

Relationship between body composition and performance in Emirati jiu-jitsu players

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Abstract

Introduction. Body composition and physical performance are key determinants of success in combat sports such as jiu-jitsu. Understanding how these variables interact can provide valuable insights for performance optimization among Emirati athletes. **Aim of Study.** This study aimed to assess the anthropometric characteristics and physical performance metrics of Emirati male jiu-jitsu athletes and to examine the correlations between body composition and performance indicators. **Material and Methods.** Twenty male jiu-jitsu athletes (mean age = 17.3 years) participated in this cross-sectional study. Assessments included body composition (body fat percentage (%BF), lean body mass (LBM), BMI) and physical performance tests for strength, endurance, and power. Key tests comprised the 5- and 10-meter sprint, multistage 20-meter shuttle run test, squat jump (SJ), countermovement jump (CMJ), 1RM power clean, back squat, and bench press. Correlation analyses were conducted to examine the relationships between anthropometric and performance variables. **Results.** Athletes showed a mean %BF of 17.09%, fat-free mass of 57.52 kg, and BMI of 24.42. Performance measures included a mean 5-meter sprint time of 0.92 s, a 10-meter sprint time of 1.83 s, an estimated $\text{VO}_{2\text{max}}$ from the multistage 20-meter shuttle run test of $47.81 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, and a CMJ height of 33.31 cm (SJ: 30.21 cm). Fat-free mass demonstrated significant positive correlations with strength and jump-derived power, particularly in power clean, back squat, and bench press. Sprint performance showed weak associations with body composition, whereas estimated $\text{VO}_{2\text{max}}$ showed small-to-moderate associations with BMI and %BF. **Conclusions.** The results suggest that Emirati jiu-jitsu athletes possess well-developed aerobic capacity and a solid physical foundation, though their strength and power levels remain slightly below elite standards. These findings establish reference values for training optimization and future research in jiu-jitsu performance in the UAE.

KEYWORDS: body composition, jiu-jitsu, combat sports, physical conditioning, performance metrics, Emirati athletes.

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Introduction

Jiu-jitsu is a combat sport characterized by grappling, throwing, and ground-control techniques, often requiring adaptability and precision in both offensive and defensive actions [1]. As the sport continues to gain global recognition, particularly in the United Arab Emirates (UAE), where it has become a national symbol of discipline and resilience, understanding the physical and physiological determinants of performance has become increasingly important. In addition to technical and tactical skills, physical fitness has been identified as a critical factor in jiu-jitsu performance [2]. Elite jiu-jitsu athletes must combine strength, endurance, agility, and optimal body

composition to sustain repeated high-intensity efforts during matches [3, 4]. The interaction between these attributes determines an athlete's ability to execute techniques efficiently, resist fatigue, and recover between bouts [5]. Muscular power, for example, is a key determinant of performance during explosive grappling, throwing, and counterattack actions that often decide the outcome of a match [6, 7]. Research has shown that elite athletes exhibit superior lower-limb power and neuromuscular coordination compared to less-trained counterparts [8, 9]. This advantage is largely attributed to the stretch-shortening cycle of the muscle-tendon unit, which enhances explosive power and movement efficiency during throws such as *seoi-nage* and *o-goshi* [10,11]. In parallel, aerobic capacity remains critical for sustaining performance across multiple bouts. Jiu-jitsu competitions, similar to other grappling sports, consist of intermittent bursts of maximal effort interspersed with brief recovery periods, placing heavy demands on both anaerobic and aerobic energy systems [12]. While elite athletes often display moderate to high maximal oxygen uptake (VO_2max) levels, approximately $50\text{--}55 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ in males, evidence suggests that differences in aerobic capacity alone do not fully explain competitive outcomes [1, 3].

Beyond the physical attributes mentioned above, anthropometric variables also play a significant role in jiu-jitsu performance. An athlete's body composition can influence their ability to perform specific techniques effectively during competitions [6]. For example, lower %BF is associated with greater anaerobic capacity and a higher frequency of offensive actions, which can improve competition outcomes [7]. Male athletes with less than 10% body fat, particularly in weight categories excluding heavyweights, tend to achieve better results in jiu-jitsu competitions [8].

Recent sport-specific research has validated reliable tools for evaluating jiu-jitsu performance [13, 14] and highlighted the importance of monitoring internal training load and physiological recovery to ensure long-term adaptation [4]. However, most of these studies have been conducted in Western or South American contexts, leaving a gap in the literature concerning Arab and Gulf populations. In the UAE, jiu-jitsu has experienced rapid institutional and cultural growth, with Emirati athletes achieving remarkable success at continental and international levels. Despite this progress, scientific data describing their anthropometric profiles and the relationship between body composition and physical performance remain limited.

Aim of Study

The aim of this study was to assess the anthropometric characteristics and physical performance metrics of Emirati male jiu-jitsu athletes and to examine the relationships between body composition and key performance indicators such as strength, power, speed, and endurance.

Material and Methods

Subjects

Twenty jiu-jitsu athletes (age = 17.3 ± 0.74 years; body mass = 69.4 ± 6.6 kg; height = $1.68 \pm 0.08\text{m}$; body mass index = $24.4 \pm 0.7 \text{ kg}\cdot\text{m}^{-2}$) volunteered for the study. Participants' ages ranged from 16 to 20 years; therefore, for athletes under 18 years, written parental/guardian consent and athlete assent were obtained. The athletes were black belts and had international and national competitive experience, having won medals at the 2024 World Championships in Athens. Data collection was performed on two separate days in the same week. On the first day, participants underwent anthropometric assessments, whereas muscle and aerobic power were measured during the second visit. All participants were informed about the nature and possible risks of the experimental procedures prior to the tests. All volunteers provided written informed consent. The study was approved by the local biomedical and scientific committee of ESE (ESE-Al Salamat; registration number: ESEADUAE241, 07/11/2024), and all procedures were performed in accordance with the Declaration of Helsinki.

Anthropometric measurements

Anthropometric measurements were performed in the morning prior to any physical exercise. All measurement were conducted according to standardized protocols established by the International Society for the Advancement of Kinanthropometry (ISAK). Body mass was measured to the nearest 0.1 kg using a digital scale (Detecto, Webb City, MO, USA), and standing height was measured to the nearest 0.5 cm using a stadiometer (Cescorf, Porto Alegre, RS, Brazil). Body mass index (BMI) was calculated as $\text{body mass}/\text{height}^2$.

Percentage body fat (%BF) was estimated using the Deurenberg equation [12]: $\%BF = 1.20 \times \text{BMI} + 0.23 \times \text{age} - 10.8 \times \text{sex} - 5.4$, where sex = 1 for males. Fat mass (kg) was calculated as $\text{body mass} \times (\%BF/100)$, and fat-free mass (FFM, kg) was calculated as $\text{body mass} - \text{fat mass}$.

*Physical measurements**Jumping assessment*

Squat jump and countermovement jump test (cm): Lower-body muscle power was assessed using two jump tests: the squat jump (SJ) and the countermovement jump (CMJ). Both tests were conducted using the validated Optojump system (Microgate, Bolzano, Italy), as outlined by Glatthorn [7].

For the SJ test, participants maintained a 90° knee-flexion position until force platform readings stabilized. They then received a three-second countdown before executing the jump. During the warm-up, a 90° knee-angle jumping routine using a chair was used to familiarize participants with the correct posture.

For the CMJ test, participants stood on a designated platform and, upon receiving a verbal signal, executed a maximal-effort vertical jump while keeping their hands on their hips to minimize arm movement. Participants were instructed to perform the eccentric phase as quickly as possible [12]. Each participant performed three consecutive jumps, with the highest jump height (measured in centimeters) recorded for further analysis. To ensure consistency and eliminate coordination as a confounding factor, participants were required to keep their hands on their hips, minimizing any lateral or horizontal movement that could influence performance. An experienced evaluator closely monitored all SJ and CMJ attempts to ensure proper technique. Any jump that did not meet the required standards was discarded, and the participant was given another attempt.

The reliability of these jump tests has been well established in previous studies involving young adult subjects [15, 16]. Jump power was estimated using the Sayers equation, incorporating jump height and body mass:

Peak Power (W) = $60.7 \times (\text{jump height [cm]}) + 45.3 \times (\text{body mass [kg]}) - 2055$ [17]. This equation provides an estimate of peak power output by factoring in both the height achieved during the jump and the athlete's body mass. Pilot data from 20 jiu-jitsu players were collected to assess the reproducibility of the test, showing an ICC = 0.982 for this test.

The 5-m and 10-m sprint tests (s): Running speed was indirectly assessed with a 5-m standing-start sprint time on a standard gym rubber floor, with the front foot placed 5 cm behind the first timing gate. The photoelectric cells were positioned 75 cm above the ground to ensure they captured trunk movement rather than false signals from limb motion. Subjects performed three maximal attempts separated by 2–3 min of passive recovery, and

the fastest time was retained for analysis. Pilot data from 20 jiu-jitsu players were collected to assess the reproducibility of the test, demonstrating ICC values ranging from 0.988 to 0.991 for all tests.

Muscle strength and power assessment

Bench press, back squat and power clean (kg): During the four-week familiarization phase, participants in each group were introduced to the testing procedures and equipment before data collection began. To ensure accuracy, a full range of motion and proper technique were mandatory for every 1RM trial. For the squat test, individuals were required to lower themselves until their thighs were parallel to the ground, as assessed by an experienced evaluator.

In the bench press test, the bar had to be lowered to the chest. Multiple familiarization sessions with heavy loads and maximal effort were conducted during this phase to better estimate participants' maximum strength. Prior to starting the training program, two 1RM testing sessions were carried out on three non-consecutive days. The testing protocol, as outlined by Kraemer et al., included: (i) a warm-up consisting of 5-10 repetitions at 40-60% of the estimated 1RM, (ii) a one-minute rest with light stretching followed by 3-5 repetitions at 60-80% of the estimated 1RM, and (iii) 3-5 attempts to determine the 1RM, with a five-minute rest between each attempt. The highest successfully lifted weight was recorded [18]. Pilot data from 20 jiu-jitsu players were collected to assess the reproducibility of the test, showing an ICC = 0.982 for this test.

Aerobic performance

Maximum oxygen uptake ($\text{VO}_{2\text{max}}$) was estimated using multistage 20-meter shuttle run test proposed by Leger and Lambert [19]. This test consisted of a shuttle run between two lines, spaced 20 m apart. The test started at a speed of 8.5 km/h, increasing by 0.5 km/h every minute, with the pace controlled by an audio signal from a pre-recorded tape. $\text{VO}_{2\text{max}}$ was estimated based on the athlete's running speed achieved in the final stage before fatigue, using the equation: $\text{VO}_{2\text{max}} = 5.857 \times \text{speed (km/h)} - 19.458$.

Testing conditions and supervision

All testing sessions were conducted indoors at the ESE Training Center of Al Salamat, located in Al Ain City, UAE.

Participants were instructed to avoid strenuous exercise and caffeine 24 hours before testing. All tests were administered by experienced evaluators certified in strength and conditioning assessment.

Statistical analyses

Descriptive statistic was used to characterize the sample. Results are presented as mean $\pm$ standard deviation (SD) and range (minimum and maximum values). The coefficient of variation was also calculated (SD/mean). Pearson's correlation was used to assess the relationships between body composition and physical performance variables. To control for multiple comparisons, *p*-values were adjusted using the Benjamini–Hochberg false discovery rate (FDR) procedure [20]. Correlation magnitudes were interpreted using Hopkins' qualitative scale, and statistical significance was set at $p < 0.05$. All analyses were performed using SPSS (version 17.0; SPSS Inc., Chicago, IL, USA) [15].

Results

Anthropometric measurements

A total of 20 jiu-jitsu players participated in the study. The baseline characteristics of the participants, including anthropometric measurements, are presented in Table 1. The participants had a mean age of 17.3 years (range: 16–20 years). Their average height was 1.68 m (range: 1.58–1.81m), and their mean body mass was 69.4 kg (range: 60.3–79.1kg). The mean BMI was 24.42 (range: 22.7–25.55). Body composition analysis showed an average %BF of 17.09% (range: 14.78–18.53%) and an average FFM of 57.52 kg (range: 50.72–65.69 kg). These morphological characteristics provide a baseline for assessing physical conditioning and identifying potential correlations with performance outcomes.

Table 1. Anthropometric characteristics of Emirates jiu-jitsu athletes (N = 20).

	N = 20	Range
Age (years)	17.3 $\pm$ 0.74	(16–20)
Height (m)	1.68 $\pm$ 0.08	(1.58–1.81)
Body mass (kg)	69.4 $\pm$ 6.57	(60.3–79.1)
Body mass index (kg·m ⁻²)	24.42 $\pm$ 0.66	(22.70–25.55)
Body fat (%)	17.09 $\pm$ 0.86	(14.78–18.53)
Fat-free mass (kg)	57.52 $\pm$ 5.39	(50.72–65.69)

Physical performance measures

The baseline performance assessments revealed significant results across multiple metrics, including sprinting, endurance, jumping, and strength. The jiu-jitsu players demonstrated strong sprinting abilities, with an average time of 0.92 $\pm$ 0.056 seconds for the

5-meter sprint (range: 0.83–1.02s) and 1.83 $\pm$ 0.047 seconds for the 10-meter sprint (range: 1.75–1.92 s), highlighting their acceleration capabilities. The multistage 20-meter shuttle run test showed a mean estimated VO₂max of 47.81 $\pm$ 3.35 mL·kg⁻¹·min⁻¹ (range: 43.7–52.5 mL·kg⁻¹·min⁻¹), indicating a moderate level of aerobic endurance. In jump performance, the players recorded an average CMJ height of 33.31 $\pm$ 1.31 cm (range: 31.2–35.7 cm) and a SJ height of 30.21 $\pm$ 1.66 cm (range: 27.5–33.2 cm), with corresponding peak power outputs of 3110.43 $\pm$ 319.60 W and 2922.57 $\pm$ 341.64 W, respectively. Strength assessments showed a mean power clean of 70.96 $\pm$ 6.59 kg (range: 61–81 kg), squat strength of 98.55 $\pm$ 9.34 kg (range: 85.63–112.32 kg), and bench press strength of 58.75 $\pm$ 6.85 kg (range: 48–70 kg), reflecting well-developed muscular power and strength. These findings emphasize the players' well-rounded capabilities in speed, power, and strength, essential for high-performance competition, as summarized in Table 2.

Table 2. Physical performance characteristics of Emirates jiu-jitsu athletes (N = 20).

Physical performance	N = 20	Range
T5 (s)	0.92 $\pm$ 0.056	(0.83–1.02)
T10 (s)	1.83 $\pm$ 0.047	(1.75–1.92)
Estimated VO ₂ max (mL·kg ⁻¹ ·min ⁻¹)	47.81 $\pm$ 3.35	(43.7–52.5)
CMJ height (cm)	33.31 $\pm$ 1.31	(31.2–35.7)
CMJ peak power (W)	3110.43 $\pm$ 319.60	(2649.34–3567.75)
SJ height (cm)	30.21 $\pm$ 1.66	(27.5–33.2)
SJ peak power (W)	2922.57 $\pm$ 341.64	(2391.14–3422.07)
Power clean (kg)	70.96 $\pm$ 6.59	(61–81)
Back squat (kg)	98.55 $\pm$ 9.34	(85.63–112.32)
Bench press (kg)	58.75 $\pm$ 6.85	(48–70)

Note: estimated VO₂max (mL·kg⁻¹·min⁻¹) – estimated maximal oxygen uptake; SJ – squat jump; CMJ – countermovement jump.

Correlation analysis

The correlation analysis between body composition and physical performance revealed several noteworthy trends. Body mass showed strong positive correlations with peak power ($r = 0.969$, $p < 0.01$), power clean ($r = 0.979$, $p < 0.01$), squat ($r = 0.99$, $p < 0.01$), and bench press ($r = 0.954$, $p < 0.01$), indicating that jiu-jitsu players with greater body mass tend to perform better in power- and strength-based exercises.

A similar pattern was observed for lean body mass, with strong correlations to peak power ($r = 0.961$, $p < 0.01$) and strength performance, further reinforcing the link between muscle mass and strength/power performance. Conversely, both BMI and %BF exhibited moderate positive correlations with aerobic fitness, as assessed by estimated VO_2max from the multistage 20-m shuttle run test, suggesting that players with higher BMI and %BF might appear to have a slight advantage in endurance performance; however, this interpretation should be made cautiously given the equation-based nature of the VO_2max estimate.

However, sprint times (T5, T10) showed weak or even negative correlations with most body composition metrics, indicating that body composition has a limited effect on short-distance sprint performance.

These findings highlight the complex relationships between body composition and various aspects of physical performance, with strength and power being most strongly linked to body mass and FFM, while aerobic fitness and sprinting abilities are less influenced by body composition.

Table 3. Relationship between fat-free mass (FFM) and physical performance in Emirates jiu-jitsu athletes.

Physical performance	Fat-free mass (FFM) (r)
T5 (s)	-0.18
T10 (s)	-0.62
Estimated VO_2max ($\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)	-0.428
CMJ height (cm)	0.138
CMJ peak power (W)	0.961**
SJ height (cm)	0.948**
SJ peak power (W)	0.967**
Power clean (kg)	0.994**
Back squat (kg)	0.938**

Note: estimated VO_2max ($\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) – estimated maximal oxygen uptake; SJ – squat jump; CMJ – countermovement jump, $p < 0.05$; $p < 0.01$.

Discussion

This study aimed to analyze the relationship between body composition and physical performance including explosive power, sprint ability, and aerobic capacity, among Emirati male jiu-jitsu athletes. The results were compared with data from countries with a strong jiu-jitsu tradition. The findings revealed that although the

athletes demonstrated slightly lower vertical jump heights and moderate aerobic power, their performance indicators remained within the expected range for competitive practitioners. However, their %BF was higher than that generally reported for elite-level jiu-jitsu athletes [1, 3].

Anthropometric profile and body composition

The anthropometric results of this study are consistent with prior research demonstrating the importance of muscular development and optimal body composition for success in combat sports [1, 3, 21]. In jiu-jitsu and other grappling disciplines, high lean mass supports both offensive and defensive actions such as throws, takedowns, and positional control [21]. The mean %BF (17.09%) observed in this sample indicates a relatively lean physique, yet it remains higher than the approximately 7-15% range previously reported among elite male jiu-jitsu and judo athletes [1, 3, 4]. This difference may reflect distinct training loads, competitive demands, and nutritional practices. Studies by Øvretveit [3] and Campos et al. [4] highlighted that athletes' physiological profiles vary across competition levels and phases of the training season. Body composition assessment plays a crucial role in identifying strengths and weaknesses that influence performance. Deurenberg et al. [6] proposed predictive formulas linking BMI and body fat to sport performance efficiency. In our study, positive correlations between FFM and key power metrics (e.g., squat, power clean, CMJ peak power) suggest that muscle mass strongly contributes to performance, consistent with previous work in combat sports [5, 7, 8, 20]. Muscle mass is not only a determinant of force production but also enhances anaerobic power and fatigue resistance during prolonged efforts [9, 11]. The importance of a favorable body composition profile is also supported by Léger and Lambert [12], who emphasized that balanced muscularity contributes to maintaining both anaerobic and aerobic performance during repeated high-intensity efforts.

Explosive power and jumping performance

Lower-limb power is a key determinant of technical and tactical performance in jiu-jitsu, where movements often involve rapid transitions, explosive lifts, and forceful displacements [7, 10, 21]. The CMJ and SJ are widely recognized as reliable indicators of lower-limb neuromuscular performance [7, 9]. The mean CMJ height (33.3 cm) and SJ height (30.2 cm) recorded in this study are consistent with previous findings among trained combat athletes [7, 10, 21]. Using the validated

Optojump system [7], we estimated peak power outputs of ~ 3110 W (CMJ) and ~ 2923 W (SJ), confirming good levels of lower-limb power. These values align with those reported by Glatthorn et al. [7], Bosco et al. [8], and Pueo et al. [10] in other combat-sport populations. Muscle-tendon properties, specifically the stretch-shortening cycle, have been identified as key contributors to explosive muscle power [5]. Nicol et al. [5] proposed that efficient use of this cycle enhances performance during jumps and throws by improving elastic energy utilization. In jiu-jitsu, where repetitive explosive actions are required, this mechanism is particularly relevant. Our results also demonstrated significant correlations between lean body mass, skeletal muscle mass, and peak power outputs confirming that greater muscularity enhances explosive performance. These findings are in agreement with prior studies by Kraemer and Ratamess [11], who emphasized the role of progressive resistance training in improving the rate of force development and overall power capacity.

Strength and power performance

Maximal strength in multi-joint movements such as the power clean, back squat, and bench press is a strong predictor of competitive success in grappling sports [11]. The average 1RM power clean observed (70.96 ± 6.59 kg) was lower than the ~ 93 kg benchmark reported by Andreato et al. [1, 2] for elite jiu-jitsu athletes, who typically lift around $1.25 \times$ body mass. Similarly, the mean squat performance (98.55 ± 9.34 kg) was below the $1.5 \times$ body mass standard observed in judo and jiu-jitsu practitioners [20]. Although these values are below elite averages, the Emirati athletes demonstrated good technical execution and stable strength foundations. As noted by Hopkins [15], small differences in maximal force production can significantly impact competition outcomes, particularly in sports requiring rapid and repeated bursts of force. Targeted resistance training programs focusing on Olympic lifts, eccentric strength, and power development may therefore enhance future performance [11, 15].

Aerobic capacity and endurance

Aerobic capacity is another key determinant of combat-sport performance, supporting recovery between high-intensity exchanges. The mean estimated $\dot{V}O_{2\max}$ in this study (47.8 ± 3.35 mL $\cdot$ kg $^{-1}\cdot$ min $^{-1}$) corresponds to moderate-to-high aerobic fitness levels and is comparable to the values reported by Léger and Lambert [12] and Campos et al. [4] in combat athletes. In line with previous findings [4, 20], our

results indicate that aerobic conditioning contributes significantly to repeated effort tolerance, lactate clearance, and sustained technical execution. While anaerobic energy systems dominate during explosive exchanges, aerobic metabolism facilitates recovery during the brief pauses between grappling sequences [5, 12, 16]. This balance between anaerobic bursts and aerobic recovery is essential in jiu-jitsu competitions, which typically involve intermittent high-intensity demands lasting several minutes [4, 12].

Comparative perspective

When compared with athletes from nations with well-established jiu-jitsu programs, Emirati athletes demonstrated promising physical profiles but slightly lower absolute strength and jump performance. These discrepancies may result from differences in long-term training exposure, developmental pathways, and cultural emphasis on physical conditioning [1, 3, 4]. Nevertheless, the presence of strong correlations between muscle mass and performance variables suggests substantial potential for improvement through structured strength and conditioning programs emphasizing resistance training, plyometrics, and aerobic conditioning [11, 12, 14, 17].

Conclusions

This study provides the first detailed analysis of body composition and performance characteristics among Emirati jiu-jitsu athletes. The results highlight a solid physical foundation, characterized by well-developed lean mass, good aerobic capacity, and moderate-to-high levels of strength and power. Although certain parameters (e.g., maximal strength and jump height) were slightly below elite international standards, the athletes exhibited strong correlations between FFM and power output, confirming the central role of muscular development in jiu-jitsu performance [11, 17]. These findings offer valuable reference data for coaches, scientists, and practitioners aiming to optimize training programs and monitor athlete progression within the UAE jiu-jitsu community.

The study's limitations include its relatively small sample size and reliance on field-based testing methods for aerobic assessment rather than sport-specific protocols. The participants' young age and off-season training phase may also have influenced strength and endurance outcomes. Future research should involve larger cohorts, use laboratory-based measurements, and include female and youth categories to better represent the national athletic population. Integrating biomechanical, hormonal, and neuromuscular analyses

could further clarify how physiological adaptations influence competitive success in jiu-jitsu [4, 11, 14, 20].

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Conflict of Interest

The authors declare no conflict of interest.

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