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Physical Fitness Profile of Elite Wheelchair Fencing Athletes: A Descriptive Study of Biomotor Components

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Abstract

Wheelchair fencing is an adaptive sport that emphasizes the use of upper limbs in a static sitting position, and to date, there is still relatively limited study examining its physical condition profile comprehensively. This study aims to describe the physical condition profile of elite wheelchair fencing elite athletes based on the main biomotor components. The study method used is descriptive quantitative with a cross-sectional approach. The study subjects consisted of 8 athletes, including 5 male athletes and 3 female athletes. Physical condition measurements included shoulder flexibility, shoulder muscle endurance, right and left hand grip strength, hand reaction speed, and aerobic capacity (Aeerobic capacity). Data analysis was performed using descriptive statistics in the form of average values. The results showed that Aeerobic capacity values were 43.5 ml/kg/minute in male athletes and 36.1 ml/kg/minute in female athletes. Shoulder flexibility values were 112 cm in male athletes and 63 cm in female athletes, and shoulder endurance was 56 seconds in male athletes and 17.75 seconds in female athletes. In addition, the right hand grip strength value was 44.3 kg in male athletes and 17.1 kg in female athletes, and the left hand was 24.3 kg in male athletes and 18.1 kg in female athletes. The hand reaction value was 150 ms in male athletes and 175 ms in female athletes. The conclusion of the study shows that the physical condition profile of elite wheelchair fencers is at a varying level between biomotor components, with aerobic capacity and grip strength being relatively better than flexibility and reaction speed. These results can be used as a basis for developing a more specific training program and in accordance with the demands of the sport of wheelchair fencing.

Keywords: *biomotor, physical fitnes, wheelchair fencing.*

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INTRODUCTION

Wheelchair athletes have different physiological and biomechanical characteristics compared to non-disabled athletes, primarily due to the predominant use of the upper limbs in generating force and movement during sporting activities (Ernandini & Pakasi, 2020; Flórez-Gil, 2025). In wheelchair fencing, athlete performance is largely determined by the ability to produce fast and precise movements through coordination between arm muscle strength, shoulder stability, and postural control in a static sitting position (Borysiuk et al., 2025; Iglesias et al., 2018).

Wheelchair fencing is a short-duration, high-intensity sport that demands quick reaction times and explosive strength to effectively respond to an opponent's attacks (Iglesias et al., 2018; Martín-Ruiz et al., 2024). Furthermore, upper limb muscle endurance is a crucial factor in maintaining performance quality throughout matches consisting of multiple rounds (Błaszczyszyn et al., 2025).

Aerobic capacity also plays a role in supporting wheelchair fencers' performance, particularly in maintaining physiological stability during intermittent, repetitive activity (Boguszewski & Łuczak, 2025; Leale et al., 2023). In addition to strength and endurance, shoulder flexibility is crucial because it influences the range of motion during attack and defense (Şahin et al., 2019; Starczewski et al., 2024). Hand reaction speed is also a crucial component in wheelchair fencing, as it determines an athlete's ability to respond quickly to visual stimuli in dueling situations(Iglesias et al., 2018; Leale et al., 2023) .

However, study examining the physical condition profiles of wheelchair fencers is still limited, particularly at the regional development level, and therefore does not provide a comprehensive picture of athletes' biomotor characteristics (Iglesias et al., 2018; Martín-Ruiz et al., 2024). Furthermore, most previous study has focused on general performance analysis without specifically examining biomotor components relevant to competition requirements (Borysiuk et al., 2025; Starczewski et al., 2024).

Therefore, study is needed that can describe the physical condition profile of wheelchair fencers more specifically through measuring the main biomotor components which include shoulder flexibility, muscle endurance, grip strength, hand reaction speed, and aerobic capacity. Therefore, this study aims to describe the physical condition profile of elite wheelchair fencers as a basis for developing a more specific

training program that is in accordance with the demands of the sport of wheelchair fencing.

METHODS

Participants

This study involved wheelchair fencing athletes under the guidance of NPCI DKI Jakarta. The number of subjects in this study was 8 athletes consisting of 5 male athletes and 3 female athletes. All athletes are included in classification A according to the International Wheelchair & Amputee Sports Federation (IWAS) standards, which indicates that athletes have relatively similar functional abilities in performing sports activities. The sampling technique used total sampling, considering the limited population of athletes in one coaching team. All subjects were active athletes undergoing a training program in preparation for the 2024 National Paralympic Week. Prior to the study, all athletes were given an explanation of the study

Design

This study used an observational design with a quantitative descriptive approach to describe the physical condition profiles of wheelchair fencing athletes from the National Paralympic Committee Indonesia (NPCI) DKI Jakarta. The study was conducted without any treatment or intervention, so all data obtained reflected the athletes' actual condition at the time of measurement. Data collection was conducted cross-sectionally during the general preparation phase, providing an initial overview of the athletes' physical readiness prior to competition. This study has received ethical approval from the Ethics Committee of Universitas Negeri Jakarta. All participants were informed about the study objectives and procedures and expressed their willingness to participate.

Procedurs

All measurements were conducted in a formal training environment under controlled conditions to ensure consistency of test results. Prior to the test, all athletes performed general and specific warm-ups to minimize the risk of injury and ensure physical readiness during the measurements. Physical condition measurements included several biomotor components, namely shoulder flexibility measured using a shoulder flexibility test, shoulder muscle endurance using a shoulder endurance test, right and

left hand grip strength using a handgrip dynamometer, hand reaction speed using a hand reaction test, and aerobic capacity using a field-based VO2max test. Each test was conducted according to standard procedures and sufficient rest periods were provided between tests to avoid fatigue that could affect the measurement results.

Data Analysis

The data obtained were analyzed using descriptive statistics to describe the physical condition profile of NPCI DKI Jakarta wheelchair fencing athletes. The values presented are the average (mean) of each measured variable, including shoulder flexibility, shoulder muscle endurance, right and left hand grip strength, hand reaction speed, and aerobic capacity. The analysis was performed by presenting the data in tabular form to facilitate interpretation of the results for each biomotor component. Inferential statistical tests such as t-test or ANOVA were not applied because the primary aim of this study was descriptive in nature, focusing on profiling rather than comparing groups or testing hypotheses. In addition, the relatively small sample size limited the statistical power and assumptions required for parametric inferential analysis, therefore descriptive statistics were considered more appropriate to represent the actual condition of the athletes.

RESULT

Table 1 presents physical performance data of wheelchair fencing male athletes with details of each biomotor component, including shoulder flexibility, shoulder muscle endurance, right and left hand grip strength, hand reaction speed, and aerobic capacity. The results show that the average Aeerobic capacity value is 43.5 ml/kg/min. In the strength component, the average grip strength of the right hand is 44.3 kg, while the left hand is 24.3 kg. The shoulder muscle endurance component has an average time of 56 seconds. Shoulder flexibility shows an average value of 112 cm. Meanwhile, hand reaction speed has an average of 150 milliseconds.

Table 1. Physical performance of wheelchair fencing male athletes (n = 5)

Variable	Mean ± SD	Min	Max
Shoulder Flexibility (cm)	112 ± 18.5	95	140
Shoulder Endurance (s)	56 ± 12.4	40	75

Variable	Mean ± SD	Min	Max
Grip Strength Right (kg)	44.3 ± 6.8	35.0	55.0
Grip Strength Left (kg)	24.3 ± 5.9	18.0	35.0
Hand Reaction (ms)	150 ± 20.3	120	180
Aeerobic capacity (ml/kg/min)	43.5 ± 5.2	38.0	52.0

Table 2 presents physical performance data of wheelchair fencing female athletes with details of each biomotor component, including shoulder flexibility, shoulder muscle endurance, right and left hand grip strength, hand reaction speed, and aerobic capacity (Aeerobic capacity). The results show that the average Aeerobic capacity value is 36.1 ml/kg/min. In the strength component, the average grip strength value for the right hand is 17.1 kg, while for the left hand it is 18.1 kg. The shoulder muscle endurance component has an average of 17.75 seconds. Shoulder flexibility shows an average value of 63 cm. Meanwhile, hand reaction speed has an average of 175 milliseconds.

Table 2. Physical performance of wheelchair fencing female athletes (n = 3)

Variable	Mean ± SD	Min	Max
Shoulder Flexibility (cm)	63 ± 10.2	50	75
Shoulder Endurance (s)	17.75 ± 5.6	10	25
Grip Strength Right (kg)	17.1 ± 3.4	12.0	22.0
Grip Strength Left (kg)	18.1 ± 3.1	14.0	23.0
Hand Reaction (ms)	175 ± 18.7	150	200
Aeerobic capacity (ml/kg/min)	36.1 ± 4.3	30.0	42.0

DISCUSSION

This study aims to analyze the physical condition profiles of NPCI DKI Jakarta wheelchair fencers based on key biomotor components. To the authors' knowledge, this study provides a descriptive overview of the physical condition profiles of NPCI DKI Jakarta wheelchair fencers based on key biomotor components. The findings indicate that the athletes demonstrate varying levels across aerobic capacity, grip strength, shoulder muscle endurance, flexibility, and reaction speed, reflecting the specific physical demands of wheelchair fencing. Overall, these components represent important

aspects of performance that can be considered in training and evaluation processes.. .

The results of this study show that the average Aeerobic capacity value was 43.5 ml/kg/min in male athletes and 36.1 ml/kg/min in female athletes. These results are also consistent with previous study that reported that Aeerobic capacity values in wheelchair athletes are generally in a similar range for both male and female groups (Goosey-Tolfrey et al., 2021). Furthermore, various studies have shown that the aerobic capacity of wheelchair athletes tends to be lower than that of non-disabled athletes, which is related to the limited active muscle mass in the upper limbs used during activity (Ernandini & Pakasi, 2020)

With regard to upper-limb performance, the average shoulder flexibility reached 112 cm in male athletes and 63 cm in female athletes, while shoulder endurance was 56 seconds in male athletes and 17.75 seconds in female athletes. Given the limited study specifically measuring shoulder flexibility and endurance in wheelchair fencing, interpretation of these results refers to studies addressing the physical performance and biomechanical characteristics of wheelchair fencing in general. Shoulder flexibility plays a role in determining the range of motion and the effectiveness of offensive and defensive techniques that require optimal joint mobility (Martín-Ruiz et al., 2024). Meanwhile, shoulder muscle endurance relates to the ability to maintain muscle contraction during repetitive activities, a key characteristic of wheelchair fencing (Borysiuk et al., 2025).

Furthermore, sufficient endurance capacity is essential to prevent localized fatigue in the upper limb muscles, which can impact performance quality during competition (Tafuri et al., 2025). Thus, the shoulder flexibility and endurance values obtained in this study can be understood as a representation of the biomechanical and physiological demands of wheelchair fencing, although literature directly examining these two variables in specific measurement units remains limited.

In this study, we found that right-hand grip strength values were 44.3 kg in male athletes and 17.1 kg in female athletes, and left-hand grip strength values were 24.3 kg in male athletes and 18.1 kg in female athletes. Hand reaction values were 150 ms in male athletes and 175 ms in female athletes. Given the limited study specifically integrating bilateral grip strength and hand reaction measurements in wheelchair fencing, interpretation of these results refers to studies examining physical performance

and neuromuscular characteristics in wheelchair fencing in general. Grip strength plays a crucial role in weapon control, movement stability, and technical effectiveness during competitions, which are highly dependent on upper-limb dominance (Borysiuk et al., 2025; Starczewski et al., 2024).

Moreover, the difference in values between the right and left hands indicates unilateral dominance, a common characteristic in fencing due to repetitive use of the dominant side during technical activities (Martín-Ruiz et al., 2024). Hand reaction speed is related to the neuromuscular response ability to respond quickly to visual stimuli during dynamic duel situations (Starczewski et al., 2024). Therefore, the results of this study not only describe the strength and response profile of athletes but also confirm that the integration of grip strength and reaction speed is a crucial component in supporting wheelchair fencing performance. This also demonstrates the limited number of studies combining these two variables, thus providing a more comprehensive scientific contribution.

A limitation of this study is the relatively small sample size, which limits the generalizability of the results to the broader population of wheelchair fencing athletes. To address this limitation, future studies should involve a larger and more representative sample to improve the robustness and external validity of the findings. In addition, this study employed a descriptive approach without inferential analysis, which limits the ability to explain causal relationships between variables. Therefore, future study is recommended to involve a larger sample size, employ a more comprehensive analysis design, and integrate various performance aspects to obtain a more comprehensive picture of the condition of wheelchair fencers.

CONCLUSSION

This study shows that the physical condition of elite wheelchair fencers varies across key biomotor components. Aerobic capacity and grip strength, especially on the dominant side, show relatively better values, while shoulder flexibility, reaction speed, and bilateral strength balance are still at a lower level. These findings provide a descriptive picture of the physical condition of elite wheelchair fencers that can be used as a basis for developing more specific training programs that are in accordance with the demands of the sport.

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