PHYSIOLOGICAL PROFILE OF THE AZERBAIJAN NATIONAL JUDO SQUAD: COMPARATIVE ANALYSES

S.S. Yusifova

Azerbaijan State Academy of Physical Education and Sport
saadat.yusifova2021@sport.edu.az, orcid.org/0009-0008-4220-9722

Annotation. Judo is an increasingly demanding sport, requiring athletes to achieve excellent physical fitness and condition for competition [1,2]. This study aimed to identify key indicators of judo performance in the Azerbaijan National Judo squad. Using a cross-sectional design, the study compared the physiological profiles of high-ranked and low-ranked judokas. Despite no statistically significant differences found in body composition, cardiovascular fitness, and anaerobic capacity between the groups, the study emphasizes the importance of a holistic approach when evaluating factors influencing success in judo. Future research should explore non-physiological and psychological factors to gain a comprehensive understanding of success determinants in judo. In summary, this study's novelty lies in comparing the physiological profiles of high-ranked and low-ranked judokas, comprehensively assessing body composition and cardiovascular fitness, acknowledging the multifaceted nature of judo performance, and considering contextual factors.

Keywords: *athletes, judo performance, bioimpedance analysis (BIA), CPET, Ramp protocol.*

Although high-ranked judo athletes' physical and physiological characteristics are well established, the characteristics of Azerbaijan national judo athletes have not been determined. So, the purpose of this study is to compare the physiological profiles of high-ranked and low-ranked judokas within the Azerbaijan national judo squad. This investigation will focus on key physiological parameters, including body composition, cardiovascular, and anaerobic capacity. By analyzing and contrasting these factors, the study aims to identify potential differences in the physical characteristics and fitness levels between high-ranked and low-ranked judokas, providing valuable insights for talent identification, training program optimization, and performance enhancement within the Azerbaijan national judo squad.

It is important to highlight the following beneficial points of research:

Total 17 judo players with more than 10-year Judo practice participated in this study. Among the participants 4 categorized as high-ranked (A group), who consistently achieving the top positions on the different national and international competitions. Another 13 participants (B group) were classified as low-ranked judokas, who had not attained significant success at the competitive level.

Characteristics of participants:

- Weight category: the participants' weight category ranged from 70 kg to 90 kg, with a mean weight of 75 ± 15 kg.
- Height: The participants' height ranged from 160 cm to 183 cm, with a mean height of 170 ± 13 cm.
- Age: The participants' ages ranged from 20 years to 31 years, with a mean age of 25 ± 5 years.

Data Collection. The data collection process included the assessment of various physiological parameters related to the participants' fitness levels. These parameters were chosen to provide a comprehensive understanding of the participants' physiological profiles and include:

Body composition analysis was performed using a BIA device - InBody770 manu-

factured in South Korea. The following parameters' indicators were considered for processing:

- TBW – total body water.
- ESW- extracellular water.
- SMM – skeletal muscle mass.
- BFM – body fat mass.
- BFP – body fat percentage.

Cardiovascular fitness was evaluated through CPET using Ramp protocol. The protocol involved gradually increasing the workload until the participants reached their maximum exertion or volitional fatigue. During the test, were continuously monitored following parameters:

- VO2 peak.
- VO2max.
- VT1.
- AT – aerobic threshold and HR1 – relevant heart rate.
- ANT – anaerobic threshold and HR2 – relevant heart rate.

Descriptive statistics, including means and standard deviations, were calculated for the participants' characteristics. To compare the physiological profiles between high-ranked and low-ranked judokas, appropriate statistical tests - chi square test and Mann-Whitney U tests were employed. The level of significance was set at $p < 0.05$.

Literature review. Several studies by E. Franchini and their co-authors have focused on physiological aspects of judo athletes [1, 3, 4, 16, 18]. These studies indicate that judo athletes aim to increase lean tissue, reduce body fat, and manage overall body weight. Typically, judokas possess a mesomorphic somatotype characterized by high musculature, low linearity, and low body fat. Male judo athletes at the world and Olympic levels often have less than 10% body fat [4].

It is important to note, that body fat percentage may differ between judo athletes in different weight categories. For instance, Murata et al. found that heavyweight judo athletes had a higher body fat percentage (13.0%) compared to non-heavyweight judo athletes (3.2%) [2].

Additionally, studies comparing body fat percentages among judokas from different competitive levels (e.g., national vs. international level) have found that national-level judokas tend to have a higher body fat percentage than international-level judokas [3]. Kubo et al. demonstrated that judokas participating in international events, such as the Olympic Games or Asian Games, had significantly higher fat-free mass than university-level judokas who did not participate in competitions [5].

Casals et al. suggest that achieving excellent physical fitness while maintaining optimal body mass is one of the most challenging tasks for elite judo athletes [6]. Low body fat and high arm muscle mass have been associated with better performance in judo competetions. Furthermore, body composition and somatotype influence other performance indicators such as anaerobic power, muscle torque, power output, and maximal oxygen uptake [7].

Judokas are characterized as athletes with enhanced aerobic and anaerobic fitness. Since the anaerobic system is responsible for scoring actions during combat and the aerobic component is responsible for recovery during and between matches in competitions, assessment of the physical condition of elite judo competitors requires specific examinations [8]. Degoutte et al. reported that peak values of oxygen consumption (VO2) reached about 55 ± 5 ml kg-1 min-1, while the heart rate is at about 182 ± 0.4 beats·min-1 with a plasma concentration of lactate of 12.3 ± 0.8 mmol· during a match [8]. The study also highlighted that good aerobic conditioning could enhance the ability to better recover after judo combat, which may play a significant role in managing a different number of combats within the same competition, thereby improving the performance ability of these athletes [8]. The research conducting by Miodrag Drapšin et.al showed that the energy for muscle activity in judo is predominantly derived from anaerobic sources [8]. Another important parameter that was widely discussed in scientific forums is

water intake, hydration status and the impact of dehydration on exercise performance [10]. Numerous studies examined the influence of body water balance on various aspects of judo performance [11]. Judelson and colleagues [12]. have highlighted the detrimental effects of dehydration on strength, power, and high-intensity endurance, making it a crucial consideration for maximizing muscular performance in athletes. In healthy adults, water consumption the largest component of body mass at the molecular level [13]. It is distributed across two main compartments intracellular water (ICW) and extracellular water (ECW). The assessment of total body water (TBW) and extracellular water (ECW) relies on dilution methods such as deuterium and bromide, while ICW can be determined as the difference between ECW and TBW [14]. Body water loss in humans leads to fluid loss from both intracellular and extracellular fluid compartments [15].

Aerobic Profile. According to Tomlin et. al [7], judo players' aerobic fitness has primarily been evaluated using the so-called anaerobic threshold for the aerobic capacity component and maximal oxygen uptake (VO2max s) or peak oxygen uptake (VO2peak) for the aerobic power component. Additionally, faster recovery after high-intensity intermittent exercise has also been linked to aerobic fitness, as reported by Franchini [16]. And Muramatsu [17]. Another study conducted by E. Franchini et al [18] found that elite judo players have higher specific anaerobic power and capacity, and greater muscle circumferences, especially in the upper body. According to different studies, there is evidence that VO2 max is not different between elite and non-elite judokas [4, 20, 21]. There is a very interesting practical approach to the study of Paolo Lopes S. et.al.: if trainers want to increase the number of throws their athletes must design training programs to improve both upper-body aerobic power and anaerobic capacity [22].
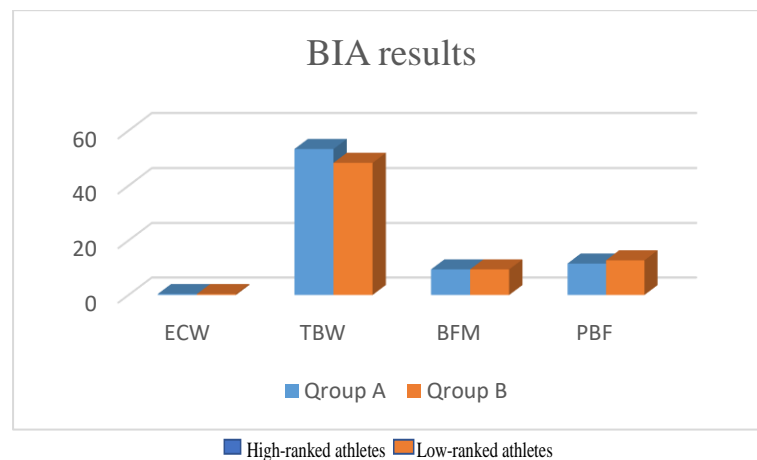

Results. BIA results. We use BIA – bioelectrical impedance was employed as the primary method for assessing the physiological profiles of participants. BIA is a non-invasive and practical technique that measures the impedance or resistance encountered by a low-intensity electrical current as it passes through the body. This method provides valuable information about body composition, including estimates of total body water, intracellular water, extracellular water, and fat-free mass. By utilizing BIA, we were able to obtain reliable and comprehensive data on the hydration status, body composition, and potentially other physiological parameters of the judokas, contributing to a deeper understanding of their physiological characteristics. It is worth noting that BIA is widely used in sports and exercise science research due to its convenience, cost-effectiveness, and ability to provide quick and practical measurements. However, it is important to acknowledge the limitations of BIA, including its sensitivity to factors such as body position, hydration status, and electrode place-

ment. These considerations were carefully controlled and standardized to ensure accurate and consistent measurements in this study. In the statistical analysis, the participants were divided into two groups: Group A and Group B. The Mann-Whitney U test was performed to analyze the data for TBW, ECW, SMM, BFM, BFP. The results indicated that there were no statistically significant differences between Group A and Group B for these parameters (p > 0,05). Similarly, the chi-square test was used to examine the BIA scores, and no significant differences were found (p > 0,05).

CPET results. Cardiopulmonary Exercise testing (CPET) was conducted to assess the aerobic fitness capacity of the Azerbaijani Judo squad, with a particular focus on parameters such as VO2max, VO2peak, and VT1. VO2max represents the maximum amount of oxygen that individual can utilize during intensive ex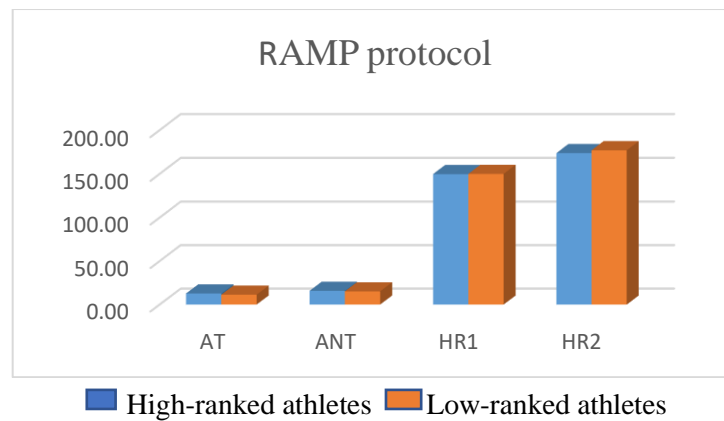ercise and is considered a key indicator of cardiovascular fitness. VO2peak, on the other hand, reflects the highest level of oxygen consumption achieved during specific exercise protocol and insights into the athlete peak aerobic capacity. Furthermore, VT1 (ventilatory threshold 1) is a significant parameter that indicates the transition from aerobic to anaerobic metabolism during exercise. Table 3 and the diagram presents the CPET indicators of the participants. In this table the same principle was used, so the first four participants, coded from 101to 104 are the high-ranked athletes, while participants coded 105 to 117 are the lower-ranked athletes. For statistical analysis the participants, which were divided into Group A and Group B, the Mann-Whitney U test was performed to analyze the data for VO2max, VO2peak, and VT1. The results indicated that there were no statistically significant differences between Group A and Group B for these parameters (p > 0,05).
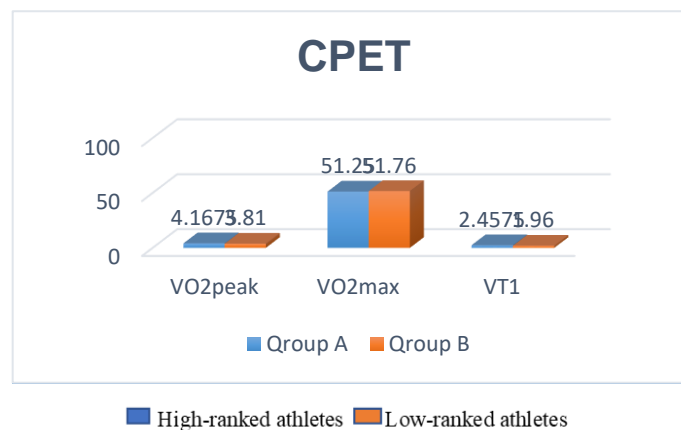
Ramp protocol. The Ramp protocol is a widely used method in CPET to assess the aerobic performance of individuals. This protocol involves gradually increasing the exercise intensity in a continuous and incremental manner until the participant reaches their maximum exertion level. The test typically starts with a warm-up period in speed, resistance, or both, depending on the exercise modality (e.g., treadmill, stationary bike). Following parameters are measured- AT and relevant HR1 and ANT and relevant HR2. These measurements are taken regular intervals throughout the test to track the participant's physiological responses to the increasing exercise intensity. By assessing the given indicators in the ASAPES laboratory condition, research gain insights into participant's aerobic and anaerobic thresholds. These thresholds are crucial for understanding their exercise capacity, endurance and performance potential in judo and other power-based sports. The diagram presents the Ramp protocol parameters of the participants. For statistical analysis the participants by dividing into Group A and Group B, and the Mann-Whitney U test was performed to analyze the data for AT, HR1, ANT and HR2. The results indicated that there were no statistically significant differences between Group A and Group B for these parameters (p > 0,05).

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Table 5. CPET (RAMP protocol)

Statistics. No statistical differences have been found between the two groups. For all measurements the $p < 0.05$ is *not* significant. Perhaps this is due to the small number of participants and there is a need for further research with an increased number of athletes.

Discussion. The fact, that we found no significant differences in physiological profiles between high-ranked and low-ranked judokas challenges the idea that these measures alone can explain why some judokas are more successful than others. Other factors such as mental status of judokas, technical skills, tactical abilities, and training methodologies is a crucial aspect of success in judo. Despite its limitations our research provides useful information and have practical implications for coaches, trainers, and athletes to optimize training programs, enhance performance, and ultimately achieve competitive success. On the other hand, although the statistical test did not find significant result, this does not discount the importance of selected variables, in the physiological profile of the Azerbaijani judo squad. These non-significant findings may be the attributed to various factors, including sample size, individual variations within the groups, and the further investigation. We recognize the importance of exploring the multifaced nature of judo performance and the interplay between various determinants. Furthermore, future research should take a wider range of aspects into account, such as technical abilities, tactical awareness, psychological characteristics, and training methods, to develop a more thorough understanding of the factors impacting judo performance. It is possible to create a more complete understanding of the factors that determine success in judo by considering these complex factors performance outcomes. Furthermore, it is essential to explore the contextual factors that may influence the physiological profiles of judokas in Azerbaijan. Factors such as weight categories, competitive level, and training environments may have varying impacts on the physiological attributes of athletes. Investigating these contextual factors will contribute to a more nuanced understanding of the physiological requirements for success within the Azerbaijani judo squad. Future research should also aim to address the limitations of this study, such as the relatively small sample size. Conducting studies with larger cohorts of judokas will enhance the statistical power and generalizability of the findings. Overall, judo performance success should be assessed using more than only physiological measures. For a more accurate evaluation of performance in judo, a comprehensive strategy that considers the complex interplay between physiological, technical, psychological, and contextual elements is required. We can improve our understanding and ultimately aid in the creation of efficient training plans and strategies for the Azerbaijani national judo team by broadening the scope of research in these areas.

Conclusion. In conclusion, this study aims to compare physiological profiles of high-ranked and low-ranked judokas within

the Azerbaijan national judo squad. Although no statistically significant differences were found between the two groups in terms of body composition and cardiovascular fitness and anaerobic capacity, it is important to interpret these findings cautiously due to the sample size. Future studies with a larger size of participants and different parameters recommendded to gain a more comprehensive understandding oof the physiological characteristics and fitness levels of the high-ranked and low-ranked judokas, providing valuable insights for talent identification, training program optimization, and performance enhancement within the Azerbaijan national judo squad.

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ФИЗИОЛОГИЧЕСКИЙ ПРОФИЛЬ ДЗЮДОИСТОВ НАЦИОНАЛЬНОЙ СБОРНОЙ АЗЕРБАЙДЖАНА: СРАВНИТЕЛЬНЫЙ АНАЛИЗ

С.С. Юсифова

Азербайджанская Государственная Академия Физической Культуры и Спорта
saadat.yusifova2021@sport.edu.az, orcid.org/0009-0008-4220-9722

Аннотация. В настоящее время дзюдо становится все более требовательным видом спорта, как физически, так и психологически. Исходя из этого, необходимо уделять особое внимание физической подготовке к соревнованиям. Для достижения успеха в соревнованиях спортсмен должен обладать отличной физической формой и состоянием во время тренировок [1,2]. Антропометрический профиль топового спортсмена может иметь значительное влияние на успех в соревнованиях и показатели в специализированных экзаменах по дзюдо. Целью данного исследования было выявить ключевые показатели, ответственные за спортивные достижения в дзюдо в кон-тексте национальной сборной Азербайджана. Исследование сравнивало физиологический профиль дзюдоистов высокого и низкого ранга в контексте национальной сборной Азербайджана. Несмотря на результаты, показавшие отсутствие статистически значимых различий в показателях состава тела, кардиоваскулярной фитнеса и анаэробных возможностей между двумя группами, исследование подчеркивает важность комплексного подхода при оценке факторов, влияющих на успех в дзюдо. В будущем исследования должны исследовать психологические и непсихологические факторы, чтобы получить всестороннее понимание детерминант успеха в дзюдо. В

заключение новизна данного исследования заключается в сравнении физиологических профилей дзюдоистов высокого и низкого ранга в контексте национальной сборной Азербайджана, всесторонней оценке состава тела и кардиоваскулярной фитнеса, учете многогранных аспектов спортивных дос-тижений в дзюдо и контекстуальных факторов.

Ключевые слова: *спортсмены, дзюдо, биоимпедансометрия, КПНТ (кадиореспираторный нагрузочный тест), протокол RAMP.*

AZƏRBAYCAN MİLLİ CUDO YIĞMASININ FİZİOLOJİ PROFİLİ: MÜQAYİSƏLİ ANALİZ

S.S. Yusifova

Azərbaycan Dövlət Bədən Tərbiyəsi və İdman Akademiyası
saadat.yusifova2021@sport.edu.az, orcid.org/0009-0008-4220-9722

Annotasiya. Cüdo getdikcə daha tələbkar idman növüdür, idmançılardan əla fiziki hazırlığa və yarışma şəraitinə nail olmağı tələb edir [1,2]. Bu tədqiqatın məqsədi Azərbaycan Milli Cüdo yığmasında cüdo üzrə göstəricilərin əsas göstəricilərini müəyyən etməkdir. Kəsitli dizayndan istifadə edərək tədqiqat yüksək və aşağı dərəcəli cüdoçuların fizioloji profillərini müqayisə edib. Qruplar arasında bədən quruluşu, ürək-damar hazırlığı və anaerob tutumda statistik əhəmiyyətli fərqlər aşkar edilməməsinə baxmayaraq, tədqiqat cüdoda uğura təsir edən amilləri qiymətləndirərkən vahid yanaşmanın vacibliyini vurğulayır. Gələcək təd-qiqatlar cüdoda uğur determinantlarını hərtərəfli başa düşmək üçün qeyri-fizioloji və psixoloji amilləri araşdırmalıdır.Xülasə, bu tədqiqatın yeniliyi yüksək və aşağı dərəcəli cüdoçuların fizioloji profillərinin müqayisəsi, bədən quruluşunun və ürək-damar hazırlığının hərtərəfli qiymətləndirilməsi, cüdo performansının çoxşaxəli xarakterinin etiraf edilməsi və kontekst faktorlarının nəzərə alınmasıdır.

Açar sözlər: *idmançılar, Cudo, bioimpedansometriya, kardiorespirator yüklənmə testi, Ramp protokolu.*