

Lean Body Mass Components and Obesity Diagnostic Parameters in Boxers, Kickboxers and Wrestlers

Componentes de la Masa Corporal Magra y Parámetros Diagnósticos de Obesidad en Boxeadores, Kickboxers y Luchadores

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SUMMARY: In boxing, kickboxing, wrestling, and other combat sports, the optimal body composition is of great importance for athletes. Combat sports are weight sensitive, and monitoring and controlling the body mass weight and optimization of body mass components is directly related to sport performance. The aim of the study was to determine and compare the components of lean body mass and obesity parameters in athletes engaged in various martial arts using bioelectrical impedance analysis. In this study, 100 combat sports athletes were included, divided into 3 groups, boxers (n=30), kickboxers (n=30) and wrestlers (n=40). The bioelectrical impedance method was used for body composition analysis (BIA InBody 720, Biospace Co. Ltd., Seoul, Korea). We have analyzed the lean body mass components: Total body water (TBW), fat free mass (FFM), soft lean mass (SLM), skeletal muscle mass (SMM), protein and minerals. Obesity diagnose parameters were: body fat mass (BFM), body fat percentage (BF %), body mass index (BMI), obesity degree and waist to hip ratio (WHR). The average value of SLM was 63.29 ± 7.9 kg, 60.53 ± 7.6 kg and 60.54 ± 7.7 kg, consequently for boxers (B), kickboxers (KB) and wrestlers (W). Skeletal muscle mass was similar between all three groups ($p=0.471$); $B = 38.17 \pm 5.1$ kg, $KB = 36.62 \pm 4.9$ kg and $W = 38.39 \pm 9.0$ kg. The boxers had insignificantly higher body fat mass (BFM) compared to kickboxers and wrestlers (10.82 ± 3.9 kg, 8.69 ± 4.4 kg and 8.90 ± 3.1 kg, $p=0.055$). The BF % in the group boxers (13.76 ± 4.1 %) was insignificantly higher than BF % in kickboxers and wrestlers (11.69 ± 4.9 % and 11.96 ± 3.3 %, $p=0.108$). Fighters from all three martial arts showed well-developed muscle mass without significant difference for lean body mass components. Obesity diagnostic parameters were low in boxers, kickboxers and wrestlers, also without intergroups differences.

KEY WORDS: Boxers; Kickboxers; Wrestlers; Body composition; Muscle mass; Body fat.

INTRODUCTION

In boxing, kickboxing, wrestling, and other combat sports, the optimal body composition is of great importance for athletes. Combat sports are weight sensitive, and monitoring and controlling the body mass weight and optimization of body mass components is directly related to sport performance. Given the wide range of weight classes, it is impossible to establish a single body type or an ideal anthropometric profile for all combat sports. Prior to each competition, boxers, kickboxers, and wrestlers should focus on limiting body mass by maximizing lean body mass and minimizing body fat (Ahlawat & Sharma, 2014). Consistent with this approach, both elite and amateur competitors in several combat sports have shown a tendency toward low body fat (Schick *et al.*, 2010). In combat sports, a high correlation between performance and body composition has been demonstrated (Slimani *et al.*, 2017).

Reference values for anthropometric measures in athletes from different sports have been published, but the interpretation and generalization of results for some sports are limited due to low number of subjects and the use of different measurement methods (Garrido-Chamorro, *et al.*, 2012). There is a need for additional sport-specific anthropometric profiles, assessed in a standardized manner and published in accordance with guidelines (Aragon *et al.*, 2017) to allow for optimal monitoring and interpretation of anthropometric characteristics in athletes (Cullen *et al.*, 2022).

Wrestlers in competitions are generally classified by body mass, to avoid physical and physiological advantages among them. Research conducted on elite wrestlers participating in the Olympics showed that more successful

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wrestlers were older, with more sports experience, higher FFM (fat-free mass), higher maximal muscle strength, better motor skills and better energy capacity, both aerobic and anaerobic (García-Pallarés *et al.*, 2011; Nikooie *et al.*, 2017). Given that combat sports are based on the athlete's weight, it is very important for combat sports athletes to have optimal body composition, i.e. a minimal percentage of subcutaneous fat tissue and a higher percentage of muscle mass (Chaabène *et al.*, 2015).

The aim of this study is to determine and compare the components of lean body mass and obesity parameters in athletes from different martial arts using bioelectrical impedance analysis.

MATERIAL AND METHOD

Sample of respondents

In this study were included 100 combat sports athletes, divided into 3 groups, boxers (n=30), kickboxers (n=30) and wrestlers (n=40). The age range of athletes was from 18 to 30, the average age of boxers was 18.5 ± 2.6 years; for kickboxers it was 19.1 ± 3.3 and wrestlers were 20.8 ± 5.3 years old.

Informed consent was obtained from all respondents, by which they confirm that they are informed about what kind of research it is about and what the obtained data will be used for. The tests were performed at the Institute of Physiology at the Faculty of Medicine in Skopje.

Our research is approved by the Scientific Ethics Committee, as it was conducted in accordance with the principles expressed in the Declaration of Helsinki.

Methods

The bioelectrical impedance method was used for body composition analysis. The device for measuring body composition – multifrequency bioelectrical impedance (BIA InBody 720, Biospace Co. Ltd., Seoul, Korea). The measurement was carried out under standard conditions: ambient temperature of 20-25 °C, according to the manuals of the manufacturer. The measurement took less than 2 minutes. From the final BIA report we have analyzed the lean body mass components: Total body water (TBW), fat free mass (FFM), soft lean mass (SLM), skeletal muscle mass (SMM), protein and minerals. Obesity diagnose parameters included: body fat mass (BFM), body fat percentage (BF %), body mass index (BMI), obesity degree and waist to hip ratio (WHR).

Statistics

The analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26.0. For all variables examined, the following statistical parameters were calculated: Arithmetic means (X), Standard deviations (SD), Minimum scores (min), Maximum scores (max), Skewness to assess the distribution of results, Kurtosis to evaluate the distribution of results, The Kolmogorov-Smirnov test (according to Liliefors) to test the normality of the result distribution, Differences in anthropometric variables were determined through analysis of variance (ANOVA). The level of statistical significance was set at $p < 0.05$.

RESULTS

This study included 100 male participants, fighters in three combat disciplines: boxing, kickboxing and wrestling, with an average age of 19.4 ± 3.5 years. The age range was the broadest among wrestlers, 18 to 38 years, in contrast to the other two groups where the range was 18 to 28 years. A significant difference in the average age was found between the boxer and wrestler groups (18.5 vs. 20.9 years, while kickboxers were 19.1 years). In terms of years of training, wrestlers had the longest experience, more than 5 years (5.17 ± 4.4 years) while boxers and kickboxers had a similar length of training experience (2.93 vs. 2.82 years), but there was a statistically significant difference only between the boxer and wrestler groups.

In Table I descriptive statistics for lean body mass components for all groups are presented. Boxers, kickboxers and wrestlers did not show significant difference for the soft lean mass (SLM), $p=0.277$. The average value of the SLM was 63.29 ± 7.9 kg, 60.53 ± 7.6 kg and 60.54 ± 7.7 kg, respectively in sports disciplines boxing, kickboxing and wrestling.

Fat-free component (FFM) was also insignificantly different between wrestlers, kickboxers and boxers (67.03 ± 8.4 vs 64.04 ± 8.1 vs 64.36 ± 8.3 kg, $p=0.305$). The osseous minerals had insignificant different values between the fighters disciplines boxing, kickboxing and wrestling (3.714 ± 0.52 kg vs 3.512 ± 0.47 kg vs 3.568 ± 0.5 kg, $p=0.256$). The average values for skeletal muscle mass (SMM) were similar between all three groups ($p=0.471$); 38.17 ± 5.1 kg, 36.62 ± 4.9 kg and 38.39 ± 9.0 kg, consequently for boxers, kickboxers and wrestlers.

Descriptive statistics for obesity diagnose parameters are shown in Table II. The mean values for body mass index (BMI) were almost similar in boxers,

kickboxers and wrestlers: $23.83 \pm 2.3 \text{ kg/m}^2$, $23.21 \pm 2.7 \text{ kg/m}^2$ and $23.62 \pm 2.1 \text{ kg/m}^2$ accordingly in the three martial disciplines ($p=0.542$). The boxers had insignificantly bigger body fat mass (BFM) compared to kickboxers and wrestlers ($10.82 \pm 3.9 \text{ kg}$, $8.69 \pm 4.4 \text{ kg}$ and $8.90 \pm 3.1 \text{ kg}$, $p=0.055$). The percentage body fat (BF %) in the group boxers ($13.76 \pm 4.1 \%$) was insignificantly higher than BF % in kickboxers and wrestlers (11.69 ± 4.9 and $11.96 \pm 3.3 \%$, $p=0.108$).

WHR (waist- hip ratio) in all martial arts groups (boxers vs kickboxers vs wrestlers) was similar: 0.85 ± 0.05 , 0.83 ± 0.04 and 0.83 ± 0.05 respectively, $p=0.172$. Obesity degree (OD %) was $108.19 \pm 10.6 \%$ in the group boxers, $105.36 \pm 12.8 \%$ in the group kickboxers, $106.96 \pm 9.1 \%$ in the group wrestlers. The difference in the OD % parameter between the groups was not statistically significant ($p=0.585$).

Table I. Lean body mass components in boxers, kickboxers and wrestlers.

	boxers	kickboxers	wrestlers	Significance (p-level)
Height (cm)	$180.7 \pm 7.3 \text{ cm}$	$177.2 \pm 7.0 \text{ cm}$	$176.4 \pm 6.7 \text{ cm}$	F=3.38
Min-max	169-195	162-192	165-193	*p=0.038 boxers vs wrestlers *p=0.034 boxers vs kickboxers
Weight (kg)	$78.1 \pm 11.5 \text{ kg}$	$72.7 \pm 9.9 \text{ kg}$	$73.5 \pm 9.7 \text{ kg}$	F=2.46 p=0.09
Min-max	56.9 – 110.7	56-102	58 – 97.7	
Lean body mass components				
TBW (L)	49.17 ± 6.1	46.99 ± 5.8	47.51 ± 5.9	F=113 p=0.326
Min-max	47.51 $\pm$ 5.9	34.3 – 62.4	37.1 – 60.6	
SLM (kg)	63.29 ± 7.9	60.53 ± 7.6	60.54 ± 7.7	F=1.3 p=0.277
Min-max	60.54 $\pm$ 7.7	44.1 – 80.3	45.8 – 78	
FFM (kg)	67.03 ± 8.4	64.04 ± 8.1	64.36 ± 8.3	F=1.2 p=0.305
Min-max	51 – 85.2	46.8 – 84.9	49.5 – 82.5	
SMM (kg)	38.17 ± 5.1	36.62 ± 4.9	38.39 ± 9.0	F=0.76 p=0.471
Min-max	28.2 – 48.5	26 – 49	28.2 – 82.2	
Proteins (kg)	13.33 ± 1.7	12.79 ± 1.6	12.86 ± 1.6	F=0.98 p=0.377
Min-max	10 – 16.7	9.3 – 16.9	10 – 16.4	
Osseous minerals (kg)	3.714 ± 0.52	3.512 ± 0.47	3.568 ± 0.5	F=1.38 p=0.256
Min-max	2.77 – 5	2.64 – 4.86	2.8 – 5	

TBW – Total body water; SLM – soft lean mass; FFM – fat free mass; SMM – skeletal muscle mass; *p<0.05

Table II. Obesity diagnosed parameters in boxers, kickboxers and wrestlers.

	boxers	kickboxers	wrestlers	Significance (p-level)
BMI	23.83 ± 2.3	23.21 ± 2.7	23.62 ± 2.1	19.5 – 27.3
Min-max	19.6 – 28.5	18.9 – 30	19.5 – 27.3	
BFM (Kg)	10.82 ± 3.9	8.69 ± 4.4	8.90 ± 3.1	F=2.97 p=0.055
Min-max	2.7 – 17.8	1.8 – 20.7	3.5 – 15.6	
BF %	13.76 ± 4.1	11.69 ± 4.9	11.96 ± 3.3	F=2.27 p=0.108
Min-max	3.2 – 19.7	3 – 21.5	4.8 – 18.8	
WHR	0.85 ± 0.05	0.83 ± 0.04	0.83 ± 0.05	F=1.79 p=0.172
Min-max	0.77 – 0.99	0.73 – 0.94	0.75 – 0.94	
OD %	108.19 ± 10.6	105.36 ± 12.8	106.96 ± 9.1	F= 2.29 p=0.585
Min-max	88 – 129	85 – 136	88-124	
BMR	1817.04 ± 183.1	1754.15 ± 172.3	1766.19 ± 174.9	F=0.54 p=0.453
Min-max	1470 – 2209	1380 – 2203	1461 – 2153	

BMI – body mass index, BF % - body fat percent; WHR – waist to hip ratio; BMR – basal metabolic rate

DISCUSSION

In this study body composition in athletes from three different combat sports, boxing, kickboxing and wrestling was analyzed. A comparison of the numerous components of body composition obtained by the bioelectrical impedance method showed that there was no statistically significant difference in the parameters of the lean body mass (TBW, SLM, FFM, SMM, proteins, and minerals). The obesity diagnosed parameters (BMI, body fat, degree of obesity, waist-to-hip ratio), were within normal values and there was no statistically significant difference for these parameters between boxers, kickboxers and wrestlers. In terms of segmental body analysis, which shows how muscle mass and fat tissue are distributed on the right and left sides of the body and torso, athletes from the three combat disciplines showed a symmetrical build.

A comparison of body height between members of different martial arts disciplines showed that boxers were the tallest (180.7 ± 7.3 cm), and kickboxers and wrestlers had similar heights (177.2 ± 7.0 cm vs. 176.4 ± 6.7 cm). Similar to height, boxers were the heaviest (78.1 ± 11.5 kg), and kickboxers and wrestlers had similar weights (72.7 ± 9.9 kg vs. 73.5 ± 9.7 kg).

Comparison of the lean body mass components

Bioelectrical impedance is a modern method that analyzes the body as a multicomponent system. Body weight is analyzed according to the amount of water in the body, total body water or Total Body Water (TBW), which is divided into two compartments, i.e. intracellular and extracellular fluid. In this study, only total body water was analyzed. TBW is an indirect indicator of the presence of tissues that are rich in water, namely muscle tissue, blood and parenchymal tissue that builds internal organs. TBW expressed in absolute values, in liters is present in similar amounts in the three groups of subjects (boxing = 49.17 ± 6.1 liters; kickboxing = 46.99 ± 5.8 liters; wrestling = 47.51 ± 5.9 liters) without a statistically significant difference, $p = 0.326$. The absence of a difference in water content among boxers, kickboxers, and wrestlers indicates a similar degree of hydration and content of lean body mass.

FFM (fat free mass) and SLM (soft lean mass) were also not significantly different in the three groups of subjects. The average value of the FFM expressed in kilograms was about 3 kg higher in boxers compared to kickboxers and wrestlers (67.03 vs. 64.04 vs. 60.54 kg), but the difference was not statistically significant ($p=0.277$). SLM was the highest in boxers and almost the same in kickboxers and wrestlers but without a significant difference (63.29 kg vs

60.53 kg vs 64.36 kg). The muscle component, i.e. the amount of skeletal muscle mass, was similar in boxers and wrestlers (38.17 kg vs 38.39 kg) and the lowest in kickboxers, 36.62 kg, but without a significant difference, $p=0.471$. If we consider muscle mass as a part of the total body mass, a relative value expressed in percentages, then boxers (48.9 %) and kickboxers (49.7 %) have similar SMM % and wrestlers have the highest SMM % (52.2 %). All four previously mentioned parameters, TBW, FFM, SLM and SMM, show that the respondents from the three martial arts disciplines have well developed skeletal muscles.

In the BIA analysis report, three more components appear that are part of the lean body mass. These are the estimated amount of protein, the total amount of minerals and bone minerals. Proteins as an organic compound are mostly present in the muscles (all types of muscles) but also in all other organs. In our subjects, the amount of protein ranged between 9 and 17 kg, with an average of about 12.33 kg in boxers, 12.79 kg in kickboxers and 12.86 kg in wrestlers. This component did not differ significantly between the three groups of fighters examined.

Bone minerals are an indicator of the presence of the bone component in the subject. In our athletes, who were mainly young people, some of whom were still in the growth phase, the amount of bone minerals ranged from 2.6 kg to 4.8 kg. The mean bone mineral values were highest in boxers (3.7 ± 0.52 kg), and slightly lower in kickboxers (3.5 ± 0.47 kg) and wrestlers (3.6 ± 0.5 kg), without significance in the difference ($p = 0.256$).

Comparison of parameters for the obesity diagnose parameters

The results of the BIA analysis have a section called obesity diagnosed parameters. This section describes BMI (body mass index); BFM (body fat mass); BF % (body fat percent); WHR (waist to hip ratio) and OD (obesity diagnosis) - the degree of obesity expressed in percentages. The body mass index (BMI) in all three groups of subjects was almost identical, 23.82 vs. 23.21 vs. 23.62 (boxers vs. kickboxers vs. wrestlers) without a significant difference, $p=0.542$. Despite the wide and routine use of BMI in the assessment of the level of nutrition, practice has shown certain disadvantages. Two people with the same weight and height can have completely different body composition, but will have the same BMI. Therefore, analysis of more sensitive indicators of obesity such as total body fat and fat percentage is recommended.

Comparison of the average BFM values among our subjects showed that boxers had the largest amount of BFM

(10.82 ± 3.9 kg), while kickboxers and wrestlers had similar absolute values (8.69 ± 4.4 vs. 8.90 ± 3.1 kg). Analysis of variance showed that the significance of the difference between the groups was $p = 0.055$, with a marginal significance of the difference. However, the conclusion is that boxers had a slightly higher amount of body fat than kickboxers and wrestlers. The values of the percentage of body fat (BF %) also showed a small difference in favor of boxers, but without statistical significance. Boxers had an average value of BF % = 13.76 ± 4.1 , kickboxers had BF % = 11.69 ± 4.9 and wrestlers BF % = 11.96 ± 3.3 , with $p = 0.108$. The obtained percentage of body fat was relatively low, i.e. adequate for optimal physical shape in all martial arts groups. The majority of our subjects had normal values for WHR, and only a few subjects had high WHR. This obesity parameter was insignificantly different between three groups (boxing = 0.85 ± 0.05 , kickboxing = 0.83 ± 0.04 and wrestlers = 0.83 ± 0.05 , $p = 0.172$). Average BMR values for boxers were 1817.04 ± 183 kcal, for kickboxers 1754 ± 172 kcal and for wrestlers 1766 ± 175 kcal, analysis of variance showed that the difference was insignificant. Basal metabolic rate depends on body mass, body composition, sex, age and hormonal status. In our subjects, larger individuals had a higher metabolic expenditure in rest, but the intergroup difference did not show statistical significance ($p = 0.336$).

Athletes and coaches are well aware that muscle mass and body fat are significantly related with sports performance (Lukaski *et al.*, 2017). Skeletal muscle mass represents functional mass which contributes for creation of strength and powerful muscular activities which are important for improve sports performance (Bosch *et al.*, 2014). BFM (Body Fat Mass) is considered as nonfunctional body component, and increased volume of BFM could mechanically and metabolically hinder sports performance and also negatively affect thermoregulation (Boileau & Horswill, 2000). High body fat content is associated with low power-to-weight ratios in athletes, reduced acceleration, and increased energy expenditure (Svantesson *et al.*, 2008). Although excess fat mass can have a negative impact on athletic performance (Malina, 2007), lower fat mass may be associated with several health complications (Ackerman *et al.*, 2019). Muscle mass and distribution are also known to play a central role in determining athletic performance, particularly in sports involving speed, strength, and power (Muracki *et al.*, 2025).

According to Meetei & Singh (2017), the average range of body fat (BFA) for male amateur boxers ranges from 9 to 16 % and from 14 to 26 % for female amateur boxers. Research suggests that low body fat percentage is a prerequisite for better performance in boxers, similar to other combat sports (James *et al.*, 2016). Senior boxers have

been found to have higher total body mass, higher lean body mass, and higher fat mass compared to younger athletes. This difference may be due to differences in training regimens. Wrestlers are very often exposed to strict restrictive diet regimens and additional weight loss methods (sauna, sweating, etc.) to meet weight criteria. Professional and amateur wrestling associations strictly monitor the health of athletes with special attention to rapid weight loss and very low levels of body fat (Demirkan *et al.*, 2012). Body fat percentage is a key predictor of athletic success in wrestlers, especially maintaining a low body fat percentage (BF %) throughout the season (Mirzaei *et al.*, 2009). It is essential to carefully monitor the body composition of wrestlers from the beginning of the preparation period until the competition and to prevent rapid weight loss strategies and maintain ideal body composition throughout the training period. Therefore, body fat percentage is also widely used to predict the minimum body mass in wrestlers (Devrim-Lanpir *et al.*, 2021). The assessment of BF % is considered crucial, especially by coaches and wrestlers throughout the season.

The percentage of body fat in male amateur kickboxers is similar to that previously observed in boxing (ranging from 9 to 16 %) for male boxers of different training levels and/or weight classes (Ljubisavljevic *et al.*, 2015) and mixed martial arts (MMA) athletes (ranging from 7 to 17 % in male amateur MMA fighters) (Catikkas *et al.*, 2013). Ruzbarsky *et al.* (2022) found that kickboxers with high competitive success tended to have low body fat, with sub-elite kickboxers having around 12 % body fat and elite kickboxers having around 8-9 % body fat. The average range of body fat percentages varied from 8.1 to 12.6 % for male national and elite kickboxers and from 9 to 16 % for male amateur kickboxers (Ruzbarsky *et al.*, 2022).

It is known that both body weight and muscle mass are greater in the heavier weight categories where greater success is achieved. In a study examining the body composition of Olympic-level boxers and wrestlers, it was found that the average percentage of body fat in the athletes was statistically similar. It was shown that wrestlers have a higher average body weight and muscle mass than boxers. Greater muscle mass in combat sports athletes has shown a strong positive correlation with the degree of muscular strength of certain muscle groups (Milosevic *et al.*, 2024). The comparative analysis on the physical development and body composition in kickboxers with different training experience confirm certain differences. The more experienced fighters had better anthropometric indicators (for example the index on shoulders, greater limb length, stronger punch, better technical abilities, etc.). The increase on the surface on the body and the relative surface on the

body it reflects the bigger one adaptive potential on more experienced fighters (Podrigalo *et al.*, 2023).

CONCLUSIONS

A comparison of lean body mass parameters between boxers, kickboxers, and wrestlers showed that there was no significant difference for any of the lean body mass components (total body water, fat-free mass, lean body mass, lean muscle mass, proteins and bone mass). Fighters from all three martial arts groups showed well-developed muscle mass and other parts of lean body mass.

Comparison of obesity parameters between boxers, kickboxers and wrestlers has also shown that there was no significant difference for these parameters. The absolute values of the obesity diagnostic parameters were higher in boxers, but only for body fat mass showed marginal statistical significance. The overall conclusion is that the boxers, kickboxers and wrestlers had optimal body composition values for a sports population.

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RESUMEN: En boxeo, kickboxing, lucha libre y otros deportes de combate, la composición corporal óptima es de gran importancia para los atletas. Los deportes de combate son sensibles al peso, y el monitoreo y control de la masa corporal, así como la optimización de sus componentes, están directamente relacionados con el rendimiento deportivo. El objetivo del estudio fue determinar y comparar los componentes de la masa corporal magra y los parámetros de obesidad en atletas que practican diversas artes marciales mediante análisis de impedancia bioeléctrica. En este estudio se incluyeron 100 atletas de deportes de combate, divididos en 3 grupos: boxeadores (n=30), kickboxers (n=30) y luchadores (n=40). Se utilizó el método de impedancia bioeléctrica para el análisis de la composición corporal (BIA InBody 720, Biospace Co. Ltd., Seúl, Corea). Analizamos los componentes de la masa corporal magra: agua corporal total (ACT), masa libre de grasa (MLG), masa magra blanda (MMB), masa muscular esquelética (MME), proteínas y minerales. Los parámetros de diagnóstico de obesidad fueron: masa grasa corporal (MGC), porcentaje de grasa corporal (%GC), índice de masa corporal (IMC), grado de obesidad y relación cintura-cadera (RCC). El valor promedio de MMB fue de $63,29 \pm 7,9$ kg, $60,53 \pm 7,6$ kg y $60,54 \pm 7,7$ kg, respectivamente para boxeadores (B), kickboxers (KB) y luchadores (W). La masa muscular esquelética fue similar entre los tres grupos ($p=0,471$); $B = 38,17 \pm 5,1$ kg, $KB = 36,62 \pm 4,9$ kg y $W = 38,39 \pm 9,0$ kg. Los boxeadores tenían una masa grasa corporal (BFM) ligeramente superior a la de los kickboxers y luchadores ($10,82 \pm 3,9$ kg, $8,69 \pm 4,4$ kg y $8,90 \pm 3,1$ kg, $p=0,055$). El BF % en el grupo de boxeadores ($13,76 \pm 4,1$ %) fue ligeramente superior al BF % en

los kickboxers y luchadores ($11,69 \pm 4,9$ % y $11,96 \pm 3,3$ %, $p=0,108$). Los luchadores de las tres artes marciales mostraron una masa muscular bien desarrollada sin diferencias significativas en los componentes de la masa corporal magra. Los parámetros de diagnóstico de obesidad fueron bajos en boxeadores, kickboxers y luchadores, sin diferencias entre los grupos.

PALABRAS CLAVE: Boxeadores; Kickboxers; Luchadores; Composición corporal; Masa muscular; Grasa corporal.

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