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Relationship Between Body Composition and Sports Performances of Wushu Sanda Players

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Abstract:
Background*: Wushu is a Martial Art which majorly has two styles namely Taolu (choreographed movements) and Sanda (sparring). Sanda performances are highly demanded and incorporated into the body composition of martial art players. The Sanda event is played according to the body weight category of the players. Therefore, the players' body composition does a crucial role in Sanda performance. This study aimed to identify the relationship between body composition and Wushu Sanda performance of national-level players of Sri Lanka.*
Materials and Methods*: A total of 41 elite male Wushu Sanda players registered for the Sri Lanka National Wushu Championship 2022 weight category between 56kg to 80kgparticipated in the study. Demographic data of age, body height, body weight, BMI, highest achievement level and training age were collected. Seven skinfold segments of the triceps, subscapular, biceps, supraspinal, abdominal, front thigh, and medial calf were measured by the Harpenden Skinfold Caliper. Four major body segments of total body, arm, trunk and legs composition were measured by the Body Composition Monitor HBF-362. Sports performances were recorded according to their sports achievement levels and awarded scores in descending order from the international level to the domestic level. The Kolmogorov-Smirnov test was used to test the data normality and the relationship between body composition and performances was tested by the Pearson correlation test using Statistical Package for the Social Sciences version 22 (SPSS) software.*
Results*: The study sample mean age was (31.46 years ± 3.53) and the training age was (8.43 years ±2.75). The results have shown, that abdominal skinfolds have a significant low-negative correlation (r=-0.448, p=0.003) with sports performances while the other six body skinfold thicknesses were not statistically significant (p>0.05). Further, analysis of the body segment compositions showed their total body fat mass percentage is significantly moderate-negatively correlated (r=-0.682, p=0.001) while arm muscle mass percentage is a significantly high-positive correlation (r=0.808, p=0.003) with sports performances.*
Conclusion: *The study can be concluded that Wushu Sanda players have a higher percentage of fat deposition in the body and it adversely affects their sports performances. Further, athletes with a minimum level of abdominal skinfolds and total body fat percentage, and athletes with higher arm muscle mass percentage have attained higher sports achievements. Henceforth, to achieve a higher level of sports Wushu Sanda players should lower their fat depositions in the body and increase muscle mass in their arms.*
Keywords: *Anthropometrics, Body composition; Sanda; Skinfolds; Sports performance, Wushu.*

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I. Introduction

Wushu was earlier recognized as Kung Fu. Wushu sport has two main modes of competing displaying events (Taolu) and fighting events (Sanda). Taolu is consist of the major events of the Chanquan, Nanquan, Taichi and weapon events. The latter discipline is also identified as the Sanda and is the fighting activity of the Wushu sport. It is the form of Chinees Boxing based on the modern combat fighting technique and is a confrontational sport[1]. It relies on the higher performances because of their certain characteristics and economic efficiency of the movements[2]. This study mainly attributed to the Sanda and is the fighting event of the Wushu sport and their intention to directly strike the opponent with a variety of attacking and defensive techniques with tactile experiences[1-3]. Sanda consists of the combination of contact of arms strikes, leg strikes, wrestling and throws techniques for winning in the bout[3]. These skills recruiting is based on the fixed rules and regulations on the competition platform. Sanda is based on winning the matches consisting of 2 minutes long 3 rounds with 1-minute breaks between the rounds[4]. Wushu Sanda is well-reputed worldwide due to its high competitiveness[5]. Therefore accurate talent identification due to the high demands of their competitiveness in Sanda events is essential[6].

Therefore, Sanda athletes' performance objectify highly maximized strategically and also uses great body composition for better performances.

Each sport has its unique performance and specific skill requirements. To achieve higher performance, athletes should have specific body composition advancement according to their sports discipline, and it offers additional support for achieving higher performances in particular sports[6-7]. For the Sanda competitions, bodyweight classifications are used to classify the events and there are 8 weight categories for men[8]. Due to the weight category-based event, body composition was recruited in the competition in a different manner[9]. It is also beneficial to identify the body figure of the athlete permits us to recognize changes in performance points. It also facilitates achieving the performance of top-level and screening of the performance of different practices[10]. Anthropometric measurements are the science that deals with the characteristics of body dimensions. They are the characteristics of physique associated with success in sports and other forms of physical performance[11]. The study mainly focused on skinfold thickness and body composition. Anthropometric measurements are one of the talent identification in the future sports performance of young athletes[12,13]. However, because the maturation stage can impact anthropometric parameters and physical performance it is observed in adult elite athletes should not be transferred to athletes who are in the process of maturing[14].

Further, studies show monitoring human body compositions have played important role in the athlete's performances and training regime. There shows tissue composition of the body significantly performances in aesthetic, weight class and gravitational sports[15]. Body composition refers to the whole mass of a person's body. It is the proportions of water, protein, fat and mineral components in the body which varied according to the body density, and obesity level[16]. To determine body composition, different approaches and methodologies were utilized, including fat mass (FM), fat-free mass (FFM), total body water (TBW), fat-free dry mass (FFDM), and bone mineral density (BMD)[17]. Additionally, it is established that body composition and sports performances have e relationship and it's changed according to the energy requirements of the sports event[18–20]. To perform at their best, athletes should have great body composition and body mass ratios[21]. As a result, determining an athlete's body composition and then assigning suitable competition weight to them is a critical element of the whole strategy implementation[22].

II. Material And Methods

Study Design: The study was conducted under an observational study design.
Study Location: The study was conducted in several Wushu training centers in Sri Lanka.
Study Duration: November 2021 to April 2022.
Population size: 48 National level Wushu athletes.
Sample size calculation: Total Population sample was used and 7 athletes were excluded.
Subjects & selection method: The study included the sample who registered for the National Wushu Championships 2022Sanda male events weight category from 52kg to 70kg.

Inclusion criteria:
1. Athletes who have more than 5 years of Wushu sports experience.

Exclusion criteria:
1. Athletes who were prevailing from an injury or illness when the data is being collected.
2. Athletes were quarantined due to Covid-19

Procedure methodology

The participants were informed about the study and signed written consent was received. A detailed sheet was used to record the observation of skinfolds, body compositions and sports performance. The detailed sheet included demographic data (age, body height, body weight, BMI, highest achievement level and training age), data of skinfold thickness, body composition (%), and Sports performance level were obtained. The athletes were informed to prevent participating in any exercise before the observation was initiated. The tests were performed in the early morning before breakfast. To ensure accuracy same investigator visited and the data were collected in the mornings of other days as well in the different training centres. The data collecting time ensured the athlete was well hydrated and normal diet and did not take coffee, tea and water before the measurements were taken.

Major seven skinfolds of triceps, subscapular, biceps, supraspinal, abdominal, front thigh, and medial calf by the Harpenden Calliper were measured. Before skin folds observations, all skinfold landmarks were marked with a marker pen to reduce placement errors and confusion. Standardized Anthropometric Professionals' Assessment Guidelines were followed according to the International Anthropometry Accreditation Scheme

(IAAS) by the International Society for the Advancement of Kinanthropometry (ISAK)[27]. Body composition was analyzed through the Bio-electrical Impedance Analysis equipment of the "Body Composition Monitor with Scale HBF-362 (HBF-362-AP)" of the total body and segment of the body. It measured the body composition variables of total body fat percentage (FM %), muscle mass (MM %), basal metabolic rate (BMR) and body mass index (BMI). Sports performances were measured according to the ranking system of the selection criteria. Marks were allotted according to the ranking systems of the competitions with given marks for their personal achieved levels. Athletes were categorized according to their highest achievement levels. Then awarded points to achievements in the last 5 years.

The highest marks were given to the athletes who Gold medal in the World Championship 20, Silver 19, Bronze 18, for participation 17, Asian level Gold 1, Silver 15, bronze 14, for participation 13, South Asian level Gold 12, Silver 11, Bronze 10, for participation 9, National level Gold 8, Silver 7, Bronze 6, for participation 5, finally province Gold 4, Silver 3, Bronze 2 and for participation 1. According to that points were awarded. The lowest marks were given to the provincial tournament participation.

Statistical analysis

Data were analyzed by appropriate statistical tests with a 95% of confidence level by using the IBM Statical Package for Social Sciences software version 22. The Kolmogorov-Smirnov test (n>30) was used to verify the normality of the data distribution. The distribution of selected skinfold segments, body composition and sports performance parameters were analyzed and interpreted by descriptive statistics with graphs and charts. The Pearson correlation test was used to identify the relationship between Sanda's performances with selected skinfold segments and body compositions.

III. Results

Table no 1 shows descriptive data of the sample. The sample's mean age was 31.46 years ±3.53, and the mean training age of 8.43 years ±2.75, with a mean height of 173.98 cm±5.12 and mean weight of 69.97 kg ±8.46. The sample's mean performance level score was 8.34±4.05. Figure 1 shows athletes' sports achievement levels. Three players (n=3) had participated in World Championships in the last five years and only five players are yet to win a national-level medal in the Wushu Sanda of the sample.

Table 1: Descriptive statistics demographic data of the sample

Parameter	Mean	SD (±)	Minimum	Maximum
Age (years)	31.46	3.53	21.00	38.00
Training age (years)	8.43	2.75	5.00	16.00
Body height (cm)	173.98	5.12	162.60	188.80
Body weight (kg)	69.97	8.46	57.10	88.70
BMI	23.45	2.84	19.9	33.7
Performance level	8.34	4.05	2.00	18.00

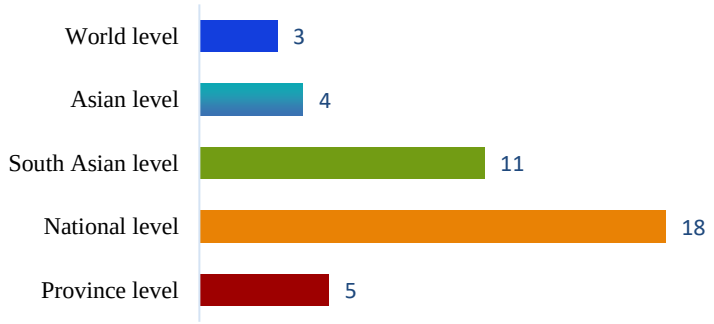

Figure 1: Distribution of the sports achievement level of the sample

The summary statistics of skinfold segments, body composition and sports performance correlations are shown in table no 2 and 3. Seven skinfold sites and eight body partials were measured. The results show abdominal skinfold site is significantly correlated with the Sanda sports performances (p=0.003). The abdominal skinfold shows a low-negative correlation (r=-0.448, p=0.003) with Sanda sports performances. It indicates a higher level of abdominal skinfolds prevents athletes from achieving higher sports performances. The lowest abdominal skinfold was 1 cm and the highest is shown by 25cm. Further, the total body fat mass percentage was moderately

negatively correlated with sports performances (r=-0.682, p=0.001) and arm muscle mass percentage was high-positively correlated (r=0.808, p=0.003) with the Sanda performances. It is evident that the total body fat mass percentage is reduced and arm muscle increments have supported the sports performances. Further, the correlation of the abdominal skinfold, total body fat percentage and arm muscle mass are shown in Figures 2, 3 and 4 respectively.

Table 2: Descriptive data and relationship between skinfolds and performances for the male national Wushu athletes

	Minimum (cm)	Maximum (cm)	Mean±SD	ST. Error	P value	r
Triceps	4.2	13.2	7.42±2.53	0.3953	0.908	0.019
Subscapular	5.40	19.8	10.03±3.46	0.5410	0.657	0.71
Biceps	2.2	6.2	3.91±0.94	0.1477	0.376	0.142
Supraspinal	2.2	19.8	8.13±4.27	0.6682	0.709	-0.060
Abdominal	1.0	25.0	10.86±6.92	1.3944	0.003	-0.448**
Front thigh	3.8	18.0	7.87±3.07	0.4806	0.925	-0.015
Medial calf	2.2	8.2	4.89±1.45	0.2272	0.550	-0.096

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3: Descriptive data and relationship between body compositions and performances for the male national Wushu athletes

	Minimum (cm)	Maximum (cm)	Mean±SD	ST. Error	P value	r
Total Body Fat Mass %	5.8	19.9	13.36±3.83	0.5983	0.001	-0.682**
Total Body Muscle Mass %	31.4	39.9	34.84±2.00	0.3134	0.676	0.067
Trunk Fat Mass %	5.2	17.2	10.39±3.10	0.4845	0.955	0.009
Trunk Muscle Mass %	15.1	36.9	29.16±3.89	0.6080	0.239	0.188
Legs Fat Mass %	8.9	52.9	17.69±8.81	1.3762	0.249	-0.184
Legs Muscle Mass %	50.6	58.8	48.44±11.24	1.7566	0.192	0.208
Arm Fat Mass %	10.0	24.4	16.81±3.75	0.5866	0.764	-0.048
Arm Muscle Mass %	28.8	59.9	39.28±9.26	1.4472	0.003	0.808**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

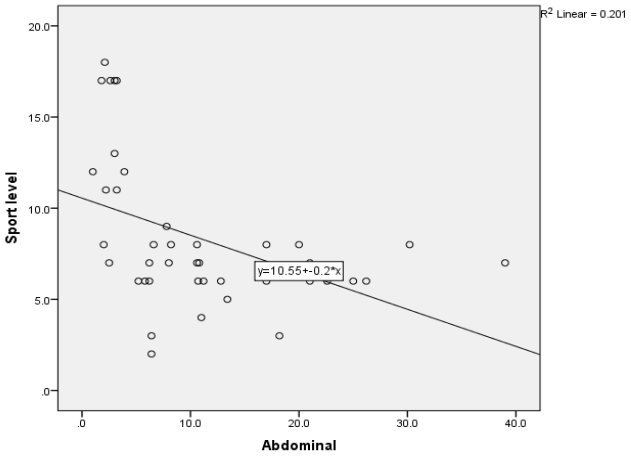

Figure 2: Correlation between the abdominal skinfold and Sandaperformances

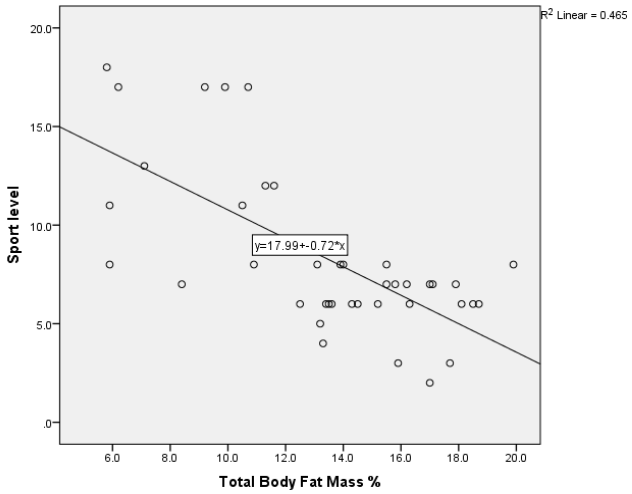

Figure 3: Correlation between total body fat percentage and Sandaperformances

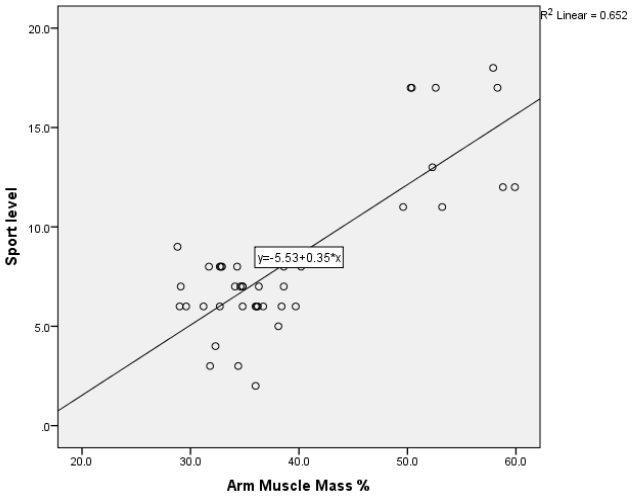

Figure 4: Correlation between the arm muscle mass and Sanda performance

IV. Discussion

The present study aimed to identify the elite Sanda players' body compositions and their relationship to sports performances. The studies have identified the determinant body composition factors that enhance the athlete's performance according to the sport. Some of the factors that influence success are the relationships between various body composition parameters and body proportions[28]. There is little extensive research on combat sports given the importance of body composition in weight category sports. The study of Kushkestani et al. found that mixed martial art athletes have shown a good body composition with their higher sportsperformance[29].

It is studied that less than 10% fat percentage bearing athletes had a great opportunity to perform well to win in several sports[30]. Thus, in the present study sample, all body segments' fat distribution percentages show higher than 10%. It was a disadvantage for Wushu Sanda athletes' performances. Total body fat percentage shows the lowest fat percentage and it is revealed that the total body fat percentage decrement assistive to the sports performance increments. Sanchooli et al., the study was done with Iranian Wushu team athletes who are placing in the higher world ranking, they found that their national team athletes also have low body fat and their power is higher related to the body fat percentage[6]. Another study has been done with 31 Judo players' body composition and the performance shows that there also has a negative correlation between body fat and sports performances[31].

A study compared athletes and non-athletes found that athletes' body muscle mass was higher than non-athletes. Further, athletes had a good body composition according to their height[20]. The Sanda also required good body composition and energy balance for the performances. It was evident that there is a positive correlation between low fat-free mass and higher muscle mass. Further, a study found a positive correlation to the power support in the sports of sprints, hockey, cycling, and volleyball[32–35]. The weight bearing sports like combat sports, an athlete had a low body fat, higher aerobic capacity, and high anaerobic capacity required to power application

during the bouts[9]. In the weight dominant sports obtain an advantage over the opponent, athletes normally attempt on improving muscle mass and decrease adiposity fat in each weight category to increase their performances[36]. The present study found no total body muscle mass percentage related to sports performance. However, a study by Christine et al. mentioned a relationship between the combat fitness test and performance. As a result, the study suggests enhancing arm muscle mass could be considered in association with other characteristics in the selection of successful athletes[37].

The study did not reveal any correlation between lower body fat mass percentage or muscle mass percentage in sports, but the study of Marinho et al., also imposed that there is a positive correlation between muscle mass and lower limb explosive power of the mixed martial art athletes[38] and also body fat percentage negatively affect the power applied activities[31-39]. According to the somatotypes, combat sports athletes generally show monomorphic properties of high muscularity and low fat[40]. The study of combat athletes and physical fitness found a negative relationship between body fat percentage and performance in several categories of athletes. It is also stated that a loss in fat percentage is linked to an increase in aerobic capacity[41]. Formally it has been revealed that athlete who is involved in combat sports have a higher anaerobic capacity, strength and low body fat[42]. Body composition is also affected bio motor ability performances such as strength, ability, speed, endurance and power[43]. It is a fact that excess fat reduces physical performance in athletes. This mass works as a dead mass in physical activities. These decrease performances as well as increase energy demand[44]. It is a therapeutic weight in most sports, but it is wanted in others[45].

Athletes' body composition could influence the winning strategies used during a match. Maintaining an athlete's ideal body weight requires maintaining an appropriate body mass and body composition[46]. Measuring errors can lead not to implementing suitable training prescription and diet design, affecting athletic performance[47]. The sample of the present study should be fast, explosive, and powerful, with increased muscle mass and less fat tissue for competing in events[48]. However, every sport has its own set of uniqueness and each athlete should have body composition data suited to the individual sport[49]. It's also essential to look at the anthropometrical qualities and body composition numbers of other sports since good body composition and body mass figures contribute to optimal workout routines and performance[51].

V. Conclusion

In the confines of the study, Wushu Sanda is a conferential sports event and is based on arm strikes, leg strikes wrestling and throwing skills. Due to a weight-bearing sports event, body composition is doing a great role. So, to identify the relationship between body composition and sports performances, the study was done with 41 national-level elite male athletes who were registered national championship in 2022. The study revealed that national-level Wushu athletes have shown a higher fat percentage according to other studies. That is a huge disadvantage for performance recruitment while the competition. Thus, athletes have to bear unnecessary body fat mass during competitions. The study also showed total body fat reduction allowed to achieve higher performances according to the sample. Averagely national-level athletes showed a higher deposition fat percentage in the study. Measured major seven skinfold sites of the athletes' bodies and they showed athletes with less abdominal skinfold thickness had a higher achievement opportunity. Humans' center of gravitation is located in the core area doing great work while playing sports. Ensuring that fact, national-level athletes have shown performance incensement with reduces abdominal skinfold thickness. Additionally, it also showed Sanda athletes with higher arm muscle mass have obtained higher performances while over the others. Perfect motor control and aerobic performance rely on body composition. Wushu Sanda is high skill-based sport and this component is very useful. It is advisable to implement a special dietary schedule to increase muscle mass and maintain precise fat percentage and it will be an advantage for leads to higher achievement for the nation. Nevertheless, coaches should monitor athletes' training regimes and nutritional intake without undergoing malnutrition state and achieve the highest achievement in the future.

References

[1]. Ma, X., Sun, W., Lu, A., Ma, P. & Jiang, C. The improvement of suspension training for trunk muscle power in Sanda athletes. *J. Exerc. Sci. Fit.***15**, 81–88 (2017).
[2]. Jin, X. & Gao, Q. Women's excellent sanda athletes' strength characteristics research. **01044**, 01044 (2017).
[3]. Judkins, B. Inventing Kung Fu. *JOMEC J.***0**, (2014).
[4]. He, X. Research on Sanda Athletes' Physical Training Methods. 587–590 (2018) doi:10.25236/issec.2018.139.
[5]. Guo, Q. Inheritance and dissemination of Chinese Wushu from the perspective of cultural geography. *IOP Conf. Ser. Earth Environ. Sci.***714**, (2021).
[6]. Sanchooli, Z., Ghoochan, F. A., Ghoochan, Z. A. & Aalaee, S. Determining Physiological Profile of National Iranian Wushu Team. *Bull. Environ. Pharmacol. Life Sci.***3**, 69–72 (2014).
[7]. Slimani, M., Miarka, B. & Chéour, F. Effects of competitive level and gender on anthropometric profile and physiological attributes in kickboxers. *Coll. Antropol.***41**, 267–274 (2017).
[8]. International Wushu Federation. Wushu Sanda Competition Rules & Judging Method. *Int. Wushu Fed.* 46 (2017).

[9]. Franchini, E., Del Vecchio, F. B., Matsushigue, K. A. & Artioli, G. G. Physiological profiles of elite judo athletes. *Sport. Med.***41**, 147–166 (2011).
[10]. Báez, E. *et al.* Anthropometric Characteristics of Top-Class Brazilian Jiu Jitsu Athletes: Role of Fighting Style Características Antropométricas en Atletas de Jiu Jitsu Brasilero de Alto Nivel: Rol del Estilo de Lucha. *Int. J. Morphol***32**, 1043–1050 (2014).
[11]. Adhikari, A. Anthropometric Characteristic, Somatotype and Body Composition of Canadian Female Rowers. *Am. J. Sport. Sci.***3**, 61 (2015).
[12]. Johnston, K., Wattie, N., Schorer, J. & Baker, J. Talent Identification in Sport: A Systematic Review. *Sport. Med.***48**, 97–109 (2018).
[13]. Sánchez-Muñoz, C. *et al.* Anthropometric and physical fitness profiles of world-class male padel players. *Int. J. Environ. Res. Public Health***17**, 1–13 (2020).
[14]. Fernandes, R. A., López-Plaza, D., Correas-Gómez, L., Gomes, B. B. & Alacid, F. The importance of biological maturation and years of practice in kayaking performance. *Int. J. Environ. Res. Public Health***18**, 10–21 (2021).
[15]. Timothy R. Ackland, Timothy G. Lohman, Jorunn Sundgot-Borgen, Ronald J. Maughan, Nanna L. Meyer, Arthur D. Stewart, W. M. *Body Composition Assessment in Women*. *Sports Medicine* vol. 17 (2012).
[16]. 'Medical Dictionary for the Health Professions and Nursing'. Medical Dictionary for the Health Professions and Nursing. *Med. Dict.* 67 (2012).
[17]. Malina, R. M. & Geithner, C. A. Body Composition of Young Athletes. *Am. J. Lifestyle Med.***5**, 262–278 (2011).
[18]. Sanders, R. T. *et al.* Assessing The Impact Of Body Fat Percentage And Lean Mass On Wingate Performance. *Med. Sci. Sport. Exerc.***50**, 158 (2018).
[19]. Maciejczyk, M. *et al.* The influence of increased body fat or lean body mass on aerobic performance. *PLoS One***9**, 0–5 (2014).
[20]. Radu, L.-E., Popovici, I.-M. & Puni, A.-R. Comparison of Anthropometric Characteristics Between Athletes and Non-athletes. *Procedia - Soc. Behav. Sci.***191**, 495–499 (2015).
[21]. Shariat, A., Shaw, B. S., Kargarfard, M., Shaw, I. & Lam, E. T. C. Kinanthropometric Attributes of Elite Male Judo, Karate and Taekwondo Athletes. *Rev. Bras. Med. do Esporte***23**, 260–263 (2017).
[22]. Gardasevic, J., Bjelica, D., Vasiljevic, I. & Masanovic, B. Differences in body composition between young soccer players (U19) members of the best soccer clubs in Serbia, Bosnia and Herzegovina, and North Macedonia. *Pedagog. Phys. Cult. Sport.***24**, 175–180 (2020).
[23]. Bayzid, B. Relationship between Anthropometric Characteristics and VO2 Max among Young Male Taekwondo Players Residing in BKSP, Dhaka. *Sport. Inj. Med.***3**, (2019).
[24]. Shete, A. N., Bute, S. S. & Deshmukh, P. R. A study of VO2 max and body fat percentage in female athletes. *J. Clin. Diagnostic Res.***8**, BC01–BC03 (2014).
[25]. Triki, M. *et al.* Comparative study of body composition and anaerobic performance between football and judo groups. *Sci. Sport.***27**, 293–299 (2012).
[26]. Hayes, L. D. & Morse, C. I. The effects of progressive dehydration on strength and power: Is there a dose response? *Eur. J. Appl. Physiol.***108**, 701–707 (2010).
[27]. da Silva, V. S. & Vieira, M. F. S. International society for the advancement of kinanthropometry (Isak) global: International accreditation scheme of the competent anthropometrist. *Rev. Bras. Cineantropometria e Desempenho Hum.***22**, 1–6 (2020).
[28]. Bilgin, U. *et al.* Relation Between Fat Distribution and Pulmonary Function in Triathletes. *Ovidius Univ. Ann. Ser. Phys. Educ. Sport. Mov. Heal.***10**, 429–432 (2010).
[29]. Kushkestani, M., Ebrahimpour, S., Parvani, M. & Rezaei, S. Evaluation of the Relationship between Explosive Power and Anthropometric and Body Composition Indices in Female Volleyball Players Evaluation of the Relationship between Explosive Power and Anthropometric and Body Composition Indices in Female Volleyball. **1**, 157–168 (2019).
[30]. Carlton, A. & Orr, R. M. The effects of fluid loss on physical performance: A critical review. *J. Sport Heal. Sci.***4**, 357–363 (2015).
[31]. Katralli, J. & Goudar, S. S. Anthropometric profile and special judo fitness levels of Indian judo players. *Asian J. Sports Med.***3**, 113–118 (2012).
[32]. Radu, L.-E., Făgăraş, S.-P. & Graur, C. Lower Limb Power in Young Volleyball Players. *Procedia - Soc. Behav. Sci.***191**, 1501–1505 (2015).
[33]. Chiarlitti, N. A., Delisle-Houde, P., Reid, R. E. R., Kennedy, C. & Andersen, R. E. Importance of body composition in the national hockey league combine physiological assessments. *J. Strength Cond. Res.***32**, 3135–3142 (2018).
[34]. Jeffrey A., P., DEAN L., S., MAIER, M. L. & FOSTER, T. S. Nuevas aportaciones en psicología del deporte. Una mirada crìtica sobre la ùltima dècada de nuesta disciplina. *J. ofStrength Cond. Res.***24**, 1755–1762 (2010).
[35]. Barbieri, D. *et al.* Body composition and size in sprint athletes. *J. Sports Med. Phys. Fitness***57**, 1142–1146 (2017).
[36]. Brito, C. J. *et al.* Methods of Body-Mass Reduction by Combat Sport Athletes. *Int. J. Sport Nutr. Exerc. Metab.***22**, 89–97 (2012).
[37]. Casals, C. *et al.* Special judo fitness test level and anthropometric profile of elite Spanish Judo athletes. *J. Strength Cond. Res.***31**, 1229–1235 (2017).
[38]. Marinho, B. F., Follmer, B., Del Conti Esteves, J. V. & Andreato, L. V. Body composition, somatotype, and physical fitness of mixed martial arts athletes. *Sport Sci. Health***12**, 157–165 (2016).
[39]. Abidin, N. Z. & Adam, M. B. Prediction of vertical jump height from anthropometric factors in male and female martial arts athletes. *Malaysian J. Med. Sci.***20**, 39–45 (2013).
[40]. Pavlovi, R., Simeonov, A. & Petkovi, E. Analysis of the Elite Athletes ' Somatotypes. *Acta Kinesiol.***8620**, 47–53 (2015).
[41]. Dalui, R. & Bandyopadhyay, A. Physical fitness of male eastern Indian judo players. *Indian J. Physiol. Pharmacol.***62**, 66–73 (2018).
[42]. GÖRAL, K. the Examination of the Relationship Between Maximum Aerobic Power, Forced Vital Capacity and Body Composition in Soccer Players. / FutbolculardaMaksimalAerobik Güç,ZorluVitalKapasite VeVücutkompozisİlişkisiniİncelenmesi. *J. Phys. Educ. Sport. Sci. / Beden Egit. ve Spor Bilim. Derg.***8**, 173–179 (2014).
[43]. Ramos-Campo, D. J. *et al.* Características antropométricas en función del puesto en jugadores profesionales de equipo: Baloncesto, balonmano y fútbol sala. *Int. J. Morphol.***32**, 1316–1324 (2014).
[44]. Nikolaidis, P. T. & Karydis, N. V. Physique and body composition in soccer players across adolescence. *Asian J. Sports Med.***2**, 75–82 (2011).
[45]. Masanovic, B. Comparative study of morphological characteristics and body composition between different team players from serbian junior national league: Soccer, handball, basketball and volleyball. *Int. J. Morphol.***37**, 612–619 (2019).
[46]. Chaabène, H. *et al.* Amateur Boxing: Physical and Physiological Attributes. *Sport. Med.***45**, 337–352 (2015).
[47]. Rodríguez-Rodríguez, F., López-Fuenzalida, A., Holway, F. & Jorquera Aguilera, C. Anthropometric differences per playing position in chilean professional footballers. *Nutr. Hosp.***36**, 846–853 (2019).
[48]. Lenetsky, S., Harris, N. & Brughelli, M. Assessment and contributors of punching forces in combat sports athletes: Implications for strength and conditioning. *Strength Cond. J.***35**, 1–7 (2013).

[49]. Sitko, S., Sastre, R. C. & Laval, I. L. Effects of a low-carbohydrate diet on performance and body composition in trained cyclists. *Nutr. Hosp.***36**, 1384–1388 (2019).
[50]. Popovic, S., Bjelica, D., Jaksic, D. & Hadzic, R. Comparative study of anthropometric measurement and body composition between elite soccer and volleyball players. *Int. J. Morphol.***32**, 267–274 (2014).
[51]. Masanovic, B., Gardasevic, J. & Bjelica, D. Comparative study of anthropometric measurement and body composition between elite handball and volleyball players from the serbian national league. *Int. J. Morphol.***39**, 287–293 (2021).

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