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# Efficacy of Resistance Band Training on Shoulder Muscle Strength and Injury Prevention in Volleyball Athletes

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**Authors' Contribution:** A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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## Abstract

**Background and study aim.** Shoulder injuries are common in women volleyball players, often resulting from repetitive overhead movements. Effective strength training methods can help prevent these injuries. This study aimed to investigate the efficacy of an eight-week resistance band training program on shoulder muscle strength enhancement and injury prevention in women volleyball athletes.

**Material and Methods.** Forty collegiate women volleyball players, aged 18-25, were randomly assigned to either an intervention group (n=20) or a control group (n=20). The intervention group underwent a structured resistance band training program targeting shoulder strength, which included exercises like shoulder presses, lateral raises, internal and external rotations, and scapular retractions. Isokinetic dynamometry was used to assess shoulder muscle strength before and after the intervention, measuring peak torque of the shoulder flexors, extensors, internal rotators, and external rotators. Injury rates were monitored throughout the volleyball season, documenting the number and severity of shoulder injuries.

**Results.** Significant improvements in shoulder muscle strength were observed in the intervention group across all measured parameters ($p < 0.001$), while the control group showed minimal changes ($p > 0.05$). Moreover, the intervention group exhibited a significant reduction in shoulder injury rates post-intervention ($p = 0.041$), whereas the control group's injury rates remained stable ($p = 0.768$).

**Conclusions.** The findings suggest that resistance band training effectively enhances shoulder muscle strength and reduces injury rates in women volleyball athletes. Integrating targeted strength training, such as resistance band exercises, into regular training routines may help enhance athlete performance and mitigate injury risk in sports characterized by repetitive overhead movements. Further research is needed to explore the long-term effects and optimal implementation strategies of resistance band training in athletic contexts.

**Keywords:** resistance band training, volleyball athletes, shoulder strength, injury prevention, isokinetic dynamometry.

## Анотація

**Ефективність тренування з еспандерами на силу м'язів плеча та профілактику травматизму у волейболістів**

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**Передумови та мета дослідження.** Травми плеча є поширеними у жінок-волейболісток, які є часто внаслідок повторюваних рухів над головою. Ефективні методи силових тренувань можуть допомогти запобігти цим травмам. Це дослідження мало на меті дослідити ефективність восьмитижневої програми тренувань на еластичних стрічках для підвищення сили м'язів плечей і запобігання травмам у жінок-волейболісток.

**Матеріал та методи.** Сорок волейболісток студенток у віці 18-25 років були випадковим чином розподілені до групи втручання (n=20) та контрольної групи (n=20). Група втручання пройшла структуровану тренувальну програму з опорною стрічкою, націлену на силу плечей, яка включала такі вправи, як жим плеча, бічні підйоми, внутрішні та зовнішні обертання та відведення лопатки. Ізокінетичну динамометрію вико-

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ристовували для оцінки сили м'язів плеча до та після втручання, вимірювання максимального крутного моменту згиначів плеча, розгиначів, внутрішніх ротаторів і зовнішніх ротаторів. Рівень травматизму спостерігався протягом усього волейбольного сезону, документуючи кількість і тяжкість травм плеча.

**Результати.** Значне покращення сили м'язів плеча спостерігалося в групі втручання за всіма виміряними параметрами ($p < 0,001$), тоді як контрольна група показала мінімальні зміни ($p > 0,05$). Крім того, група втручання продемонструвала значне зниження частоти травм плеча після втручання ($p = 0,041$), тоді як показники травм у контрольній групі залишалися стабільними ($p = 0,768$).

**Висновки.** Отримані дані свідчать про те, що тренування з еластичною стрічкою ефективно підвищують силу м'язів плечей і знижують рівень травм у волейболісток. Інтеграція цілеспрямованих силових тренувань, таких як вправи з опорною стрічкою, у звичайній програмі тренувань може допомогти підвищити результативність спортсмена та зменшити ризик травм у видах спорту, для яких характерні повторювані рухи над головою. Потрібні подальші дослідження, щоб дослідити довгострокові наслідки та оптимальні стратегії впровадження тренувань з опорними стрічками в спортивних контекстах.

**Ключові слова:** тренування з опорною стрічкою, волейболісти, сила плечей, профілактика травм, ізокінетична динамометрія.

## Introduction

Volleyball is a sport that requires a high degree of upper body strength, particularly in the shoulders, to perform actions such as serving, spiking, and blocking effectively. These repetitive overhead movements are fundamental to the game, but they also place significant stress on the shoulder joints, making volleyball athletes particularly prone to shoulder injuries [1, 2, 3]. To mitigate these risks and enhance performance, athletes often engage in conditioning programs designed to strengthen the shoulder muscles. While traditional weight training is a common approach, resistance band training offers a versatile and portable alternative that can be seamlessly integrated into routine training sessions [4, 5, 6]. The shoulder joint is a critical component in volleyball, enabling athletes to perform a variety of essential actions. However, the joint's extensive range of motion and the repetitive nature of volleyball movements make it particularly susceptible to injuries [4, 7]. Overhead motions such as serving and spiking involve high-velocity, high-force actions that can strain the shoulder muscles and connective tissues. As a result, shoulder injuries are among the most common issues faced by volleyball players, often leading to significant downtime and impacting overall team performance [8, 9]. Enhancing shoulder strength is not only vital for improving performance but also for injury prevention. Strong shoulder muscles provide better support and stability to the joint, reducing the likelihood of injuries [4, 10]. Various studies have demonstrated that targeted shoulder conditioning programs can significantly decrease the incidence of shoulder injuries among athletes [9, 11]. These programs typically focus on strengthening the rotator cuff muscles and the surrounding stabilizing muscles to improve joint resilience and function. Resistance band training is gaining popularity as an effective method for strength training, particularly for the shoulder muscles [10]. Unlike traditional weight training, which often relies on free weights or machines, resistance bands provide continuous resistance throughout the entire range of motion. This unique characteristic allows for more comprehensive muscle engagement and can help improve muscle strength and endurance more efficiently [12, 13]. Studies have shown that resistance band exercises can effectively target the shoulder muscles, enhancing both strength and joint stability. The elasticity of the bands ensures that muscles are under tension throughout the movement, promoting muscle activation and growth [14, 15, 16]. Additionally, resistance bands are highly portable and versatile, making them an ideal tool for athletes who need to maintain their training regimen while traveling or during off-seasons. One of the significant advantages of resistance band training is its potential to reduce injury rates [17]. Unlike traditional weight training, which can sometimes lead to improper form and excessive strain on the joints, resistance band exercises are generally safer and easier to perform correctly. This safety factor is particularly important for volleyball players, who need to maintain optimal shoulder health to perform at their best [18, 19].

Injury prevention is a critical aspect of sports training, aimed at maintaining athlete performance and extending their career longevity. For volleyball players, whose performance heavily relies on shoulder functionality, targeted strength training is essential. Effective injury prevention strategies typically include exercises that enhance the strength and stability of vulnerable areas, such as the shoulders [3, 20]. Incorporating resistance band training into regular practice sessions presents a feasible and effective method for reducing injury risk. The adaptability and ease of use of resistance bands make them suitable for a wide range of exercises that can be tailored to target specific muscle groups and movement patterns relevant to volleyball. By integrating these exercises into their training routine, athletes can build stronger, more resilient shoulder muscles, thereby decreasing the likelihood of injuries and enhancing their overall performance [10, 13, 21].

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**The purpose of the study:** To evaluate the impact of resistance band training on shoulder muscle strength and injury prevention in volleyball athletes. By comparing shoulder strength before and after a structured resistance band training program and analysing injury rates pre- and post-intervention, this research aims to provide empirical evidence on the effectiveness of this training method.

## Material and methods

The study focused on evaluating the impact of a resistance band training program on shoulder strength and injury prevention in volleyball athletes. This research employed practical and accessible exercise interventions without the use of advanced technological tools. This technology-free approach ensured that the resistance band training could be easily implemented and replicated in typical athletic training settings.

*Participants*

The study involved 40 women volleyball players, aged 18-25, from a collegiate volleyball team from various institutions in India. Participants were randomly divided into two groups: an intervention group (20 participants) and a control group (20 participants).

*Procedure*

Participants in the intervention group engaged in an eight-week resistance band training program specifically targeting shoulder strength enhancement. The program, conducted under the supervision of certified trainers, comprised a series of exercises aimed at improving various aspects of shoulder musculature. The resistance band training program included exercises such as shoulder presses, lateral raises, internal rotations, external rotations, and scapular retractions, with each exercise performed through the full range of motion to ensure maximum muscle engagement. The resistance band exercises were integrated at the beginning of the training sessions, lasting approximately 30 minutes per session, and were conducted three times per week on alternate days. Each exercise involved 3 sets of 12-15 repetitions with a 60-second rest between sets and the intensity level was moderate to high, progressively adjusted to match the athletes' increasing strength and conditioning over the eight-week period. This program was incorporated into the athletes' regular training sessions, not conducted as separate sessions, and was integrated into the athletes' yearly training plan, boosting shoulder strength in the preparatory phase, sustaining it during the competitive phase, and reducing intensity in the transition phase for recovery. Incorporated into regular sessions, it supported overall fitness and help to prevent injuries. The control group continued their usual training routine, which included standard volleyball drills and conditioning exercises that did not specifically focus on shoulder strength enhancement. They did not engage in the resistance band exercises.

*Measurements*

Shoulder muscle strength was assessed using an isokinetic dynamometer before and after the intervention period. Measurements included peak torque of the shoulder flexors, extensors, internal rotators, and external rotators. Injury rates were tracked throughout the volleyball season by the team's medical staff, recording the number and severity of shoulder injuries.

*Statistical Analysis*

Data were analysed using paired t-tests to compare pre- and post-intervention shoulder strength within each group. Independent t-tests were used to compare the changes in shoulder strength between the intervention and control groups. Injury rates before and after the intervention were analysed using chi-square tests.

## Results

The present research study findings evaluating the resistance band training's impact on shoulder strength and injury rates among volleyball athletes.

Table 1 illustrates the mean shoulder strength measurements for flexors, extensors, internal rotators, and external rotators pre- and post-intervention for both the intervention and control groups. The intervention group exhibited significant improvements in all shoulder strength measurements with paired t-test p-values $< 0.001$, indicating that the resistance band training significantly enhanced muscle strength. In contrast, the control group showed no significant changes in shoulder strength (p-values $> 0.05$). The independent

**Table 1.** Shoulder Strength Pre- and Post-Intervention for Intervention and Control Groups

| Measurement | Group | Mean Pre (Nm) | Mean Post (Nm) | Mean Change (Nm) | Paired t-test p-value | Independent t-test p-value |
|---|---|---|---|---|---|---|
| Flexors | Intervention | 45.0 ± 5.0 | 51.8 ± 5.2 | 6.8 ± 1.2 | < 0.001 | < 0.001 |
| | Control | 44.5 ± 4.8 | 45.2 ± 4.9 | 0.7 ± 0.1 | 0.078 | |
| Extensors | Intervention | 50.0 ± 4.5 | 59.0 ± 4.7 | 9.0 ± 1.2 | < 0.001 | < 0.001 |
| | Control | 49.5 ± 4.3 | 49.8 ± 4.4 | 0.3 ± 0.1 | 0.082 | |
| Internal Rotators | Intervention | 40.0 ± 3.5 | 48.0 ± 4.0 | 8.0 ± 0.5 | < 0.001 | < 0.001 |
| | Control | 39.5 ± 3.2 | 39.8 ± 3.3 | 0.3 ± 0.1 | 0.077 | |
| External Rotators | Intervention | 35.0 ± 3.0 | 42.7 ± 3.2 | 7.7 ± 0.2 | < 0.001 | < 0.001 |
| | Control | 34.5 ± 2.8 | 34.7 ± 2.9 | 0.2 ± 0.1 | 0.080 | |

**Table 2.** Injury Rates Pre- and Post-Intervention for Intervention and Control Groups

| Group | Pre-Intervention Injuries | Post-Intervention Injuries | Chi-square p-value |
|---|---|---|---|
| Intervention | 8 | 4 | 0.041 |
| Control | 7 | 6 | 0.768 |

t-tests confirmed that the strength gains in the intervention group were significantly greater than those in the control group (p-values < 0.001).

Table 2 presents the injury rates before and after the intervention for both groups. The intervention group experienced a significant reduction in shoulder injuries, as indicated by a chi-square p-value of 0.041, demonstrating the effectiveness of the resistance band training in injury prevention. Conversely, the control group did not exhibit a significant change in injury rates, with a chi-square p-value of 0.768, suggesting that their injury rates remained relatively constant. These findings collectively underscore the benefits of resistance band training in improving shoulder strength and reducing injury risk among volleyball players.

## Discussion

The current study sought to assess the effectiveness of resistance band training in boost shoulder muscle strength and averting injuries among volleyball athletes. The technology-free approach ensured that the resistance band training could be easily implemented and replicated in typical athletic training settings. Through a thorough examination of pre- and post-intervention shoulder strength measurements and injury rates, we gleaned valuable insights into the impact of resistance band exercises on athlete performance and safety [5, 22]. The study reveals substantial enhancements in shoulder muscle strength among participants who underwent resistance band training. Post-intervention, the intervention group exhibited significant increases in mean peak torque values across all measured parameters, including flexors, extensors, internal rotators, and external rotators. These improvements were statistically significant, with paired t-test p-values < 0.001. Conversely, the control group, which did not undergo the resistance band training program, demonstrated marginal changes in shoulder strength, with no statistically significant differences observed (p > 0.05). This disparity underscores the effectiveness of resistance band training in specifically targeting and augmenting shoulder muscle strength among volleyball athletes. In addition to its influence on shoulder strength, resistance band training demonstrated promising outcomes in curtailing shoulder injury rates among volleyball players. Examination of injury rates pre- and post-intervention revealed a notable decrease in the number of shoulder injuries reported by the intervention group. Specifically, the chi-square test yielded a p-value of 0.041, signifying a substantial reduction in injury incidence subsequent to the implementation of the resistance band training program. Conversely, the control group displayed no significant change in injury rates post-intervention (p = 0.768), indicating a consistent injury incidence. These findings highlight the potential of resistance band training as an effective strategy for preventing shoulder injuries among volleyball athletes, accentuating its role in fostering shoulder health and minimizing injury risk [13, 23].

The outcomes of this study carry significant implications for athletic training and injury prevention strategies in volleyball and potentially other sports characterized by repetitive overhead movements [24]. By affirming the efficacy of resistance band training in augmenting shoulder strength and reducing injury rates, the findings underscore the importance of integrating targeted strength training into athletes' routine training regimens. Resistance band exercises offer a versatile and accessible means of fortifying muscle strength and joint stability, with the added advantage of being portable and easily incorporable into existing training routines [25, 26]. While this study provides valuable insights into the benefits of resistance band training for volleyball athletes, further research is warranted to explore additional dimensions of its effectiveness and implementation. Future investigations could delve into the long-term effects of resistance band training on shoulder strength maintenance and injury prevention, as well as its comparative efficacy against other strength training modalities [7, 27]. Additionally, research focusing on optimal resistance band training protocols and exercises tailored to specific athletic demographics could enhance our understanding of its utility in sports performance and injury mitigation [28, 29].

## Conclusions

The study underscores the efficacy of resistance band training in fortifying shoulder muscle strength and averting injuries among volleyball athletes. By demonstrating significant enhancements in shoulder strength and reductions in injury rates following the implementation of a structured resistance band training program, this research contributes to the growing body of evidence supporting the adoption of resistance band exercises in athletic training and injury prevention. Moving forward, continued research in this realm has the potential to refine training methodologies and enhance athlete performance and well-being in volleyball and beyond.

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### Article details

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