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The Effect of Different Racket Weights on Accuracy in Forehand and Backhand Strokes in Recreational Tennis Players

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ABSTRACT

Purpose: Racket weight is a critical parameter influencing stroke mechanics and performance in tennis. This study aimed to examine the effects of two different racket masses on the accuracy of forehand and backhand strokes in recreational tennis players.

Methods: Twenty-nine recreational tennis players (18 males, 11 females; mean age: 22.86 ±2.52 years) participated in the study. A quantitative experimental design was employed using two identical racket models with different masses: lightweight (280g) and heavyweight (300g). Following a standardized warm-up, participants performed the Hitting Accuracy Tennis Test (HATT) for both forehand and backhand strokes in a counterbalanced order. Data was analyzed using Paired Samples t-tests to compare racket conditions and Paired Samples t-tests to evaluate gender differences.

Results: The analysis revealed no statistically significant differences in accuracy scores between the heavy and light rackets for either forehand (13.14 ±2.57 vs. 13.41 ±2.38, $p = 0.53$) or backhand strokes (13.28 ±2.14 vs. 13.41 ±2.24, $p = 0.77$). Furthermore, gender did not significantly influence accuracy performance across any of the tested conditions ($p > 0.05$).

Conclusion: State A 20g variation in racket mass does not significantly impact stroke accuracy among recreational players. These findings suggest that for this population, individual motor consistency is more influential than minor equipment modifications. Coaches should prioritize technical skill development over precise racket weight calibration for amateur athletes.

Keywords: Tennis; Racket mass; Stroke accuracy; Equipment selection; Recreational tennis players

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INTRODUCTION

Tennis is a complex sport that requires the integration of technical skills, biomechanical efficiency, neuromuscular coordination, and appropriate equipment selection (Fernandez et al., 2014; Pluim et al., 2007; Kramer et al., 2017; Piquer et al., 2025). In this context, the tennis racket is not merely a tool, but an important factor directly influencing stroke mechanics and overall performance (Liu Z., 2023). Racket characteristics such as mass, balance point, string tension, and frame stiffness may affect ball velocity, control, and the player's ability to execute strokes efficiently (Kotze et al., 2000; Elliott, 2006). Among these variables, racket mass has been widely emphasized as one of the main determinants of stroke production because it influences both energy transfer to the ball and the maneuverability of the racket (Cross, 2001). Previous biomechanical studies have shown that racket mass can affect the balance between power and control (Taraborrelli et al., 2019). According to basic mechanical principles, heavier rackets may generate greater momentum at impact and therefore contribute to higher ball velocity (Cross, 2001). However, increasing racket mass may also reduce swing speed and make the racket more difficult to control, especially during repeated strokes. In contrast, lighter rackets may improve maneuverability and allow quicker positioning, which can support stroke precision and directional control (Elliott, 2006; Whiteside et al., 2014). For this reason, racket selection should not be considered only in terms of strength or comfort, but also in relation to stroke accuracy and technical execution.

From a biomechanical perspective, successful tennis strokes depend on the effective transfer of force through the kinetic chain, starting from the lower limbs and continuing through the trunk, shoulder, arm, and finally the racket. Since the racket is the final segment of this chain, its mass may influence the efficiency and timing of force transfer. A racket that is too heavy for the athlete may disrupt stroke timing, reduce racket-head acceleration, and negatively affect the control of the racket face at impact. On the other hand, a racket with suitable mass may provide greater impact stability and contribute to more consistent stroke production (Elliott, 2006; Wang, 2005). Therefore, racket weight should be evaluated as a factor closely associated with both movement coordination and performance outcomes. In addition, accuracy is one of the most important components of tennis performance, particularly during forehand and backhand groundstrokes, where players aim to place the ball into specific target areas. Accuracy depends not only on technical ability, but also on the player's capacity to regulate force, maintain body stability, and control racket orientation during impact. Small changes in racket path or face angle may substantially affect ball placement. In this regard, racket weight may influence accuracy by changing the mechanical and coordinative demands of the stroke. While heavier rackets may provide a more stable impact feel, they may also require greater muscular effort and reduce fine control. Lighter rackets, by contrast, may allow faster preparation and easier adjustment, potentially benefiting target accuracy (Kwon et al., 2017; Reid et al., 2013).

The effect of racket mass may also differ according to stroke type. Forehand and backhand strokes are not biomechanically identical; the forehand generally allows greater trunk rotation and more natural force generation on the dominant side, whereas the backhand often involves different grip mechanics and coordination demands. Because of these differences, players may respond differently to racket weight depending on the stroke being performed. In particular, the backhand may be more sensitive to changes in maneuverability and timing than the forehand (Elliott, 2006; Busuttil et al., 2022). In addition, repeated use of heavier rackets may increase upper-extremity loading and contribute to fatigue, which could further reduce stroke consistency and precision over time (Creveaux et al., 2013; Rota et al., 2014; Allen et al., 2011; Banwell et al., 2014). Although many studies in tennis biomechanics have focused on ball velocity, serve mechanics, spin production, and stroke kinematics, fewer studies have directly examined how different racket weights affect target accuracy in both forehand and backhand strokes. This limitation is particularly important because performance in tennis depends not only on producing powerful shots, but also on placing the ball accurately and consistently. Therefore, investigating the relationship between racket weight and stroke accuracy may contribute to the literature and provide useful information for coaches and athletes in equipment selection.

The aim of this study is to examine the effects of different racket weights on the accuracy of forehand and backhand strokes in recreational tennis players. Accordingly, the main hypothesis of the study is that variations in tennis racket weight significantly affect the target accuracy of forehand and backhand groundstrokes in recreational tennis players.

MATERIAL and METHODS

This study adopts a quantitative experimental design to examine the comparative effects of varying tennis racket masses on the accuracy of forehand and backhand strokes among recreational players. The investigation will be conducted on public, outdoor tennis courts during off-peak hours to ensure a standardized and controlled environment. To mitigate external environmental influences, all testing sessions will be performed under similar weather conditions (e.g., low wind speed) to maintain the reliability of the performance data.

Participants

The target population consists of recreational adult tennis players aged 18–30 years. To determine the necessary sample size, a priori power analysis was performed using G*Power (v3.1.9.7). For a "Paired Samples t-test" designed to detect a medium effect size (d = 0.50) with an alpha level of alpha = 0.05 and a statistical power of 0.80, the minimum required sample size was calculated as 34 participants. Prior to the commencement of the study, all participants were comprehensively informed about the research objectives, experimental procedures, and potential risks. The study protocol was approved by the Izmir Demokrasi University Non-Interventional Research Ethics Committee (Approval No: IDU-GOAEK 2026/57) and conducted in strict accordance with the Declaration of Helsinki. Prior to data collection, written informed consent was obtained from each participant , and the confidentiality of all personal and performance data was strictly maintained throughout the study.

*Inclusion Criteria: i) v*oluntary participation and signing of informed consent, ii) absence of any musculoskeletal injuries within the last six months, iii) minimum of 2 years of active tennis experience and proficiency in the service stroke.

*Exclusion Criteria: i) a*ny physical impairment or injury precluding full-effort tennis performance, ii) inability to execute technically sound serves as required by the assessment protocol.

Procedures and Measures

The primary intervention involves the manipulation of racket mass while keeping all other technical specifications constant to ensure internal validity. Two identical racket models will be utilized: a lightweight racket (280g) and a heavyweight racket (300g). To ensure internal validity, two identical racket models from the same manufacturer were utilized. Both rackets shared the exact same head size, grip size, string type, and tension; the only varying parameter was the racket mass (Figure 1).

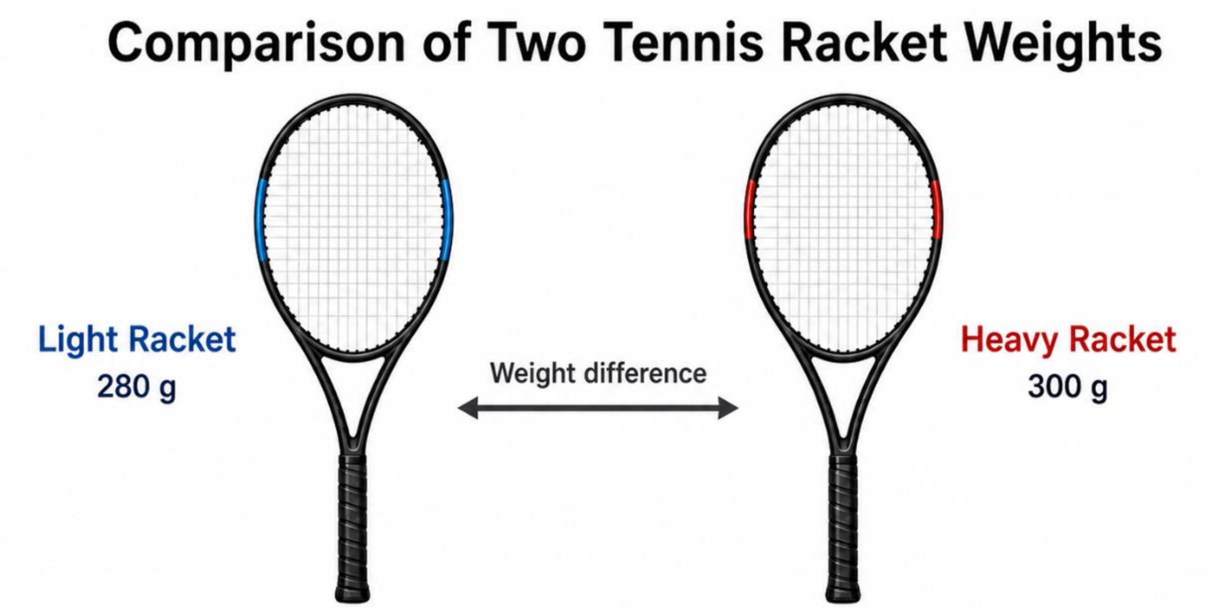

Figure 1: Racket Type

Scoring Protocol: To objectively assess hitting accuracy during the forehand and backhand groundstrokes, the modified Hitting Accuracy Tennis Test (HATT), developed by Strecker et al. (2011), was used. This approach is a validated method utilized in tennis literature for the evaluation of shot precision. The scoring process was based on pre-defined target zones designated on the court. Each shot was evaluated and assigned a score ranging from 1 to 5 points according to these zones, as follows:

5 points: Direct hit on the central target area, 4 points: Shots hitting very close to the central target, 3 points: Acceptable target area (service box or middle zone), 2 points: Shots landed out of the primary target area but within the court boundaries, 1 point: Errors (shot into the net or outside the court). Each participant executed a total of 20 forehand and 20 backhand strokes in each experimental condition (different racket weights). The scores for these shots were recorded individually. Subsequently, the total points accumulated by the participants from the different groundstroke trials were analyzed (Strecker et al., 2011; ITF, 2004).

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics (v27.0). Descriptive statistics were calculated and presented as mean ($\bar{x}$) standard deviation (±SD). The normality of the data distribution was verified using the Shapiro-Wilk test, which confirmed that all variables met the assumptions for parametric testing. To evaluate the impact of racket mass on performance, a Paired Sampe t-test was employed to compare the service scores of the forehand and backhand strokes obtained with the heavy (300g) versus the light (280g) rackets. Furthermore, to quantify the magnitude of the differences between the two conditions, Cohen's d effect sizes were calculated. Effect sizes were interpreted as small (0.2), medium (0.5), and large (0.8). The level of statistical significance for all analyses was set at $p < 0.05$.

RESULTS

The study involved 29 recreational tennis players (18 male and 11 female). The demographic and physical characteristics of the participants were as follows: mean age 22.86 ±2.52 years, mean body mass 64.79 ±12.13 kg, and mean height 168.00 ±8.5 cm. Additional body composition analysis revealed a mean body fat percentage of 22.24 ±3.43 and a muscle mass percentage of 38.76 ±3.08 (Table 1). These baseline characteristics indicate a physically active young adult population.

Table 1: Descriptive Characteristics of the Participants (Mean ± SD)

N= 29	**Mean**	**Std. Deviation**
Age (years)	22.86	2.51
Body Mass (kg)	64.79	12.12
Height (cm)	168.00	8.55
Body Fat Percentage (%)	22.24	3.42
Muscle Mass Percentage (%)	38.75	3.07
Heavy Racket Forehand (Score)	13.13	2.57
Heavy Racket Backhand (Score)	13.27	2.13
Light Racket Forehand (Score)	13.41	2.38
Light Racket Backhand (Score)	13.41	2.24

A Paired Sampe T- test was performed to evaluate whether a difference in racket mass (Heavy: 300g vs. Light: 280g) significantly altered the accuracy scores of recreational tennis players. The analysis confirmed that changes in racket weight within this range did not lead to statistically significant differences in performance for either stroke type. For the forehand strokes, the mean accuracy score with the heavy racket was 13.14 ±2.57, while the light racket resulted in a mean score of 13.41 ±2.38. This difference was not statistically significant ($t(28) = -0.630$, $p= .534$; $d = -0.117$). Similarly, no significant difference was observed in backhand stroke accuracy between the heavy racket (13.28 ±2.14) and the light racket (13.41 ±2.24; $t(28) = -0.293$, $p= .771$; $d = -0.054$; Figure 2).

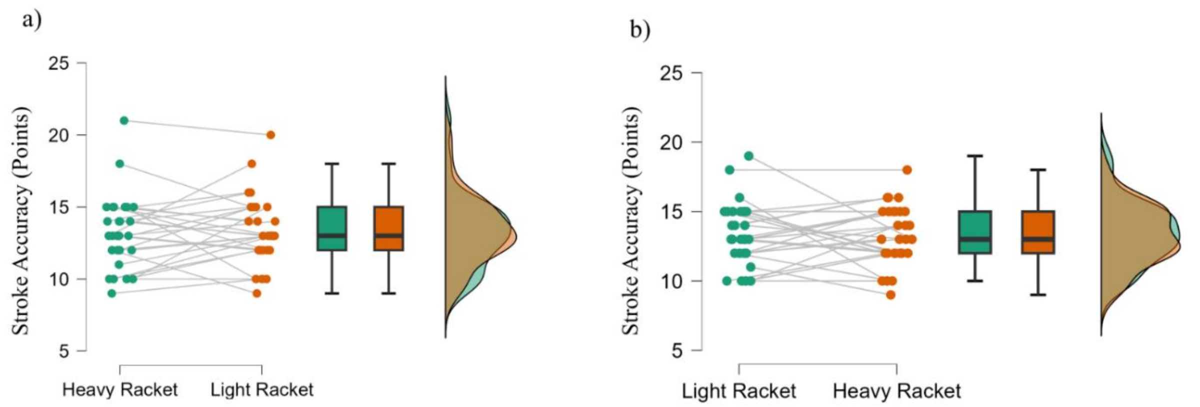

Figure 2: Raincloud plots illustrating the distribution and individual changes in accuracy scores for forehand and backhand strokes across different racket weight conditions (Light:280g vs. Heavy:300g). a) Forehand stroke accuracy, b) Backhand stroke accuracy.

In addition, an Independent Sampe T-test was conducted to examine whether stroke accuracy scores differed significantly between male and female participants. The analysis revealed no statistically significant differences based on gender for any of the tested conditions ($p > .05$). Accuracy scores remained consistent across genders for both the heavy racket (Forehand: $p= .61$; Backhand: $p= .99$) and the light racket (Forehand: $p= .094$; Backhand: $p= .272$) trials.

DISCUSSION

The primary objective of this study was to investigate the influence of racket mass variations (280g vs. 300g) on the accuracy of forehand and backhand strokes in recreational tennis players. It was hypothesized that a lighter racket would enhance maneuverability and result in higher accuracy scores, whereas a heavier racket might compromise precision due to increased muscular demand. However, our findings demonstrated that a 20g difference in racket mass did not lead to any statistically significant differences in stroke accuracy for either forehand or backhand trials. Furthermore, no significant performance variations were observed based on the gender of the participants.

When examining these results within the context of current literature, our findings partially diverge from studies conducted on elite or professional athletes. In professional tennis, even marginal changes in equipment specifications can significantly alter swing kinematics and ball velocity (Cross, 2001; Elliott, 2006; Knudson, 2008). Specifically, research on impact mechanics indicates that increased racket mass leads to a higher post-impact ball velocity due to a more favorable coefficient of restitution and increased effective mass at the point of contact (Haake et al., 2000; Rogowski et al., 2009). However, the lack of significant findings in our study may be attributed to the technical proficiency level of the participants. According to the "speed-accuracy trade-off" principle, higher momentum from a heavier racket often requires a compensatory reduction in swing acceleration to maintain directional control, a phenomenon particularly evident in non-elite populations (Knudson, 2007).

As recreational players primarily focus on basic motor execution rather than refined biomechanical efficiency, they may possess a lower degree of "neuromuscular sensitivity" toward equipment weight variations. In this specific population, the 20g mass difference might not be substantial enough to surpass the threshold required to disrupt their established stroke mechanics or accuracy. Furthermore, Allen et al. (2011) suggest that recreational players often lack the "impact consistency" found in professionals, meaning their inherent shot-to-shot variability likely masks any subtle mechanical advantages provided by different racket weights. The absence of a significant difference suggests that at the recreational level, individual variability and general motor consistency play a more dominant role in shot precision than the physical attributes of the racket.

Another factor to consider is the moment of inertia (swing weight). While we manipulated the static mass, the perceived "heaviness" during a swing is dictated by the mass distribution (Cross & Bower, 2006). It is possible that for recreational players, the sensory feedback from a 20g difference is insufficient to trigger a significant alteration in the kinetic chain or the timing of the "distal-to-proximal" sequencing required for accurate ball placement. While heavier rackets technically provide higher momentum transfer (Cross, 2001), recreational players may inadvertently compensate for the extra mass by reducing their swing speed, thereby maintaining a consistent but non-significant accuracy level across different equipment.

Practical Applications

The findings of this study provide evidence-based insights for coaches and recreational athletes regarding equipment selection. For players at an amateur or recreational level, the choice between a 280g and a 300g racket can be made based on personal comfort and "feel" rather than concerns over technical accuracy. Coaches should prioritize technical skill development and motor consistency over specific equipment calibration for this demographic, as racket mass within this range does not appear to be a limiting factor for performance precision.

Limitations and Future Research

Several limitations should be acknowledged. First, the sample was restricted to recreational players; therefore, the results cannot be generalized to professional or high-performance athletes who may be more sensitive to equipment changes. Although the priori power analysis indicated a required sample size of 34, the study was completed with 29 participants, which may have slightly reduced the statistical power of the findings. Second, only two specific racket weights were compared; a wider range of mass variations might yield different results. Future research should incorporate kinematic analysis, such as using high-speed cameras or wearable sensors, to observe how swing paths and joint angles adapt to different racket weights even when the final accuracy score remains unchanged.

CONCLUSION

In conclusion, this study demonstrates that a 20g variation in tennis racket mass does not significantly impact the forehand and backhand stroke accuracy of recreational tennis players. Additionally, the results indicate that accuracy performance remains consistent across genders under these conditions. These findings suggest that for the recreational population, equipment weight within the 280g-300g range is not a primary determinant of shot precision, emphasizing that technical training remains the most critical factor for improving performance at this level.

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Data Availability: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of AI Use: During the preparation of this work, the authors used Grammarly and ChatGPT 5.1 to improve the readability and language. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

Credit Authorship Contribution Statement

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