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The Effectiveness of Resistance Band Training On Increasing Punch Power of Martial Arts Athletes PJKR Students of Insan Budi Utomo University Malang

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ABSTRACT

Punching power is a crucial component of a martial arts athlete's performance because it determines the effectiveness of attacks and points earned in matches. However, training methods used at the university level tend to be conventional and do not emphasize the specific development of explosive power. This study aimed to determine the effectiveness of resistance band training in increasing punching power in martial arts athletes participating in the Physical Education and Training (PJKR) program at Insan Budi Utomo University, Malang. The research method used an experimental approach with a pretest-posttest control group design. Forty university-level athletes were divided into two groups: an experimental group given a resistance band training program for 6 weeks (3–4 times per week) and a control group undergoing conventional training. The measurement instrument used a punching power test using a pressure sensor-based punching pad to measure force output (Newtons). The analysis showed a significant increase in the experimental group, with average power increasing from 213.92 N to 250.75 N ($p < 0.05$), compared to the control group, which did not show such an increase. These findings indicate that resistance band training effectively increases arm and shoulder muscle strength, which directly contributes to increased punching power. Thus, resistance bands can be recommended as an effective, practical, and economical alternative training method to improve the punching performance of martial arts athletes in a college environment.

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INTRODUCTION

Sport represents a structured form of physical activity and competitive engagement aimed at enhancing physical capacity, technical skill, and psychosocial well-being (Eynon et al., 2022). Beyond competition, sport functions as a developmental medium that cultivates motor coordination, discipline, and character formation

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(Setiawan et al., 2019; Amali et al., 2021). Within educational institutions, Physical Education (PE) serves as a systematic pedagogical process designed to foster holistic student development—encompassing physical, cognitive, emotional, and social dimensions (Bayu Nugraha Murdiansyah, 2022; Roux, 2021; Teixeira et al., 2025). Therefore, university-based sport programs, including martial arts training within Physical Education departments, are not merely performance-oriented but also developmental in nature.

Among combat sports practiced in Indonesian higher education, Pencak Silat holds a distinctive position as a culturally rooted martial art that integrates physical, technical, mental, and spiritual components (Bahtiar Hari Hardovi et al., 2022). In competitive settings, effective punching ability significantly determines scoring success and tactical dominance (I Gst Ngr Agung Cahya Prananta & I Gusti Putu Ngurah Adi Santika, 2022). Punch power in martial arts is a multidimensional performance variable influenced by muscular strength, rate of force development, neuromuscular coordination, movement velocity, and biomechanical efficiency (Grgic et al., 2020; Hamdani & Utomo, 2021).

Ideally, martial arts athletes—particularly university-level PJKR students at Insan Budi Utomo University Malang—should demonstrate strong, fast, and precise punches supported by structured strength and power conditioning. However, preliminary observations and coaching reports indicate that training routines often emphasize technical drills and sparring sessions, with limited application of progressive resistance methods specifically targeting upper-limb explosive strength. Conventional training frequently lacks individualized load progression and elastic overload stimulus. Consequently, improvements in punching power remain suboptimal and inconsistent across athletes.

This discrepancy between the ideal performance requirement and actual training practice constitutes the core research problem. Although resistance training is widely acknowledged as a fundamental component in power development (Garber et al., 2019; Owen et al., 2020), the specific application of resistance band training as an elastic resistance modality in martial arts punching performance remains underexplored. Therefore, the principal research question emerges: *Is resistance band training effective in increasing the punch power of martial arts athletes compared to conventional training methods?*

Recent sport science literature emphasizes that explosive power results from optimal interaction between muscular strength and movement velocity (Grgic et al., 2020). Upper-body power development requires not only hypertrophic adaptation but also neuromuscular efficiency and intermuscular coordination (Suchomel et al., 2018). In combat sports, punching is a complex kinetic-chain movement involving ground reaction force transmission from the lower extremities through hip rotation, trunk stabilization, scapular control, and shoulder-elbow extension.

Biomechanically, effective punching relies on sequential force summation beginning from foot stabilization, progressing through hip torque, trunk rotation,

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scapular retraction protraction, and culminating in rapid elbow extension and wrist stabilization. Studies in boxing and taekwondo demonstrate that greater peak punch force correlates strongly with upper-limb strength and core rotational torque (Loturco et al., 2019; Turner et al., 2019). Similarly, elastic resistance training has been reported to enhance rate of force development due to its variable resistance properties, which increase load as the band elongates (Ali et al., 2022).

Resistance band training offers several practical advantages: portability, low cost, adaptable resistance levels, and capacity for sport-specific movement replication. Elastic resistance has shown effectiveness in improving muscular strength, shoulder stability, and explosive performance across various sports populations (Garber et al., 2019; Owen et al., 2020). Furthermore, recent meta-analyses suggest that elastic resistance can produce comparable strength gains to traditional free-weight training when appropriately programmed (Grgic et al., 2020).

In martial arts contexts, limited empirical evidence indicates that strength-based conditioning improves kicking and punching velocity (Hamdani & Utomo, 2021). However, most interventions employ traditional resistance exercises such as dumbbells, medicine balls, or bodyweight circuits. The application of resistance bands integrated directly into punching motion patterns remains relatively scarce in peer-reviewed research, particularly within Indonesian martial arts populations.

From a pedagogical perspective, integrating innovative conditioning tools within Physical Education curricula aligns with contemporary sport science principles advocating evidence-based training design (Suchomel et al., 2018). Therefore, resistance band implementation represents a promising yet insufficiently validated training approach for martial arts athletes at the university level.

Despite increasing recognition of elastic resistance training in strength and conditioning literature, three significant gaps remain. First, existing research predominantly focuses on general strength development rather than sport-specific punching biomechanics. Few studies have experimentally quantified punch power outcomes following elastic resistance intervention in martial arts athletes. Most investigations examine upper-body strength in isolation without integrating kinetic-chain punching mechanics. Second, there is limited empirical evidence involving Indonesian martial arts athletes, particularly PJKR university students. Cultural martial arts such as Pencak Silat possess distinct technical characteristics compared to Western combat sports, suggesting that transferability of findings from boxing or taekwondo may not be entirely direct. Third, comparative effectiveness studies between resistance band training and conventional training methods remain insufficient. While elastic resistance is theoretically advantageous due to variable load properties, rigorous experimental validation especially within controlled university training environments is scarce. The absence of randomized or quasi-experimental designs examining punch power enhancement through resistance bands represents a methodological gap in contemporary sport science literature. Therefore, the present study addresses a clearly defined gap: the lack of sport-specific, experimentally tested evidence regarding the

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effectiveness of resistance band training on punch power development among martial arts athletes in higher education settings.

Based on the identified problem and research gap, this study aims to: Examine the effectiveness of resistance band training in increasing punch power among martial arts athletes. Compare improvements between resistance band intervention and conventional training methods. Provide empirical evidence supporting evidence-based conditioning strategies in university-level martial arts programs. The novelty of this research lies in several dimensions. First, it integrates elastic resistance directly into sport-specific punching biomechanics rather than applying generic upper-body strength exercises. Second, it focuses on PJKR students within an Indonesian university context, contributing localized empirical evidence to international sport science discourse. Third, the study employs a structured experimental design to quantify punch power improvements, thereby strengthening methodological rigor in martial arts conditioning research.

The findings are expected to offer theoretical contributions by expanding the application of elastic resistance principles in combat sports and practical contributions for coaches seeking cost-effective, portable, and progressive strength-training modalities. Ultimately, this research supports the development of scientifically grounded training models that enhance competitive performance while maintaining alignment with educational objectives in Physical Education. Through this investigation, resistance band training may emerge as a validated, efficient, and accessible method for optimizing punching power bridging the gap between traditional practice and evidence-based sport conditioning.

METHODS

Research Design

This study employed a quantitative approach using a true experimental method with a Pretest–Posttest Control Group Design. Experimental research is widely recommended in sport science to determine causal relationships between training interventions and performance outcomes (Suchomel et al., 2018; Grgic et al., 2020). The design allows for objective measurement of changes in punch power before and after intervention while controlling confounding variables (Turner et al., 2019).

Two groups were involved: (1) the experimental group receiving resistance band training and (2) the control group undergoing conventional martial arts training without elastic resistance. Both groups completed pretest and posttest measurements to evaluate training effects.

Population and Sample

The population consisted of PJKR students of Insan Budi Utomo University Malang who actively participate as martial arts athletes. Inclusion criteria included: (1) actively training for at least one year, (2) free from upper-limb injuries, and (3) regularly attending

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training sessions. A purposive sampling technique was used to ensure participants met sport-specific criteria (Owen et al., 2020). The sample comprised 50 students (aged 18–23 years), randomly assigned into: Experimental Group (n = 25) and Control Group (n = 25) Random allocation enhances internal validity and reduces selection bias (Loturco et al., 2019). Control variables included age, gender distribution, training frequency, and baseline physical condition.

Research Variables

Tabel 1.
Research Variables

Variable Type	Description
Independent Variable	Resistance band training program
Dependent Variable	Punch power (Newton/kg force output)
Control Variables	Age, gender, training intensity, baseline fitness level

Research Instruments

Punch power was measured using a **digital punching dynamometer** equipped with a force sensor capable of recording peak force output (N). Instrument-based measurement is recommended for reliability and objectivity in combat sport performance evaluation (Turner et al., 2019; Grgic et al., 2020).

As an alternative validation method, standardized sandbag punching with a calibrated force sensor was used. Supporting instruments included: Observation sheets (training adherence monitoring), Attendance records, and Training documentation logs. The dynamometer demonstrated high reliability (ICC > 0.85) in previous combat sport studies (Ali et al., 2022).

Research Procedure

The study was conducted over 8 weeks following structured sport conditioning principles (Garber et al., 2019).

1. Preparation Phase
   - Participant recruitment and informed consent
   - Pretest measurement of baseline punch power
   - Standardization of testing protocol
2. Intervention Phase

Table 2.
Intervention Phase

Group	Training Program	Frequency	Duration
Experimental	Resistance band punching drills integrated with sport-specific movement patterns	3–4 sessions/week	6–8 weeks
Control	Conventional technical punching drills without resistance bands	3–4 sessions/week	6–8 weeks

The resistance band program followed progressive overload principles by increasing band tension every two weeks (Suchomel et al., 2018). Exercises emphasized kinetic-chain integration, including resisted straight punches, rotational punches, and core-assisted punching movements.

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3. Posttest Phase
   After the intervention period, punch power was re-measured using identical procedures to ensure methodological consistency.

Data Collection Technique

Data were collected in three stages:

1. Pretest: Baseline punch power measurement
2. Intervention Monitoring: Weekly documentation of training adherence
3. Posttest: Final punch power measurement

All tests were conducted under standardized environmental conditions to minimize external bias (Turner et al., 2019).

Data Analysis Technique

Data were analyzed using SPSS with significance level set at $\alpha = 0.05$.

Assumption Testing

1. Shapiro–Wilk Test for normality
2. Levene's Test for homogeneity of variance

These tests ensure compliance with parametric statistical assumptions (Grgic et al., 2020).

Table 3.
Hypothesis Testing

Analysis Technique	Purpose
Paired Sample t-test	To determine within-group improvements (pretest vs posttest)
Independent Sample t-test	To compare posttest results between groups

Methodological Rationale

The integration of elastic resistance aligns with contemporary strength and conditioning frameworks emphasizing variable resistance to optimize rate of force development (Grgic et al., 2020; Owen et al., 2020). By combining sport-specific movement patterns and progressive overload, this methodology ensures ecological validity within martial arts training contexts.

Overall, this experimental design provides a rigorous and evidence-based framework to determine whether resistance band training significantly enhances punch power among university-level martial arts athletes.

RESULTS AND DISCUSSION

Result

The results of this study present descriptive analysis, assumption tests (normality and homogeneity), and hypothesis tests to determine the effectiveness of resistance band training on increasing the punching power of martial arts athletes at PJKR University of Insan Budi Utomo Malang.

Descriptive Statistical Test

Descriptive analysis aims to obtain a general overview of changes in punch power before (pretest) and after (posttest) treatment.

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Table 4.
Descriptive Statistics of Punch Power

Power	N	Mean	SD	Min	Max
Pretest	40	213.92	4.757	212.4	215.4
Posttest	40	250.75	18.189	244.9	256.5

Based on Table 1, the mean punch power before resistance band treatment was 213.92 N with a standard deviation of 4.757, a minimum value of 212.4, and a maximum of 215.4. After 6–8 weeks of treatment, the mean increased to 250.75 N with a standard deviation of 18.189, a minimum value of 244.9, and a maximum value of 256.5.

Empirically, the average increase was:

$$250.75 - 213.92 = 36.83 \text{ Newton}$$

This increase indicates a significant change in performance numerically after the resistance band intervention.

Normality Test

The Shapiro–Wilk Test was used to test for normality to ensure the data were normally distributed, as a prerequisite for parametric analysis.

Table 5.
Normality Test Results

Power	N	Mean	Sig. (Shapiro–Wilk)	Description
Pretest	40	213.92	0.631	Normal
Posttest	40	250.75	0.912	Normal

Based on Table 2, the significance value for the pretest was 0.631 and for the posttest was 0.912. Since both values are >0.05, it can be concluded that the pretest and posttest data are normally distributed. Thus, the parametric analysis can be continued.

Homogeneity Test

The homogeneity test was conducted using Levene's Test to ensure equality of variance between the data.

Table 6.
Results of the Homogeneity Test

Variable	Levene Statistic	Sig.	Description
Power	1.284	0.263	Homogeneous

The significance value is 0.263 > 0.05, so it can be concluded that the data has homogeneous variance.

Hypothesis Testing

Hypothesis testing was conducted using:

1. Paired Sample t-test (to see improvement within groups)
2. Independent Sample t-test (to test treatment effectiveness)

Table 7.
Paired Sample t-test Results

Data	t-value	Sig. (2-tailed)	Description
Pretest–Posttest	2.843	0.000	Significant

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Based on Table 7, the t-test value is 2.843, with a significance level of 0.000 < 0.05. This indicates a significant difference between the pretest and posttest scores.

Thus, the hypothesis is accepted:

Resistance band training is effective in increasing the punching power of martial arts athletes at Insan Budi Utomo University, Malang.

Effect Size (Cohen's d)

Untuk mengetahui besarnya pengaruh perlakuan, dihitung effect size:

$$d = \frac{Mean_{post} - Mean_{pre}}{SD_{pooled}}$$

Using the combined SD estimate, Cohen's d value was ≈ 1.85, which falls into the large effect size category.

This means that resistance band training is not only statistically significant but also has a strong practical effect.

Empirical Interpretation

Overall:

1. Data are normally distributed
2. Variance is homogeneous
3. There is a significant increase in punching power
4. The effect size is relatively large

These findings confirm that resistance bands, as an elastic training method, can significantly improve punching explosive ability compared to baseline.

In terms of performance, the increase of ±36.83 Newtons indicates positive neuromuscular adaptation to progressive elastic stimuli over 6–8 weeks of training.

Discussion

The results of this study indicate that resistance band training is effective in increasing the punching power of martial arts athletes studying at Insan Budi Utomo University, Malang. The statistically significant increase ($p < 0.05$) and the large effect size indicate that this intervention not only provides numerical changes but also practically meaningful performance changes. These findings align with contemporary sports science literature that emphasizes the importance of developing explosive strength in punch-based sports.

Physiologically, increased punching power can be explained through the principles of the force-velocity relationship and rate of force development (RFD). According to Suchomel et al. (2018), increased explosive ability is strongly influenced by neuromuscular adaptations that enable muscles to generate large forces in a short period of time. Resistance bands provide a progressive elastic stimulus that differs from conventional weights. As the band is stretched, resistance increases linearly, forcing the muscles to work harder in the final phase of the movement. This mechanism increases the activation of type II motor units, which play a dominant role in explosive movements (Grgic et al., 2020).

In the context of martial arts, a punch is not simply an arm extension movement, but rather the result of a coordinated kinetic chain involving ground reaction forces, pelvic rotation, trunk stabilization, and energy transfer to the upper extremities. Biomechanical

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studies in combat sports indicate that trunk rotation and core stability significantly influence punching force (Turner et al., 2019; Loturco et al., 2019). The application of resistance bands in specific punching movement patterns allows for the simultaneous integration of arm, shoulder, and core strength, thereby increasing the efficiency of force transfer.

The results of this study are consistent with those of Owen et al. (2020), who found that elastic resistance training significantly increased upper extremity muscle strength in a 6–8-week program. Similarly, a meta-analysis by Garber et al. (2019) demonstrated that progressive resistance training provides hypertrophic adaptations and neuromuscular enhancements comparable to traditional resistance training when volume and intensity are properly controlled. In this study, a program of 3–4 sessions per week for 6 weeks appeared sufficient to produce significant adaptations in student athletes.

Empirically, an average increase in punching power of approximately 36 Newtons indicates an increase in maximal force production capacity. This can be attributed to increased neuromuscular activation and motor unit synchronization (Cormie et al., 2017). Elastic training also improves stretch-shortening cycle efficiency, as the muscle is forced to control the eccentric phase before the explosive concentric contraction. This mechanism is important in punching movements that require high acceleration in a short period of time.

From a sports pedagogical perspective, these findings are also relevant to the development of evidence-based training models in university-level physical education. The integration of resistance bands into the martial arts curriculum supports the principles of innovative sports learning as advocated by modern sports education research (Roux, 2021; Teixeira et al., 2025). Students not only learn techniques but also understand the scientific basis for performance improvement.

The advantages of resistance bands as a training tool also have strong practical implications. Compared to conventional weight training equipment such as dumbbells or machines, resistance bands are portable, inexpensive, and flexible. Ali et al. (2022) emphasize that elastic resistance is particularly suitable for use in the university population due to its ease of implementation and relatively higher safety. This is important in the university context with limited training facilities.

Studies in boxing and taekwondo also show that resistance-based training significantly increases punch speed and power (Loturco et al., 2019; Turner et al., 2019). Although the technical characteristics differ from those of Indonesian martial arts, the physiological principles of increasing power remain the same. Thus, the results of this study expand the empirical evidence on elastic resistance in the context of martial arts in Indonesia.

In addition to increasing strength, resistance bands also promote improved shoulder stability and scapular control. Sports rehabilitation research shows that elastic bands effectively increase glenohumeral joint stability and prevent overuse injuries (Andersen et al., 2018). In striking sports, shoulder stability is crucial to ensure that maximum force transfer is not hampered by joint instability.

From a neuromuscular adaptation perspective, elastic training improves intermuscular and intramuscular coordination (Behm & Sale, 2019). The simultaneous

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activation of the deltoid, triceps brachii, pectoralis major, and core muscles such as the obliques and rectus abdominis creates a more efficient movement synergy. This explains why power increases are not solely due to arm strength, but rather to the integration of the entire motor system.

However, this study has limitations. The intervention duration was only 6 weeks, so it cannot yet describe long-term effects. Literature shows that maximal strength adaptations are typically more optimal over periods of 8–12 weeks (Suchomel et al., 2018). Furthermore, the sample was limited to PJKR students at Insan Budi Utomo University, Malang, so generalizations to professional athlete populations or other age groups should be approached with caution.

The relatively small sample size may also limit external statistical power. Studies with a large-scale randomized controlled trial design would provide greater validity. Further research could also combine resistance bands with plyometric training or velocity-based training to examine synergistic effects on punching power.

Nevertheless, conceptually and empirically, these results support the theory that elastic resistance is an effective stimulus for explosive power development. Resistance bands provide a dynamic load that follows the muscle's natural strength curve, unlike traditional static loads. This approach aligns with the principle of specificity in modern sports conditioning (Cormie et al., 2017).

Practically, university-level martial arts coaches can integrate resistance bands as part of a periodized explosive training program. Implementation can be done in the pre-competition phase to increase power without increasing the risk of injury due to heavy loads. The low cost and ease of use make this method highly relevant for educational institutions.

In conclusion, this discussion confirms that resistance band training effectively increases punching power through neuromuscular adaptation mechanisms, increased type II motor unit activation, kinetic chain optimization, and force transfer efficiency. These results are consistent with international and national literature from the past 10 years emphasizing the importance of elastic resistance in developing explosive performance. However, further research with longer durations and broader populations is needed to strengthen the generalizability of these findings.

Therefore, resistance band training can be recommended as a scientific, practical, economical, and effective alternative training method for improving punching performance in martial arts athletes, particularly in PJKR students in higher education settings.

CONCLUSION

Based on the research results, it can be concluded that resistance band training is proven effective in increasing the punching power of martial arts athletes from the Physical Education and Training (PJKR) program at Insan Budi Utomo University, Malang. Empirically, there was an increase in average punching power from 213.92 N in the pretest to 250.75 N in the posttest, with a difference of 36.83 N. The results of the paired

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sample t-test showed a t value of 2.843 with p = 0.000 < 0.05, indicating a significant improvement after the treatment. Furthermore, the large effect size indicates that the intervention has a strong practical impact on punching performance.

Conceptually, resistance bands provide a progressive elastic stimulus that dynamically trains the arm, shoulder, and core muscles through the kinetic chain mechanism and increases the rate of force development. The increasing elastic load with stretching encourages more explosive muscle contractions, thereby directly increasing punching power.

The practical implications of this study suggest that resistance bands can be recommended as an economical, portable, and effective alternative training method for developing explosive strength in martial arts athletes, particularly in the collegiate environment. However, the limited training duration (6 weeks) and specific sample size require caution in generalizing the results to a broader population of athletes.

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