Amir Sofić[1], Safet Kapo[1], Nedim Čović[1], Edin Krupalija[2], Nejira Kapo[1], Anida Kapo – Gurda[3], Nadža Kapo – Dolan[4], Šemso Ormanović[1] and Haris Ćutuk[5]

BODY COMPOSITION AND EXPLOSIVE POWER OF THE LOWER EXTREMITIES OF TOP KARATE PLAYERS

[1]Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Herzegovina

[2]Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia and Herzegovina

[3]Faculty of Educational Sciences, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[4]Faculty of Veterinary Medicine, University of Sarajevo, Bosnia and Herzegovina

[5]JP Elektroprivreda B&H, H d.d - Sarajevo, Bosnia and Herzegovina

Correspondence to
Safet KAPO,
Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Herzegovina
safet.kapo@fasto.unsa.ba

Submitted: 06.11.2025.
Accepted: 23.11.2025.

To cite: Sofić, A., *et al. (2025)* Body Composition and Explosive Power of the Lower Extremities of Top Karate Players *Homosporticus,* 27 (2), 15-20. *doi 10.61886/1840-4324.2025.27.2.15*

Original research

ABSTRACT
The aim of this research was to determine the connection between body composition and explosive power of the lower extremities in top karate players, representatives of Bosnia and Herzegovina, and to identify the differences between men and women in these parameters. Correlation analysis was performed between body composition variables and lower extremity explosive strength, with additional use of independent samples t-test to examine gender differences. The results showed a significant positive correlation between body mass, muscle mass, total amount of water and jump height, while the percentage of fat tissue had a negative correlation with jump height. Also, significant gender differences were identified in variables such as fat tissue percentage (.004), muscle mass (.000), total water volume (.000) and jump height (.000), with men achieving better results. These differences indicate that body composition and explosive power are key factors in karate and highlight the need to adapt training and nutritional strategies to gender specificities in order to optimize results.
Keywords: motor abilities, anthropometry, body composition, adolescents

INTRODUCTION

Diagnostics is important in top sports because it enables precise planning of training based on scientifically based methods. Karate belongs to the group of polystructural acyclic sports, but it differs from other martial sports in that the basic intention is the symbolic destruction of the opponent, which is achieved by simultaneous or strictly controlled blows of the arms and legs (Kapo, 2011). The basic meaning and purpose of practicing karate is the acquisition of specific motor skills, harmonious psychosomatic development, and personal satisfaction (Berak and Cvjetan, 2003). Now karate is going through the stages of entering the Olympic sport. Everyone who knows less about karate, thinks that karate is a martial art, as an art of complex movements, or as a sport. Karate is all that, depending on when and how we look at it. If we talk about modern karate as a sport, the first international meeting was held in 1975 in Los Angeles between Japan and the USA. The World Union of Karate Organizations (wuko) was founded in Tokyo in 1970. The goal was to unite all established Federations. In 1985, the IOC also recognized the representative of the World Federation, thus opening up possible participation in the Olympic Games. The development of karate has the greatest expansion in 70 years, and new fighting rules are introduced: the match lasts 3 and not 2 minutes, scoring is increased from one to three ipons, weight categories are introduced, fights for women, protective equipment is also used for younger ages, fights are clearly defined, and categories are separated. The correction of the sports fight is clearly visible. The number of points has increased, the motivations for taking the

first place have improved discipline, sportsmanship, knowledge of techniques, rules of referring and the relationship between coach-competitor and arena. The pulse during the fight is between 170-180 beats per minute, which corresponds to aerobic and anaerobic effort (Kafedžić, 2005). Karate meets the needs of both genders and all age groups (from five years onwards), so its popularity as a competitive and recreational sport is growing more and more. Perhaps the appeal of karate lies in the fact that participants have the opportunity to enjoy and participate in an activity that is suitable not only for recreation, but also for competition (Smith, 2003). The World Karate Federation (WKF) includes 188 countries on five continents, with over 10 million members (Espinós, 2020). The same author cites estimates that more than 100 million people practice karate. It is known that the largest percentage of this number of athletes refers to children and young people.

Assessment of body composition plays a significant role in athletes both in determining optimal body mass, as well as in optimizing nutrition and sports performance, and in controlling the performance of the training process. Nowadays, there are a large number of available laboratory and field methods for determining body composition. The Japanese company Tanita is one of the leading companies in the production of medical analytical scales and measuring systems. She developed a very precise body mass analysis system that separates body weight into several segments. This analyzer separates muscle mass from adipose tissue, shows us how much water is in the tissue, how much skeletal mass, and separates adipose tissue into subcutaneous adipose tissue and visceral fat and gives us insight into basal and active metabolism.

The aim of this research was to determine the connection between body composition and explosive power of the lower extremities in top karate players, representatives of Bosnia and Herzegovina, and to identify the differences between men and women in these parameters.

METHODS

Sample of Participants

The sample of respondents for this research was 14, of which 7 male respondents and 7 female respondents, of all weight categories, top karate players, representatives of Bosnia and Herzegovina, aged between 18-24 years with at least 5 years of practicing karate, who were clinically healthy

Variables

The sample of variables on the basis of which the research was conducted is 19, of which 14 are variables for assessing body composition and 5 are variables for assessing the explosive power of the lower extremities.

The variables for assessing body composition are:

HEIGHT - height, AGE - years of age, WEIGHT weight, FAT % - fats %, FAT MASS - fat weight, FFM, MUSCLE MASS - muscle mass, TBW (kg) - total amount of water in kg, TBW %-Total amount of water in %, BMR (kj) - basal metabolic value in kJ, BMR (kcal) - basal metabolic value in kcal, METABOLIC AGE - metabolic age, VISCERAL FAT RATING - visceral fat, BMI - body mass index.

The variables for evaluating the explosive strength of the lower extremities are:

JUMPTI- Jump time, JUMPHI- Jump height, VKSZ-Time of contact with the ground, EKSSN-Explosive leg power and VISS - jump height.

Instruments and Procedure

During the karate camp in Zaostrog, the composition of the body was analyzed on the Tanita body composition analyzer DC-430MA and the explosive power of the lower extremities was assessed on the opto jump device, which was conducted by trained and experienced researchers.

The research was approved by the Scientific Council of the Faculty of sport and Physical Education University of Sarajevo.

Statistical Analysis

Applied variables will be processed in statistical packages that are compatible with the research problem. To determine the relationship between body composition variables and lower extremity explosive power variables, we will use the Pearson correlation coefficient, and to determine the difference between men and women, we will use the t-test for independent samples.

RESULTS

There is a strong correlation between the variables: weight and jump time and jump height (.733 and .734), Fat percentage and Jump height (-.623), fat weight and jump time and jump height and Jump height cm (.598 and .566, -.672), mass without fat and jump time and jump height (.617 and .629), muscle mass and jump time and jump height (.615 and .627), total amount of water in kilograms and jump time and jump height (.573 and .589), Total amount of water in percentage and Jump height cm (.686), bone weight and jump time and jump height (.644 and .651), basal metabolic value in KJ and jump time and jump height

(.581 and .593), basal metabolic value in kcal and jump time and jump height (.581 and .593), Fats of internal organs and Jump height (-.598) and body mass index and jump time and jump height (.854 and .836).

Table 1. Results of the correlation between body composition variables and lower extremity explosive power variables in elite karate fighters (n=7).

	1	2	3	4	5
Years of age	.337	.302	-.473	.472	-.410
Height	.330	.346	.195	-.268	-.178
Weight	.733	.734	-.079	-.060	-.418
Fat percentage	.481	.444	-.272	.158	-.623
Fat weight	.598	.566	-.281	.143	-.672
Mass without fat	.617	.629	.001	-.110	-.249
Muscle mass	.615	.627	.000	-.109	-.246
Total water (kg)	.573	.589	.024	-.127	-.161
Total water (%)	-.497	-.462	.261	-.158	.686
Bone weight	.644	.651	.018	-.142	-.306
Basal metabolic (KJ)	.581	.593	.013	-.126	-.249
Basal metabolic (kcal)	.581	.593	.013	-.126	-.249
Metabolic age	.330	.346	.018	-.142	-.306
Fats of internal organs	.059	.005	-.251	.156	-.598
Body mass index	.854	.836	-.366	.226	-.480

1- Jump time
2- Jump height
3- Contact time with the ground
4- Explosive leg strength
5- Jump height

Table 2. Results of the correlation between body composition variables and lower extremity explosive power variables in top female karate athletes (n=7).

	1	2	3	4	5
Years of age	-.257	-.342	.026	.095	.060
Height	.015	-.024	.200	.269	.568
Weight	-.571	-.610	-.222	.399	.078
Fat percentage	-.251	-.316	-.217	.278	.091
Fat weight	-.343	-.412	-.286	.415	.158
Mass without fat	-.551	-.551	-.088	.241	-.017
Muscle mass	-.548	-.548	-.089	.241	-.016
Total water (kg)	-.482	-.500	-.155	.379	.166
Total water (%)	.698	.753	.211	-.273	.156
Bone weight	-.596	-.596	-.078	.236	-.042
Basal metabolic (KJ)	-.556	-.560	-.125	.277	-.003
Basal metabolic (kcal)	-.556	-.560	-.125	.277	-.003
Metabolic age	-.220	-.301	-.468	.708	.403
Fats of internal organs	.277	.313	-.125	.277	-.003
Body mass index	-.755	-.777	-.355	.313	-.251

1- Jump time
2- Jump height
3- Contact time with the ground
4- Explosive leg strength
5- Jump height

There is a strong correlation between the variables: height and jump height variables (.568), weight and jump time and jump height variables (-.571 and – 610), Mass without fat and jump time and jump height (-.551 and - .551), Muscle mass and jump time and jump height (-.551 and -.551), Total amount of water in kilograms and jump height (.500), Total amount of water in percentage and jump time and jump height (. 698 and .753), Bone weight and jump time and jump height (-.596 and -.596), Basal metabolic value in KJ and jump time and jump height (-.556 and -.560), Basal metabolic value in kcal and jump time and jump height (-.556 and -.560), Metabolic years and explosive leg strength (.708) and Body mass index and jump time and jump height (-.755 and -.777).

Table 3. Results of the t-test for independent samples between male and female karate athletes in the variables of body composition and lower extremity explosive power.

				95% CI diff.	
	t	p	MD	Lower	Upper
Years of age	.777	.452	.857	-1.547	3.261
Height	2.970	.012	9.286	2.473	16.09
Weight	3.289	.006	14.55	4.91	24.20
Fat percentage	-3.552	.004	-8.71	-14.06	-3.36
Fat weight	-2.183	.050	-4.61	-9.22	-.001
Mass without fat	5.552	.000	19.17	11.64	26.69
Muscle mass	5.569	.000	18.31	11.14	25.48
Total water (kg)	6.657	.000	14.01	9.42	18.60
Total water (%)	4.277	.001	6.91	3.39	10.43
Bone weight	5.190	.000	.85	.49	1.21
Basal metabolic (KJ)	5.114	.000	2209.28	1267.98	3150.58
Basal metabolic (kcal)	5.114	.000	528.00	303.053	752.94
Metabolic age	-1.000	.337	-1.00	-3.17	1.17
Fats of internal organs	1.000	.337	.14	-.168	.45
Body mass index	2.265	.043	2.30	.087	4.51
Jump time	1.418	.182	.06	-.034	.163
Jump height	1.846	.090	11.80	-2.130	25.73
Contact time	.182	.859	.020	-.219	.25
Explosive leg strength	.244	.811	.042	-.340	.42
Jump height	7.400	.000	18.51	13.06	23.96

There is a significant statistical difference between male and female karate athletes in the variables: fat percentage (.004), mass without fat (.000), muscle mass (.000), total amount of water in kilograms (.000), total amount of water in percentage (.000), bone weight (.000), basal metabolic value in KJ (.000), basal metabolic value in kcal (.000) and jump height (.000).

DISCUSSION

Based on the results of the correlation of body composition variables and variables for evaluating the explosive power of the lower extremities in top male karate players, a significant correlation was observed, which indicates the importance of body composition for performance in jumping and explosive power. First, a strong positive correlation between body mass (weight) and jump time (.733), as well as jump height (.734) suggests that a higher body mass contributes to a higher jump time, but also to a higher jump height. This result can be interpreted as an indication that karate fighters with a larger total mass tend to generate a larger force needed for the jump, but also that due to their larger mass, they need more time to perform the jump. The negative correlation between fat percentage

and jump height at 50.8 cm (-.623) indicates that a higher proportion of fat tissue negatively affects the ability of karate athletes to reach higher jump heights. This is the expected result, since adipose tissue represents a part of the body composition that does not contribute to force generation, but additionally burdens the organism, reducing explosiveness. Marković and Sekulić (2006) state that increasing fat mass does not have a positive effect on explosive power. Similarly, fat weight shows a statistically significant correlation with jump time and jump height (.598 and .566), while a negative correlation with jump height at 50.8 cm (-.672) confirms that a larger amount of fat tissue adversely affects explosiveness karate strength. These data highlight the importance of optimizing body composition, especially reducing fat tissue, for better results in explosive movements. Body mass without fat (mass without fat), muscle mass (muscle mass), as well as the total amount of water in the body in kg (total amount of water in kg), show a significant positive correlation with the time and height of the jump. The results showed that higher fat-free mass, higher muscle mass and higher water volume were associated with better performance in explosive movements. Research by Cormie et al. (2011) showed that muscle mass and strength are key factors for generating explosive power, which is in line with the findings of this paper, where greater muscle mass shows a positive correlation with jump performance. Similar results were recorded in the research on sprinters, where greater muscle mass positively correlated with performance in running and jumping (Marković & Mikulić, 2010). Kubo et al. (2017) confirmed in research on basketball players that a lower percentage of fat tissue was associated with greater explosive power. These variables directly reflect the functional aspects of the body (muscles and water), which is crucial for generating power and movement efficiency. On the other hand, it is interesting to note the positive correlation between the variables of the total amount of water in percentage (total amount of water in percentage) and the height of the jump at 50.8 cm (.686). These results suggest that optimal body hydration is an important factor for jumping performance, which may be relevant for karate athletes' preparations in terms of maintaining an adequate level of hydration. Bone weight and basal metabolism (either in KJ or kcal) also show strong correlations with jump time and height (.644 and .651 for bone weight, .581 and .593 for basal metabolism). The above results indicate that karate with higher bone mass and higher basal metabolism perform better in explosive movements, probably because these variables contribute to overall physical strength and jumping capacity. Also, BMI shows the strongest positive correlation with jump time and height (.854 and .836), which may mean that karate with a higher body mass index, which is not necessarily just an indicator of body fat but of overall muscle mass and body structure, tends to perform better results in explosive movements. However, it should be taken into account that too high BMI, caused by excessive fat mass, can be counterproductive. The negative correlation between fats of internal organs and jump height at 50.8 cm (-.598) suggests that an increased amount of visceral fat may reduce the ability to generate explosive power. This is relevant because visceral fat is not directly related to the performance of muscle tissue, but is an indicator of a worse metabolic and health picture, which can negatively affect sports efficiency. When it comes to karate women, the first significant correlation was identified between body height (height) and jump height at 50.8 cm (.568). This positive correlation suggests that taller karate have an advantage in reaching higher jump heights. This can be explained by the fact that taller athletes have longer lower limbs, which can enable greater impulse during the jump and better mechanical performance in force production. Body weight shows a negative correlation with jump time and jump height (-.571 and -.610). This result indicates that increased body mass may interfere with the ability to rapidly generate explosive force and jump height. Heavier athletes may have difficulty achieving optimal speed and jump height, especially if that weight comes from fat or other non-functional components. A similar pattern was observed in mass without fat and muscle mass, which have negative correlations with jump time and height (-.551 and -.548). Although muscle mass is critical for force generation, these results may indicate that karate with greater muscle mass have some limitation in the efficiency of performing rapid explosive movements, possibly due to the increased load that comes with greater total body mass. Kostić et al. (2006) state in their research that a higher percentage of fat mass can negatively affect performance. The positive correlation between total amount of water in kilograms and jump height (.500) highlights the importance of optimal hydration for performance. Water plays a key role in muscle function and circulation, so karate with a higher percentage of body water can generate explosive power more efficiently. Interestingly, the percentage of water in the body (total amount of water in percentage) shows a high positive correlation with the time and height of the jump (.698 and .753), which emphasizes the importance of proper hydration for optimizing performance in explosive movements. On the other hand, bone weight shows a negative correlation with jump time and height (-.596 and -.596), suggesting that although stronger bones may contribute to overall body strength, excessive bone mass may limit explosiveness and efficiency in jumping. . The stated result on the positive correlation between the percentage of water in the body and explosive power

(.698 and .753) complements the research that indicates the importance of optimal hydration for sports efficiency (Casa, et al., 2005). Basal metabolic parameters, including values in kilojoules (KJ) and kilocalories (kcal), were also negatively associated with jump time and height (-.556 and -.560). These results suggest that athletes with a higher basal metabolic rate, which is often associated with greater body mass or greater muscle mass, may have reduced efficiency in performing fast, explosive movements, possibly due to the energetic costs of maintaining a larger body at rest. One of the interesting results is the high positive correlation between metabolic years and explosive leg strength 2.5 (.708). This association may indicate that karate with a "younger" metabolic age, which is an indicator of good physical fitness and metabolism, are able to generate greater explosive power. This is important because metabolic age reflects a karate general physiological ability and fitness level. The strongest negative correlation was observed between body mass index (BMI) and jump time and jump height (-.755 and -.777). This is a key observation, as it indicates that athletes with a higher BMI, which may be caused by excess fat or uneven mass distribution, perform worse in explosive tests. Excess body mass, especially in the form of fat, can severely limit the ability to generate rapid force and achieve greater jumping height.

When it comes to differences between men and women, independent samples t-test results showed significant statistical differences in body composition and lower extremity explosive power variables. These differences point to physiological and physical characteristics that influence sports performance and allow insight into the specific needs of both genders for adjusting training and optimizing results. One of the most important variables, fat percentage, showed a significant difference between men and women (.004). In accordance with biological characteristics, women have a higher percentage of fat tissue than men, which can affect performance. Adipose tissue is considered "unregrettable" in sports that require explosiveness and speed, and this statistic is expected. These data emphasize the need for women, even though they naturally have a higher body fat percentage, to focus their training on reducing fat tissue without compromising their muscle mass. Mass without fat, as well as muscle mass, also showed statistically significant differences (.000). Men have significantly more muscle mass and total fat-free mass compared to women, which directly affects their performance in explosive sports like karate. These results confirm that muscle mass plays a key role in generating the power needed to perform explosive movements such as jumps and kicks. The difference in the total amount of water in kilograms and percentage (.000 for both variables) further highlights the differences in physical structure between the genders. Men have a higher amount of water in their body, both in absolute amounts and in percentages. Water is essential for maintaining muscle function, transporting nutrients and maintaining optimal performance, and a higher amount of water in men can contribute to better regeneration and muscle endurance. Also, bone weight shows a significant difference (.000), with men having a higher bone mass. This difference may be related to men's greater overall body mass and body structure, which gives them a more stable base for power generation in explosive movements. Basal metabolism, expressed in kilojoules (KJ) and kilocalories (kcal), also shows a significant difference between genders (.000). Men have a higher basal metabolic rate, which indicates a higher energy expenditure at rest. This data is consistent with the differences in muscle mass and total body composition, because a larger amount of muscle tissue requires more energy to maintain. This may have implications for nutritional needs and recovery strategies in athletes, as men require more energy to maintain optimal performance. The most significant difference was observed in the jump height variable at 50.8 cm, where men achieved significantly better results compared to women (.000). This difference is directly related to higher muscle mass, lower percentage of fat tissue and higher amount of water in the body in men. Given that the height of the jump is one of the key indicators of the explosive strength of the lower extremities, these results indicate the natural advantages of men in this type of physical activity. The difference in performance between the genders noted in this paper, where men achieved significantly better results in jump height and had greater muscle mass, is also consistent with works that analyze differences in sports performance. For example, studies in athletics and gymnastics (Thomas, et al., 2016) confirm that men generally have an advantage in explosive movements due to greater muscle mass and a lower percentage of fat tissue. However, the specificity of this research lies in the fact that it is about top karate players, which means that the differences between the genders could be less pronounced compared to some other sports, considering the nature of karate, which implies a high level of technical and tactical preparation in addition to physical fitness. Smith et al. (2024) in a study entitled "gender differences in martial arts: a study of performance and training in karate" stated that men exhibited greater strength and speed, while women often exhibited superior accuracy and flexibility.

CONCLUSION

The data obtained in this research emphasize the importance of optimizing body composition, especially in terms of fat tissue reduction, to achieve better results

in explosive movements. The t-test results indicate significant differences between men and women, with men having better results in variables related to explosive strength and body composition, which is consistent with differences in muscle mass and overall body composition. Men had more muscle and bone mass, as well as more water, which allows them to perform better in jumps and other explosive activities. The obtained statistical indicators have significant implications for planning training and adjusting nutrition programs for both genders, in order to improve sports performance. It is especially important to focus training on reducing fat tissue and increasing muscle mass in athletes, while maintaining adequate hydration levels. The results of this research can be useful to the Karate Federation of Bosnia and Herzegovina in order to improve the performance of competitors.

REFERENCES

B Berak, M. and Cvjetan, V. (2003). Karate Manual. River

Cormie, P., McGuigan, M.R., & Newton, R.U. (2011). "Developing maximal neuromuscular power: Part 1—biological basis of maximal power production." Sports Medicine, 41(1), 17–38.

Cormie, P., McGuigan, M.R., & Newton, R.U. (2011). "Developing maximal neuromuscular power: Part 2—training considerations for improving maximal power production." Sports Medicine, 41(2), 125–146.

Espinós, A. (2020). World karate federation book, WKF.

Kafedžić E; Kapo S. and Kajmović, H. (2005) Periodization in Karate, Sarajevo: International Scientific Symposium - New Technologies in Sport

Kapo, S. (2008) Karate Sarajevo: Faculty of Sports and Physical Education

Kostić, R., Zagorc, M., Uzunović, S., and Miletić, Đ. (2006). "Effect of body composition parameters on explosive strength performance in adolescent female soccer players." *Facta Universitatis, Series: Physical education and sport.

Kostić, R., Zagorc, M., Uzunović, S., and Miletić, Đ. (2006). "Effect of body composition parameters on explosive strength performance in adolescent female soccer players." *Facta Universitatis, Series: Physical Education and Sports.

Kukolj, M., Ropret, R., Ugarković, D., & Jaric, S. (1999). "Anthropometric, strength, and power predictors of sprinting performance." Journal of Sports Medicine and Physical Fitness, 39(2), 120-122.

Malisoux, L., Francaux, M., Nielens, H., & Theisen, D. (2006). "Stretch-shortening cycle exercises: an effective training paradigm to enhance power output of human single muscle fibers." Journal of Applied Physiology, 100(3), 771-779.

Marković, G. and Sekulić, D. (2006). "Modeling the influence of body size on weightlifting and powerlifting performance." Collegium Antropologicum.

Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2004). "Reliability and factorial validity of squat and countermovement jump tests." Journal of Strength and Conditioning Research, 18(3), 551-555.

Smith, JA, & Johnson, LM (2024). Gender differences in martial arts: A study of performance and training in karate. Journal of Sports Science and Martial Arts, 12(3), 45-62.

Smith, S. (2003). Karate. Zagreb: Znanje.

Conflict of Interest

The authors do not have any conflicts of interest to disclose. All co-authors have reviewed and concurred with the manuscript's content, and no financial interests need to be reported.