

Effectiveness of Hand Grip and Shoulder Muscle Strengthening Programmes on Shooting Performance in Air Rifle Shooters: A narrative review

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Abstract

Air rifle shooting is a precision sport that requires upper-limb strength, postural stability, and technical control to achieve consistent performance. Handgrip and shoulder muscle strength play an important role in maintaining firearm stability and shooting accuracy. To review the available evidence on the effectiveness of handgrip and shoulder muscle-strengthening programmes in improving shooting performance among competitive air rifle and air pistol shooters. A narrative review was conducted using ten studies published between 2015 and 2025. The selected literature included experimental, observational, cross-sectional, and systematic review studies. Evidence was synthesised to evaluate the effects of handgrip strength, shoulder muscle strength, balance, and functional strength training on shooting performance. The reviewed studies consistently reported that improvements in handgrip and shoulder muscle strength were associated with better firearm stability, aiming accuracy, trigger control, postural balance, and shooting scores. Functional strength training and enhanced upper-limb muscle activation further contributed to improved shooting consistency and performance. The available evidence suggests that handgrip and shoulder muscle-strengthening programmes are effective in improving shooting performance. Incorporating structured strength training into regular conditioning programmes may enhance upper-limb function, stability, and competitive shooting outcomes.

Keywords: Air Rifle Shooting; Handgrip Strength; Shooting Performance; Shoulder Muscle Strength; Strength Training.

1. Introduction

Air rifle shooting is a highly demanding precision sport in which even minor variations in body control can influence performance. Achieving consistent shooting accuracy requires a combination of physical fitness, technical skill, and psychological control. During competition, shooters must maintain a stable posture, control firearm movement, and execute smooth trigger release while sustaining concentration over repeated shots. These physical demands make upper-limb function an important component of successful performance. [3]

Handgrip strength and shoulder muscle strength are essential for maintaining firearm stability and reducing unnecessary movement during aiming. Strong and well-conditioned upper-limb muscles help shooters hold the rifle steadily, improve trigger control, and sustain an optimal shooting position throughout competition. Consequently, strength training has become an important part of physical conditioning for competitive shooters. [8]

In recent years, increasing attention has been given to strengthening programmes aimed at improving the physical capabilities of shooters. While individual studies have examined the influence of handgrip strength, shoulder muscle strength, balance, and neuromuscular control on shooting performance, the findings have not been collectively synthesised to provide a comprehensive understanding of their effectiveness. [1]

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Therefore, the objective of this narrative review is to synthesise the available evidence on the effectiveness of handgrip and shoulder muscle-strengthening programmes in improving shooting performance among competitive air rifle and air pistol shooters.

1.1. Aim of the study

To review the effectiveness of handgrip and shoulder muscle-strengthening programmes on shooting performance in rifle air shooters through a narrative review.

2. Methodology

This study was conducted as a narrative review to synthesise the available evidence on the effectiveness of handgrip and shoulder muscle-strengthening programmes in improving shooting performance among competitive air rifle shooters.

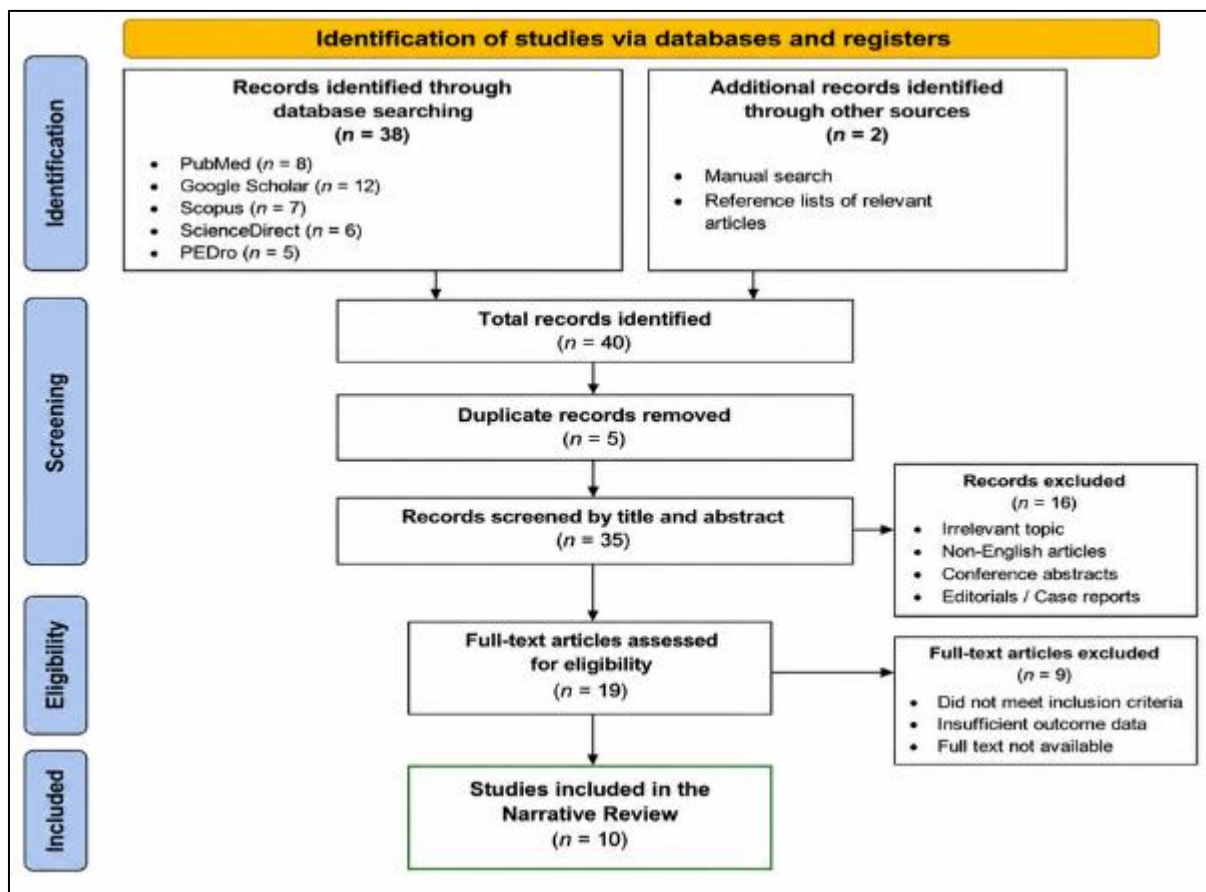


Figure 1: PRISMA flowchart of the study selection process for the narrative review.

A comprehensive literature search was performed using electronic databases, including PubMed, Google Scholar, Scopus, and ScienceDirect.

2.1. Inclusion Criteria

- Studies focusing on handgrip and shoulder muscle strength, strengthening programs, and their association with shooting performance.
- Shooting performance as outcome.
- Original research articles, clinical trials, observational studies, systematic reviews and randomised controlled trials.
- Studies involving the upper limb.
- Studies published between 2015 and 2025.

2.2. Exclusion Criteria

- Conference abstracts, editorial publications, letters to the editor, and case reports
- Studies not related to shooting sports.
- Studies with insufficient outcome data.

After screening the identified literature, ten studies that met the eligibility criteria were selected for qualitative synthesis. Information regarding study design, participant characteristics, intervention or assessment methods, outcome measures, and key findings was extracted and analysed descriptively to identify common evidence and overall trends.

As this study is a narrative review based exclusively on previously published literature, no human participants or animals were directly involved. Therefore, approval from the institutional ethics committee and informed consent were not required.

3. Results

Table 1: Overview of Study Features and Key Outcomes

Author (Year)	Study Design	Main Variable	Key Finding
Gowda & Chippala (2025)	Experimental	Handgrip & shoulder strengthening	Improved upper-limb strength and shooting performance.
Basha & Varma (2024)	Cross-sectional	Factors affecting shooting performance	Handgrip strength and postural stability influenced performance.
Sundaram et al. (2024)	Systematic review	Technical determinants	Stability, aiming, and trigger control improved shooting accuracy.
Gümüşsoy et al. (2024)	Cross-sectional	Shoulder muscle strength	Greater shoulder strength was associated with better shooting scores.
Loh et al. (2021)	Experimental	Upper-limb muscle activation	Improved muscle activation enhanced aiming stability.
Hung et al. (2021)	Experimental	Functional strength training	Improved balance and shooting performance.
Marković et al. (2020)	Observational	Handgrip strength	Improved grip strength contributed to better pistol stability and increased shooting precision.
Mon-López et al. (2019)	Cross-sectional	Handgrip & shoulder strength	Upper-limb strength positively influenced shooting performance.
Ihalainen et al. (2016)	Observational	Physical & technical factors	Reduced body sway and improved rifle stability enhanced performance.
Mon et al. (2015)	Observational	Finger flexor strength	Greater finger strength improved shooting scores.

The literature search and study selection process resulted in the inclusion of 10 studies published between 2015 and 2025. The included studies comprised two experimental intervention studies, four cross-sectional studies, two observational studies, one systematic review and meta-analysis, and one study evaluating upper-limb muscle activation. The characteristics and key findings of the included studies are summarised in Table 1.

Among the included studies, handgrip strength and shoulder muscle strength were consistently identified as important physical determinants of shooting performance. The experimental study by Gowda and Chippala demonstrated that a six-week handgrip and shoulder muscle-strengthening programme significantly improved handgrip strength, shoulder muscle strength, and shooting scores in competitive air rifle shooters. [1] Similarly, Hung et al. reported that an eight-week functional strength training programme improved balance, postural stability, and shooting performance in rifle shooters. [6]

Cross-sectional and observational studies showed positive associations between upper-limb strength and competitive shooting performance. Greater handgrip strength, shoulder muscle strength, and finger flexor strength were associated with improved firearm stability, reduced pistol movement, enhanced trigger control, and higher competition scores [4,7,8,10].

The systematic review and meta-analysis identified stability of hold, aiming accuracy, trigger control, time on target, and postural balance as the principal technical determinants of shooting performance. [3] In addition, studies evaluating elite shooters reported that reduced body sway, improved rifle stability, and efficient upper-limb muscle activation contributed to greater shooting consistency and accuracy [5,9].

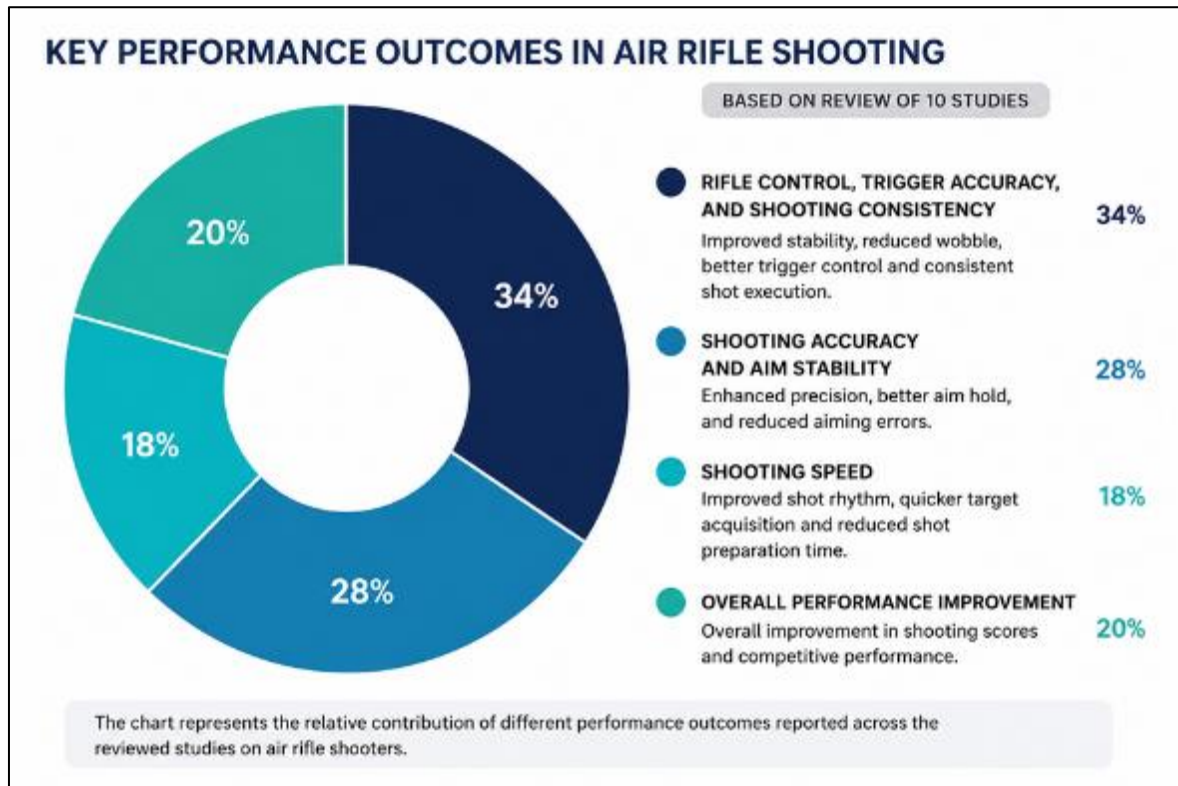


Figure 2 Distribution of key performance outcomes associated with handgrip and shoulder muscle-strengthening programmes in air rifle shooters.

4. Discussion

The findings of this narrative review indicate that handgrip and shoulder muscle strength are important physical components influencing shooting performance in competitive air rifle and air pistol shooters. The reviewed studies consistently showed that greater upper-limb strength contributes to improved firearm stability, aiming precision, and overall shooting accuracy. In particular, structured strengthening programmes were associated with significant improvements in hand grip strength, shoulder muscle strength, and shooting scores, demonstrating the value of incorporating these exercises into regular training programmes. [1,6]

From a physiological perspective, shooting requires sustained isometric contraction of the forearm, shoulder, and scapular stabilising muscles to maintain a stable shooting posture throughout aiming and trigger release. When these muscles are strengthened, their ability to generate force and resist fatigue improves, allowing shooters to maintain rifle stability for longer durations. Increased muscular endurance also reduces involuntary tremors and postural sway that commonly occur during prolonged aiming, resulting in greater shooting consistency. [1,6,9]

Handgrip strength plays a crucial role in maintaining a firm yet controlled hold on the rifle or pistol. Strong finger flexor and forearm muscles improve grip stability and facilitate smooth trigger control without disturbing the aiming position. Likewise, greater shoulder muscle strength enhances scapular stability and upper-limb control, reducing unnecessary

firearm movement during aiming. These physiological adaptations improve coordination between the upper limb and the firearm, leading to higher shooting accuracy and performance. [4,7,8,10]

In addition to muscular strength, successful shooting depends on the integration of technical and neuromuscular factors. The systematic review by Sundaram et al. identified stability of hold, aiming accuracy, trigger control, and postural balance as the primary determinants of shooting performance.[3] Similarly, Loh et al. reported that efficient upper-limb muscle activation during simulated competition enhances neuromuscular coordination and movement control, while Ihalainen et al. found that elite shooters demonstrate reduced body sway and superior rifle stability compared with lower-performing shooters. [5,9]

Although the overall evidence supports the benefits of hand grip and shoulder muscle strengthening, the included studies differed in study design, sample size, intervention duration, and outcome measures. Most intervention programmes lasted between six and eight weeks and involved competitive shooters, which may limit the generalizability of the findings to novice athletes. Therefore, future well-designed randomised controlled trials with standardised strengthening protocols are needed to establish the optimal training programme for improving shooting performance. [1,6]

5. Conclusion

This narrative review demonstrates that handgrip and shoulder muscle strength are important physical components influencing shooting performance in competitive air rifle and air pistol shooters. The available evidence indicates that structured strengthening programmes improve upper-limb strength, firearm stability, postural control, and shooting accuracy. In addition, factors such as balance, neuromuscular coordination, and technical proficiency contribute to consistent shooting performance when integrated with strength training. Collectively, these findings support the incorporation of targeted handgrip and shoulder muscle-strengthening exercises into regular conditioning programmes for competitive shooters. Such evidence-based training strategies may enhance athletic performance and assist sports physiotherapists and coaches in developing comprehensive rehabilitation and performance enhancement programmes. Further well-designed studies with standardised training protocols are recommended to strengthen the current evidence and establish optimal exercise programmes for competitive shooting.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

The present research work does not contain any studies performed on animals or human subjects by any of the authors.

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