent an important population for investigation because they are still undergoing substantial technical and physical development. At this stage, improvements in physical conditioning can directly influence the refinement of technical skills. Identifying the most effective training method for enhancing service accuracy may provide valuable information for coaches in designing evidence-based conditioning programs. Furthermore, despite growing interest in tennis-specific conditioning, research comparing periodized core training and resistance-based strength training as strategies for improving service accuracy remains scarce. This gap in the literature highlights the need for further investigation to determine which training modality produces greater improvements in service performance. Therefore, the purpose of this study was to examine and compare the effects of periodized core training and resistance-based strength training on service accuracy among intermediate-level tennis players at TitikTemuTennis Club. The findings are expected to contribute to the growing body of knowledge regarding tennis conditioning strategies and provide practical recommendations for coaches and athletes seeking effective methods to improve service accuracy and overall competitive performance.

METHODS

This study utilized a quantitative experimental methodology with a two-group pre-test-post-test design. This method was used to see how well the therapies worked on two different groups by looking at the results before and after the treatment. The study lasted a month and took place at the TitikTemuTennis Club tennis court. There were 12 training sessions, three times a week. This study encompassed all intermediate-level tennis players who were active members of the TitikTemuTennis Club. The chosen sampling method was total sampling, meaning that all members of the community who met the specified criteria were included as study participants, resulting in a total of 16 participants. The sample was subsequently partitioned into two cohorts of eight participants each: one designated for periodized core

training and the other for resistance-based strength training. The research methodology begins with a preliminary test of service accuracy to evaluate the participants' initial competence before the application of treatments.

After that, each group got a personalized training program that fit with the planned method for 12 training sessions. The first group finished a core training program that was split into periods. The second group did a strength training program that used resistance. After the training, everyone took a post-test to see how well they could do their jobs after the treatments. The study utilized a tennis service accuracy test as the research instrument, meticulously crafted to evaluate players' precision in positioning the ball within the specified service target area. The test results were written down as scores based on how many successful serves hit the target area. We looked at the research data using both descriptive and inferential statistics. Descriptive statistics were employed to demonstrate the mean values, standard deviations, and score variations between the pre-tests and post-tests. The research procedure began with a pre-test to measure the initial service accuracy of the participants. After the pre-test, the participants were divided into two groups: the periodized core training group and the resistance-based strength training group. Each group followed a structured training program for four weeks with three sessions per week. At the end of the training period, a post-test was conducted to measure the improvement in service accuracy. The overall research procedure is illustrated in **Figure 1**.

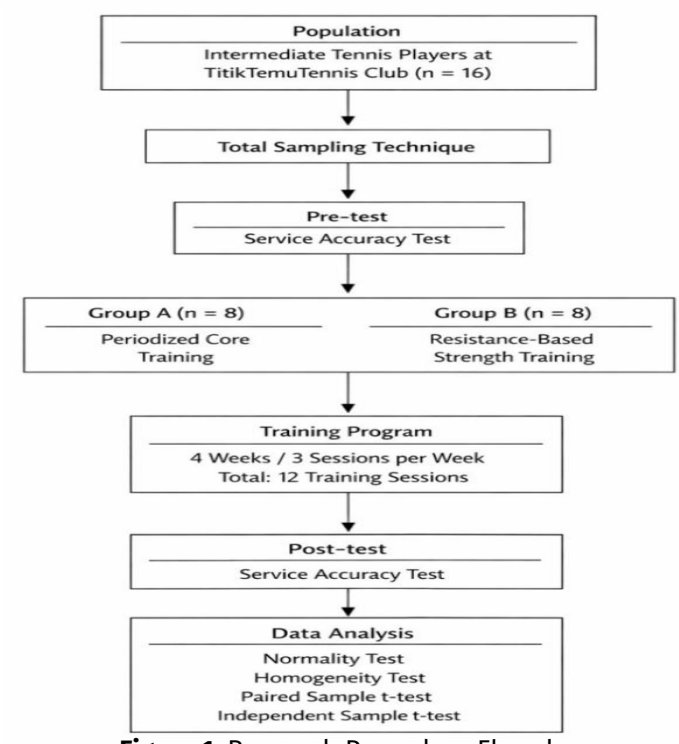

Figure 1. Research Procedure Flowchar

Prior to the examination of the hypothesis, the data underwent normality and homogeneity tests as prerequisites for statistical analysis. A paired sample t-test was utilized to assess the hypotheses concerning the influence of each training method on service accuracy. An independent sample t-test was then employed to determine the efficacy of the two strategies.

RESULTS AND DISCUSSION

The objective of this study is to evaluate the effects of periodized core training and resistance-based strength training on service accuracy among intermediate-level tennis players at TitikTemuTennis Club. The data were gathered by examining the pre-test and post-test results of service accuracy in both treatment groups.

DESCRIPTIVE ANALYSIS RESULTS

The descriptive analysis showed that both treatment groups got better at providing accurate service after the training sessions during the research period.

Table 1. Mean Results of Pre-test and Post-test of Service Accuracy

Training Group	Pre-test (Mean)	Post-test (Mean)	Improvement
Periodized Core Training	21.13	31.63	10.50
Resistance-Based Strength Training	17.13	24.88	7.75

The periodized core training group had a mean score of 21.13 on the pre-test, which went up to 31.63 on the post-test, a difference of 10.50 points. In the resistance-based strength training group, the average score on the pre-test was 17.13, and it went up to 24.88 on the post-test, which is a 7.75-point improvement. The data show that both training methods helped tennis players serve better.

Normality Test Results

Prior to hypothesis testing, the normality test was used to determine whether the research data were normally distributed.

Table 2. Results of Data Normality Test

Group	Sig.	Description
Periodized Core Training (Pre-test)	> 0.05	Normal
Periodized Core Training (Post-test)	> 0.05	Normal
Resistance-Based Strength Training (Pre-test)	> 0.05	Normal
Resistance-Based Strength Training (Post-test)	> 0.05	Normal

The normality test showed that all of the data had a significance level higher than 0.05. So, we can assume that the research data is normally distributed and meets the requirements for more statistical testing.

Homogeneity Test Results

The homogeneity test was used to see if the variations between the two research groups were homogeneous.

Table 3. Homogeneity Test Results

Data	Sig.	Description
Pre-test of both groups	> 0.05	Homogeneous
Post-test of both groups	> 0.05	Homogeneous

Based on the findings of the homogeneity test, the significance value was larger than 0.05, indicating that the variances of the two research groups are homogeneous.

Hypothesis Test Results

A paired sample t-test assessed the efficacy of the therapy within each group, while an independent sample t-test evaluated the differential effectiveness of the two training methods. The results of the statistical test showed that both training methods helped tennis players serve better. The independent sample t-test results also showed that the two ways of training didn't work as well as each other. The group that did periodized core training did better on the post-test than the group that did strength training with resistance. These data demonstrate that intermediate-level tennis players at TitikTemuTennis Club experience enhanced benefits from periodized core training in terms of serving accuracy. The study's results show that both periodized core training and strength training with resistance can help intermediate-level tennis

players at TitikTemuTennis Club serve better. The fact that scores went up from the pre-test to the post-test in each treatment group shows this. These results show that a structured physical training program can help tennis players improve their technical skills, especially their serving skills. The serve is one of the most important parts of tennis because it starts each point. If a player serves well, they can take control of the game's pace and put pressure on their opponent early on. To be able to serve, you need more than just good technical movement skills. You also need to be in good shape so you can do the action quickly and well.

The results of the study show that the group that did periodized core training got better at their service accuracy than the group that did resistance-based strength training.The training intervention consisted of two different training programs, namely periodized core training and resistance-based strength training. The training program was conducted for four weeks with a frequency of three training sessions per week, resulting in a total of twelve training sessions. The detailed training program is presented in **Table 1**.

Table 4. Training Programs

Periodized Core Training (Group A)	**Resistance-Based Strength Training (Group B)**
Week 1: Plank (3 × 30 sec), Bridge (3 × 15 reps), Russian Twists (3 × 20 reps)	Week 1: Bench Press (3 × 10 reps), Lat Pulldown (3 × 12 reps), Dumbbell Squats (3 × 12 reps)
Week 2: Side Plank (3 × 25 sec each side), Superman (3 × 15 reps), Bicycle Crunches (3 × 25 reps)	Week 2: Shoulder Press (3 × 10 reps), Seated Row (3 × 12 reps), Bicep Curls (3 × 15 reps)
Week 3: Dead Bug (3 × 20 reps), Rotational Med Ball Throws (3 × 15 reps), Pallof Press (3 × 20 sec)	Week 3: Deadlift (3 × 8 reps), Tricep Pushdown (3 × 12 reps), Leg Press (3 × 12 reps)
Week 4: Plank with Leg Lift (3 × 20 sec), Swiss Ball Rollout (3 × 15 reps), Standing Cable Twist (3 × 20 reps)	Week 4: Chest Fly (3 × 12 reps), Lunges with Weights (3 × 15 reps each leg), Weighted Back Extension (3 × 10 reps)

The findings of this study indicate that periodized core training produced greater improvements in service accuracy compared with resistance-based strength training among intermediate-level tennis players. The periodized core training group demonstrated a mean improvement of 10.50 points, whereas the resistance-based strength training group improved by 7.75 points. These findings suggest that although both training methods positively influenced service performance, the development of core stability and neuromuscular control may play a more significant role in improving service accuracy than muscular strength alone. The superiority of periodized core training can be explained through the biomechanical demands of the tennis serve. During the service motion, the body operates as an integrated kinetic chain in which force is generated from the lower extremities, transferred through the trunk, and finally delivered through the upper limbs and racket. The core muscles function as a central link in this kinetic chain, facilitating efficient energy transfer while maintaining postural stability and balance. When core stability is enhanced, athletes are able to control trunk rotation more effectively, maintain proper body alignment, and execute technical movements with greater precision. As a result, the direction and placement of the ball become more consistent during service execution (Pavlović, 2026).

Periodized core training is specifically designed to improve muscular endurance, trunk stability, balance, and neuromuscular coordination through progressive training loads. The structured progression of exercises allows athletes to gradually adapt to increasing physical demands while minimizing fatigue and movement inefficiencies. Improved core stability contributes to better control of body positioning during the preparation, backswing, acceleration, and follow-through phases of the serve. Consequently, athletes are better able to maintain movement consistency and accuracy throughout the entire service action. These findings are consistent with those reported by (Deng, 2024), who concluded that structured physical training programs emphasizing core development significantly improved tennis-specific performance variables, including balance, coordination, and stroke execution. Similarly, (ARSLAN, 2022) found that core training interventions enhanced agility, strength performance, and technical tennis

skills among young players. The present findings are also supported by (Kizilca, 2025), who demonstrated that integrated core and plyometric training improved balance, strength, and tennis performance in adolescent athletes. Furthermore, (Naik, 2022) reported that core stability training significantly enhanced stroke accuracy and spin control among tennis players. These studies collectively suggest that improvements in trunk stability facilitate more efficient movement patterns and greater control of racket positioning, which are essential components of service accuracy. The current results therefore reinforce the importance of incorporating structured core training into tennis conditioning programs.

Another explanation for the effectiveness of periodized core training is its influence on movement efficiency. Efficient movement patterns reduce unnecessary body sway and improve coordination between the upper and lower extremities. In tennis serving, small deviations in body position can substantially affect ball placement. Athletes with greater core stability are more capable of maintaining balance during explosive rotational movements, resulting in more accurate ball placement. (Wang, 2022) reported that periodized core training improved physical fitness and movement efficiency among racket sport athletes, supporting the findings of the present study. (Osman Kurttekin, 2024) found significant improvements in service performance following a structured core training intervention, highlighting the relationship between trunk stability and tennis-specific technical execution. Although resistance-based strength training resulted in lower improvements compared with periodized core training, the findings indicate that this training method still contributed positively to service accuracy. Resistance-based strength training increases muscular strength and power through the application of external loads. Greater muscular strength enhances racket-head speed, force production, and stroke consistency, all of which are important for successful service execution. The improvements observed in the resistance-training group suggest that increased upper-body strength enabled participants to generate more controlled and powerful service movements. These findings are consistent with (Naik, 2022), who reported significant improvements in tennis-related fitness and skill variables following resistance-training interventions.

The positive effect of resistance-based strength training can also be explained through its contribution to muscular control during racket-ball contact. Stronger muscles in the shoulders, arms, forearms, and wrists allow athletes to maintain racket stability throughout the service motion. This stability improves the ability to direct the ball accurately toward the intended target area. (Chen, 2025), in their systematic review and meta-analysis, concluded that strength and conditioning interventions significantly improved tennis performance variables, particularly serve speed and stroke effectiveness. Therefore, strength development remains an important component of tennis conditioning programs despite its lower impact on service accuracy compared with core-focused training. The relationship between muscular strength and service performance is further supported by the findings of (Dong, 2025), who reported that hand-grip strength accounted for 94.2% of the variance in service accuracy among competitive tennis players. Similarly, (Pavlović, 2026) emphasized the importance of neuromuscular and strength-oriented training for improving sports performance and reducing injury risk in tennis athletes. These findings suggest that muscular strength contributes substantially to service execution; however, optimal performance requires the integration of strength, balance, stability, and coordination. Strength alone may not fully compensate for deficiencies in movement control and trunk stability during the serving action.

Overall, the findings of the present study indicate that both training approaches are effective for improving service accuracy among intermediate-level tennis players. However, periodized core training appears to provide superior benefits because it directly addresses the biomechanical and neuromuscular requirements of the tennis serve. The results emphasize the importance of developing core stability as a foundation for efficient force transfer, movement coordination, and technical precision. Therefore, coaches and practitioners should consider incorporating structured periodized core training into regular tennis conditioning programs, particularly for intermediate-level athletes seeking to improve service accuracy and overall performance.

CONCLUSION

The research and analysis of the data show that both periodized core training and resistance-based strength training help intermediate-level tennis players at TitikTemuTennis Club serve more accurately. The fact that both treatment groups' average scores went up from pre-test to post-test shows that the training programs worked. The study's results show that periodized core training is better for improving service accuracy than resistance-based strength training. The group that did periodized core training had a bigger increase in their average scores than the group that did resistance-based strength training. The periodized core training group's improved service accuracy shows that having strong core muscles is important for tennis service approaches. Players who have good body stability may be able to stay balanced better and swing their racket in the right direction better, which will help them hit the ball more accurately to the service target area. So, periodized core training might be a good way for tennis players who are at an intermediate level to get better at serving.

REFERENCES

Aprial. (2025). Technical proficiency analysis in table tennis: A comparative study between advanced and intermediate players. *INSPIREE: Indonesian Sport Innovation Review*, *6*(1), 26–35. https://doi.org/10.53905/inspiree.v6i01.139

Arslan, E. (2022). The effect of core training on agility, strength performance and tennis skills on 10-14 year old tennis players. *Mediterranean Journal of Sport Science*, *5*(4), 1165–1175. https://doi.org/10.38021/asbid.1165237

Bangari, D. (2025). Effects of a 12-week integrated core and plyometric training program on tennis skills, agility, strength, and balance in adolescent. *Pedagogy of Physical Culture and Sports*, *29*(4), 408–418. https://doi.org/10.15561/26649837.2025.0408

Chen, C. (2025). The effects of core stability training on stroke accuracy and spin control in tennis players. *Revista Brasileira de Medicina do Esporte*, *22*(1), 1–14. https://doi.org/10.62617/mcb982

Deng, N. (2023). Effects of physical training programs on female tennis players' performance: A systematic review and meta-analysis. *Frontiers in Physiology*, *14*, 1–20. https://doi.org/10.3389/fphys.2023.1234114

Deng, N. (2024). Does motor imagery training improve service performance in tennis players? A systematic review and meta-analysis. *Behavioral Sciences*, *14*(3), Article 207. https://doi.org/10.3390/bs14030207

Deng, N. (2025). The effects of strength and conditioning interventions on serve speed in tennis players: A systematic review and meta-analysis. *Frontiers in Physiology*, *15*, 1–14. https://doi.org/10.3389/fphys.2024.1469965

Dong, K. (2025). Effects of periodization core training on physical fitness in college table tennis players. *PLOS ONE*, *20*(3), 1–14. https://doi.org/10.1371/journal.pone.0323430

Kizilca, S. (2025). The effects of six weeks of core training on service speed and certain motor characteristics in tennis players. *International Journal of Sport Exercise and Training Science*, *11*(1), 1–8. https://doi.org/10.18826/useeabd.1594321

Koya, N. (2022). Prediction of service performance based on physical strength in elite junior tennis players. *Frontiers in Psychology*, *13*, Article 898224. https://doi.org/10.3389/fpsyg.2022.898224

Kurttekin, O. (2024). The effects of combined training on tennis-specific performance in young tennis players. *Turkish Journal of Kinesiology*, *10*(4), 289–297. https://doi.org/10.31459/turkjkin.1563073

Muzaqir, M. R. (2025). Evaluation of physical fitness and technical skill levels in young table tennis athletes. *Journal of Physical Education, Sport, Health and Recreations*, *14*(2), 748–752. https://doi.org/10.15294/active.v14i2.28807

Naik, V. S. V. (2026). The impact of complex and resistance training on performance-related fitness and skill variables in adolescent tennis players. *International Journal for Multidisciplinary Research*, *8*(3), 8–11. https://doi.org/10.36948/ijfmr.2026.v08i03.80050

Pavlović, Đ. (2026). Effects of a training program on strength development in senior table tennis players. *Sport Media and Business*, *12*(1), 19–28. https://doi.org/10.58984/smb2601019d

Sohail, S. (2024). A sequel of integrative neuromuscular training to emphasize sports performance and injury prevention among tennis players. *VIMS Journal of Physical Therapy*, *6*(1), 29–37. https://doi.org/10.46858/VIMSJPT.6109

Wang, T. (2022). Core strength training in university female tennis players. *Revista Brasileira de Medicina do Esporte*, *28*(6), 651–653. https://doi.org/10.1590/1517-8692202228062022_0087

Zhu, J. (2023). Retraction: A novel artificial neural network-based biomechanical research on elbow injury of tennis serve. *Computational Intelligence and Neuroscience*, *2023*, Article 9806164. Hindawi. https://doi.org/10.1155/2023/9806164