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Somatotypes and handgrip strength analysis of elite Serbian sambo athletes

Jelena Slankamenac[1] • Tatjana Trivić[1] • Damjan Jakšić[1] • Miodrag Drapšin[1,2] • Nemanja Lakićević[3] • Patrik Drid[1]

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Abstract

The aim of this study was to establish whether there are differences between weight categories in different anthropometric measurements and handgrip strength between elite Serbian male and female sambo athletes divided into weight categories.

A total of 70 elite Serbian sambo athletes participated in the study, who were participants of the World Cadet Sambo Championship held in Novi Sad. Athletes are classified into categories according to gender and official weight categories. Using anthropometry, we calculated somatotypes and hand-grip strength. For statistical analysis, we used a one-way analysis of variance and Tukey's post hoc tests to compare group differences by weight categories.

Somatotype analysis shows that a typical somatotype in male sambo athletes was endomorphic mesomorphs. In female groups, the most common somatotype in the lightest categories was mesomorphic ectomorphs, and in the heaviest categories were endomorphic mesomorphs. Examining the handgrip for both left and right hand, as well as in total, shows that there is a statistically significant difference between the categories. In total, the strength of the handgrip increases progressively in groups. In male categories, the difference exists between the first 4 groups and -78kg, as well as between -42kg and -46kg and the heaviest weight category. Differences between weight categories in female athletes were found between the lightest group and last six groups in total, in favor of the last six.

Anthropometric measurements revealed a statistically significant difference between weight categories. Mesomorphy was the most dominant somatotype in male categories, while female athletes differed concerning weight category. The achieved results can serve as data to compare the somatotype and handgrip strength of elite sambo athletes on a national and international level. These findings suggest that the handgrip strength and somatotypes are the keys to success in relation to the weight category.

Keywords hand strength • skinfold • somatotypes • body weight • martial arts • combat sports.

✉ patrikdrid@gmail.com

[1] University of Novi Sad, Faculty of Sport and Physical Education, Novi Sad, Serbia

[2] University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia

[3] University of Palermo, Sport and Exercise Sciences Research Unit, Palermo, Italy

Introduction

Sambo is an international martial art (combat sport) that appeared in the USSR in the 1930s (Drid et al., 2018). Sambo wrestling is known as one of the national sports of the Russian Federation in which they had a long history of success. (Serporezyuk et al., 2014.). This type of martial arts is characterized by the performance of various throws, grabs, holds, and painful techniques. Because sambo is a young sport, the training technique of qualified athletes has not yet been fully researched. There are still significant differences in the technique and tactics of wrestlers specializing in sambo and combat sambo (Dadelo et al., 2013). At the same time, Sambo wrestling, as well as various other styles of wrestling such as Jiu-jitsu, Greco-Roman wrestling, women's wrestling, grappling, and freestyle wrestling, is considered as one of the main styles that are recognized as a universal amateur competitive wrestling (Vardar et al., 2007). Weight categories are an essential factor in determining the morphological differentiation of sambo competitors. There are ten weight categories for cadets in sambo competition for each gender. According to the category-specific demands, differences in technique, tactics, physiology, and functional aspects have been studied in similar combat sports (Franchini et al., 2014). Combat sports are divided into weight categories to enable fair competition by matching opponents of equal stature and body mass. Many athletes lose weight to compete in the lightest category, believing that in that way they will gain an advantage over the opponent (Lagan Evans et al., 2011). Elite athletes are always aiming for peak performance throughout the year. Sambo athletes are no different besides maintaining excellent physical shape and technical skills (Osipov et al., 2020).

Anthropometry has long been the only available method of measuring the human body and its proportions. In 1921, the first formulas for predicting body fat based on measurements of body height, width, circumference, and thickness of skinfolds were developed (Matigka, 1921). The main advantages of anthropometry are that it is non-invasive, easily portable, inexpensive, suitable for field research and there is plenty of literature available. It is still the most commonly used method of measurement, and lately, it has been used to assess the distribution of body fat (Goran et al., 1998).

The term handgrip strength is used in clinical and occupational settings and by strength athletes. Handgrip strength refers to muscular strength and force which can be produced by the hands. The strength of a handgrip is a measure of the maximum static force that the subject can produce by squeezing a dynamometer, through the voluntary muscle contraction and flexion of all finger’s joints, and wrists (Shyamal and Yadav, 2009). Factors considered during these activities include the muscle strength necessary to perform the tasks and the fatigue of the muscles responsible for these movements (Blackwell et al., 1999).

The aim of this study was to determine whether there are differences between weight categories in different anthropometric measurements and handgrip strength.

Method

This study consisted of 38 male sambo athletes and 32 female sambo athletes. All testing procedures were conducted during the World Cadet Sambo Championship held in Novi Sad (Serbia). Participants were divided into ten official male (−42, −46, −50, −55, −60, −66, −72, −78, −84, and +84 kg) and female categories (−38, −41, −44, −48, −52, −56, −60, −65, −70, and +70 kg). Written informed consent was obtained from the national team coach as their legal guardian during the championship. Participants were familiarized with all testing procedures used in the present study.

Anthropometrical measurements

Following anthropometric measurements were conducted: height and body mass, four skinfolds (triceps, subscapular, supraspinal, calf), breadths (humerus and femur diameters), girths (arm and calf), breadths (humerus and femur diameters). Body height was determined using a Martin anthropometer (GPM, Switzerland), skinfolds were measured using a John Bull caliper (British Indicator Ltd, UK) accurate to 0.2 mm, girth measurements were acquired with a steel measuring tape, and wrist girth and bicondylar diameters of the femur and humerus were measured using a small spreading caliper (SiberHegner, Switzerland). Somatotypes were determined according to the Carter and Heath method (1990).

Handgrip strength

Maximum handgrip strength for both hands was measured with a portable Takei handgrip dynamometer (Takei Scientific Instrument CO., Tokyo, Japan).

Data are presented as means and standard deviation (±). A one-way analysis of variance and Tukey's post hoc tests were used to compare group differences by weight categories. In cases where Kolomogorov–Smirnov test shows statistically significant differences from a normal curve, deference between occurred weight category and any other categories was calculated with Mann–Whitney U test. Effect size (η2) was calculated as well. The level of significance was set at 5%. All analyses were conducted using SPSS statistics software.

Results

The study involved 38 male and 32 female sambo athletes who participated in the World Cadet Sambo Championships held in Novi Sad, who modified their weight to compete in the appropriate category.

In the male sambo category, the first two weight categories show a statistically significant difference in body height compared to the last six categories. On average, the highest number of participants was in the -84kg category. A significant difference was found in humerus breadth between -46, -50, and -78kg. In femoral breadths, the only difference was observed between the -46kg and -78kg groups. Measuring arm and calf circumference, statistically significant differences are shown by almost all groups with each other. Triceps skinfold did not differ between groups, while supraspinal and subscapular skinfolds differed between the lighter (up to -66kg supraspinal and -60kg subscapular, respectively) and the heaviest categories. A significant difference in the skin folds of the calf exists between -55kg and >84kg (Table 1).

Somatotype analysis of male categories found a difference between the first four categories and the last category in endomorphy. In mesomorphy there is a difference between -46 kg, -50 kg, -60 kg and -78 kg categories and between -50 kg and -66 kg, > 84 kg. Observing ectomorphy, a statistically significant difference exists between the first five categories and the heaviest category, as well as between -50kg and -78kg groups (Figure 1). Examining the handgrip for both left and right hand, as well as in total, there is a statistically significant difference between the categories. In total, the strength of the handgrip increases progressively in groups. Differences in left-hand grip were noted between the first four weight categories and -78kg and above 84kg. The difference was also noticed between the lighter, -46kg group and the last four groups. Similar results were found in the right arm. The difference exists between the first 4 groups and -78kg, as well as between -42kg and -46kg and the heaviest weight category. Most subjects have an endomorphic, mesomorph somatotype.

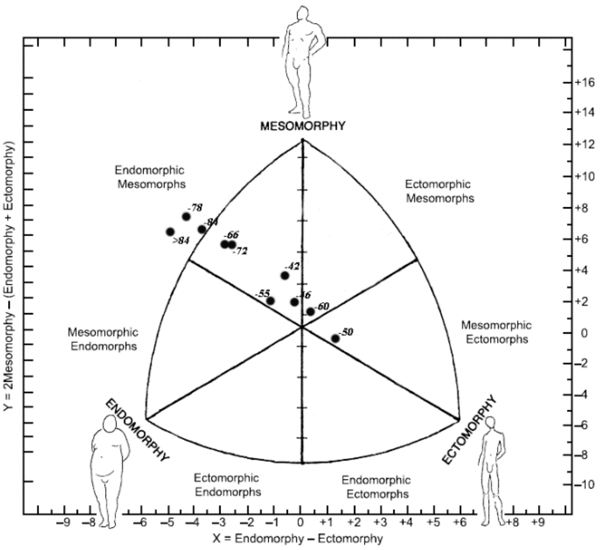

Figure 1. Somatochart of Serbian elite cadet male sambo athletes by weight categories

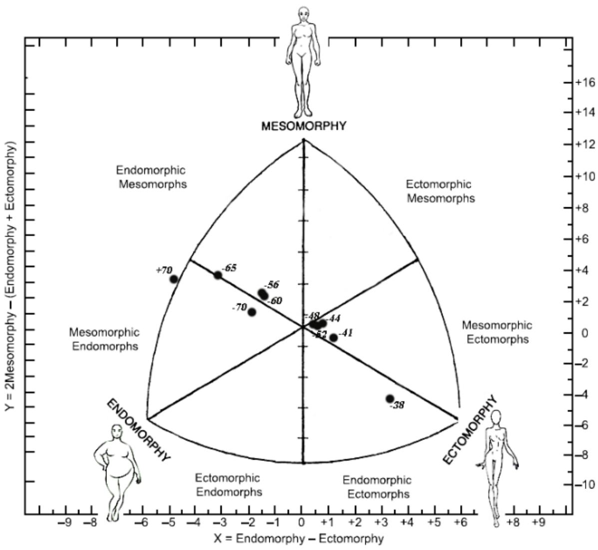

Figure 2. Somatochart of Serbian elite cadet female sambo athletes by weight categories

In the female groups, body height differed statistically significantly between the first four groups and the last, heaviest group, between -38kg and -70kg, as well as between -56 and above 70kg group. The breadth of the humerus differs statistically significantly between the lightest category and -60kg, -65kg, -70kg, while the difference in femur breadth exists between almost all groups and the heaviest category. Measuring arm and calf circumference, a statistically significant difference was observed between almost all groups of participants. Differences in the thickness of all skinfolds exist between > 70kg and all other categories (Table 2).

Somatotype analysis of female sambo wrestlers shown the difference in endomorphism exists between the heaviest category and all other categories. Significant differences between groups were not found in mesomorphy, except between the first group and -65kg,> 70kg. In ectomorphy, there is a statistically significant difference between the lighter and heavier categories (Figure 2).

In the domain of handgrip strength, differences between weight categories in female athletes were found between the lightest group and last six groups in right hand and in total in favor of the last six. In the left hand, differences were found between the first group and last 5 groups, as well as for -48 and >70 kg, the heaviest weight category.

Discussion

Quantifying human body composition plays a major role in monitoring all-athlete performance and training regimes, but is especially important in gravitational and aesthetic sports, as well as in sports with weight categories where body composition has a great impact on achieving top results and performance (Ackland et al., 2012). To maximize performance, athletes strive to achieve an optimum sport-specific body size, body composition, and mix of energy stores (Loucks, 2013). By determining the specific anthropometric characteristics and handgrip of sambo athletes allows us to assess the criteria for success in this sport. A small number of researches have been written on a topic that investigates anthropometric characteristics associated with handgrip strength of elite cadet competitors of both genders, allowing us to compare the results.

Considering the anthropometrical characteristics, the highest average height is observed in the -84kg category in male groups, and in female categories, body height grew progressively in the weight categories. Analysis of bone diameters demonstrated a linear increase from the light to the heavyweight categories. Exception in linear increase for humerus breadth was found in male -50kg, -78kg, and above 78kg weight category. In female athletes, humerus breadth was different between the lightest weight category, -52kg,-65kg, and above 70kg (Drid et al., 2018). A significant difference in male groups was found in humerus breadth between -46, -50, and -78kg. In femoral breadths, the only difference was observed between the -46kg and -78kg groups. The breadth of the humerus, in female categories, differs statistically significantly between the lightest category and -60kg, -65kg, -70kg. In contrast, the difference in femur breadth exists between almost all groups and the heaviest category. Observing arm and calf circumference, it could be concluded that almost all weight categories are statistically different from each other in both genders. Higher levels of body fat are negatively correlated with the performance of locomotion (Franchini et al., 2005; Franchini et al., 2016). Control of body composition is necessary to define an athlete's best weight category (Mendes et al., 2013). In male categories, triceps skinfolds did not differ between groups and show a progressive increase in weight groups, while supraspinal and subscapular skinfolds differed between the lighter and the heaviest categories. A significant difference in the skinfolds of the calf exists between -55kg and > 84kg. Female categories show differences in the thickness of all skinfolds exist between > 70kg and all other categories. The largest percentage of male athletes had an endomorphic mesomorph somatotype. Female athletes in the heavier categories were represented by an endomorphic mesomorph somatotype, and among the lighter categories was dominated by a mesomorphic ectomorph somatotype. In a previous study, slightly different results were obtained for female athletes. -38kg category showed an endomorphic ectomorph somatotype. In total, the strength of the handgrip increases progressively in groups. Differences in left-hand grip were noted between the first four weight categories and -78kg and above 84kg. The difference was also noticed between the -46kg group and the last four groups. Strength differences between weight categories in female athletes were found between the lightest group and last six groups in right hand and in total in favor of the last six. Similar results were found in the other study.

Table 1. Differences in anthropometric variables and handgrip strength between weight categories of Serbian elite cadet male sambo athletes

MALE	-42[a] (n=2)	-46[b] (n=4)	-50[c] (n=3)	-55[d] (n=7)	-60[e] (n=3)	-66[f] (n=5)	-72[g] (n=3)	-78[h] (n=5)	-84[i] (n=2)	>84[j] (n=4)	Statistics
Variable	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	
Body height (cm)	155.50±11.46[e,g,h,i,j]	157.50±1.30[e,f,g,h,i,j]	166.73±.75[i]	165.46±4.68[h,i,j]	175.80±2.79[a,b]	169.94±4.86[b]	175.53±5.60[a,b]	176.94±4.68[a,b,d]	183.55±7.99[a,b,c,d]	178.95±6.35[a,b,d]	F=10.19, P=.000, η^2=.77
Breadths											
Humerus (cm)	6.55±.07	6.03±.34[h]	5.87±.35[h]	6.49±.76	6.57±.47	6.62±.47	7.10±.26	7.14±.34[b,c]	7.30±.42	6.78±.15	F=3.17, P=.009, η^2=.51
Femur (cm)	9.35±.21	8.40±.37[h]	8.50±.52	8.96±.81	9.17±1.16	9.68±.83	9.63±.64	10.18±.39[b]	10.10±.14	9.98±1.00	F=2.92, P=.014, η^2=.48
Girths											
Arm (cm)	24.50±2.12[f,g,h,i,j]	24.93±2.29[d,e,f,g,h,i,j]	27.57±1.29[h,i,j]	28.79±1.32[b,h,i,j]	29.67±.29[b,h,i,j]	31.80±1.92[a,b]	31.33±1.15[a,b]	35.30±.91[a,b,c,d]	35.25±1.06[a,b,c,d,e]	34.43±3.01[a,b,c,d,e]	F=17.86, P=.000, η^2=.85
Calf (cm)	29.25±1.06[e,f,g,h,i,j]	31.08±.70[e,f,g,h,i,j]	31.27±1.42[f,g,h,i,j]	32.16±1.58[f,g,h,i,j]	34.67±1.53[a,b,h,i,j]	36.60±1.19[a,b,c,d,i,j]	36.00±.50[a,b,c,d,i,j]	38.06±1.25[a,b,c,d,e]	41.00±.71[a,b,c,d,e,f,g]	41.07±1.89[a,b,c,d,e,f,g]	F=31.72, P=.000, η^2=.91
Skinfolds											
Triceps (mm)	4.30±.71	6.78±3.17	6.33±2.50	6.09±1.41	7.33±.95	9.38±4.22	9.27±2.44	10.04±3.72	9.40±.57	11.60±4.14	F=2.00, P=.078, η^2=.39
Supraspinale (mm)	3.60±.28[j]	4.55±1.00[j]	5.20±2.25[j]	5.37±.39[j]	5.53±1.14[j]	6.72±2.27[j]	9.83±1.04	8.16±2.84	9.40±2.26	17.10±12.04[a,b,c,d,e,f]	F=3.17, P=.009, η^2=.51
Subscapular (mm)	5.40±.00[j]	5.98±1.50[j]	6.80±1.74[j]	6.89±1.15[j]	7.80±1.83[j]	9.48±1.47	10.37±1.37	10.56±.79	10.10±1.56	15.25±6.83[a,b,c,d,e]	F=4.89, P=.001, η^2=.61
Calf (mm)	3.80±1.13	6.70±3.19	5.80±2.95	5.71±1.38[j]	6.87±1.68	9.18±3.31	8.73±3.04	10.16±4.35	10.50±2.40	14.90±9.28[d]	F=2.18, P=.055, η^2=.41
Somatotypes											
Endomorphy	1.25±.27[j]	1.73±.72[j]	1.73±.78[j]	1.77±.25[j]	1.90±.44	2.53±.85	2.86±.49	2.75±.70	2.67±.20	3.92±1.80[a,b,c,d]	F=3.28, P=.008, η^2=.51
Mesomorphy	4.54±1.85	3.54±.57[h]	2.80±.33[f,h,j]	4.16±1.24	3.52±1.12[h]	5.28±.84[c]	4.76±.99	5.98±.67[b,c,e]	5.67±.63	5.49±.71[c]	F=4.56, P=.001, η^2=.59
Ectomorphy	3.98±1.99[j]	3.39±.21[j]	4.11±.23[h,j]	3.09±.87[j]	3.82±.32[j]	2.37±.83	2.19±1.16	1.71±.92[c]	2.08±1.01	.58±1.16[a,b,c,d,e]	F=5.57, P=.000, η^2=.64

different from: **a** -42; **b** -46; **c** -50; **d** -55; **e** -60; **f** -66; **g** -72; **h** -78; **i** -84; **j** >84

Table 2. Differences in anthropometric variables and handgrip strength between weight categories of Serbian elite cadet female sambo athletes

FEMALE	-38[a] (n=2)	-41[b] (n=2)	-44[c] (n=2)	-48[d] (n=3)	-52[e] (n=4)	-56[f] (n=5)	-60[g] (n=3)	-65[h] (n=4)	-70[i] (n=3)	>70[j] (n=4)	Statistics
Variable	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	
Body height (cm)	151.80±3.82[i,j]	155.05±.07[j]	156.70±1.84[j]	158.03±2.95[j]	166.65±4.11	162.58±5.22[j]	167.17±4.33	166.67±2.23	169.63±2.90[a]	176.83±9.59[a,b,c,d,f]	F=6.84, P=.000, η^2=.74
Breadths											
Humerus (cm)	4.75±.07[e,g,h,j]	5.75±.07	5.80±.57	5.77±.06	6.18±.56[a]	5.86±.65	6.27±.25[a]	6.33±.25[a]	6.07±.12	6.48±.48[a]	F=3.25, P=.012, η^2=.57
Femur (cm)	7.55±.35[h,j]	7.55±.07[h,j]	8.20±.57[j]	7.87±.85[h,j]	8.65±.77[j]	8.92±.49	8.70±.26[j]	9.55±.51[a,b,d]	8.70±.26[j]	10.20±.54[a,b,c,d,e,g,i]	F=7.40, P=.000, η^2=.75
Girths											
Arm (cm)	22.25±.35[c,d,e,f,g,h,i,j]	24.05±.07[h,i,j]	24.15±1.20[h,i,j]	27.67±1.15[a,j]	27.38±1.25[a,j]	28.50±.35[a,j]	29.13±2.40[a,j]	30.18±.95[a,b,c,j]	29.90±2.15[a,b,c,j]	35.13±2.80[a,b,c,de,f,g,h,i]	F=15.45, P=.000, η^2=.86
Calf (cm)	27.50±2.12[d,e,f,g,h,i,j]	30.05±.07[h,i,j]	30.85±.21[h,j]	31.00±2.00[h,i,j]	32.60±1.14[a,j]	33.18±.60[a,j]	34.10±1.95[a,j]	36.38±2.11[a,b,c,d,j]	35.83±1.44[a,b,d,j]	40.88±2.25[a,b,c,d,e,f,g,h,i]	F=16.59, P=.000, η^2=.87
Skinfolds											
Triceps (mm)	9.05±4.45[j]	6.85±.07[j]	7.20±.57[j]	10.20±.92[j]	7.95±2.72[j]	10.68±4.03[j]	10.47±1.27[j]	15.00±4.10[j]	14.30±1.66[j]	25.38±2.36[a,b,c,d,e,f,g,h,i]	F=12.82, P=.000, η^2=.84
Supraspinale (mm)	5.45±2.19[j]	4.05±.07[j]	4.50±.42[j]	5.40±.40[j]	5.25±1.24[j]	8.32±2.78[j]	7.27±1.22[j]	13.10±3.04[j]	15.20±3.20[j]	29.60±9.75[a,b,c,d,e,f,g,h,i]	F=12.96, P=.000, η^2=.84
Subscapular (mm)	7.10±2.97[j]	6.25±.07[j]	5.20±.28[h,i,j]	9.73±2.83[j]	7.45±1.56[h,j]	9.84±2.43[j]	8.47±.12[j]	12.95±1.46[c,e,j]	12.73±3.00[c,j]	27.05±2.99[a,b,c,d,e,f,g,h,i]	F=28.94, P=.000, η^2=.92
Calf (mm)	5.75±.92[j]	5.25±.07[j]	7.40±1.98[j]	9.20±1.39[j]	6.23±1.97[h,i,j]	9.94±4.51[j]	11.00±4.42[j]	16.05±6.36[e]	16.00±1.91[e]	23.00±1.78[a,b,c,d,e,f,g]	F=8.66, P=.000, η^2=.78
Somatotypes											
Endomorphy	2.36±1.28j	1.77±.03[h,i,j]	1.71±.01[h,i,j]	2.73±.44[j]	2.02±.64[h,i,j]	3.00±1.05[j]	2.66±.09[j]	4.13±.68[b,c,e,j]	4.20±.45[b,c,e,j]	6.46±.26[a,b,c,d,e,f,g,h,i]	F=16.66, P=.000, η^2=.87
Mesomorphy	1.58±.66[h,j]	2.81±.12	3.13±.83	3.33±1.27	3.31±1.08	3.93±.90	3.80±.90	4.82±1.11[a]	3.58±.57	5.36±1.27[a]	F=3.18, P=.013, η^2=.57
Ectomorphy	4.91±1.79[h,i,j]	3.97±.00[j]	3.81±.14[j]	3.05±.60	3.89±.86[j]	2.45±1.09	2.40±.92	1.76±.53[a]	1.69±.56[a]	.57±1.35[a,b,c,e]	F=5.82, P=.000, η^2=.70

different from: **a** -38; **b** -41; **c** -44; **d** -48; **e** -52; **f** -56; **g** -60; **h** -65; **i** -70; **j** >70

Conclusion

This study could help with profiling elite sambo athletes based on gender, age, and weight categories. Anthropometric characteristics show differences regarding weight categories. In male groups, the most common somatotype was endomorphic mesomorph, while in the female groups, heavier categories were represented by an endomorphic mesomorph somatotype, and among the lighter categories dominated mesomorphic ectomorph somatotype. Differences in hand-grip strength were found related to the weight category. Handgrip values were higher in heavier weight categories, compared to lighter categories. Differences found in handgrip strength among weight categories are probably linked to differences in muscle mass between them. The achieved results can serve as data to compare the somatotype and handgrip strength of elite sambo athletes on national and international levels. These findings suggest that the handgrip strength and somatotypes are the keys to success in relation to the weight category.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Ackland, T.R., Lohman, T.G., Sundgot-Borgen, J., Maughan, R.J., Meyer, N.L., Stewart, A.D., & Müller, W. (2012). Current status of body composition assessment in sport. *Sports Medicine, 42*(3), 227-249.

Blackwell, J.R., Kornatz, K.W., & Heath, E.M. (1999). Effect of grip span on maximal grip force and fatigue of flexor digitorum superficialis. *Applied Ergonomics*, 30(5), 401-405.

Carter JRL, Heath BH. Somatotyping: Development and Applications. Cambridge: Cambridge University Press; 1990.

Dadelo, S., Mečkovskis, A., & Štarevičius, E. (2013). Sports and combat sambo exposure and differences in stage-activity. *Ugdymas. Kūno kultūra. Sportas*, 2, 12-18.

Drid, P., Tabaković, S., Eliseev, S., Selimovic, N., Jakšić, D., Trivić, T., & Ostojić, S. (2018). Somatotypes of elite male and female junior sambo athletes. *Archives of Budo*, 14, 189-195.

Franchini, E., Takito, M.Y., Kiss, M.A.P.D.M., & Strerkowicz, S. (2005). Physical fitness and anthropometrical differences between elite and non-elite judo players. *Biology of Sport*, 22(4), 315.

Franchini, E., Sterkowicz-Przybycien, K., & Yuri Takito, M. (2014). Anthropometrical profile of Judo Athletes: comparative analysis between weight categories. *International Journal of Morphology*, 32, 36-42.

Franchini, E., Julio, U.F., Panissa, V.L., Lira, F.S., Gerosa-Neto, J., & Branco, B.H. (2016). High-intensity intermittent training positively affects aerobic and anaerobic performance in judo athletes independently of exercise mode. *Frontiers in Physiology*, 7, 268.

Goran, M.I., Gower, B.A., Treuth, M., & Nagy, T.R. (1998). Prediction of intra-abdominal and subcutaneous abdominal adipose tissue in healthy pre-pubertal children. *International Journal of Obesity*, 22(6), 549-558.

Lagan Evans, C., Close, G., Morton, J. (2011). Making weight in combat sports. *Strength and conditioning Journal*, 33(6), 25-39.

Loucks, A.B. (2004). Energy balance and body composition in sports and exercise. *Journal of Sports Sciences*, 22(1), 1-14.

Matigka, J. (1921). The testing of physical efficiency. *American Journal of Physical Anthropology*, 4, 223-230.

Mendes, S.H., Tritto, A.C., Guilherme, J.P.L., Solis, M.Y., Vieira, D.E., Franchini, E., ... & Artioli, G.G. (2013). Effect of rapid weight loss on performance in combat sport male athletes: does adaptation to chronic weight cycling play a role? *British Journal of Sports Medicine*, 47(18), 1155-1160.

Osipov A.Y., Kudryavtsev, M.D., Jagiełło, W., Iermakov, S.S., & Błach, W. (2020). Increasing of special physical fitness of the female athletes practicing sambo. *Archives of Budo*, 16, 53-59.

Serporezyuk, S.D., & Chekhranov, Yu.V. (2014). Formation of basics of tactics of wrestling in standing position in junior sambo wrestling. *Physical Culture: upbringing, education, workout*, 2, 34-36.

Shyamal, K., & Yadav, K.M. (2009). An association of handgrip strength with some anthropometric variables in Indian cricket players. *Facta universitatis-series: Physical Education and Sport*, 7(2), 113-123.

Vardar, S., Tezel, S., Öztürk, L., & Kaya, O. (2007). The relationship between body composition and anaerobic performance of elite young wrestlers. *Journal of Sport Science and Medicine*, 6, 34-38.

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