

Morphological features in female judoka of different grades

Características morfológicas de judocas do sexo feminino de diferentes categorias

Salman Elipkhanov¹
Oleg Nemtsev¹

Abstract – The evaluation of morphological differences among female judoka of different grades would make it possible to estimate the influence of motor activity in judo on athletes' performances, leading to a more refined selection process in this sport. Therefore, this study aimed to compare the morphological characteristics of female judoka of different ranks. Twenty-three athletes of higher grades and thirty-two judoka of lower ranks participated in this study. We measured the lengths of six body segments and the circumferences of twelve body segments, as well as nine skinfolds. We also evaluated body fat percentage. The mean differences between both groups were measured using ANOVA. This study shows that highly skilled judoka have significantly lower total body fat percentage (19.6 ± 4.4 and 22.7 ± 5.2 %, $p < 0.05$) and skinfold values ($p < 0.05-0.01$) in five body sites. They have significantly larger neck (34.4 ± 2.9 and 32.3 ± 2.4 cm, $p < 0.01$), thorax at forced inspiration (94.7 ± 5.1 and 91.4 ± 4.1 cm, $p < 0.05$) and expiration (88.6 ± 5.1 and 85.5 ± 4.4 cm, $p < 0.05$), and relaxed arm (27.8 ± 2.5 and 26.3 ± 2.1 cm, $p < 0.05$) circumferences. High-rank judoka have significantly longer hands (19.4 ± 1.3 and 18.1 ± 1.5 cm, $p < 0.001$) and significantly shorter thighs (37.2 ± 2.6 and 40.2 ± 3.2 cm, $p < 0.001$). Judoka with less body fat, more thoracic muscle mass, and shorter arms and legs are more successful in female judo.

Key words: Adiposity; Anthropometry; Body fat percentage; Judo; Skinfolds.

Resumo – A avaliação das diferenças morfológicas entre mulheres judocas de diferentes categorias possibilitaria estimar a influência da atividade motora no judô sobre o desempenho das atletas, aperfeiçoando o processo de seleção no judô feminino. Assim, este estudo objetivou comparar as características morfológicas de mulheres judocas de diferentes categorias. Vinte e três atletas de maior graduação e trinta e duas judocas de graduações mais baixas participaram do estudo. Mediram-se o comprimento de seis segmentos corporais e a circunferência de doze, bem como nove dobras cutâneas. Também se avaliou o percentual de gordura corporal. Utilizamos o ANOVA para testar as diferenças médias entre os dois grupos de judocas. Este estudo demonstra que, em judocas altamente qualificadas, cinco das dobras cutâneas têm medidas significativamente menores ($p < 0.05-0.01$), e o percentual de gordura corporal é significativamente mais baixo ($19,6 \pm 4,4$ e $22,7 \pm 5,2$ %, $p < 0,05$). As circunferências do pescoço ($34,4 \pm 2,9$ e $32,3 \pm 2,4$ cm, $p < 0,01$), do tórax durante inspiração ($94,7 \pm 5,1$ e $91,4 \pm 4,1$ cm, $p < 0,05$) e expiração ($88,6 \pm 5,1$ e $85,5 \pm 4,4$ cm, $p < 0,05$) forçadas e do braço em estado relaxado ($27,8 \pm 2,5$ e $26,3 \pm 2,1$ cm, $p < 0,05$) são significativamente maiores. Além disso, as mãos são significativamente mais longas ($19,4 \pm 1,3$ e $18,1 \pm 1,5$ cm, $p < 0,001$), e as coxas significativamente mais curtas ($37,2 \pm 2,6$ e $40,2 \pm 3,2$ cm, $p < 0,001$). Judocas com menor índice de gordura corporal, maior massa muscular torácica e menores braços e pernas são mais bem-sucedidas no judô feminino.

Palavras-chave: Adiposidade; Antropometria; Dobras cutâneas; Judô; Percentual de gordura corporal.

1 Adygea State University. Institute of Physical Training and Judo, Adygea, Russia

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INTRODUCTION

Several authors have claimed that competitive and training activities, as well as selection procedures in different sports, rely largely on athletes' morphological features^{1,2}. Motor and physical capacity tests may not always have reliable or valid results, since athletes' performances on such tests depend strongly on their level of motivation during the procedure. Therefore, morphological data may be particularly valuable in evaluating athletes' performances. Assessing the morphological changes in athletes as they improve their skills is helpful in determining which characteristics play a role in their success. Therefore, evaluation of morphological differences among female judoka of different grades would make it possible to estimate the influence of competitive and training activities on athletes' performances, leading to a more refined selection process in judo. Similar studies have been previously conducted for male judo³⁻⁶.

When it comes to female judo, only fragmented data exist on the specific morphological characteristics of judoka in different weight categories and of different grades^{7,8}. The morphological characteristics of judoka assessed in these investigations may be used as landmarks for athletes, but it is not clear which characteristics are more useful in female judo, since no one registered the morphological changes in athletes as they improved their skills.

Thus, this study aimed to compare morphological characteristics of female judoka of different judo grades.

METHODS

We compared the morphological characteristics of twenty-three women classified as Masters of Sport of Russia, International Class (group A), and thirty-two first-grade judoka and Candidates for Master of Sports of Russia (Group B) (Fig. 1).

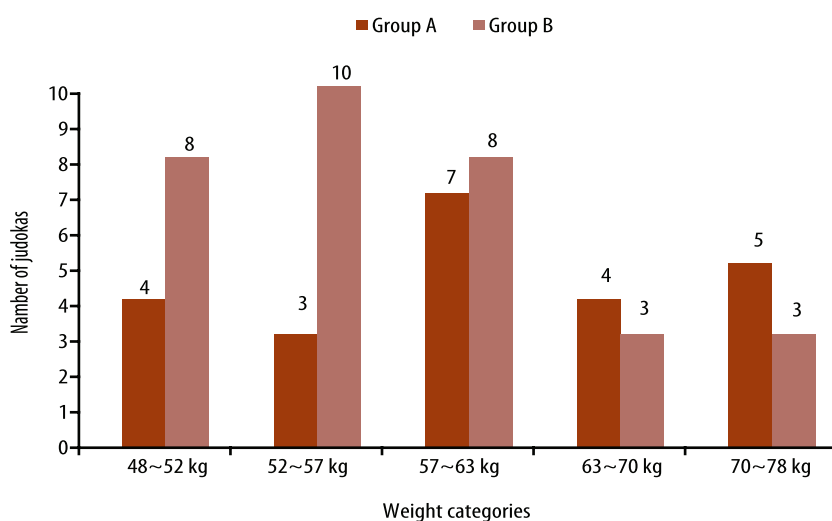


Figure 1. Participants in the study.

All athletes participated voluntarily in the study and were given detailed information on the study and its design. Each of them signed a consent agreement that had been approved by the Ethics Committee of the Institute of Physical Training and Judo of Adygea State University, approval protocol number 2-11.

An experienced researcher took the anthropometric measurements, following the International Standards for Anthropometric Assessment⁹. Additionally, he measured the forearm skinfold (at the point of widest circumference in the posterior aspect of the forearm). For the last measurement, taken to evaluate the growth of forearm muscle groups, the participants flexed their hands and fingers while gripping a kimono. Measurements (length and circumference of body segments) were taken with GPM anthropological instruments (DKSH Switzerland Ltd., Zurich, Switzerland). The Lange Skinfold Caliper (Beta Technology Inc., USA, accuracy of ± 1 mm) was used to measure skinfold thickness. Weight was measured on a digital scale with an accuracy of 0.1 kg. The relative technical error of measurement for lengths of body segments ranged from 0.4 to 0.8%; for circumferences of body segments, it ranged from 0.5 to 0.8%; and for skinfold thickness values, from 3.2 to 5.3%.

Calculation of the body fat mass was based on four skinfold thickness measurements (triceps, supraspinale, abdominal and front thigh), according to Jackson et al.¹⁰.

The ANOVA test was used to analyse statistical differences between both groups of female judoka. All statistical tests were performed with the SPSS 15.0 software.

RESULTS

General data on both groups are provided in Table 1.

Table 1. General characteristics of the surveyed female judoka (Mean \pm S.D.).

Data	Group A	Group B	p value
Weight (kg)	61.9 \pm 7.9	58.8 \pm 7.5	p>0.05
Height (cm)	165.2 \pm 5.8	163.5 \pm 6.7	p>0.05
Age (years)	22.6 \pm 3.4	18.2 \pm 2.7	p<0.001

Analysis of Table 1 shows no significant differences in height and weight between the groups. However, judoka in group A are significantly older, since it takes more time to reach their level of athletic skill. It was difficult, then, to gather large, representative groups of female athletes of the same age but of different grades. However, the differences revealed by the study and described below cannot be explained by age-related factors.

We found that judoka of higher grades have significantly longer hands and significantly shorter thighs (Table 2).

We found no significant differences in arm, forearm, tibial, and foot lengths among judoka of different grades (Table 2).

Table 2. Lengths and circumferences of body segments in female judoka of different grades (Mean±S.D., cm).

Body segments	Group A	Group B	p value
Lengths			
Arm (acromiale - radiale)	30.7 ± 2.1	30.6 ± 1.8	p>0.05
Forearm (radiale - stylium)	24.1 ± 1.6	23.9 ± 1.5	p>0.05
Hand (midstylium - dactylium)	19.4 ± 1.3	18.1 ± 1.5	p<0.001
Thigh (trochanterion - tibiale laterale)	37.2 ± 2.6	40.2 ± 3.2	p<0.001
Tibial (tibiale mediale - sphyrion tibiale)	40.0 ± 2.9	39.8 ± 2.3	p>0.05
Foot	24.6 ± 1.1	24.4 ± 1.2	p>0.05
Circumferences			
Head	55.3 ± 1.5	55.2 ± 1.6	p>0.05
Neck	34.4 ± 2.9	32.3 ± 2.4	p<0.01
Thorax during forced inspiration	94.7 ± 5.1	91.4 ± 4.1	p<0.05
Thorax during forced expiration	88.6 ± 5.1	85.5 ± 4.4	p<0.05
Arm, relaxed	27.8 ± 2.5	26.3 ± 2.1	p<0.05
Wrist	16.3 ± 1.1	16.1 ± 1.0	p>0.05
Forearm	25.0 ± 1.6	23.9 ± 1.7	p<0.05
Hand	19.6 ± 1.1	19.1 ± 1.0	p>0.05
Thigh	56.7 ± 3.9	58.0 ± 7.4	p>0.05
Mid-thigh	49.8 ± 3.5	50.0 ± 4.0	p>0.05
Calf	34.1 ± 2.0	35.1 ± 2.4	p>0.05
Ankle	21.2 ± 1.3	22.3 ± 1.9	p<0.05

Judoka in group A also had significantly larger maximum circumferences of forearm, thorax at forced inspiration and expiration, arm, and neck (Table 2). Ankle circumference was significantly larger in group B. We found no significant difference in the thigh, mid-thigh, and calf circumferences between the groups (Table 2).

As shown in Table 3, highly skilled female judoka had significantly thinner skinfolds in the triceps, forearm, chest, front thigh, and mid calf.

We found no significant difference in the subscapular, biceps, supraspinale, and abdominal skinfold thickness between the groups, although the skinfolds were slightly thicker in less skilled athletes. The body fat percentage was significantly lower in group A (Table 3).

Table 3. Skinfold thickness and body fat percentage in female judoka of different grades (Mean±S.D.).

Data	Group A	Group B	p value
Triceps (mm)	13.9 ± 3.9	17.7 ± 6.3	p<0.05
Subscapular (mm)	13.4 ± 4.4	15.6 ± 7.5	p>0.05
Biceps (mm)	6.5 ± 2.2	7.5 ± 4.4	p>0.05
Forearm (mm)	5.9 ± 2.0	8.0 ± 4.1	p<0.05
Chest (mm)	8.0 ± 2.8	11.7 ± 6.4	p<0.05
Supraspinale (mm)	13.3 ± 5.6	15.0 ± 7.4	p>0.05
Abdominal (mm)	21.7 ± 8.3	24.0 ± 7.9	p>0.05
Front thigh (mm)	22.2 ± 5.0	26.6 ± 7.7	p<0.05
Medial calf (mm)	16.1 ± 4.3	23.7 ± 8.7	p<0.001
Body fat (%)	19.6 ± 4.4	22.7 ± 5.2	p<0.05

DISCUSSION

Some authors compared skinfold thicknesses and body circumferences in male judoka of different grades and came to contradictory results and conclusions. They found that elite judoka (Brazilian national and international medallists) have significantly larger arm (flexed), forearm, wrist and calf circumferences when compared to non-elite judo players (non-medallists in Brazilian national tournaments)⁶. Moreover, researchers found no significant difference in six skinfold thicknesses between both groups of judoka. This shows that motor activity in judo requires good muscle development in the upper and lower extremities. However, later studies showed no significant difference in the circumferences of eight body segments among judo players of the Brazilian team and judo players of teams B and C¹¹. Other authors noticed significantly different skinfold thicknesses and body fat values in male judoka of different grades⁵. However, researchers who found no significant difference in skinfold thickness among athletes of different grades think these findings confirm the hypothesis that highly skilled judoka try to minimise the fat content in their bodies⁶.

Other researchers found no significant difference in circumference measurements/skinfold thicknesses of seven body sites and in body fat percentage among Indian judoka with different practice periods (≤ 5 years and > 5 years)¹². Authors concluded that long-term practice has minimal effects on judoka's anthropometric profile.

Our study showed a considerable reduction of body fat content in the more skilled female judoka. This confirms some experts' hypothesis that athletes need to minimise body fat in order to improve performance¹³⁻¹⁵. It also suggests that the less skilled judoka have not followed this recommendation. We noticed that both groups in this study had higher skinfold thickness values and even higher body fat percentages when compared to the Turkish national women's judo team¹⁶.

We observed significantly larger thorax, arm, and forearm circumferences in the more skilled female judoka, as well as thinner skinfolds at these same body sites. This suggests that the improvement of an athlete's skill in female judo relates to the development of muscle groups in the trunk and upper limbs, as well as to a reduction in total body fat percentage. It is also possible that the athletes' grip strength is enhanced by better-developed muscles in the forearm and by significantly larger hand length, as seen in group A (Table 2).

We noticed a similar tendency when comparing circumferences and skinfolds thicknesses of leg segments in female judoka of different ranks. No significant difference in the circumferences of the thigh, mid-thigh and calf were found between the groups (Table 2). At the same time, front thigh and medial calf skinfolds appeared to be significantly thinner in group A (Table 3). This suggests that, although circumferences of the lower limbs were equal for both groups, group A owes its measurements to better muscle development, while group B owes it to a greater fat content. Furthermore,

the significantly larger neck circumference in group A (Table 2) may be interpreted as an additional sign of masculinity.

The significantly shorter thighs in group A (Table 2) might be related to a low center of mass, which increases a judoka's stability on the tatami. However, the lengths of different body segments are largely determined by genetics and cannot be significantly modified by training. Therefore, longer hands and shorter thighs, like seen in group A, might serve as key characteristics in the selection of judo athletes.

Limitations

It is important to stress the limitations of this study. In the first place, female judo is a relatively new sport, which means there is still little research comparing the morphological profiles of female judoka in different ranks. Some of our findings, then, may apply to Russian female judoka only. More research is needed on this subject.

In the second place, measuring skinfold thickness to estimate body fat percentage is a relatively simple and inexpensive method. However, literature shows that these equations have an estimated standard error of 3-7%. Therefore, checking our results with high-tech and more reliable devices (magnetic resonance, computerized tomography) could improve their validity.

CONCLUSION

When compared with less skilled judoka (first-grade judoka and Candidates for Master of Sports of Russia), highly skilled judoka (Masters of Sport of Russia and Masters of Sport of Russia, International Class) have significantly thinner triceps, forearm, chest, medial calf and front thigh skinfolds, as well as a lower total body fat percentage. They also have shorter lower limbs, longer hands, and more developed forearm muscles (greater values for maximum forearm circumference and lower values for forearm skinfold measurements). Their neck, arms (relaxed) and thorax (during forced inspiration and expiration) have larger circumferences.

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Corresponding author

Oleg Nemtsev
Naberezhnaya 36,
Belorechensk, Krasnodar region,
352630 - Russia
E-mail: oleg.nemtsev@mail.ru