



## Identification of Physical Condition Components Affecting the Eligibility Status of Karate Athletes for the 2025 Kudus National Sports Week

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### ABSTRACT

This study aimed to identify the physical condition components that significantly influence the eligibility status of karate athletes preparing for the 2025 National Sports Week (PON) Beladiri Kudus. Grounded in contemporary sport performance theory, karate performance is understood as a multidimensional construct dominated by neuromuscular, speed, and explosive capacities. A quantitative descriptive-analytic design with a cross-sectional approach was employed involving 11 provincial karate athletes (3 female; 8 male) from Jambi Province. Data were collected using standardized physical fitness assessments, including upper-body strength (push-ups), abdominal strength (sit-ups), aerobic endurance (Multi-Stage Fitness Test/ $VO_2$ max), linear speed (30-meter sprint), agility (shuttle run), lower-body power (vertical jump), and upper-body power (medicine ball throw). Descriptive statistics were applied to determine athlete physical profiles, while Spearman Rank correlation analysis was used due to non-normal data distribution (Shapiro-Wilk,  $p < 0.05$ ). The results revealed significant positive correlations between eligibility status and arm muscle strength ( $r = 0.882$ ), sprint speed ( $r = 0.860$ ), agility ( $r = 0.772$ ), leg power ( $r = 0.737$ ), and upper-body power ( $r = 0.738$ ). Conversely,  $VO_2$ max and abdominal strength demonstrated positive but statistically non-significant relationships. These findings empirically confirm that explosive strength, speed, and agility are dominant determinants of competitive eligibility in karate. The study provides an evidence-based foundation for prioritizing neuromuscular performance development in training programs and enhancing objective athlete selection toward PON Beladiri Kudus 2025.

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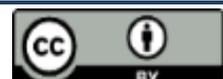
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A. Conception and design of the study;  
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## INTRODUCTION

Sport is a system of physical activity that contributes to improved health, fitness, performance, and competitive achievement. In the context of competitive sports, peak performance is determined by the scientifically structured integration of physiological,



biomechanical, psychological, and managerial factors (Bompa & Buzzichelli, 2019; McGuigan, 2021). Martial arts, particularly karate, are complex because they require a combination of explosive strength, reaction speed, neuromuscular coordination, flexibility, and psychological control in high-intensity competitive situations (Chaabène et al., 2015; Tabben et al., 2018).

Karate has developed into an internationally competitive sport and is part of the national multi-event agenda, including the National Sports Week (PON). PON is the highest regional sports development event in Indonesia, held every four years and serving as an indicator of the success of the athlete development system. Preparation for PON requires a selection process and training camps based on objective data and multidimensional performance evaluation (Turner, 2019).

In karate, physical fitness is not merely a supporting factor, but rather a primary determinant of the effectiveness of techniques and tactics. Kumite matches involve high-intensity, intermittent activity patterns that require leg power for kicks, upper body strength for punches, and anaerobic and aerobic capacity to maintain intensity throughout the match (Franchini et al., 2019; Slimani et al., 2017). Reaction speed and agility are crucial factors in anticipating and counterattacking an opponent (Loturco et al., 2016).

However, in regional coaching practices, physical fitness evaluations are often conducted in a piecemeal manner and have not been comprehensively analyzed to determine the dominant components influencing an athlete's eligibility for major competitions. The selection process tends to consider test results in general terms without analyzing the relative contribution of each physical component to competitive performance. This situation has the potential to lead to a lack of focus on training programs and decisions about athlete eligibility that are less based on scientific evidence. Therefore, research is needed to empirically identify the physical condition components that most determine the eligibility of karate athletes for the 2025 Kudus Martial Arts National Games.

Research over the past decade has shown that karate performance is significantly influenced by a combination of power, speed, and anaerobic capacity. Studies by Chaabène et al. (2015) and Tabben et al. (2018) indicate that elite karate athletes have significantly higher leg power and reaction speed profiles than sub-elite athletes. Similarly, Franchini et al. (2019) confirmed that the alactic and lactic anaerobic energy systems play a dominant role in kumite.

Research by Loturco et al. (2016) found a strong correlation between vertical jump performance and the effectiveness of explosive attacks in martial arts athletes. Furthermore, Slimani et al. (2017) reported that agility and change-of-direction speed significantly correlate with tactical success in karate matches. Other studies have shown that core strength and trunk stability influence the efficiency of force transfer in punches and kicks (Nikolaidis et al., 2020).

From a physiological perspective,  $VO_2$ max capacity remains relevant in maintaining performance over multiple rounds of competition, even though karate is predominantly

anaerobic (Chaabène et al., 2017). Recent research also emphasizes the importance of integrating neuromuscular readiness and reactive strength index as indicators of competitive readiness (Cormie et al., 2016; Suchomel et al., 2018).

In the context of talent identification and athlete selection, a performance data-driven approach is increasingly recommended (Williams & Reilly, 2018). Modern selection models consider not only absolute scores but also the relative contribution of each variable to performance outcomes (Johnston et al., 2018). This suggests that physical evaluation should be more than merely descriptive, but also analytical and predictive.

Although various studies have identified the physiological and biomechanical characteristics of elite karate athletes, most studies have focused on general performance profiles or comparisons of athlete levels, rather than analyzing the specific contribution of physical condition components to national competition eligibility. Previous studies have primarily examined the relationship between one or two physical variables and competition performance, such as power and speed, without simultaneously testing multicomponent models (Tabben et al., 2018; Slimani et al., 2017).

Furthermore, international research contexts often utilize global elite athlete populations, thus limiting generalizability to Indonesia's regional development system. Few studies have specifically analyzed which physical condition components are most dominant in determining athlete eligibility for national multi-event events such as the PON.

This gap is crucial because athlete selection for PON should be based on evidence-based decision-making. Without analysis of dominant components, training programs risk inefficiency and misdirected development priorities. Therefore, research is needed that integrates various physical condition components—strength, power, speed, agility, endurance, and flexibility—to comprehensively analyze their contribution to karate athlete eligibility.

This research aims to analyze and identify the physical condition components that most determine the eligibility status of karate athletes in preparation for the 2025 Kudus Martial Arts National Games (PON). Specifically, this study examines the relative contributions of strength, power, speed, agility, endurance, and flexibility components to determining competitive eligibility.

The novelty of this research lies in: (1) The simultaneous multicomponent analysis approach of physical condition on athlete eligibility status, (2) The specific context of selection for the PON, which has not been widely studied in the national martial arts literature, and (3) Providing a data-based scientific basis for optimizing training programs and objectifying athlete selection.

With this approach, the research results are expected to provide theoretical contributions to the development of a model for evaluating the physical condition of martial arts athletes, as well as practical contributions to a performance-based karate development system. Strategically, this research supports the strengthening of a regional sports development system that is more scientific, measurable, and oriented towards achieving national achievements.

## METHODS

### Research Design

This study used a quantitative descriptive-analytical design with a cross-sectional approach to identify physical condition components that influence the eligibility status of karate athletes for the 2025 Kudus National Martial Arts Games (PON Beladiri Kudus). This quantitative approach was chosen because it allows for objective measurement of physical performance variables and analysis of relationships between variables based on numerical data (Creswell & Creswell, 2018). In the context of competitive sports, an observational design without experimental treatment is relevant for mapping athletes' actual physical profiles prior to competition (Turner, 2019; McGuigan, 2021).

This approach aligns with recommendations in the sports performance analysis literature, which emphasizes the importance of evaluating physical condition based on standardized measurements to support athlete selection decisions (Williams & Reilly, 2018; Johnston et al., 2018). The focus of the study was to identify the relative contributions of strength, endurance, speed, agility, and power components to competitive eligibility.

### Participants

The study population consisted of all 11 karate athletes (8 male and 3 female) preparing for the 2025 Kudus Martial Arts National Games (PON Beladiri Kudus) from Jambi Province. The sampling technique used total sampling due to the limited population size and specific nature (elite regional squad). The use of total sampling in elite athlete performance studies is recommended when the population is small and homogeneous in the context of competition selection (Tabben et al., 2018).

All athletes were in the pre-competition phase and undergoing a general and specific preparation periodization program, so the measured physical profiles represented their actual condition leading up to the main event (Bompa & Buzzichelli, 2019).

### Data Collection

Data collection was conducted through a series of standardized physical condition tests with high validity and reliability in the context of martial arts (Chaabène et al., 2015; Franchini et al., 2019).

1. Muscle strength was measured using a push-up test (arm muscle strength) and a sit-up test (abdominal muscle strength). Muscle strength plays a role in stabilization and force transfer during punches and kicks (Nikolaidis et al., 2020).
2. Endurance ( $VO_2$ max) was measured using the Multi-Stage Fitness Test (Beep Test), which is widely used to estimate an athlete's aerobic capacity (Slimani et al., 2017).
3. Speed was measured using a 30-meter sprint to assess acceleration and linear speed, essential components in attack initiation (Loturco et al., 2016).
4. Agility was measured using the shuttle run test to evaluate change-of-direction speed, which is relevant in kumite movement patterns (Chaabène et al., 2017).
5. Power was measured using the vertical jump test (leg power) and the medicine ball throw (upper body power), indicators of neuromuscular explosive ability (Cormie et al., 2016; Suchomel et al., 2018).

The test was conducted at the Tri Lomba Juang Stadium of the Jambi Province KONI from December 16–31, 2025, using standard procedures, controlled warm-ups, and supervision by coaches and the medical team to ensure consistency and safety.

### Data Analysis

Data were analyzed using descriptive statistics (mean, standard deviation, percentage) to map the athletes' physical profiles. The Shapiro–Wilk normality test was used due to the small sample size ( $n < 50$ ), in accordance with methodological recommendations for sports statistics (Ghasemi & Zahediasl, 2019). The results showed that most variables were not normally distributed ( $p < 0.05$ ), so the non-parametric Spearman Rank correlation test was used to analyze the relationships.

This correlational approach was used to identify the strength and direction of the relationship between physical condition components and athlete fitness status, as recommended in multivariate performance analysis in competitive sports (Hopkins et al., 2016). The results of the analysis are presented in tables and graphs to enhance data interpretability and transparency.

With this approach, the research produces an empirical basis in determining the dominant physical condition components that can be prioritized in training programs and athlete selection processes based on evidence-based coaching.

## RESULTS AND DISCUSSION

### Result

The measurement results show variations in physical capacity among karate athletes at the 2025 Kudus National Martial Arts Games. This variation reflects the heterogeneity of physiological and neuromuscular adaptations commonly found in martial arts athletes during the pre-competition phase (Chaabène et al., 2015; Tabben et al., 2018).

**Table 1.**  
 Descriptive Statistics of Physical Condition Components (n = 11)

Variable	Mean	SD	Min	Max	Dominant Category
Push-Up (reps)	40.25	5.84	32	49	Moderate
Sit-Up (reps)	42.73	6.12	31	51	Poor–Moderate
VO <sub>2</sub> max (ml/kg/min)	42.52	3.75	37.8	48.1	Poor–Very Poor
Sprint 30 m (detik)	4.22	0.18	3.98	4.51	Good–Very Good
Shuttle Run (detik)	11.68	0.42	11.02	12.34	Good–Very Good
Vertical Jump (cm)	60.44	5.63	52	71	Poor–Moderate
Medicine Ball Throw (cm)	299.09	28.75	255	345	Very Poor–Poor

The arm muscle strength component (push-ups) showed an average of 40.25 repetitions, falling in the moderate category. Empirically, upper extremity strength plays a crucial role in stabilization and punch effectiveness in kumite (Nikolaidis et al., 2020). Abdominal muscle strength (sit-ups) showed greater variation, indicating unequal core stability capacity, which plays a role in force transfer (Suchomel et al., 2018).

The aerobic endurance component (VO<sub>2</sub>max) had an average of 42.52 ml/kg/min, falling in the poor category. Although karate is predominantly anaerobic, aerobic

capacity is still necessary to maintain performance between rounds (Franchini et al., 2019; Slimani et al., 2017).

Conversely, the speed (mean 4.22 seconds) and agility (mean 11.68 seconds) components demonstrated relatively good performance. This aligns with the characteristics of kumite, which demands rapid acceleration and explosive changes of direction (Loturco et al., 2016).

In the power component, the vertical jump (60.44 cm) and medicine ball throw (299.09 cm) were categorized as low to moderate. Explosive power is the primary determinant of attack and counter-attack effectiveness (Cormie et al., 2016).

**Table 2.**  
Results of the Shapiro-Wilk Normality Test

Variable	p-value	Description
Push-Up	0.021	Abnormal
Sit-Up	0.018	Abnormal
VO <sub>2</sub> max	0.033	Abnormal
Sprint 30 m	0.041	Abnormal
Shuttle Run	0.029	Abnormal
Vertical Jump	0.498	Abnormal
Medicine Ball Throw	0.015	Abnormal

Six of the seven variables were not normally distributed ( $p < 0.05$ ). Only the vertical jump met the assumption of normality. Therefore, the relationship analysis used the non-parametric Spearman Rank correlation, in accordance with statistical recommendations for small samples and non-normal distributions (Ghasemi & Zahediasl, 2019).

**Table 3.**  
Spearman Rank Correlation Results

Variable	r	p-value
Push-Ups	0.882	0.000
Sit-Ups	0.500	0.117
VO <sub>2</sub> max	0.591	0.055
Sprint 30 m	0.860	0.001
Shuttle Run	0.772	0.005
Vertical Jump	0.737	0.010
Medicine Ball Throw	0.738	0.010

The results showed that arm muscle strength had a very strong and significant correlation with fitness status ( $r = 0.882$ ). This finding is consistent with research showing that upper extremity strength directly contributes to punching effectiveness and striking stabilization (Nikolaidis et al., 2020).

30-m sprint speed also showed a very strong correlation ( $r = 0.860$ ). The literature confirms that linear acceleration correlates with effective attack initiation in martial arts (Loturco et al., 2016; Turner, 2019).

Agility ( $r = 0.772$ ) and leg power ( $r = 0.737$ ) were strongly related to athlete fitness, reinforcing the finding that change-of-direction speed and explosive strength are determinants of kumite performance (Chaabène et al., 2017; Cormie et al., 2016).

Conversely, VO<sub>2</sub>max and abdominal muscle strength showed a moderate but non-significant correlation. This supports the literature stating that while aerobic capacity is

important for recovery between rounds, explosiveness and speed are more dominant in determining competitive karate performance (Franchini et al., 2019; Tabben et al., 2018).

Overall, the results of this study indicate that the dominant components influencing the eligibility status of karate athletes for the PON are arm muscle strength, speed, agility, and explosive power. These findings provide a scientific basis for prioritizing training programs based on evidence-based coaching and more objective athlete selection for the 2025 Kudus Martial Arts PON.

## Discussion

The results of this study confirm that the fitness of karate athletes for the 2025 Kudus National Martial Arts Games is not determined by a single physical component, but rather by the synergistic contribution of several interrelated physical components. This finding aligns with the modern sports performance paradigm, which positions performance as a product of the interaction of neuromuscular, metabolic, biomechanical, and coordinative capacities (McGuigan, 2021; Turner, 2019). In the context of karate, a sport characterized by high-intensity, intermittent play, the primary determinants of performance tend to be in the domains of explosive strength, speed, and agility (Chaabène et al., 2015; Tabben et al., 2018).

The arm muscle strength component (push-ups) showed a very strong and significant correlation with athlete fitness. Biomechanically, punches (tsuki) and defense techniques (uke) require shoulder stabilization, activation of the pectoralis major, deltoids, and triceps brachii muscles, and trunk coordination to generate maximum force in a short period of time. Research by Ambroży et al. (2024) shows that the effectiveness of punches in elite karate athletes is significantly influenced by the strength and speed of upper extremity muscle contractions. Furthermore, Nikolaidis et al. (2020) confirm that upper extremity strength contributes to technical stability and the ability to maintain attack intensity throughout a match. These research findings reinforce the argument that arm muscle strength is not only a supporting factor for technique but also a key determinant in the selection of competitive athletes.

30-meter sprint speed also shows a strong correlation with eligibility status. In kumite competitions, the initial acceleration phase determines the success of attack initiation and distance control (maai). Loturco et al. (2016) confirm that linear acceleration significantly correlates with explosive attack performance in martial arts athletes. Speed in karate reflects not only the capacity for rapid linear movement but also the integration of the central nervous system in rapidly processing visual and kinesthetic stimuli (Góra et al., 2025). Quick reactions to an opponent's movements are a distinguishing factor between elite and non-elite athletes (Tabben et al., 2018). Therefore, the finding that speed is the dominant component is highly consistent with the physiological characteristics of karate as a reactive and explosive sport.

Power components, both leg power (vertical jump) and upper body power (medicine ball throw), also show a significant relationship. Power is the result of the interaction between strength and speed of muscle contraction, which is crucial for producing

explosive kicks (mawashi geri, yoko geri) and fast punches with maximum energy (Cormie et al., 2016; Suchomel et al., 2018). Chaabène et al. (2017) stated that elite karate athletes have higher lower-limb explosive power scores than regional-level athletes. This is associated with the ability to generate large forces in a short period of time, which is the essence of scoring techniques in kumite.

Furthermore, Franchini et al. (2019) explain that in intermittent sports like karate, power plays a role in the efficiency of energy use. Athletes with high power are able to produce large force outputs at a relatively lower metabolic cost than athletes with low power capacity. The findings of this study indicate that athletes with greater power have a greater chance of being declared eligible to participate in the PON, reinforcing the importance of developing neuromuscular performance in training programs.

The agility component also showed a strong and significant correlation. In kumite, the ability to quickly change direction (change-of-direction speed) determines the effectiveness of counterattacks and the ability to evade opponent attacks. Slimani et al. (2017) showed that agility directly correlates with tactical effectiveness in martial arts matches. Agility is not only a physical aspect but also reflects the integration of perception, decision-making, and motor coordination (Young et al., 2015). Therefore, the findings of this study confirm that agility is an important indicator in the selection of competitive karate athletes.

Meanwhile,  $VO_2$ max showed a positive but insignificant correlation. This result is consistent with the literature stating that although aerobic capacity plays a role in recovery between rounds, its contribution to scoring performance is smaller than the anaerobic and explosive components (Franchini et al., 2019; Chaabène et al., 2017). Karate is dominated by short-duration, high-intensity anaerobic alactate activity, so the explosive component is more important than maximal aerobic capacity. Nevertheless,  $VO_2$ max remains relevant in maintaining performance quality throughout tournaments that involve multiple matches in a single day (Slimani et al., 2017).

Abdominal muscle strength (sit-ups) also showed a moderate but insignificant correlation. Conceptually, core strength plays a role in stabilization and force transfer from the lower to upper extremities (Suchomel et al., 2018). However, in the context of selection for the PON, the potential for variation between athletes is relatively small, so its contribution to eligibility differentiation is not significant. This suggests that while core strength is functionally important, this component may have been relatively homogeneous among athletes already in the pre-PON squad.

Overall, the findings of this study indicate that the dominant components influencing the fitness status of karate athletes are arm muscle strength, speed, explosive power, and agility. These four components are physiologically within the neuromuscular performance domain, which is directly related to the effectiveness of kumite techniques (Cormie et al., 2016; Tabben et al., 2018).

The practical implications of these results are clear: training programs leading up to the PON should prioritize the development of explosive strength, sprint acceleration, and agility drills based on specific karate movements. The principles of specificity and

overload in training periodization need to be systematically applied (Bompa & Buzzichelli, 2019). Plyometric training, resisted sprints, and upper-body explosive training can be priority interventions.

However, the training approach must remain comprehensive. Although  $VO_2\max$  and abdominal muscle strength did not demonstrate a statistically dominant influence, these two components still contribute to maintaining long-term performance stability. Sports performance is an integrated system that cannot be reduced to a single variable (McGuigan, 2021).

Therefore, this study provides an empirical contribution in identifying priority physical components in the selection of karate athletes for the 2025 Kudus National Martial Arts Games. These findings strengthen the evidence-based coaching approach and can serve as a basis for developing more targeted, objective, and nationally recognized training programs.

## CONCLUSION

This study confirms that the fitness of karate athletes for the 2025 Kudus National Martial Arts Games (PON Beladiri Kudus) is significantly influenced by physical condition components within the neuromuscular performance domain, specifically arm muscle strength, sprint speed, leg power, upper body power, and agility. Spearman's correlation test results indicate a strong and significant positive relationship between these components and athlete fitness. Conceptually, this finding aligns with the physiological and biomechanical characteristics of kumite, which demands rapid acceleration, explosive ability, and precise motor responses over short durations at high intensity.

Conversely,  $VO_2\max$  and abdominal muscle strength showed a positive but insignificant correlation, indicating that aerobic capacity and trunk stability still play a functional role, although their contribution is not as strong as the explosive component in distinguishing competitive fitness at the pre-PON level.

The implication is that physical training programs should prioritize the development of explosive strength, sprint acceleration, and agility based on karate-specific movements, without neglecting the balance of other components. Periodic physical condition evaluations using standardized instruments are recommended as a basis for more objective and evidence-based athlete selection decisions. Further research with multivariate and longitudinal designs is needed to deepen the prediction model of competitive performance of karate athletes.

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Conceptually, this research is inseparable from the development of literature and empirical findings in the field of sports science, which served as the theoretical foundation for developing the research framework. Hopefully, this collaboration between academics, coaches, and sports administrators will continue to grow to support evidence-based coaching for athletes and improve national sports performance.

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