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Analysis of Muscle Strength and Explosive Power of Fencing Athletes in West Kalimantan

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Abstract

Objectives. This study aimed to analyze the muscle strength and explosive power of fencing athletes in West Kalimantan, with the goal of providing baseline data to support training program development.

Materials and Methods. A total of 16 fencing athletes (9 male and 7 female) who were members of the regional training center (Pelatda) of the Indonesian National Sports Committee (KONI) of West Kalimantan Province in preparation for the 2024 PON XX Aceh-Sumut participated in this study. Muscle strength was measured using a handgrip dynamometer, push-pull dynamometer test and leg dynamometer test, while explosive power was assessed through the medicine ball test for the arm power and standing broad jump test for the leg power. Descriptive statistics and t-test were used to analyze athletes' performance levels based on standardized norms and the differences between gender.

Results. The findings showed that most athletes fell into the low to moderate categories for both muscle strength and explosive power indicators. Male athletes demonstrated higher absolute scores compared to females.

Conclusions. The results indicate that fencing athletes in West Kalimantan require more targeted strength and conditioning programs, particularly focused on strength and explosive power. This study provides initial data for Indonesian fencing athletes and highlights the importance of region-specific research to guide evidence-based training strategies.

Keywords: Fencing, Strength, Power, West Kalimantan

Introduction

Muscle strength and explosive power are essential for performance in many sports, including fencing. Strength provides the foundation for force production, while explosive power allows athletes to apply that force quickly, both of which are critical for rapid attacks, lunges, and defensive actions (Chen et al., 2017; Ntai et al., 2021; Permana et al., 2022). In fencing, effective weapon control relies heavily on grip strength, whereas lower-limb power supports speed, agility, and the efficiency of lunging movements (Al-Kayeed et al., 2024; Sarvaiya & Puntambekar, 2022; Witkowski et al., 2020).

Recent studies have shown that fencers with higher levels of strength and power tend to perform better in competition and demonstrate improved technical efficiency (Bottoms et

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al., 2023; Qiao et al., 2022; Renanda et al., 2024). Moreover, well-developed strength and power not only enhance performance but also contribute to injury prevention by supporting joint stability and explosive movement control (Davies et al., 2015; Huang et al., 2023; Ling et al., 2020). These findings highlight the importance of monitoring and developing these physical attributes in fencing athletes.

However, most research in this area has focused on athletes from Europe and North America, while studies in Southeast Asia—particularly Indonesia—remain very limited (Di Martino et al., 2024; Renanda et al., 2024; Stanicki et al., 2025; Turner et al., 2016). This is important because regional differences in training culture, facilities, and athlete development may influence physical performance outcomes. To date, no published study has examined the strength and explosive power profile of fencing athletes in West Kalimantan, leaving a gap in the understanding of their physical conditioning.

Therefore, the purpose of this study is to analyze muscle strength and explosive power among fencing athletes in West Kalimantan. The findings are expected to provide baseline data that can help coaches design training programs better suited to the needs of local athletes and contribute to the broader literature on fencing performance.

Therefore, the purpose of this study is to analyze muscle strength and explosive power among fencing athletes in West Kalimantan. The findings are expected to provide baseline data that can help coaches design training programs better suited to the needs of local athletes and contribute to the broader literature on fencing performance, particularly by offering the first region-specific strength–power profile for West Kalimantan fencers and highlighting context-based training priorities for Indonesian fencing development**.**

Materials and Methods

Study Participants.

The sample consisted of 16 fencing athletes who were members of the regional training center (Pelatda) of the Indonesian National Sports Committee (KONI) of West Kalimantan Province in preparation for the 2024 PON XX Aceh-Sumut, with details of 9 male athletes and 7 female athletes. Inclusion criteria included: (1) registered as active Pelatda athletes in fencing, (2) following a regular training program, and (3) willing to take part in all series of tests. Exclusion criteria were a history of musculoskeletal injuries in the last 6 months that could interfere with the test implementation.

Study organization.

This study used a quantitative descriptive design with a cross-sectional approach to analyze the strength and explosive power profiles of fencing athletes in West Kalimantan.

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The measurement instruments were adjusted to the muscle groups and physical condition components: Arm strength, measured using a handgrip dynamometer and a push and pull dynamometer. Leg strength, measured using a leg dynamometer. Arm power, measured using a medicine ball throw. Leg power, measured using a standing broad jump. These instruments were chosen because they have been widely used in sports research and have proven reliable and valid as indicators of muscle strength and explosive power (Hardy et al., 2025; Lipovšek et al., 2022; Marin-Jimenez et al., 2024; Sánchez-Aranda et al., 2025; Yoo et al., 2025). Before data collection, all athletes participated in a standard 10-minute warm-up session consisting of dynamic stretching and light mobility exercises. Measurements were conducted in one session with the following sequence: (1) arm strength test (handgrip dynamometer, push and pull dynamometer), (2) leg strength test (leg dynamometer), (3) arm power test (medicine ball throw), and (4) leg power test (standing broad jump).

Statistical analysis.

The data obtained were analyzed using descriptive statistics (mean scores and standard deviations) to describe the strength and explosive power profiles and categories of West Kalimantan fencers. Then data were compared by gender using an Independent Sample t-test.

Results

Table 1. Sample Characteristics

Variables	Male (N=9)		Female (N=7)	
	Mean	SD	Mean	SD
Age (years)	20,44	3,12	20,57	4,50
Weight (Kg)	69,44	9,64	55,71	7,54
Height (cm)	171,55	7,53	161,42	5,50
BMI (Kg/m^2)	23,59	3,01	21,32	2,20

Table 1 presents the sample characteristics of male (N=9) and female (N=7) participants. The average age of the male group was 20.44 ± 3.12 years, while the female group showed a slightly higher mean age of 20.57 ± 4.50 years. Male participants demonstrated greater body weight (69.44 ± 9.64 kg) compared to females (55.71 ± 7.54 kg). Similarly, mean height was higher in males (171.55 ± 7.53 cm) than in females (161.42 ± 5.50 cm). In terms of body mass index (BMI), males recorded an average value of 23.59 ± 3.01 kg/m², while females had a lower average of 21.32 ± 2.20 kg/m². These data indicate

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that, although the participants were comparable in age, males generally exhibited higher anthropometric scores in weight, height, and BMI compared to their female counterparts.

Table 2. Result of Strength and Power Measurement

Variables		Male (N=9)		Female (N=7)	
		Mean	**SD**	**Mean**	**SD**
Strength	Left Hand Grip (Kg)*	42,48	6,41	24,31	4,55
	Right Hand Grip (Kg)*	46,38	5,38	29,32	3,35
	Push (Kg)*	26,55	8,11	14,85	3,28
	Pull (Kg)*	27,00	6,83	16,28	5,85
	Leg (Kg)*	107,22	22,02	61,57	8,50
Power	Arm (m)*	2,81	0,31	2,18	0,27
	Leg (m)*	2,46	0,28	1,95	0,45

*p scores < 0,05 statistically significant difference between males and females on the variable

Table 2 presents the results of strength and power measurements between male (N=9) and female (N=7) participants. Overall, males demonstrated significantly higher result across all variables compared to females ($p < 0.05$). For strength, males showed greater left hand grip (42.48 ± 6.41 kg) and right hand grip (46.38 ± 5.38 kg) than females (24.31 ± 4.55 kg and 29.32 ± 3.35 kg, respectively). Similarly, push strength (26.55 ± 8.11 kg) and pull strength (27.00 ± 6.83 kg) in males were nearly double those of females (14.85 ± 3.28 kg and 16.28 ± 5.85 kg, respectively). The most pronounced difference was observed in leg strength, with males averaging 107.22 ± 22.02 kg compared to 61.57 ± 8.50 kg in females. In terms of power, males also outperformed females in both hand power (2.81 ± 0.31 m vs. 2.18 ± 0.27 m) and leg power (2.46 ± 0.28 m vs. 1.95 ± 0.45 m).

For a clearer interpretation of those strength and power analysis, this study categorizes strength and power results according to normative standards. Both male and female participants were classified as “fair” in hand grip strength, although males showed higher absolute scores. In contrast, push and pull strength were rated “fair” in males but “very poor” in females, indicating a notable sex-related disparity in upper body strength. Leg

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strength was categorized as "poor" in males and "very poor" in females, reflecting suboptimal lower limb strength relative to reference norms. For power, arm performance was categorized as "very poor" for both groups, while leg power was rated "poor" in both males and females. These classifications emphasize that despite males outperforming females in absolute measures, both groups demonstrated generally low categorizations, suggesting limited strength and power capacities when benchmarked against established standards.

Discussion

The present study aimed to analyse muscle strength and explosive power performance of West Kalimantan fencing athletes as seen from mean score of each indicator then compare it to normative standards, and comparison between male and female participants score. The findings revealed that, although males consistently outperformed females across all measured variables, both groups demonstrated relatively low classifications when evaluated using standardized categories.

Anthropometric differences between males and females (Table 1) likely contributed to the observed disparities in performance. Male participants exhibited greater body weight, height, and BMI compared to their female counterparts, which are commonly associated with higher lean muscle mass and force-generating capacity (Belzunce et al., 2023; Pérez et al., 2024). These physical attributes provide males with a biomechanical advantage in producing strength and power, particularly in tasks involving maximal force output of both the upper and lower limbs. Additionally, differences in body composition—specifically higher fat-free mass in males—are well-documented as a determinant of strength outcomes (Ben Mansour et al., 2021).

The results of strength testing (Table 2) indicated that males achieved nearly double the performance scores of females in push and pull strength, with significant differences also observed in grip and leg strength. These findings are consistent with previous studies reporting gender-based differences in muscular strength, where males generally display higher absolute scores due to larger cross-sectional muscle area and higher concentrations of anabolic hormones such as testosterone (Mohan et al., 2017; Nuzzo, 2023). Furthermore, neuromuscular factors, including motor unit recruitment, firing frequency, and muscle fiber distribution, may also contribute to superior male performance in maximal strength tasks (Bartolomei et al., 2021; Feuerbacher et al., 2025; Giuriato et al., 2024).

When viewed through the lens of normative categorizations, both groups were predominantly classified as "fair," "poor," or "very poor" across most strength and power domains. Notably, arm grip strength reached the "fair" category for both males and females,

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aligning with its status as a reliable indicator of overall muscular fitness and health (Karaoğlu et al., 2025; Lee, 2021; Vaishya et al., 2024). Conversely, leg strength and power were rated "poor" or "very poor," suggesting that lower limb capacity may represent a limiting factor for this participant. This finding is particularly relevant as lower limb strength is essential not only for sports performance but also for functional movement and injury prevention (Beato et al., 2021; Sašek et al., 2024; Yang, 2023).

The poor categorization of power performance in both sexes underscores an area for targeted intervention. Despite males achieving higher absolute scores, both groups fell below optimal standards, with arm power rated as "very poor" and leg power as "poor." Power is a key determinant of performance in activities requiring explosive movements, such as sprinting, jumping, and changes of direction, especially in fencing (Ntai et al., 2021; Renanda et al., 2024; Shuai et al., 2025; Wang et al., 2023). The limited outcomes in this domain suggest inadequate training exposure to plyometric or explosive strength development exercises within the studied population. Previous evidence emphasizes that specific resistance training and plyometric-based programs can significantly enhance lower limb explosive power and overall athletic performance (Ahsan et al., 2025; di Cagno et al., 2020; Zhu et al., 2024).

Taken together, the results suggest that while sex-based physiological differences account for the higher absolute scores in male participants, the generally low categorical outcomes highlight a shared need for strength and power development among both groups. Structured resistance training programs emphasizing progressive overload, neuromuscular activation, and plyometric-based power training may be necessary to elevate performance to normative standards. Future research should explore longitudinal training interventions to determine whether targeted strength and power programs can mitigate these deficits and improve both absolute and relative performance outcomes across sexes.

Conclusions

This study highlights that muscle strength and explosive power play a crucial role in fencing performance, particularly in supporting speed, agility, and weapon control. The findings show that fencing athletes in West Kalimantan generally fall into low to moderate categories of strength and power, with male athletes outperforming females in absolute scores but both groups remaining below optimal standards. These results emphasize the need for targeted training programs—especially in grip strength, lower-limb power, and upper-body conditioning—to improve competitive readiness. Importantly, this research provides baseline

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data for Indonesian fencing athletes, addressing a gap in regional literature and offering practical insights for coaches to design more effective training strategies.

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Conflict of interest

There is no conflict of interest.

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