

The Winning Formula: Differentiating Technical Efficiency Between Winners and Losers in National-Level Pencak Silat Olahraga

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DOI: <https://doi.org/10.47772/IJRISS.2026.100800176>

Received: 14 August 2026; Accepted: 19 August 2026; Published: 29 August 2026

ABSTRACT

Background: Match analysis provides essential objective data for evidence-based tactical strategies in combat sports. However, previous Pencak Silat Olahraga (PSO) research has primarily focused on overall technique frequencies rather than how technical efficiency and point conversion rates differentiate match outcomes.

Objective: To identify the key technical efficiency metrics and performance indicators (PIs) distinguishing winners from losers among national-level male PSO athletes at Sukan Malaysia (SUKMA) 2024.

Methods: A total of 27 matches (81 rounds) were recorded and analyzed using LongoMatch software. Striking (turning, front, side, back kicks; punches) and grappling (Jatuhan, Anti-Jatuhan, counterattacks, Guntingan) PIs were coded for total volume, successful executions, and technical efficiency ratios (successful actions / total attempts). Outcome differences across match rounds were analyzed using independent samples t-tests and multivariate analysis of variance (MANOVA).

Results: Total attack volume did not significantly differ between outcome groups ($p > 0.05$). However, winning athletes demonstrated significantly higher technical efficiency in turning kicks ($p < 0.01$) and legal takedowns (Jatuhan, $p < 0.05$). Defensive grappling efficiency (Anti-Jatuhan) was significantly greater in winners during Round 3 ($p < 0.05$), neutralizing high-value scoring attempts late in competition. Punching efficiency remained low across both groups due to minimal point yield relative to counter-attack risks.

Conclusion: Elite PSO match success is governed by technical precision and conversion efficiency rather than raw attack frequency. Coaches should design data-driven training interventions emphasizing high-yield striking accuracy, defensive grappling stability, and tactical decision-making under match conditions.

Keywords Silat, Technical Efficiency, Match Outcome, Performance Indicators, Combat Sport

INTRODUCTION

Pencak Silat originated in Southeast Asia as a traditional form of self-defence and has evolved into a formalized combat sport governed by standardized competitive rules. It is broadly divided into two main disciplines: Pencak Silat Artistik (PSA), which centers on choreographed movements, step patterns, traditional attire, and weapons, and Pencak Silat Olahraga (PSO), which focuses on full-contact, dynamic competitive sparring (Setiadi et al., 2022). Over recent decades, PSO has attained recognition as an official event in major international and regional multi-sport competitions, including the South East Asian (SEA) Games, World Pencak Silat Championships, and Malaysia's premier national games, Sukan Malaysia (SUKMA) (Subekti et al., 2021a). As the sport matures

professionally, the margin between victory and defeat has narrowed significantly, driving coaches and sports scientists toward performance analysis to secure tactical competitive advantages. Performance analysis the systematic observational evaluation of athletic actions during competition plays a fundamental role in modern sports science by establishing evidence-based benchmarks for training and tactical planning (Azizah et al., 2019). While computerized notation systems, video tracking, and wearable inertial sensors have been extensively implemented in team sports like soccer (Nicholls et al., 2016), rugby (Parmar et al., 2017), and hockey (Huo et al., 2024), as well as combat sports like Judo (Dopico-Calvo et al., 2023), Ju-Jitsu (Ambroży et al., 2023a), Taekwondo (Suppiah et al., 2017), and Mixed Martial Arts (MMA) (Bello et al., 2019), performance analysis in PSO remains in its early stages. Historically, research in PSO has focused heavily on biomechanical evaluations of isolated techniques, such as the turning kicks or sidekicks. Only a limited number of studies have attempted to map technical performance indicators (PIs) during live matchplay. A key area of divergence in current combat sports literature lies in how technical actions are evaluated to predict success (Gusciglio & Morin, 2023). Traditional descriptive analyses focus primarily on overall technique volume or frequency identifying which actions occur most often during a bout (Loeb et al., 2017). For example, initial studies on PSO match profiles indicate that kicking techniques (specifically turning kicks) account for the highest volume of offensive output (28%), followed by punches (17%) and takedowns (Jatuhan, 16%) (Subekti et al., 2021a). Similar volume-centric patterns favouring strikes have been documented in Taekwondo and other Silat cohorts. However, a growing body of evidence in combat sports analytics argues that raw volume is a poor predictor of competitive outcome. In sports such as Judo (Segedi & Sertić, 2014) and MMA (Bello et al., 2019), victorious fighters are distinguished not by the sheer quantity of attacks attempted, but by their technical efficiency, spatial-temporal timing, and point-conversion accuracy. In PSO, where different technical actions carry distinct point values such as 1 point for a hand strike, 2 points for a successful leg strike, and 3 points for a legal takedown (Jatuhan) relying solely on strike counts masks the tactical risk-to-reward efficiency required to win (Mohd et al., 2011). Furthermore, controversy exists regarding the tactical utility of lower-scoring versus higher-scoring techniques (Ambroży et al., 2021). While some literature suggests that low-risk, lower-scoring techniques like punches (1 point) serve as vital strategic tools to disrupt opponent stance, manage distance, and set up follow-up strikes, recent findings demonstrate that athletes frequently decrease punching output due to the risk of being caught and thrown via Jatuhan counterattacks (Ishac & Eager, 2021). Although takedowns yield the highest score per execution (3 points) and are critical statistical predictors of fight outcome, they require substantial physical exertion, leaving athletes vulnerable to counter-takedowns (Anti-Jatuhan) if executed inefficiently (Segedi & Sertić, 2014). Despite these complex tactical trade-offs, existing PSO match analysis research largely aggregates data across whole athlete cohorts without distinguishing performance profiles between winners and losers (Aiswarya et al., 2026). Consequently, it remains unclear whether winning in elite PSO is driven by higher overall work rates or superior technical efficiency and point conversion rates. To address this gap, the purpose of this study is to differentiate technical efficiency and performance indicator profiles between winners and losers in national-level PSO male athletes during SUKMA 2024. By moving beyond simple frequency counts, this study evaluates attempt to success ratios across striking (turning, front, side, and back kicks; punches) and grappling (Jatuhan, Guntingan, and Anti-Jatuhan) techniques. We test two primary hypotheses winning athletes will demonstrate significantly higher technical efficiency (point conversion rates) across kicks and takedowns (Jatuhan) compared to losing athletes, despite potential similarities in total technique volume defensive grappling efficiency (Anti-Jatuhan) and counterattack success will serve as critical statistical discriminators separating winners from losers in the final round of competition. Establishing these key performance indicators will provide coaches and practitioners with objective, data-driven frameworks to refine tactical decision-making, optimize combat conditioning, and structure specialized training interventions tailored for elite PSO competition.

METHOD

Research Design

This study employed an observational, quantitative match-analysis design to investigate technical performance indicators and differentiate technical efficiency between winners and losers in national-level Pencak Silat Olahraga (PSO) male athletes. The competitive matches evaluated were sampled from the Sukan Malaysia (SUKMA) 2024 games, representing the elite national tier of youth-to-senior combat sports in Malaysia. Ethical

approval and consent for video recording were obtained from tournament officials, coaches, and athletes prior to data collection.

A sample of 27 matches ($n = 27$ matches, comprising 81 individual rounds) was analyzed. Matches spanned across competition phases, including the preliminary round, quarter-finals, semi-finals, and final matches. Bout inclusion criteria required complete matches consisting of three full rounds. Matches terminated prematurely due to severe injury, medical disqualification, or referee stoppage were excluded to maintain standardized bout durations across the dataset.

Data Collection Procedure

All competition matches were recorded live in high-definition (HD) resolution using a Sony HDR-CX405 digital camcorder. The camera was mounted on a stable tripod and positioned at an elevated vantage point adjacent to the mat arena (gelanggang). This location ensured an unobstructed, complete view of both athletes, the referee, and the electronic scoring display throughout each 3-round bout. Video files were systematically cataloged, stored, and prepared for offline observational coding

Video Analysis & LongoMatch Software Tagging

Video annotation and observational coding were executed using LongoMatch software. A customized tagging template was designed within the software to code both offensive and defensive performance indicators (PIs) for winning and losing athletes independently. Each tagged action was categorized by outcome: Attempted (technique initiated toward the target) or Successful (technique clearly connected, awarded points by judges, or successfully executed a defense/takedown). To quantify technical proficiency beyond raw attempt counts, Technical Efficiency (TE) was calculated for each technical category using the following equation:

$$\text{Technical Efficiency (\%)} = \left(\frac{\text{Successful Executions}}{\text{Total Attempts}} \right) \times 100$$

To minimize observational bias and establish coding reliability, all matches were coded by a primary performance analyst. Inter-rater reliability was assessed by having a secondary analyst independently code a randomly selected subset of matches (20% of the total sample). Cohen's Kappa coefficient (K) was calculated to evaluate agreement between raters, yielding a high level of agreement ($\text{kappa} > 0.85$).

Statistical Analysis

Data normality was evaluated using the Shapiro-Wilk test, and homogeneity of variance was assessed using Levene's test. Descriptive statistics were expressed as Mean $\pm$ Standard Deviation for total technique attempts, successful executions, and technical efficiency percentages. Statistical comparisons were executed through the following methods Independent Samples T Tests used to analyze differences in total technique volume, successful technique counts, and technical efficiency percentages between Winners and Losers across the overall match. Multivariate Analysis of Variance (MANOVA): Conducted to assess the main and interaction effects of Outcome (Winner vs. Loser) and Round (Round 1 vs. Round 2 vs. Round 3) across multiple technical efficiency metrics simultaneously. Effect Size Calculation: Cohen's d (for t -tests) and partial eta squared for MANOVA were calculated to quantify the magnitude of differences between groups. Effect sizes for Cohen's d were interpreted as small (0.20), medium (0.50), and large (0.80); p values were categorized as small (0.01), medium (0.06), and large (0.14). Statistical significance for all tests was set at $p < 0.05$. Statistical processing was performed using IBM SPSS Statistics (Version 21.0, SPSS Inc., Chicago, IL, USA)

RESULTS

Overall Match Profile and Volume vs. Efficiency Comparison

Across the 27 analyzed matches (81 rounds), a total of 1,242 technical actions were observed. A initial comparison between total technical volume (total attempts) and overall technical efficiency revealed distinct operational patterns between match outcomes.

As detailed in Table 1, no statistically significant difference was observed between winners and losers in total technique attempts ($p = .412, d = 0.22$). Winners executed a total mean volume of 23.6 ± 4.1 technical attempts per match, compared to 22.7 ± 3.9 attempts by losers. However, winners achieved a significantly higher overall match technical efficiency ($42.8 \pm 6.2\%$) compared to losers ($28.4 \pm 5.1\%$), $t(52) = 9.32, p < .001, d = 2.54$.

Table 1: Comparison of overall match volume, successful actions, and technical efficiency between Winners and Losers (n = 27 matches).

Variable	Winners (Mean±SD)	Losers (Mean±SD)	t-value	p-value	Effect Size (Cohen's d)
Total Attempts (Volume)	23.6 ± 4.1	22.7 ± 3.9	0.83	.412	0.22
Successful Executions	10.1 ± 1.8	6.4 ± 1.4	8.43	<.001*	2.30
Overall Technical Efficiency (%)	42.8 ± 6.2%	28.4 ± 5.1%	9.32	<.001*	2.54

Striking Technical Efficiency

Striking techniques accounted for the largest overall proportion of technical attempts. Table 2 summarizes the volume, successful executions, and technical efficiency percentages across specific striking techniques for both groups. Turning kicks were the most frequently attempted offensive technique. While attempt volume did not differ ($p = .689$), winners achieved significantly greater technical efficiency ($48.6 \pm 11.2\%$) compared to losers ($31.4 \pm 10.5\%$), $t(52) = 5.81, p < .001, d = 1.58$. Winners recorded higher technical efficiency in front kicks ($39.5 \pm 12.1\%$) relative to losers ($30.4 \pm 15.3\%$), $t(52) = 2.44, p = .018, d = 0.66$. No statistically significant differences were observed between winners and losers in technical efficiency for side kicks ($p = .362$) or back kicks ($p = .758$). Punches demonstrated low efficiency across both groups. Winners achieved an efficiency of $21.1 \pm 11.4\%$, whereas losers registered $16.7 \pm 16.8\%$, showing no statistically significant difference ($p = .255$).

Table 2: Striking technical efficiency and performance indicators by match outcome.

Striking Metric	Group	Total Attempts	Successful Executions	Technical Efficiency (%)	t-value (TE)	p-value	Effect Size (d)
Turning Kick	Winners	7.2 ± 1.8	3.5 ± 1.1	48.6 ± 11.2%	5.81	<.001*	1.58
	Losers	7.0 ± 1.9	2.2 ± 0.9	31.4 ± 10.5%			
Front Kick	Winners	4.8 ± 1.2	1.9 ± 0.7	39.5 ± 12.1%	2.44	.018*	0.66
	Losers	4.6 ± 1.1	1.4 ± 0.6	30.4 ± 15.3%			
Side Kick	Winners	1.8 ± 0.9	0.5 ± 0.4	27.8 ± 18.2%	0.92	.362	0.25
	Losers	1.7 ± 1.0	0.4 ± 0.3	23.5 ± 16.1%			
Back Kick	Winners	0.4 ± 0.5	0.1 ± 0.2	25.0 ± 30.1%	0.31	.758	0.08
	Losers	0.4 ± 0.4	0.1 ± 0.2	22.5 ± 28.4%			
Punches	Winners	3.8 ± 1.2	0.8 ± 0.5	21.1 ± 11.4%	1.15	.255	0.31
	Losers	3.6 ± 1.3	0.6 ± 0.4	16.7 ± 16.8%			

Grappling and Counterattack Technical Efficiency

Grappling metrics (Jatuhan, Anti-Jatuhan, Guntingan) and counterattacks were evaluated to assess high-yield point conversion and defensive stability. Results are detailed in Table 3. Winners demonstrated a significantly higher takedown conversion efficiency ($57.1 \pm 18.4\%$) than losers ($34.6 \pm 20.6\%$), $t(52) = 4.21, p < .001, d = 1.15$. Winners successfully defended against opponent takedown attempts at a rate of $71.4 \pm 19.2\%$, whereas losers recorded a defense rate of $45.0 \pm 20.5\%$, $t(52) = 4.88, p < .001, d = 1.33$. Counterattack efficiency was significantly higher in winners ($50.0 \pm 28.6\%$) compared to losers ($28.6 \pm 25.5\%$), $t(52) = 2.89, p = .006, d = 0.79$. Scissor takedown execution remained low in both volume and efficiency, with no significant difference observed between outcome groups ($p = .255$).

Table 3: Grappling and counterattack technical efficiency by match outcome.

Grappling Metric	Group	Total Attempts	Successful Executions	Technical Efficiency (%)	t-value (TE)	p-value	Effect Size (d)
Jatuhan (Takedowns)	Winners	2.8 ± 0.8	1.6 ± 0.6	$57.1 \pm 18.4\%$	4.21	<.001*	1.15
	Losers	2.6 ± 0.9	0.9 ± 0.5	$34.6 \pm 20.6\%$			
Anti-Jatuhan (Defensive)	Winners	2.1 ± 0.8	1.5 ± 0.6	$71.4 \pm 19.2\%$	4.88	<.001*	1.33
	Losers	2.0 ± 0.7	0.9 ± 0.5	$45.0 \pm 20.5\%$			
Counterattacks	Winners	0.8 ± 0.6	0.4 ± 0.3	$50.0 \pm 28.6\%$	2.89	.006*	0.79
	Losers	0.7 ± 0.5	0.2 ± 0.2	$28.6 \pm 25.5\%$			
Guntingan (Scissor)	Winners	0.4 ± 0.4	0.1 ± 0.2	$25.0 \pm 32.1\%$	0.84	.405	0.23
	Losers	0.3 ± 0.3	0.05 ± 0.1	$16.7 \pm 28.9\%$			

Round-by-Round Progression of Key Efficiency Metrics

A 2×3 (Outcome $\times$ Round) Repeated Measures MANOVA was conducted across key scoring metrics (*Turning Kick TE*, *Jatuhan TE*, and *Anti-Jatuhan TE*).

Turning Kick Efficiency

There was a significant main effect for Outcome ($F(1,52) = 33.76, p < .001, \eta_p^2 = .394$), but no main effect for Round ($p = .182$) or Outcome $\times$ Round interaction ($p = .310$). Winners maintained high turning kick efficiency from Round 1 ($46.8 \pm 12.1\%$) through Round 3 ($50.2 \pm 11.8\%$), whereas losers exhibited lower efficiency that declined slightly in Round 3 ($32.1 \pm 11.0\%$ to $29.8 \pm 10.2\%$).

Jatuhan (Takedown) Efficiency

A significant main effect was observed for both Outcome ($F(1,52) = 17.72, p < .001, \eta_p^2 = .254$) and Round ($F(2,104) = 8.12, p = .001, \eta_p^2 = .135$). Takedown efficiency increased in Round 3 for both winners ($63.3 \pm 19.5\%$) and losers ($41.2 \pm 21.0\%$), reflecting elevated late-match tactical focus on high-scoring maneuvers.

Anti-Jatuhan (Defensive Grappling) Efficiency

A significant Outcome $\times$ Round interaction effect was identified for defensive grappling efficiency, $F(2,104) = 5.42, p = .006, \eta_p^2 = .094$. While defensive efficiency remained stable across Rounds 1 and 2, winners

demonstrated a substantial increase in *Anti-Jatuhan* efficiency in Round 3 ($78.2 \pm 16.4\%$), whereas losers showed a decline ($38.5 \pm 21.1\%$), $p < .001$.

DISCUSSION

The primary objective of this study was to differentiate technical efficiency and PI profiles between winning and losing male athletes in national-level PSO during SUKMA 2024. Moving beyond traditional observational studies that focus solely on raw technique frequency, this investigation evaluated attempt to success ratios across striking, grappling, and counter-offensive actions (Subekti et al., 2021b). The principal finding of this study is that overall technical attempt volume does not statistically discriminate winners from losers ($p = .412$); rather, match outcome is dictated by superior technical conversion rates and defensive efficiency. This confirms our primary hypothesis (H_1) and aligns with performance analytics trends observed across elite combat sports.

The analysis revealed that both winners and losers engaged in comparable offensive output, executing approximately 23 to 24 technical attempts per match. However, winners achieved a significantly higher overall match technical efficiency (42.8%) compared to losers (28.4%). This distinction was most pronounced in kicking techniques, particularly the turning kick (Ambroży et al., 2020). Confirming earlier descriptive findings on PSO, turning kicks represented the most frequently attempted offensive maneuver. Crucially, while both groups attempted similar volumes of turning kicks (Ambroży et al., 2020), winners converted these attempts into scoring points at a rate of 48.6%, whereas losers achieved only 31.4%.

A traditional premise in combat sports match analysis is that high attack volume correlates directly with competitive dominance (Ambroży et al., 2023b). However, the current data demonstrates that total technical output was nearly identical between winners (23.6 ± 4.1 attempts) and losers (22.7 ± 3.9 attempts). Instead, the operational boundary separating victorious athletes lies in technical efficiency (42.8% in winners vs. 28.4% in losers). This finding aligns with modern performance analysis literature across other combat disciplines, such as Judo (Segedi et al., 2014) and Mixed Martial Arts (MMA) (Miarka et al., 2016), where strike accuracy and tactical timing rather than volume predict match outcomes.

Among striking techniques, turning kicks emerged as the primary offensive tool, accounting for the highest volume of execution (Gutiérrez-Santiago et al., 2020). While both groups attempted a similar number of turning kicks, winners achieved a significantly higher point conversion efficiency (48.6%) compared to losers (31.4%). This superiority in leg-strike precision mirrors observations by Bridge et al. (2014) in Taekwondo, where elite competitors prioritize high yielding kicks executed within optimal distance windows. In PSO, turning kicks yield 2 points per successful execution thus, a higher conversion efficiency allows victorious athletes to accumulate point leads without expending unnecessary metabolic energy on blocked or missed strikes (Mohd et al., 2011).

Conversely, punching techniques exhibited low technical efficiency across both winners (21.1%) and losers (16.7%). This low conversion rate reinforces earlier observations by Setiadi et al. (2022) and Tama et al. (2020), who noted that hand strikes in PSO carry high tactical risk relative to reward. Because punches yield only 1 point and require close-range proximity, inefficient punching exposes the athlete to counter-clinching, sweeps, and takedowns (*Jatuhan*). While Setiadi et al. (2022) observed high punching frequencies in regional Indonesian cohorts to disrupt opponent stance, the present SUKMA 2024 dataset indicates that at elite national levels, punching functions primarily as a tactical distance feint rather than a primary point-scoring metric.

Legal takedowns (*Jatuhan*) represent the highest single-action point yield in PSO (3 points per execution). In line with findings by Soo et al. (2018), who identified takedown metrics as the strongest statistical predictor of fight outcomes in elite Silat (75% classification accuracy), the present study confirmed that winners achieved a 57.1% efficiency rate in *Jatuhan* attempts compared to 34.6% in losers. Because executing a takedown demands high biomechanical effort and exposes the initiator to counter-attacks, successful athletes exhibit superior spatial-temporal timing, initiating grappling sequences only when the opponent's center of gravity is compromised (Soo et al., 2018). Scissor takedowns (*Guntingan*), while visually impactful, displayed negligible execution volume and efficiency across both groups (25.0% vs. 16.7%). This minimal reliance on *Guntingan* is consistent with findings by Pawista et al. (2019) and Shapie et al. (2029), who noted that high-risk acrobatic actions are

increasingly abandoned in high stakes competition in favour of high probability sweep and catch and throw mechanics.

The round-by-round efficiency progression provides crucial insights into the interaction between conditioning, fatigue, and tactical decision-making (Miarka et al., 2016). Both winners and losers exhibited an increase in *Jatuhan* attempts and efficiency in Round 3. This late match surge in grappling reflects a deliberate tactical shift where trailing athletes initiate high scoring takedown attempts to overturn deficits, while leading athletes seek to finalize match outcomes (Subekti et al., 2021b). Similar late-bout intensity shifts have been documented in Judo by Dopico-Calvo et al. (2023) and Ju-Jitsu by Ambroży et al., (2021) where point scoring actions escalate as time constraints tighten. However, the definitive tactical discriminator in Round 3 was defensive grappling efficiency (*Anti-Jatuhan*). While losers experienced a drop in defensive efficiency (38.5%), winners elevated their *Anti-Jatuhan* efficiency to 78.2%. This finding mirrors research in MMA by Bello et al., (2019) who established that neutralizing opponent grappling in closing phases is vital for maintaining point advantages under high physical fatigue. Elite winners in PSO possess the isometric trunk stability, balance recovery, and tactical composure necessary to withstand desperate late-match takedown attempts by opponent (Bello et al., 2019).

Practical Application

The findings of this study offer direct practical applications for performance analysts, martial arts coaches, and combat sports scientists: (1) Shift focus from volume to conversion accuracy: Training regimens should prioritize target precision, timing, and strike setup over high-repetition pad work. Drills should replicate competitive resistance to build realistic point-conversion capacity. (2) Integrate defensive grappling under fatigue: Given the critical role of *Anti-Jatuhan* in Round 3, coaches must design sport-specific conditioning protocols that combine high-cardiovascular loads with dynamic balance recovery and takedown defense drills. (3) Optimize risk-reward tactical frameworks: Athletes should be conditioned to limit low-yield, un-setup punches (1 point) that carry high counter risks, focusing instead on structured kick-to-clinch combinations that set up high-value turning kicks (2 points) and *Jatuhan* throws (3 points).

Research Contributions

This study advances Pencak Silat Olahraga (PSO) analytics by replacing traditional technique frequency counts with a technical efficiency model that measures point-conversion accuracy ($TE \% = \frac{\text{Successful Executions}}{\text{Total Attempts}} \times 100$). The findings demonstrate that overall work rates do not separate winners from losers; instead, match success hinges on superior point conversion in high-value actions like turning kicks and legal takedowns (*Jatuhan*). Furthermore, evaluating round-by-round efficiency progression reveals that late-match defensive grappling (*Anti-Jatuhan*) serves as a crucial tactical discriminator in Round 3, allowing winners to maintain leads under fatigue. These empirical benchmarks provide coaches with a data-driven framework to design interventions that prioritize striking precision and grappling stability over high-volume output.

Limitations of the Study

Several constraints should be considered when interpreting these findings. The sample was limited to national-level male athletes at SUKMA 2024, restricting direct generalization to female, junior, or international cohorts. Additionally, performance data was aggregated across all weight divisions without segmenting for weight-class dynamics or opponent fighting styles. The study also relied on manual observational tagging in LongoMatch rather than automated optical tracking, and it evaluated discrete technical outcomes without incorporating wearable sensors or physiological markers (e.g., heart rate, blood lactate) to measure metabolic fatigue.

CONCLUSION

In conclusion, competitive success in national-level male PSO is driven by technical efficiency and precision rather than raw attack volume. While winners and losers produce similar total attempt counts, victorious athletes convert turning kicks and takedowns (*Jatuhan*) at significantly higher rates and sustain elite defensive grappling

(*Anti-Jatuhan*) in the final round. Low-scoring actions like un-setup punches offer minimal point yield relative to counter-attack risks. Coaches should therefore adapt training strategies to focus on target accuracy, high-yield tactical setups, and sport-specific grappling defense under match-induced fatigue

Authors' Contribution

NFS, SAA and HH was responsible for the design and conceptualization of the research and the drafting of the manuscript. SAA & NFS was responsible for analyzing the data and discussing the findings. All authors read and approved the final manuscript.

Conflict Of Interest

Authors declare that there are no conflicts of interest associated with this study.

ACKNOWLEDGEMENTS

The authors would like to thanks to all athletes and coaches or their cooperation, support, and permission to conduct this study.

REFERENCES

1. Aiswarya, A. U., Patel, P., & Mathavan, S. B. (2026). Performance Analysis of Technical-Tactical Factors Determining Match Outcomes in Elite Female Taekwondo Players. *Health Technologies*, 4(2), 61–71. <https://doi.org/10.58962/Ht.303>
2. Ambroży, T., Rydzik, Ł., Spieszny, M., Chwała, W., Jaszczur-Nowicki, J., Jekielek, M., Görner, K., Ostrowski, A., & Cynarski, W. J. (2021). Evaluation of the Level of Technical and Tactical Skills and Its Relationships with Aerobic Capacity and Special Fitness in Elite Ju-Jitsu Athletes. *International Journal of Environmental Research and Public Health*, 18(23). <https://doi.org/10.3390/Ijerp182312286>
3. Ambroży, T., Rydzik, Ł., Wąsacz, W., Małodobry, Z., Cynarski, W. J., Ambroży, D., & Kędra, A. (2023a). Analysis Of Combat in Sport JU-JITSU During the World Championships in Fighting Formula. *Applied Sciences (Switzerland)*, 13(20). <https://doi.org/10.3390/App132011417>
4. Ambroży, T., Rydzik, Ł., Wąsacz, W., Małodobry, Z., Cynarski, W. J., Ambroży, D., & Kędra, A. (2023b). Analysis Of Combat In Sport JU-JITSU During The World Championships In Fighting Formula. *Applied Sciences (Switzerland)*, 13(20). <https://doi.org/10.3390/App132011417>
5. Ambroży, T., Rydzik, Ł., Kędra, A., Ambroży, D., Niewczas, M., Sobilo, E., & Czarny, W. (2020). The Effectiveness Of Kickboxing Techniques And Its Relation To Fights Won By Knockout (Vol. 16, Number 11).
6. Azizah Abdul Aziz, N., Nizam Mohamed Shapie, M., Indrayuda, I., Al-Syurgawi, D., Rahizam Abdul Rahim, M., Meara Abdullah, N., Parnabas, V., Syazwan Nawai, N., Samsudin, H., Muhammed Kassim, R., Anizu Mohd Nor, M., Alam Selangor, S., Seni Gayung Fatani Malaysia, P., Silat Olahraga Nasional, P., & Alam, S. (2019). Silat Tempur League: The Analysis Of Athletes Performance In 2019 Competitions.
7. Bello, F. D., Brito, C. J., Amtmann, J., & Miarka, B. (2019). Ending MMA Combat, Specific Grappling Techniques According To The Type Of The Outcome. *Journal Of Human Kinetics*, 67(1), 271–280. <https://doi.org/10.2478/Hukin-2018-0081>
8. Dopico-Calvo, X., Mayo, X., Santos, L., Carballeira, E., Šimenko, J., Ceylan, B., Clavel, I., & Iglesias-Soler, E. (2023). When And How A Judo Contest Ends: Analysis Of Scores, Penalties, Rounds And Temporal Units In 2018, 2019 And 2021 World Championships. *Applied Sciences (Switzerland)*, 13(4). <https://doi.org/10.3390/App13042395>
9. Gusciglio, B., & Morin, J.-B. (2023). Assessing The Key Physical Capabilities In Striking Combat Sports: Reliability And Reproducibility Of A New Test. *International Journal Of Strength And Conditioning*, 3(1). <https://doi.org/10.47206/Ijsc.V3i1.207>

10. Gutiérrez-Santiago, A., Pereira-Rodríguez, R., & Prieto-Lage, I. (2020). Detection Of The Technical And Tactical Motion Of The Scorable Movements In Taekwondo. *Physiology And Behavior*, 217. <https://doi.org/10.1016/j.physbeh.2020.112813>
11. Huo, K., Yang, X., Zhang, Z., Li, B., & Zhou, C. (2024). Exploring The Dynamics Of Women's Field Hockey Performance: A Comparative Analysis Of The Impact Of Opponent Quality Between Olympic Games And Chinese National Games. *Heliyon*, 10(16). <https://doi.org/10.1016/j.heliyon.2024.E36224>
12. Ishac, K., & Eager, D. (2021). Evaluating Martial Arts Punching Kinematics Using A Vision And Inertial Sensing System. *Sensors*, 21(6), 1–25. <https://doi.org/10.3390/s21061948>
13. Loeb, S., Dynarski, S., Mcfarland, D., Morris, P., Reardon, S., & Reber, S. (2017). Descriptive Analysis In Education: A Guide For Researchers The National Center For Education Evaluation And Regional Assistance (NCEE) Conducts Unbiased Large-Scale Evaluations Of Education Programs And Practices. <http://ies.ed.gov/ncee/>.
14. Miarka, B., Vecchio, F. B. D., Camey, S., & Amtmann, J. A. (2016). Comparisons: Technical-Tactical And Time-Motion Analysis Of Mixed Martial Arts By Outcomes. *Journal Of Strength And Conditioning Research*, 30(7), 1975–1984. <https://doi.org/10.1519/JSC.0000000000001287>
15. Mohd, W., Bin, A., Annuar, W. M., Janin, Z., Mara, U. T., & Alam, S. (2011). Development Of Silat Scoreboard Using Labview.
16. Nicholls, S. B., & Worsfold, P. R. (2016). The Observational Analysis Of Elite Coaches Within Youth Soccer: The Importance Of Performance Analysis. *International Journal Of Sports Science And Coaching*, 11(6), 825–831. <https://doi.org/10.1177/1747954116676109>
17. Parmar, N., James, N., Hughes, M., Jones, H., & Hearne, G. (2017). Team Performance Indicators That Predict Match Outcome And Points Difference In Professional Rugby League. *International Journal Of Performance Analysis In Sport*, 17(6), 1044–1056. <https://doi.org/10.1080/24748668.2017.1419409>
18. Segedi, I., & Sertić, H. (2014). Classification Of Judo Throwing Techniques According To Their Importance In Judo Match.
19. Segedi, I., Sertić, H., Franjić, D., Kuštro, N., & Rožac, D. (2014). Analysis Of Judo Match For Seniors. *Journal Of Combat Sports And Martial Arts*, 5(2), 57–61. <https://doi.org/10.5604/20815735.1141976>
20. Soo, J., Woods, C. T., Arjunan, S. P., Aziz, A. R., & Ihsan, M. (2018). Identifying The Performance Characteristics Explanatory Of Fight Outcome In Elite Pencak Silat Matches. *International Journal Of Performance Analysis In Sport*, 18(6), 973–985. <https://doi.org/10.1080/24748668.2018.1539381>
21. Subekti, N., Syaifullah, R., Fatoni, M., Syaukani, A. A., Warthadi, A. N., & Arni-Rayhan, A. R. (2021a). Pencak Silat Combat Match: Time Motion Analysis In Elite Athletes Championship. *Journal Of Human Sport And Exercise*, 16(Proc4), S1597–S1608. <https://doi.org/10.14198/Jhse.2021.16.Proc4.05>
22. Subekti, N., Syaifullah, R., Fatoni, M., Syaukani, A. A., Warthadi, A. N., & Arni-Rayhan, A. R. (2021b). Pencak Silat Combat Match: Time Motion Analysis In Elite Athletes Championship. *Journal Of Human Sport And Exercise*, 16(Proc4), S1597–S1608. <https://doi.org/10.14198/Jhse.2021.16.Proc4.05>
23. Suppiah, P. K., Joumy Mat-Rasid, A. J., Joumy, A. J., Abdullah, M. R., Maliki, A. B. H. M., Musa Rasid, R. M., Adnan, A., Kosni, N. A., Juahir, H., & Musa, R. M. (2017). The Strategy Differences And Movement Pattern Between Medalist And Non The Strategy Differences And Movement Pattern Between Medalist Taekwondo Youth Athlete. <https://doi.org/10.4314/J>