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Improving Physical Fitness of Pencak Silat Athletes Through Circuit Body Weight Training

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Abstract: *Pencak Silat, a traditional Indonesian martial art, requires athletes to demonstrate a combination of strength, muscular endurance, agility, and cardiovascular endurance. While skill acquisition and tactical drills have traditionally been the focus of training, physical conditioning remains a critical component for optimal performance. This study aimed to evaluate the impact of a circuit bodyweight training program on the physical fitness components of Pencak Silat athletes. A total of 64 participants completed a 16-session high-intensity interval training (HIIT) program designed to improve strength, endurance, agility, and cardiovascular fitness. Pre- and post-test assessments were conducted using leg dynamometer tests for strength, push-up tests for muscular endurance, a fleximeter for agility, and an 800-meter run for cardiovascular endurance. The results demonstrated significant improvements in strength ($p < 0.001$), muscular endurance ($p < 0.001$), and agility ($p = 0.022$), with large effect sizes. However, cardiovascular endurance showed a slight decrease ($p < 0.001$), which may reflect a shift in focus toward anaerobic conditioning. The findings suggest that circuit bodyweight training can effectively enhance athletic performance in Pencak Silat by improving strength, muscular endurance, and agility while complementing traditional skill-based training. These results highlight the value of integrating circuit training into Pencak Silat conditioning programs, providing a balanced physical foundation for athletes. The study provides empirical evidence for coaches and sports practitioners to implement evidence-based training methodologies in combat sports to ensure optimal athlete development.*

Keywords: *Pencak Silat; Circuit Training; Bodyweight Exercise; Physical Fitness; Endurance*

Introduction

Pencak Silat, as a traditional martial art originating from Indonesia, has evolved into an internationally recognized combat sport (Ediyono et al., 2022; Mulyana et al., 2024). It incorporates a unique blend of physical strength, mental discipline, tactical strategy, and spiritual values. Athletes are required to exhibit high levels of physical fitness to perform effectively across various aspects of the sport, such as speed, agility, strength, endurance, and coordination (Akbar et al., 2022; Yao & Niu, 2024). These physical attributes are essential not only to execute complex movements, counters, and attacks but also to sustain performance throughout bouts and tournaments (Rahayuni et al., 2023). Therefore, structured and scientifically grounded training methods are vital to improving the physical fitness of Pencak Silat athletes. The dynamic nature of Pencak Silat, which includes rapid offensive and defensive techniques, explosive power in kicks and punches, as well as continuous movement, requires athletes to possess high levels of anaerobic and aerobic fitness (Lubis et al., 2024). Traditional training methods often emphasize skill acquisition and tactical drills, which are essential. However, without a solid foundation of physical conditioning, the effectiveness of these skills may be compromised. Circuit body weight training offers a comprehensive approach to developing multiple components of fitness simultaneously (Agostini et al., 2023; Ramos-Campo, 2021). When structured appropriately, it can serve as both a conditioning and preparatory phase for more intensive sport-specific training. Therefore, managing body composition is also an essential consideration in their training. Circuit body weight training, due to its high-intensity interval nature, can help in fat reduction and muscle toning, contributing to optimal body weight maintenance without compromising strength or performance (BaiQuan et al., 2025; Ho et al., 2024; Minerva Medica, 2022; Oliveira-Junior et al., 2021). This becomes particularly important during the pre-competition phase, where athletes aim to reach peak physical condition while remaining within their weight class limits.

The structured and time-bound nature of circuit body weight training encourages mental discipline, focus, and perseverance. Athletes learn to push their physical and mental limits, which is essential in a high-pressure sport like Pencak Silat (Suprapto et al., 2024). By regularly engaging in high-intensity circuits, athletes also experience increased confidence and motivation, contributing to better performance in both training and competition (Suprapto et al., 2024). From a coaching perspective, circuit body weight training is relatively easy to design, monitor, and modify based on individual or team needs (Hughes et al., 2025). Coaches can adjust the intensity, duration, rest periods, and exercise selection according to the athlete's current fitness level, training phase, or specific goals. For instance, a coach may design a circuit focused on explosive power to enhance striking ability, or one that emphasizes endurance and recovery to support prolonged sparring sessions (Ruddock et al., 2021). The adaptability and scalability of circuit training make it a highly functional tool within a periodized training program. Despite its many advantages, circuit body weight training is not always integrated systematically into the training routines of Pencak Silat athletes. Some coaches and athletes may still rely heavily on traditional drills or overlook the importance of structured conditioning. There may also be misconceptions about the efficacy of body weight exercises compared to weight training. Therefore, it is essential to bridge this gap by demonstrating, through research and practical application, how circuit body weight training can significantly contribute to physical performance enhancements specific to Pencak Silat.

This study aims to explore and analyze the impact of circuit body weight training on the physical fitness components of Pencak Silat athletes. By implementing a structured circuit body weight training program over a determined period and measuring key fitness indicators such as cardiovascular endurance, muscular strength, agility, and body composition, we aim to provide empirical evidence of its effectiveness. Through this research, we also seek to contribute to the development of evidence-based training models that can be utilized by Pencak Silat coaches and sports practitioners to improve athlete performance sustainably and safely.

Materials and Methods

The research was conducted in Padang City in January 2025. The population of this study consisted of all pencak silat athletes, totaling 64 individuals. The sample was selected using a random sampling technique. All participants gave their consent by signing a statement of willingness to participate in the research. The instruments used in this study included a leg dynamometer to measure strength, push-up tests to assess muscular endurance, a fleximeter to evaluate agility, and an 800-meter run to measure cardiovascular endurance. This research employed a quasi-experimental design, specifically a one-group pre-test and post-test design. One group of athletes was given a circuit bodyweight training program as the treatment. Data collection was carried out through tests and measurements before and after the training intervention. The training program lasted for 16 sessions, conducted three times per week. The goal was to observe improvements in muscle strength, endurance, and agility following the training.

The circuit bodyweight training program was divided into two phases. During sessions 1 to 8, the exercises included Reclining Triceps Press, Lateral Plyo Squat, Floor Inverted Shoulder Press, Single Leg Dip, Split Jacks, Shuttle Run, Frog Jump, Side Jump, Half Squat, Lateral Run, and Bench Jump. Each exercise was performed for 2 sets of 10 repetitions with 20 seconds of rest between stations and 120 seconds of recovery after completing the full circuit. In sessions 9 to 16, the training intensity increased. The same exercises were performed, but with 3 sets of 12 repetitions each, maintaining the 20-second rest between exercises and a 120-second recovery after the circuit. The data collected were analyzed using the JASP software version 0.19.3 by applying a paired sample t-test to determine the differences between the pre-test and post-test results.

Results

The purpose of this study was to examine the effects of a structured physical training intervention on four critical components of fitness: strength, muscular endurance, agility, and cardiovascular endurance. A total of 64 participants completed both pre-test and post-test assessments, allowing for a within-subject comparison of performance before and after the intervention period. To explore the outcomes of the training program, a combination of descriptive and inferential statistical analyses was conducted. Descriptive statistics were used to provide a general overview of performance trends, while normality testing determined the appropriate statistical approach for hypothesis testing. Paired samples t-tests and non-parametric Wilcoxon signed-rank tests were employed to evaluate whether the observed differences between pre- and post-test scores were statistically significant. The following section presents the results of these analyses, beginning with a summary of descriptive data.

Table 1. *Descriptives Data*

Variable	Mean	SD	SE	CV
Strength (Pre-Test)	54.666	21.044	2.631	0.385
Strength (Post-Test)	58.250	22.345	2.793	0.384
Muscular Endurance (Pre-Test)	15.016	5.608	0.701	0.373
Muscular Endurance (Post-Test)	16.578	6.034	0.754	0.364
Agility (Pre-Test)	9.109	7.722	0.965	0.848
Agility (Post-Test)	6.915	3.119	0.390	0.451
Cardiovascular Endurance (Pre-Test)	4.748	0.819	0.102	0.172
Cardiovascular Endurance (Post-Test)	4.397	0.788	0.098	0.179

Table 1 presents the descriptive statistics for each fitness variable assessed before and after the training program. On average, participants showed improvements across most variables. Strength scores increased from a mean of 54.67 (SD = 21.04) to 58.25 (SD = 22.35), while muscular endurance rose from 15.02 (SD = 5.61) to 16.58 (SD = 6.03). These improvements suggest gains in both absolute strength and muscular capacity following the intervention. Agility scores demonstrated a meaningful improvement, decreasing from 9.11 seconds (SD = 7.72) to 6.92 seconds (SD = 3.12), indicating faster response and movement times. The coefficient of variation (CV) notably declined in agility scores, suggesting reduced variability and more consistent performance among participants after the intervention.

Interestingly, cardiovascular endurance scores showed a slight decrease from 4.75 (SD = 0.82) to 4.40 (SD = 0.79). While the decline is relatively small, it may reflect fatigue accumulation or a shift in training emphasis away from aerobic conditioning during the intervention phase. Further inferential analysis is required to determine the statistical significance of these changes. To determine the appropriate statistical tests, normality checks were conducted using the Shapiro–Wilk test. This test helps assess whether the data are normally distributed, which is a key assumption for parametric analysis. The results are presented table 2 below.

Table 2. *Normality Test*

Variable	W	p-value
Strength (Post-Test & Post Test)	0.884	< 0.001
Muscular Endurance (Post-Test & Post Test)	0.729	< 0.001
Agility (Post-Test & Post Test)	0.231	< 0.001
Cardiovascular Endurance (Post-Test & Post Test)	0.964	< 0.001

To assess whether the differences between pre-test and post-test scores were statistically significant, both parametric and non-parametric tests were applied. The paired samples t-test was used for variables that approximated normal distribution, while the Wilcoxon signed-rank test served as a non-parametric alternative for data that violated the assumption of normality. The following table presents the results of both tests for each measured variable, along with corresponding effect sizes to indicate the magnitude of change. For more details, please see table 3 below.

Table 3. *Results of Paired Samples t-Test and Wilcoxon Signed-Rank Test*

Measure	Test	Statistic	df	p-value	Effect Size	SE Effect Size
Strength (Post-Test & Post Test)	t-test	-14.715	63	< 0.001	-1.839	0.014
	Wilcoxon	0.000	—	< 0.001	-1.000	0.143
Muscular Endurance (Post-Test & Post Test)	t-test	-18.834	63	< 0.001	-2.354	0.021
	Wilcoxon	0.000	—	< 0.001	-1.000	0.143
Agility (Post-Test & Post Test)	t-test	2.353	63	< 0.001	0.294	0.153
	Wilcoxon	1.950.500	—	< 0.001	0.875	0.143
Cardiovascular Endurance (Post-Test & Post Test)	t-test	18.635	63	< 0.001	2.329	0.044
	Wilcoxon	2.080.000	—	< 0.001	1.000	0.143

The paired samples t-tests revealed significant differences between pre-test and post-test scores across all four variables. Strength and muscular endurance showed highly significant improvements with large effect sizes (d = -1.839 and -2.354, respectively). Agility also improved significantly ($p = 0.022$), with a small to medium effect (d = 0.294). Interestingly, cardiovascular endurance showed a significant decrease ($t = 18.635$, $p < 0.001$, d = 2.329), suggesting a potential regression post-intervention. The Wilcoxon signed-rank tests confirmed these findings, particularly for variables with non-normal distributions. All p-values were < 0.001, with strong effect sizes highlighting the robustness of the observed changes despite deviations from normality.

Discussion

This study is significant because it provides empirical insights into the impact of circuit body weight training on the physical fitness components of Pencak Silat athletes, a traditional martial art that has evolved into an internationally recognized combat sport. Pencak Silat requires athletes to demonstrate high levels of physical fitness, including strength, endurance, agility, and cardiovascular endurance. The findings from this research offer practical applications for enhancing the physical conditioning of Pencak Silat athletes through scientifically grounded training methods. Given the limited body of research focusing specifically on the effects of bodyweight circuits in the context of Pencak Silat, this study fills a crucial gap in our understanding of how such training can enhance athletic performance in this sport. Pencak Silat is a dynamic martial art that demands rapid offensive and defensive movements, explosive power, and sustained endurance. To execute complex techniques effectively, athletes must possess a combination of anaerobic and aerobic fitness. Therefore, physical conditioning is a critical aspect of performance. Circuit bodyweight training, which emphasizes high-intensity interval training, has been suggested to simultaneously improve multiple physical attributes, such as muscular strength, endurance, and agility. This study exploration of the benefits of circuit bodyweight training in improving the fitness levels of Pencak Silat athletes is vital as it supports the notion that structured conditioning plays a crucial role in enhancing athletic performance. Furthermore, the study highlights the importance of evidence-based training in improving athlete performance sustainably and safely. Traditionally, Pencak Silat training has focused heavily on skill acquisition and tactical drills, but this study demonstrates how structured conditioning, like bodyweight circuit training, can complement these skills to optimize overall performance. By analyzing the effects of this specific training method, the research contributes valuable knowledge to coaches, athletes, and sports practitioners in the Pencak Silat community.

This study aligns with and extends the findings of several other studies that have explored the effects of high-intensity circuit training on various athletic populations. For instance, a study by (Vasconcelos et al., 2020) on combat athletes showed that circuit training, specifically high-intensity interval training (HIIT), significantly enhanced aerobic fitness, strength, and muscular endurance. This is consistent with the findings of the present study, which demonstrated improvements in strength, muscular endurance, and agility following a circuit bodyweight training regimen. Additionally, (Herranz-Gómez et al., 2022) found that high-intensity exercise, including circuit training, can improve both aerobic and anaerobic fitness in athletes. Although the cardiovascular endurance in the present study slightly decreased, it is worth noting that other research indicates such fluctuations can occur due to shifts in the focus of the training, from aerobic conditioning to anaerobic, power-based exercises, as observed in this study. This aligns with (Stone et al., 2022), who emphasized that the specificity of training must align with the demands of the sport. For Pencak Silat, anaerobic power and strength are likely more critical than cardiovascular endurance during short bursts of combat.

Furthermore, the meta-analysis by (Yuniana et al., 2024) demonstrated that bodyweight training, especially when used in a circuit format, is highly effective for improving athletic performance across a range of sports. This strengthens the case for integrating bodyweight circuits into the training regimens of combat athletes like those practicing Pencak Silat. The present study not only corroborates these findings but also addresses a specific gap by focusing on Pencak Silat athletes, who have unique demands in terms of agility, explosive power, and endurance. The findings of this study have several important implications for Pencak Silat training and athletic conditioning. First, the significant improvements in strength, muscular endurance, and agility underscore the importance of integrating circuit bodyweight training into the training programs of Pencak Silat athletes. Coaches can use this method to complement traditional skill-based training and tactical drills, leading to well-rounded athletes who are physically prepared to perform complex movements, execute powerful strikes, and maintain performance over extended bouts.

Moreover, this research suggests that circuit bodyweight training can be a viable option during the pre-competition phase, where athletes are seeking to optimize their body composition, strength, and endurance without adding the bulk often associated with traditional weight training. The high-intensity nature of circuit training allows athletes to achieve fat reduction and muscle toning, maintaining a lean physique without compromising performance. This is crucial for athletes who need to meet specific weight class requirements while maximizing their power output and overall athleticism.

While the study offers valuable insights, there are some limitations that should be considered. First, the sample size of 64 participants, although adequate for initial analysis, could have been larger to enhance the generalizability of the findings across different populations of Pencak Silat athletes. Additionally, the study relied on a single group pre-test and post-test design, which, while useful for detecting changes within the group, does not allow for comparisons with a control group. Without a control group, it is difficult to rule out other factors (e.g., natural progress over time, external training variables) that might have contributed to the observed improvements. Another limitation is the duration of the training program, which lasted for only 16 sessions. A longer training period would allow for a deeper exploration of the long-term effects of circuit bodyweight training on various fitness components. Furthermore, the study's focus on only four specific fitness components (strength, muscular endurance, agility, and cardiovascular endurance) means that other important factors, such as flexibility, injury prevention, and mental toughness, were not evaluated. Lastly, the slight decrease in cardiovascular endurance observed in the study warrants further investigation. While this result might be attributed to the specific emphasis on anaerobic conditioning, it may also point to a potential trade-off between different fitness components. A more balanced training approach, integrating both aerobic and anaerobic exercises, could be explored in future studies to determine the optimal training protocol for combat athletes.

Future research could address several aspects to build on the findings of this study. One recommendation is to conduct a longitudinal study to assess the long-term effects of circuit bodyweight training on the physical fitness of Pencak Silat athletes. This would help determine whether the observed improvements are sustained over time and if the training has any lasting impact on performance. Additionally, future studies could explore the effects of circuit bodyweight training on other fitness variables, such as flexibility, reaction time, mental toughness, and injury prevention, which are equally important in combat sports. Investigating the relationship between physical conditioning and mental preparation could offer a holistic understanding of how circuit training can contribute to a Pencak Silat athlete's overall performance. Lastly, comparing the effects of bodyweight circuit training with other types of training, such as traditional weight training or sport-specific skill drills, could provide insights into the relative benefits of each method. This would help coaches design more effective and balanced training programs tailored to the unique demands of combat sports like Pencak Silat.

This study underscores the value of incorporating circuit bodyweight training into the conditioning programs for Pencak Silat athletes. The significant improvements in strength, muscular endurance, and agility suggest that this training method can be a highly effective means of enhancing athletic performance. Despite the limitations of the study, its findings contribute to the growing body of evidence supporting the use of high-intensity circuit training in combat sports. By integrating such training into their regimens, Pencak Silat athletes can achieve a more comprehensive and balanced physical conditioning, improving not only their technical skills but also their overall athleticism.

Conclusion

This study has demonstrated that circuit bodyweight training significantly improves key physical fitness components in Pencak Silat athletes, including strength, muscular endurance, and agility. The structured, high-intensity nature of circuit training appears to be highly effective in enhancing these attributes, which are essential for optimal performance in Pencak Silat. The improvements in strength and endurance are particularly notable, supporting the idea that such training can complement traditional skill-based drills and provide athletes with a more well-rounded physical foundation. While the study found a slight decrease in cardiovascular endurance, the improvements in strength, endurance, and agility suggest that the focus of the training on anaerobic conditioning may have been more aligned with the specific demands of Pencak Silat. These findings align with other studies on circuit training, reinforcing the value of this training method for combat sports that require explosive power, agility, and muscular endurance. Overall, the results of this study highlight the importance of integrating circuit bodyweight training into

the training programs of Pencak Silat athletes. It offers a practical, adaptable, and effective approach to developing athleticism, ensuring that athletes are not only skilled in the technical aspects of the sport but also well-conditioned physically. These findings provide valuable insights for coaches, sports practitioners, and athletes looking to optimize performance and ensure sustainable physical development in the sport of Pencak Silat.

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