

ORIGINAL SCIENTIFIC PAPER

Comparative Analysis of Anthropometric Characteristics and Body Composition among Elite Female Futsal Players in Montenegro, North Macedonia and Croatia

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Abstract

Anthropometric characteristics and body composition play an important role in achievements in most sports, however, there are still no specific recommendations on anthropometry-body composition for women in futsal. The research aimed to determine differences in anthropometric characteristics and body composition between elite female futsal players, members of the best futsal clubs in Montenegro, North Macedonia, and Croatia. The sample of respondents consisted of 30 elite female futsal players. The first sub-sample consisted of players from Montenegro ($n=11$, 19.18 ± 2.44 yrs), the second sub-sample consisted of players from North Macedonia ($n=10$, 18.10 ± 3.03 yrs), and the last sub-sample was consisted by players from Croatia ($n=9$, 20.33 ± 5.17 yrs). Anthropometric characteristics and body composition were evaluated by a battery of 11 variables: body height (BH), body mass (BM), triceps skinfold (TS), biceps skinfold (BiS), back skinfold (BS), abdominal skinfold (AS), upper leg skinfold (UIS), lower leg skinfold (LIS), body mass index (BMI), fat percentage (FP), and muscle mass percentages (MP). Based on the ANOVA and post-hoc tests, findings showed that there are differences between the groups in 4 anthropometric parameters such as body height, body mass, abdominal skinfold, and muscle mass percentages. Female futsal players from Montenegro and Croatia have significantly higher results in parameters such as body height, body mass, and muscle mass percentages. While futsal players from Montenegro have significantly higher abdominal skinfold values than Croatia. The results suggest that there is some difference in anthropometry-body composition between groups of female futsal players, but for more complete conclusions an analysis should be performed on a larger sample of high-level female futsal players. However, despite that, this research made a significant contribution because it was the first to identify differences in anthropometric characteristics and body composition among elite female futsal players from different countries in this part of the world. In this way, it has opened the doors for further research into the anthropometry of female futsal players in this region.

Keywords: female, professional futsal players, morphological characteristics, body fat percentages

Introduction

The International Association Football Federation (FIFA) has authorized the five-a-side indoor soccer game known as futsal, which has been played for more than 80 years and

has gained popularity all over the world (Komici, Verderosa, D'Amico, Parente, & Guerra, 2023). One of the fastest growing indoor sports in the globe during the past ten years has been futsal. In the mentioned game, two teams of five play-



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ers—four on-court players, plus the goalkeeper - play against one another (Spyrou, Ribeiro, Ferraz, Alcaraz, & Travassos, 2023). In contrast to soccer, which uses 11 athletes per team, this game has a pivot (attacker), a fixed (defender), and two wings (left and right). Futsal is played with considerable intensity on a smaller field (20x40 m) for a shorter amount of time (2x20 min) (Queiroga, Cavazzotto, Portela, Tartaruga, & Silva, 2019). In addition, the performance is the impact of combining several high-intensity intermittent actions (such as accelerations, ion, decelerations, and direction changes) to fulfill certain tactical requirements (Atakan, Karavelioğlu, Harmancı, Cook, & Bulut, 2019).

Various sporting disciplines have researched body composition and physical fitness (Komici et al., 2023). However, little is known about the anthropometric traits and body composition of competitive elite female futsal players, likewise, there are still no specific recommendations on anthropometry-body composition for women in futsal. Multiple techniques were used to examine body composition parameters. Body composition and anthropometric measurements are made for a variety of reasons, including tracking athletes' growth and development and identifying changes in body composition due to nutritional therapies and physical exercise (Mendoza-Muñoz, Adsuar, Pérez-Gómez, Muñoz-Bermejo, & Carlos-Vivas, 2020).

When compared to less competitively successful teams, better teams had much lower percentages of body fat (Arnason, Sigurdsson, Gudmundsson, Holme, & Bahr, 2004). It is necessary to take into account that the athlete's body composition may affect all physical performance measures. Furthermore, the fat percentage can affect sprint time and body power as measured by the vertical jump. (Castillo, Martínez-Sanz, Penichet-Tomás, Sellés, & Sospedra, 2022).

However, despite being an indoor form of the world's most popular sport, there have been little research on the morphological structure of female participants. Some authors linked female players' anthropometric characteristics to key futsal skills (ball control, ball sprint speed, passing, dribbling, and shooting), concluding that there was a direct negative relationship between fat percentage and the ability to dribble and control the ball at maximum speed, with the ability to dribble and control the ball at maximum speed being worse the higher the fat percentage (Kooshaki & Nikbakht, 2014). On the contrary, the findings imply that in order to compete at the highest level in women's futsal, they should be a greater weight, taller, and have a higher BMI than their non-elite counterparts (Gómez-Campos, Vidal-Espinoza, Muñoz-Muñoz, Vasquez, Portugal, & Bolaños, 2023). The previous findings revealed that there is no association between body combination parameters (height, weight, body fat percentage, and body mass index) and basic skills like control and shooting. However, there is a negative and substantial association between body fat percentage and dribble skill, which means that increasing this component reduces subject performance (Kooshaki & Nikbakht, 2014).

Although there is some information on the anthropometry of female futsal players, it is not consistent, so it is essential to investigate the anthropometric characteristics of female players. Furthermore, there is no research on the anthropometry of female futsal players in this region, especially no study that has compared the anthropometry of female futsal players from different countries in this region. Based on the aforementioned, the aim of this research was to determine differences

in anthropometric characteristics and body composition between elite female futsal players, members of the best futsal clubs in Montenegro, North Macedonia, and Croatia.

Method

Participants

The sample of respondents consisted of 30 elite female futsal players. The first sub-sample consisted of players from Montenegro (n=11, 19.18±2.44 yrs), the second sub-sample consisted of players from North Macedonia (n=10, 18.10±3.03), and the last sub-sample was consisted by players from Croatia (n=9, 20.33±5.17). The participants provided written consent, and the study was conducted in accordance with the Helsinki Declaration.

Measurements

Anthropometric assessments were conducted following the guidelines of the International Biological Program (Eston & Reilly, 2009). Anthropometers, calipers, and measuring tape were employed for the morphological measurements. A Tanita body fat scale (model BC-418MA) was utilized to assess body composition. Anthropometric characteristics and body composition were evaluated by a battery of 11 variables: body height (BH), body mass (BM), triceps skinfold (TS), biceps skinfold (BiS), back skinfold (BS), abdominal skinfold (AS), upper leg skinfold (ULS), lower leg skinfold (LLS), body mass index (BMI), fat percentage (FP), and muscle mass percentages (MP).

Statistics

Descriptive statistics were utilized to represent the data as mean values and standard deviations for each variable. To assess disparities in anthropometric characteristics and body composition among the three groups of futsal players, a discriminative parametric approach was employed, involving ANOVA and post-hoc testing, with a statistical significance threshold set at $p < 0.05$. Data analysis was carried out using SPSS 26.0 software (Chicago, IL, USA).

Results

Based on the descriptive statistics (Table 1), it was noticeable that Macedonian female futsal players had slightly lower body height (161.28±6.96 cm) and weight (54.84±4.60 kg) compared to players from Montenegro (169.24±3.87 cm, 63.26±6.21 kg) and Croatia (173.22±6.11 cm, 62.12±4.09 kg). The highest numerical values of BMI were observed in Montenegrin players (22.04±1.66) compared to Macedonian (21.10±1.84) and Croatian (20.69±1.20) female futsal players. On the other hand, the distribution of fat percentages was highest among Macedonian female futsal players (20.48±4.98), followed by players from Montenegro (19.22±3.95), and the lowest percentage was observed in Croatian players (18.09±3.61). Meanwhile, muscle mass values were similar between Montenegrin (28.81±1.97) and Croatian (28.79±2.11) female futsal players, and slightly lower in Macedonian players (24.61±1.72).

Based on the ANOVA with Post-hoc test (Table 1), differences were observed among the groups in anthropometric parameters. It was found that the female futsal players from Montenegro and Croatia had significantly higher values in body height (0.000) and body weight (0.002) compared to the group of Macedonian female futsal players. Additionally, sig-

nificantly higher values were found in the Montenegrin female futsal players compared to Croatian female futsal players in abdominal skinfold (0.025). In the parameter of muscle mass, the Montenegrin and Croatian female futsal players achieved

significantly higher values than the group of Macedonian female futsal players (0.000). However, there were no significant differences observed in other anthropometric characteristics among these three groups of female futsal players.

Table 1. Descriptive data and ANOVA with post-hoc test of futsal players from different clubs

	Montenegro Mean±SD	Macedonia Mean±SD	Croatia Mean±SD	p	Post-hoc
Age	19.18±2.44	18.10±3.03	20.33±5.17	.420	/
Body height	169.24±3.87	161.28±6.96	173.22±6.11	.000*	I>II, III>II
Body weight	63.26±6.21	54.84±4.60	62.12±4.09	.002*	I>II, III>II
Triceps skinfold	13.25±2.99	11.99±3.99	13.27±3.89	.669	/
Skinfold of the back	12.54±2.67	10.70±2.08	11.19±1.87	.174	/
Biceps skinfold	10.42±2.26	7.95±2.17	8.82±2.38	.056	/
Abdominal skinfold	15.55±5.88	11.14±3.93	9.92±3.27	.025*	I>III
Upper leg skinfold	12.11±4.06	10.15±4.07	11.20±3.80	.539	/
Lower leg skinfold	15.19±4.59	16.03±3.04	15.13±3.38	.840	/
Body mass index	22.04±1.66	21.10±1.84	20.69±1.20	.172	/
Fat percentage	19.22±3.95	20.48±4.98	18.09±3.61	.478	/
Muscle mass	28.81±1.97	24.61±1.72	28.79±2.11	.000*	I>II, III>II

Legend: Mean - Arithmetic mean; SD - Standard deviation; * - significant difference between groups.

Discussion

This study aimed to identify differences in anthropometric characteristics and body composition among female futsal players from different countries. Based on ANOVA and post-hoc tests, it was observed that groups of elite female futsal players from Montenegro and Croatia had significantly higher results in parameters such as body height, body mass, and muscle mass percentages compared to the group of futsal players from Macedonia. However, futsal players from Montenegro had significantly higher abdominal skinfold values than those from Croatia. There were no significant differences in other parameters among the groups. The results suggest that there are some differences in anthropometry and body composition among groups of elite female futsal players.

By examining the obtained values, it is noticed that futsal players from Macedonia have a body height similar to the average height of players from Spain and Brazil, ranging from 161.5 to 164.1 cm (Kravchychyn, Silva, & Machado, 2013; Rubio-Arias et al., 2015; Teixeira et al., 2019; Queiroga et al., 2019). However, these values are lower compared to the average height of players from Montenegro (169.2 cm) and especially Croatia (173.2 cm) in this study. Additionally, Macedonian players have a lower average body mass (54.8 kg), which is less than the values of futsal players from Montenegro (63.3 kg) and Croatia (62.1 kg), and it is approximately similar to the values of players from Spain and Brazil (58.5-62.2 kg) (Kravchychyn et al., 2013; Rubio-Arias et al., 2015; Teixeira et al., 2019; Queiroga et al., 2019; Castillo et al., 2022). When considering BMI as a measure of the degree of nutrition among futsal players, similar values are observed for all three groups (20.7-22.04), which is consistent with the results of other studies (22.3-22.6; Kravchychyn et al., 2013; Queiroga et al., 2019; Castillo et al., 2022). Among other measures, it is worth noting the thickness of abdominal skinfold, which is 15.6 mm in players from Montenegro, corresponding to data from the study (Castillo et al., 2022), while it is significantly

lower in futsal players from Macedonia and Croatia (11.1 mm and 9.9 mm, respectively).

The percentage of body fat, as an objective indicator of adipose tissue, is 18.09% for Croatia, 19.22% for Montenegro, and 20.48% for Macedonia. These results are approximately in line with values for professional female futsal players from Spain and Brazil (18.8-21.0%), although slightly higher values were reported in one study (22.4%; Queiroga et al., 2019), and significantly higher values were found in Spanish professional futsal players (27.1%; Rubio-Arias et al., 2015). On the other hand, the percentage of muscle mass varies from 24.6% in Macedonian futsal players to 28.8% in Croatian and Montenegrin players, which is significantly lower compared to a study (Castillo et al., 2022) where participants had 38.4% muscle mass. This may indicate possible differences in the way muscle mass is measured between these studies.

It should be noted that most research in these countries has focused on assessing the anthropometric characteristics and body composition of male soccer and futsal players (Arifi, Bjelica, & Masanovic, 2019; Gardasevic, Bjelica, Corluka, & Vasiljevic, 2019; Cerkez, Bjelica, Katanic, & Corluka, 2023; Katanic, Bjelica, & Milosevic, 2023), with very few studies focusing on women in these sports. This represents a limitation when comparing the given results. However, the obtained values of anthropometric parameters are roughly consistent with results achieved in anthropometric studies on female soccer players from this region (Stanković, Đorđević, Lilić, & Hadžović, 2022; Stankovic, Capric et al., 2023), as well as other female athletes (Milic et al., 2017; Katanic, Bjelica, & Covic, 2022) from these areas.

The main findings of this study indicate that the groups of female futsal players from Montenegro and Croatia are significantly taller and heavier than the group of futsal players from Macedonia. These findings align with the assertions of Gomez-Campos and colleagues (2023), who emphasize that female futsal players aiming to compete at the highest lev-

el should have slightly higher body weight, greater height, and a higher BMI compared to their non-elite counterparts. Montenegro players had significantly higher values in abdominal skinfold compared to Croatian futsal players. Additionally, both Montenegro and Croatia player groups achieved significantly higher values in muscle mass percentages compared to the group of Macedonian futsal players. There were no significant differences in other parameters among the groups. These results cannot be directly compared to other studies because this is the first study evaluating anthropometric parameters in female futsal players in this specific region. However, some studies that assessed differences in anthropometric parameters based on residential and regional characteristics did not find differences among participants from similar regions (Gardasevic, Bjelica, Corluka, & Vasiljevic, 2019; Ilic, Vitasovic, Katanic, Rakocevic, & Vasileva, 2023). In contrast, some studies did find differences in certain anthropometric parameters based on place of residence (Katanic et al., 2023). Nevertheless, drawing conclusions can be challenging due to the different samples of participants, so further anthropometric research, especially on female athletes from these countries, is needed in the future.

The previous findings have revealed that there is no association between body composition parameters (height, weight, body fat percentage, and body mass index) and fundamental skills such as ball control and shooting. However, there is a negative and significant correlation between body fat percentage and dribbling skill, indicating that an increase in this component reduces the subject's performance (Kooshaki & Nikbakht, 2014). In comparison to less successful teams, better teams have a much lower body fat percentage (Arnason, Sigurdsson, Gudmundsson, Holme, & Bahr, 2004). It is known that body fat percentage can affect sprint time and lower limb explosive power (Castillo et al., 2022). Therefore, in line with this, Kooshaki and Nikbakht (2014) found a direct negative relationship between body fat percentage and the ability to control, dribble, and handle the ball at maximum speed. Additionally, the results have shown a negative correlation between agility and the fat component, as well as a positive correlation between the muscle component and aerobic capacity, agility, speed, and explosiveness (Stankovic, Capric et al., 2023). These findings underscore the importance of maintaining optimal body composition in female futsal players, as it

can significantly impact their performance in various aspects of the game.

It should be emphasized that this is one of the rare studies in this field, and the only one that has examined the differences in anthropometry among elite female futsal players in this region. Therefore, it may serve as a stimulus for future researchers to conduct more detailed investigations into the anthropometric status of professional female futsal players in the region. Particularly, considering that, based on a systematic analysis (Katanić, Ugrinić, & Ilić, 2019), anthropometric characteristics and body composition have been identified as among the most significant parameters in football, it can be expected that anthropometric characteristics could be a crucial factor in futsal as well.

One of the limitations of this study pertains to the small sample size, especially within subgroups, making it challenging to generalize the obtained results. Therefore, future studies should aim to research a larger sample of female futsal players, considering position-specific anthropometric parameters. Additionally, alongside anthropometric measurements, incorporating specific motor tests could provide insights into the overall morpho-motor status of female futsal players.

Conclusion

The results indicate that there are differences in anthropometry and body composition among groups of elite female futsal players from different countries. It is known that an effective training program depends on understanding the anthropometric parameters and body structure of professional futsal players, as well as the demands placed on them directly during matches (Stanković, Đorđević et al., 2023). Therefore, the practical implications of this study would be to provide significant information about the anthropometry of female futsal players, which would be beneficial for practitioners and coaches in their work.

However, for more comprehensive conclusions, an analysis should be conducted on a larger sample of high-level female futsal players. Nevertheless, this research has made a significant contribution as it was the first to identify differences in anthropometric characteristics and body composition among elite female futsal players from different countries in this part of the world. In this way, it has paved the way for further research into the anthropometry of female futsal players in this region.

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Conflict of Interest

The author declares that there is no conflict of interest.

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