JOURNAL OF SPORTS, EXERCISE, AND PERFORMANCE

The Effect of Shoulder-Specific Warm-up on Serve Performance in Recreational Female Tennis Players

Sevdiye KARADAYI[1], Melis ORDO[1], Meltem ÖLMEZ[1], Gülseren YÜREKLİ[1]

[1] Department of Exercise and Sports Sciences, Faculty of Health Sciences, Izmir Demokrasi University, Izmir, Turkey

ABSTRACT

Purpose: The tennis serve is a complex stroke governed by the kinetic chain, wherein the shoulder girdle plays a vital role in force transmission and joint centricity. This study aimed to investigate the acute effects of a supplemental shoulder girdle activation protocol on serve accuracy in recreational female tennis players.

Methods: Thirty-three recreational female tennis players (mean age: 25.45 ± 3.55 years; mean tennis experience: 6.81 ± 4.19 months) participated in a quasi-experimental, within-subjects repeated measures design. Participants performed a modified 10-serve International Tennis Federation (ITF) On-Court Assessment test (maximum score: 40 points) under two separate conditions separated by at least 48 hours: a control condition (general warm-up alone) and an experimental condition (general warm-up plus a targeted 5-exercise shoulder girdle activation protocol utilizing resistance bands and dynamic tennis ball tosses). The data were analyzed using the non-parametric Wilcoxon signed-rank test.

Results: Serve accuracy scores were significantly higher following the specific shoulder girdle activation protocol (24.82 ± 16.79 points) than following the general warm-up alone (14.94 ± 7.06 points; $p = .002$, rank-biserial $r = -0.64$).

Conclusions: A brief, targeted shoulder girdle warm-up added to a general warm-up acutely improved serve accuracy in recreational female tennis players. This time-efficient on-court routine may offer coaches and players a practical strategy to support serve consistency; however, given the fixed order of conditions and the large inter-individual variability, these findings should be confirmed in randomized, counterbalanced designs.

Keywords: Rotator cuff; Scapular stability; Kinetic chain; Post-activation performance enhancement; Racket sports

Corresponding Author:

**Gülseren YÜREKLİ*
Izmir Demokrasi University, Izmir-Turkey
gulseren.yurekli@idu.edu.tr
ORCID: 0000-0002-5195-4766

To Cite This Article:

Karadayı, S., Ordo, M., Ölmez, M., & Yürekli, G. (2026). The Effect of Shoulder-Specific Warm-up on Serve Performance in Recreational Female Tennis Players. *Journal of Sports, Exercise, and Performance, 1*(2), 132–142. https://doi.org/10.66614/josep2026.8

Copyright:

© 2026 by the authors. Published by the Journal of Sports, Exercise, and Performance (JOSEP).

This is an open access article distributed under the terms of the Creative Commons Attribution (CC BY 4.0) license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Tennis is a sport that requires a sophisticated blend of physiological attributes, including aerobic endurance, anaerobic power, and highly refined motor coordination. In recent years, both professional and recreational participation in tennis has surged globally. As the physical demands of the sport increase, the implementation of structured pre-activity warm-up routines has become a standard practice to maximize athletic output and mitigate the risk of musculoskeletal injuries. Traditionally, these routines comprise low-intensity aerobic exercises, static or dynamic stretching, and sport-specific movements designed to increase core temperature and enhance joint range of motion (ROM) (Ayala et al., 2016; He, 2024).

The tennis serve is arguably the most complex and vital stroke in the game, serving as the primary tool for point initiation and dominance. Biomechanically, the serve is characterized by a "kinetic chain" that originates from the lower extremities, transfers through the trunk and torso rotation, and culminates in the explosive acceleration of the upper extremity (van der Hoeven & Kibler, 2006; Kovacs & Ellenbecker, 2011; Yaşar et al., 2026). Within this chain, the shoulder girdle - encompassing the glenohumeral joint, the scapulothoracic articulation, and the surrounding musculature - acts as a critical junction for force transmission. Specifically, the rotator cuff muscles and scapular stabilizers are tasked with the dual role of generating torque and maintaining joint centricity during the high-velocity "cocking" and "follow-through" phases of the serve (Elliott, 2006; Ryu et al., 1988). In recreational female players, the shoulder complex often encounters significant eccentric loads without the benefit of the advanced neuromuscular conditioning typically found in elite athletes. Literature suggests that conventional warm-up protocols may not sufficiently activate the stabilizing musculature of the shoulder girdle, potentially leading to suboptimal force transfer and an increased risk of impingement or overuse syndromes (Hoppe et al., 2022).

Recent advancements in sports science have highlighted the efficacy of "Post-Activation Performance Enhancement" (PAPE) and dynamic activation through resistance tubing and plyometric drills. These methods are hypothesized to increase motor unit recruitment and synovial fluid production, thereby optimizing the mechanical efficiency of the shoulder during explosive overhead tasks (Reinold et al., 2010; Wilk et al., 1993). In addition, activation of the rotator cuff and scapular stabilizers in overhead athletes has been shown to vary considerably with shoulder position, suggesting that activation exercises performed in serve-relevant positions, such as 90° of shoulder abduction, may be particularly appropriate (Ashworth et al., 2025). Evidence-based interventions focusing on the shoulder girdle have shown promise in

improving throwing velocity in other overhead sports, yet their acute impact on tennis serve accuracy and performance in recreational female cohorts remains under-researched. Bridging the gap between elite-level sports science and recreational practice is essential for enhancing players' longevity and performance. Isolating the effects of shoulder-specific activation drills—such as external rotations and sport-specific deceleration tosses—may therefore clarify whether a localized intervention can improve serve accuracy beyond a standard general warm-up (Fernández-Fernández et al., 2020; Riddle et al., 2018).

The primary objective of this study is to investigate the acute effects of a specific shoulder girdle warm-up protocol, performed in addition to a general warm-up routine, on tennis serve accuracy performance among recreational female tennis players. By isolating the impact of targeted scapular and rotator cuff activation, this research seeks to determine whether a localized neuromuscular intervention can yield immediate performance enhancements beyond the results of traditional preparation methods. In this context, the study is guided by the hypothesis (H1) that a specific shoulder girdle activation protocol added to a general warm-up routine will result in significantly higher serve accuracy scores in recreational female tennis players compared to the application of a general warm-up routine alone.

MATERIAL and METHODS

This study employed a quasi-experimental, within-subjects repeated measures design to evaluate the acute effects of a specific shoulder girdle warm-up on tennis serve performance. By utilizing each participant as their own control, the study aimed to minimize inter-individual variability and enhance the statistical power of the performance comparisons.

Participants

The study sample consisted of recreational female tennis players (n = 33) recruited from local tennis clubs in İzmir, Turkey, aged 18–30 years. The required sample size was determined using G*Power (v3.1.9.7). For a one-tailed dependent-samples t-test (matched pairs) designed to detect a medium effect size (d = 0.50) with $\alpha = 0.05$ and a statistical power of 0.80, the minimum required sample size was calculated as 27 participants. A corresponding calculation for the Wilcoxon signed-rank test (matched pairs, one-tailed; parent distribution: normal) yielded a minimum of 28 participants (31 under the more conservative min ARE assumption); the final sample of 33 participants therefore exceeded these requirements. Prior to the commencement of the study, all participants were comprehensively informed about the research objectives, experimental procedures, and potential risks. Each participant provided written

informed consent by signing a voluntary participation form. The study was conducted in strict accordance with the ethical principles for medical research involving human subjects as outlined in the Declaration of Helsinki. The study protocol was approved by the Non-invasive clinical research ethics committee of Izmir Demokrasi University (approval number: 2026/7-6). Additionally, the confidentiality of all personal and performance data was strictly maintained throughout the data collection and analysis processes.

Inclusion Criteria: i) voluntary participation, ii) absence of any musculoskeletal injuries within the last 6 months, iii) age between 18 and 30 years, iv) having previously played tennis and being able to serve.

Exclusion Criteria: i) any physical limitation or injury when playing tennis, ii) inability to perform technically sound serves as specified in the evaluation protocol.

Procedures and Measures

Data collection was conducted over two separate sessions, with a minimum 48-hour recovery period between visits to prevent fatigue carry-over. The conditions were administered in a fixed order, with the control condition always completed in Session 1 and the experimental condition in Session 2.

Session 1 (Control Condition): Participants initially provided demographic data (age, height, and months of tennis experience). They then performed their habitual general warm-up routine (5 minutes of light jogging and general dynamic stretching). Immediately following this routine, participants underwent the Tennis Serve Accuracy Test (ITF, 2004).

Session 2 (Experimental Condition): Participants performed the same general warm-up routine as in Session 1. This was immediately followed by the Specific Shoulder Girdle Warm-up Protocol. Each exercise was performed for three sets. The number of repetitions per set was not recorded, and rest intervals were self-selected: because participants were warmed up individually, each participant proceeded to the next set or exercise when she felt ready. Resistance-band exercises were performed with an elastic band of blue resistance level (Decathlon, France), and all tossing and throwing drills were performed with a standard tennis ball. The total duration of the specific protocol was less than 10 min. The protocol comprised the following exercises:

i. *External Rotation with Resistance Band (Neutral):* Performed with the shoulder in a neutral adducted position and the elbow flexed at 90°, focusing on the isolated activation of the infraspinatus and teres minor.

ii. *90°/90° External Rotation with Resistance Band:* Conducted with the shoulder abducted to 90° and the elbow flexed at 90°, specifically targeting the rotator cuff during the terminal phases of the serve's cocking motion.

iii. *Overhead Tennis Ball Toss:* A sport-specific dynamic loading drill utilizing the stretch-shortening cycle (SSC) to prepare the upper extremity for the explosive overhead demands of the service stroke.

iv. *90°/90° Rotational Side Toss:* Performed in a 90° abducted position to optimize rotational force transmission and kinetic chain integration across the transverse plane.

v. *Deceleration Throw (Slowed Baseball Throw):* A functional exercise emphasizing the eccentric control of the posterior shoulder musculature, specifically designed to prepare the joint for the high-intensity deceleration forces following racquet-ball impact.

Following this specific warm-up activation, participants performed the same Serve Accuracy Test. In both conditions, the interval between the end of the warm-up and the first test serve was less than 1 min.

Scoring Protocol: To evaluate service performance, a modified version of the ITF On-Court Assessment Protocol (ITF, 2004) was employed. While the original International Tennis Number (ITN) protocol involves a higher volume of serves and a broader scoring range, this study utilized a condensed version consisting of 10 service attempts per session. This modification was implemented to prevent the potential impact of physical fatigue on performance metrics and to ensure the protocol remained appropriate for the skill and conditioning levels of recreational players. Under this modified protocol, each participant aimed for four pre-defined target zones within the service boxes. Each of the two service boxes was divided into a front half (adjacent to the net) and a back half (adjacent to the service line), yielding four equal target zones: zones 1 and 2 at the front and zones 3 and 4 at the back. Of the 10 attempts, three were directed at each front zone and two at each back zone (3 + 3 + 2 + 2 = 10). For each attempt, a second serve was allowed if the first serve was a fault. The score was calculated as follows: 0 Points: Ball hitting the net or landing outside the target area. 1 Point: Ball landing in the correct service box but missing the specific target on the second serve. 2 Points: Ball landing in the specific target on the second serve OR in the correct service box but missing the target on the first serve. 4 Points: Ball landing in the specific target on the first serve. The maximum attainable score in each condition was therefore 40 points (10 serves × 4

points). All serves were scored by the researchers, who were not blinded to the testing condition. The reliability of the modified test was not assessed in the present sample.

Statistical Analysis

Statistical analyses were performed using JASP (version 0.95). Descriptive statistics were calculated and presented as mean ± standard deviation (SD). The normality of the data distribution was assessed using the Shapiro–Wilk test. The results indicated that serve accuracy scores in the experimental condition, as well as age, height and tennis experience, significantly deviated from a normal distribution ($p < .05$). Because the primary outcome measures violated the assumption of normality, the non-parametric Wilcoxon Signed-Rank Test was employed to evaluate the acute differences in serve accuracy between the control condition (General Warm-up) and the experimental condition (General Warm-up + Specific Shoulder Girdle Warm-up). Effect size was quantified using the matched-pairs rank-biserial correlation (r_{rb}) with its 95% confidence interval (CI); because differences were computed as control minus experimental condition, a negative r_{rb} indicates higher scores in the experimental condition. Pairs with identical scores in both conditions (zero differences) were excluded from the ranking procedure, as is standard for the Wilcoxon signed-rank test; this applied to one participant. The level of statistical significance for all analyses was set at $p < .05$.

RESULTS

The present study evaluated the acute effects of a supplemental shoulder girdle activation protocol on serve accuracy performance among recreational female tennis players. Prior to conducting inferential analyses, exploratory data screening and normality assessments were performed on all measured parameters. Descriptive statistics for baseline anthropometric characteristics, tennis experience, and serve accuracy scores across conditions are summarized in Table 1. The cohort comprised 33 female participants with a mean age of 25.45 ± 3.55 years, an average height of 166.42 ± 5.45 cm, and mean tennis playing experience of 6.81 ± 4.19 months.

Table 1: Descriptive Statistics and Normality Assessment of Study Variables (N = 33)

Variable	Mean	SD	Shapiro–Wilk (W)	p
Age (years)	25.45	3.55	0.903	.006
Height (cm)	166.42	5.45	0.921	.019
Tennis Experience (months)	6.81	4.19	0.712	< .001
Serve score: GW	14.94	7.06	0.967	.410
Serve score: GW + SSW	24.82	16.79	0.925	.024

Note. SD = standard deviation; GW = general warm-up (control condition); SSW = specific shoulder girdle warm-up (experimental condition). Shapiro–Wilk p values below .05 indicate a significant departure from normality.

Comparison of Serve Accuracy Across Conditions

A Wilcoxon signed-rank test was conducted to determine whether the addition of a targeted shoulder girdle activation protocol yielded acute improvements in service accuracy compared with the control condition (general warm-up alone). The analysis demonstrated a statistically significant enhancement in serve accuracy scores following the specific shoulder activation protocol ($W = 95.00$, $z = -3.160$, $p = .002$, $r_{rb} = -0.640$, 95% CI [−0.818, −0.351]). As detailed in Table 2, participants achieved a mean serve accuracy score of 14.94 ± 7.06 points under the control condition, which increased to 24.82 ± 16.79 points following the supplemental shoulder girdle warm-up intervention. The effect size, quantified via the matched-pairs rank-biserial correlation, was large ($|r_{rb}| = 0.64$). The negative sign of r_{rb} reflects the direction of the comparison (control minus experimental condition) and indicates that most participants obtained higher serve accuracy scores after the specific shoulder girdle warm-up than after the general warm-up alone. These findings support the research hypothesis (H1), suggesting that adding targeted scapular and rotator cuff exercises to a general warm-up may acutely improve serve accuracy in recreational female players. However, the large standard deviation in the experimental condition (SD = 16.79 points) indicates considerable inter-individual variability in the response to the protocol.

Table 2: Wilcoxon Signed-Rank Test Results Comparing Serve Accuracy Between Warm-Up Conditions

Condition	*N*	Mean	*SD*	*W*	*z*	*p*	r_{rb} (95% CI)	*SE*
GW (control)	33	14.94	7.06	95.00	−3.160	.002	−0.640 [−0.818, −0.351]	0.200
GW + SSW (experimental)	33	24.82	16.79					

Note. GW = general warm-up (control condition); SSW = specific shoulder girdle warm-up (experimental condition); N = sample size; SD = standard deviation; W = Wilcoxon test statistic; z = standardized test statistic; r_{rb} = matched-pairs rank-biserial correlation (negative values indicate higher scores in the GW + SSW condition); CI = confidence interval; SE = standard error of the effect size. Level of significance: $p < .05$.

DISCUSSION

The present findings suggest that a targeted shoulder girdle activation protocol, added to a general warm-up, may acutely improve serve accuracy among recreational female players, a result that is consistent with the broader literature showing that scapular and rotator cuff activation patterns are closely tied to the kinetic chain of the tennis serve (Kibler et al., 2007). The direction of this effect also parallels findings in elite junior players, in whom a dynamic warm-up produced faster and more accurate serves than a traditional warm-up (Ayala et al., 2016). Previous work on the serve has similarly emphasized that efficient force transfer from the lower limbs and trunk to the upper extremity depends on adequate scapular positioning and glenohumeral mobility, with thoracic posture directly influencing the range of motion available at the end of the cocking phase (Le Solliec et al., 2023). Within this kinetic-chain framework, the findings of the present study suggest that the acute gains in accuracy may reflect improved proximal stability that allows more repeatable sequencing of the serve, although this mechanism was not measured directly. This interpretation is in line with evidence that brief pre-serve interventions that do not alter stroke technique can acutely influence serve performance; for example, contracting the non-dominant hand before serving improved serve performance under pressure in skilled tennis players (Mizuno & Masaki, 2024). Consistent with this mechanism, the acute benefit observed here may also reflect a reduction in the variability of impact height, although this variable was not measured in the present study; in junior players, lower variability in impact height has been shown to strengthen the relationship between shoulder-rotation strength and serve speed (Vacek et al., 2025). Because the present protocol targeted scapular and rotator cuff activation rather than maximal force production, the observed gains are better interpreted as a shift in how existing shoulder-girdle capacity is organized and sequenced during the serve, consistent with evidence that shoulder kinematics during the serve, such as internal rotation velocity, may be modified acutely by interventions that do not target strength (Zappala et al., 2017). Accordingly, the present protocol may be most useful as a low-cost, pre-serve preparation strategy in which scapular and rotator cuff activation supports the timing and consistency of the kinetic chain, although whether these acute accuracy gains translate into sustained improvements in serve performance across repeated sessions remains to be determined. Future work should examine whether repeated application of this protocol across training blocks produces cumulative adaptations in serve consistency, and whether these effects generalize to match play conditions where fatigue and competitive pressure may alter scapular control.

Limitations and Future Research

The present findings should be interpreted in light of several limitations. First, the protocol was applied only once (i.e., a single application of the protocol); therefore, only its acute effect was examined, and whether repeated application produces cumulative or lasting improvements remains unknown. Second, the conditions were administered in a fixed order (control condition first) without randomization or counterbalancing, so learning, familiarization or order effects may have contributed to the higher scores in the experimental condition. Third, the assessor who scored the serves was not blinded to the testing condition, which may have introduced assessment bias. Fourth, serve speed was not measured; because players may trade speed for accuracy, the improvement in accuracy cannot be interpreted independently of possible changes in serve velocity. Fifth, scores in the experimental condition showed considerable inter-individual variability (SD = 16.79 points on a 40-point scale), indicating that responses to the protocol differed markedly between participants and that the mean improvement may not apply to all players. Sixth, the design did not include a control condition with non-specific upper-body activation of equal duration and did not isolate the individual components of the protocol; consequently, it cannot be determined whether targeting the scapular stabilizers and rotator cuff, rather than additional warm-up volume or time, accounts for the observed gains. Finally, the convenience sample was limited to recreational female players with relatively short playing experience, which restricts generalizability to male, younger or more skilled players. Future studies should use randomized, counterbalanced crossover designs with blinded assessors, measure serve speed alongside accuracy, examine whether the effects persist across repeated training sessions and transfer to match play, and include more diverse samples.

CONCLUSION

The findings of this study suggest that a brief, targeted shoulder girdle activation protocol, added to a general warm-up, may acutely improve serve accuracy among recreational female tennis players. Although the underlying mechanisms were not measured, priming the rotator cuff and scapular stabilizers may support a more reproducible kinetic chain transfer and more consistent racket delivery at ball impact.

From a practical and on-court perspective, these results suggest that a general warm-up alone (e.g., light jogging and dynamic stretching) may not fully prepare the shoulder for the complex mechanics of the overhead serve. Coaches, strength and conditioning specialists, and

recreational athletes may consider integrating targeted resistance-band external rotations and deceleration drills as a time-efficient component of their pre-match or pre-practice preparation. Requiring minimal equipment and less than 10 minutes to complete, this protocol offers an accessible, low-cost field strategy that may support serve accuracy from the first game; its potential role in injury prevention was not examined and warrants future investigation. Given the fixed order of conditions and the large inter-individual variability, these recommendations should be regarded as preliminary until confirmed in randomized, counterbalanced studies.

Acknowledgments: We would like to thank all the participants for their participation in this study.

Author Contributions: Sevdiye KARADAYI: Data Curation, Formal Analysis, Visualization, Writing – Original Draft, Writing – Review & Editing; Melis ORDO: Data Curation, Investigation (Data Collection), Formal Analysis, Visualization, Writing – Original Draft, Writing; Meltem ÖLMEZ: Formal Analysis, Writing – Original Draft, Writing – Review & Editing; Gülseren YÜREKLİ: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Supervision. All authors read and approved the final manuscript.

Funding: This study was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2209-A University Students Research Projects Support Program (project number: 1919B012517441).

Ethics Statement: The study protocol was approved by the non-invasive clinical research ethics committee of Izmir Demokrasi University (approval number: 2026/7-6) and was conducted in accordance with the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants prior to participation.

Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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.

REFERENCES

Ashworth, B., Hank, M., Khaiyat, O., Coyles, G., Miřátský, P., Verbruggen, F. F., Zahálka, F., & Malý, T. (2025). Muscle activity relationships during isometric shoulder internal and external rotation using the ForceFrame dynamometer and athletic shoulder tests in baseball athletes. *Frontiers in Physiology, 16*, 1632248. https://doi.org/10.3389/fphys.2025.1632248

Ayala, F., Moreno-Pérez, V., Vera-García, F. J., Moya, M., Sanz-Rivas, D., & Fernández-Fernández, J. (2016). Acute and time-course effects of traditional and dynamic warm-up routines in young elite junior tennis players. *PLoS ONE, 11*(4), e0152790. https://doi.org/10.1371/journal.pone.0152790

Elliott, B. (2006). Biomechanics and tennis. *British Journal of Sports Medicine, 40*(5), 392–396. https://doi.org/10.1136/bjsm.2005.023150

Fernández-Fernández, J., García-Tormo, V., Santos-Rosa, F. J., Teixeira, A. S., Nakamura, F. Y., Granacher, U., & Sanz-Rivas, D. (2020). The effect of a neuromuscular vs. dynamic warm-up on physical performance in young tennis players. *Journal of Strength and Conditioning Research, 34*(10), 2776–2784. https://doi.org/10.1519/jsc.0000000000003703

He, C. (2024). The influence of pre-competition warm-up strategies on athletes' performance. *Frontiers in Humanities and Social Sciences, 4*(10), 176–187. https://doi.org/10.54691/a353cx07

Hoppe, M. W., Brochhagen, J., Tischer, T., Beitzel, K., Seil, R., & Grim, C. (2022). Risk factors and prevention strategies for shoulder injuries in overhead sports: An updated systematic review. *Journal of Experimental Orthopaedics, 9*(1), 78. https://doi.org/10.1186/s40634-022-00493-9

International Tennis Federation. (2004). *ITN on-court assessment manual*.

Kibler, W. B., Chandler, T. J., Shapiro, R., & Conuel, M. (2007). Muscle activation in coupled scapulohumeral motions in the high performance tennis serve. *British Journal of Sports Medicine, 41*(11), 745–749. https://doi.org/10.1136/bjsm.2007.037333

Kovacs, M. S., & Ellenbecker, T. S. (2011). An 8-stage model for evaluating the tennis serve: Implications for performance enhancement and injury prevention. *Sports Health: A Multidisciplinary Approach, 3*(6), 504–513. https://doi.org/10.1177/1941738111414175

Le Solliec, T., Blache, Y., & Rogowski, I. (2023). Effects of an 8-week multimodal program on thoracic posture, glenohumeral range of motion and serve performance in competitive young tennis players. *Frontiers in Sports and Active Living, 5*, 1128075. https://doi.org/10.3389/fspor.2023.1128075

Mizuno, K., & Masaki, H. (2024). Effects of left-hand contraction on tennis serve performance. *Frontiers in Psychology, 15*, 1386025. https://doi.org/10.3389/fpsyg.2024.1386025

Reinold, M. M., Gill, T. J., Wilk, K. E., & Andrews, J. R. (2010). Current concepts in the evaluation and treatment of the shoulder in overhead throwing athletes, part 2: Injury prevention and treatment. *Sports Health: A Multidisciplinary Approach, 2*(2), 101–115. https://doi.org/10.1177/1941738110362518

Riddle, E., Balala, L., & Kopecka, B. (2018). *The effect of a resistance band shoulder strengthening program on tennis serve accuracy in women's collegiate tennis players* [Conference presentation]. Linfield College Student Symposium. https://digitalcommons.linfield.edu/symposium/2018/all/51

Ryu, R. K. N., McCormick, J., Jobe, F. W., Moynes, D. R., & Antonelli, D. (1988). An electromyographic analysis of shoulder function in tennis players. *The American Journal of Sports Medicine, 16*(5), 481–485. https://doi.org/10.1177/036354658801600509

Vacek, J., Vágner, M., Maleček, J., Simsa, J., Oláh, V., & Šťastný, P. (2025). The role of toss zenith and impact height in the relationship between shoulder rotation strength and serve speed in junior tennis players. *Journal of Functional Morphology and Kinesiology, 10*(4), 438. https://doi.org/10.3390/jfmk10040438

van der Hoeven, H., & Kibler, W. B. (2006). Shoulder injuries in tennis players. *British Journal of Sports Medicine, 40*(5), 435–440. https://doi.org/10.1136/bjsm.2005.023218

Wilk, K. E., Voight, M., Keirns, M. A., Gambetta, V., Andrews, J. R., & Dillman, C. J. (1993). Stretch-shortening drills for the upper extremities: Theory and clinical application. *Journal of Orthopaedic and Sports Physical Therapy, 17*(5), 225–239. https://doi.org/10.2519/jospt.1993.17.5.225

Yaşar, O. M., Durduran, S., & Akyürek, H. (2026). The effect of different racket weights on accuracy in forehand and backhand strokes in recreational tennis players. *Journal of Sports, Exercise, and Performance, 1*(1), 1–11. https://doi.org/10.66614/josep2026.1

Zappala, J., Orrego, C., Boe, E., Fechner, H., Salminen, D., & Cipriani, D. (2017). Influence of posture-cuing shirt on tennis serve kinematics in Division III tennis players. *Journal of Chiropractic Medicine, 16*(1), 49–53. https://doi.org/10.1016/j.jcm.2016.05.003