



## PHYSIOTHERAPY INTERVENTIONS FOR STRENGTH TRAINING: A STUDY ON BOXERS

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### ABSTRACT:

**Background:** Boxing is a high-intensity combat sport that demands exceptional levels of strength, power, neuromuscular coordination, and injury resilience. Conventional boxing training programs often emphasize technical skill development and cardiovascular conditioning, while structured strength training and injury prevention strategies may be inconsistently applied. Physiotherapy-led strength training interventions provide a scientific and clinical framework to enhance performance while reducing injury risk.

**Purpose:** To investigate the effects of a physiotherapy-supervised strength training program on muscular strength, functional performance, and injury incidence in amateur boxers.

**Methods:** Twenty-four amateur male boxers (mean age  $23.2 \pm 3.4$  years) were randomly assigned to either an intervention group ( $n = 12$ ) or a control group ( $n = 12$ ). The intervention group completed a 12-week physiotherapy-guided strength training program in addition to routine boxing training, while the control group continued routine boxing training alone. Outcome measures included isometric knee extension strength, shoulder internal rotation strength, seated medicine ball throw distance, and injury incidence. Data were analyzed using repeated measures ANOVA with effect sizes reported as partial eta squared ( $\eta^2$ ).

**Results:** Significant group  $\times$  time interactions were observed for knee extension strength,  $F(1,22) = 14.87$ ,  $p = .002$ ,  $\eta^2 = .40$ ; shoulder internal rotation strength,  $F(1,22) = 16.92$ ,  $p = .001$ ,  $\eta^2 = .43$ ; and medicine ball throw distance,  $F(1,22) = 13.11$ ,  $p = .003$ ,  $\eta^2 = .37$ . Injury incidence was lower in the intervention group (15%) compared to the control group (40%), though this difference did not reach statistical significance ( $p = .08$ ).

**Conclusion:** Physiotherapy-supervised strength training significantly improves strength and functional performance in amateur boxers and demonstrates a trend toward reduced injury incidence. Integrating physiotherapy-led strength interventions into boxing conditioning programs may enhance performance and athlete longevity.

### KEYWORDS:

PHYSIOTHERAPY, BOXING, STRENGTH TRAINING, INJURY PREVENTION, PERFORMANCE.

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### INTRODUCTION

Boxing is a physically demanding combat sport characterized by repetitive high-velocity punches, rapid changes in direction, and frequent physical contact. Performance in boxing relies heavily on muscular strength, power, neuromuscular coordination, and the ability to tolerate high mechanical loads (Smith et al., 2020). Inadequate strength preparation has been associated with decreased performance and increased injury risk, particularly in the shoulder, wrist, and lower extremities (Jones & Patel, 2019).

Traditional boxing conditioning programs prioritize technical skill development, sparring, and cardiovascular endurance. While these components are essential, insufficient emphasis on structured strength training and movement quality may predispose athletes to overuse injuries and performance plateaus (Rodriguez et al., 2021). Strength training that is poorly supervised or lacks sport specificity may further exacerbate injury risk.

Physiotherapy-led strength training interventions differ from conventional approaches by emphasizing

individualized assessment, progressive overload, neuromuscular control, and biomechanical efficiency. Physiotherapists are uniquely positioned to design strength programs that enhance performance while addressing injury risk factors through targeted exercise prescription (Brown et al., 2021). Evidence from various athletic populations suggests that physiotherapist-guided interventions improve strength outcomes and reduce injury incidence (Anderson & Davis, 2020). However, limited research has specifically examined the impact of physiotherapy-supervised strength training in boxers.

Given the high prevalence of musculoskeletal injuries and the critical role of strength in boxing performance, further investigation into physiotherapy-based strength interventions is warranted. Therefore, the purpose of this study was to evaluate the effects of a 12-week physiotherapy-supervised strength training program on muscular strength, functional performance, and injury incidence in amateur boxers. It was hypothesized that the intervention group would demonstrate significantly greater improvements in strength and functional performance compared to a control group, with a lower incidence of injuries.

## METHODS

### STUDY DESIGN

A randomized controlled trial design was employed. Ethical approval was obtained from the institutional review board, and all participants provided written informed consent prior to participation.

### PARTICIPANTS

Twenty-four male amateur boxers competing at district and state levels were recruited. Inclusion criteria included age between 18 and 30 years, a minimum of two years of boxing experience, and active participation in regular training. Exclusion criteria were any musculoskeletal injury within the previous three months, history of surgery affecting performance, or medical conditions contraindicating resistance training.

Participants were randomly allocated into either the physiotherapy intervention group ( $n = 12$ ) or the control group ( $n = 12$ ) using a computer-generated randomization sequence. Baseline demographic characteristics did not differ significantly between groups ( $p > .05$ ).

### INTERVENTION

The intervention group participated in a physiotherapy-supervised strength training program three times per week for 12 weeks, in addition to routine boxing training. Each session lasted approximately 60 minutes and consisted of:

- Core stabilization exercises emphasizing trunk control and force transfer
- Progressive resistance training for upper and lower extremities
- Plyometric exercises targeting explosive power

- Neuromuscular control and proprioceptive drills

Exercise intensity and volume were progressively increased based on individual performance and tolerance. All sessions were supervised by a licensed physiotherapist to ensure correct technique and appropriate progression.

The control group continued routine boxing training, which included technical drills, sparring, and cardiovascular conditioning, without additional structured strength training.

## OUTCOME MEASURES

### ISOMETRIC STRENGTH

Isometric knee extension and shoulder internal rotation strength were measured using a handheld dynamometer. Three maximal trials were performed for each measure, with the highest value recorded.

### FUNCTIONAL PERFORMANCE

Functional performance was assessed using the seated medicine ball throw test. Participants performed three trials, and the longest distance achieved was recorded.

### INJURY INCIDENCE

All injuries sustained during training and competition were recorded prospectively throughout the 12-week period. Injuries were defined as any musculoskeletal complaint requiring modification or cessation of training.

### STATISTICAL ANALYSIS

Data were analyzed using IBM SPSS Statistics (Version 26). Normality was assessed using the Shapiro-Wilk test. A two-way repeated measures ANOVA (group  $\times$  time) was conducted for each outcome variable. Effect sizes were calculated using partial eta squared ( $\eta^2$ ), with values of .01, .06, and .14 representing small, medium, and large effects, respectively. Statistical significance was set at  $p < .05$ .

## RESULTS

### BASELINE CHARACTERISTICS

No significant differences were observed between groups for age, body mass, or baseline strength measures ( $p > .05$ ), indicating comparability at baseline.

### STRENGTH OUTCOMES

A significant group  $\times$  time interaction was found for knee extension strength,  $F(1,22) = 14.87$ ,  $p = .002$ ,  $\eta^2 = .40$ . Post-hoc analysis revealed a 15.2% increase in the intervention group compared to a 3.2% increase in the control group.

Similarly, shoulder internal rotation strength demonstrated a significant group  $\times$  time interaction,  $F(1,22) = 16.92$ ,  $p = .001$ ,  $\eta^2 = .43$ . The intervention group improved by 19.7%, whereas the control group improved by 4.0%.

### FUNCTIONAL PERFORMANCE

Medicine ball throw distance showed a significant group  $\times$  time interaction,  $F(1,22) = 13.11$ ,  $p = .003$ ,  $\eta^2 = .37$ . The intervention group demonstrated an 11.2% improvement

compared to a 2.3% improvement in the control group.

### INJURY INCIDENCE

Over the 12-week period, the intervention group sustained three minor injuries (15% incidence), while the control group sustained eight injuries (40% incidence). Although the difference did not reach statistical significance ( $\chi^2 = 3.12, p = .08$ ), the trend favored the intervention group.

### DISCUSSION

The findings of this study demonstrate that a physiotherapy-supervised strength training program significantly improves muscular strength and functional performance in amateur boxers. Large effect sizes observed across outcome measures indicate clinically meaningful adaptations attributable to the intervention.

Enhanced knee extension strength likely contributed to improved lower-limb force production, which is essential for effective punching mechanics and movement efficiency (Lee & Chang, 2022). Improvements in shoulder internal rotation strength are particularly relevant for punching velocity and shoulder joint stability, a region commonly affected by overuse injuries in boxers (Rodriguez et al., 2021).

The observed improvement in functional performance, as measured by the medicine ball throw, suggests successful transfer of strength gains to sport-specific tasks. This finding supports the principle that physiotherapy-led strength training emphasizes movement patterns relevant to sport performance rather than isolated muscle strengthening alone (Brown et al., 2021).

Although injury incidence reduction did not reach statistical significance, the lower number of injuries in the intervention group aligns with previous research highlighting the protective effects of neuromuscular and strength training (Anderson & Davis, 2020). The study may have been underpowered to detect statistically significant differences in injury rates.

### LIMITATIONS

This study has several limitations. The sample size was relatively small, limiting generalizability. The follow-up period was limited to 12 weeks, and long-term adaptations were not assessed. Additionally, performance variables such as punch velocity or competitive outcomes were not directly measured.

### CLINICAL IMPLICATIONS

The results highlight the value of integrating physiotherapists into boxing training programs. Physiotherapy-supervised strength training can enhance performance outcomes while addressing injury risk factors, supporting athlete longevity and consistent training participation.

### CONCLUSION

Physiotherapy-supervised strength training significantly enhances muscular strength and functional performance in amateur boxers and demonstrates a trend toward reduced injury incidence. These findings support the integration of physiotherapy-led strength interventions into boxing conditioning programs to optimize performance and athlete health.

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