

Sex-Based Analysis of Body Components in Elite First-League Handball Players

Elit Birinci Lig Hentbol Oyuncularında Vücut Bileşenlerinin Cinsiyete Göre Analizi

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Abstract

The effects of sex differences in body components have been researched for years by the scientists. The purpose of this research was to examine the sex-based analysis of body components in elite first-league handball players. 28 participants were included in the study. Participants were divided into two different groups according to sex. Female group (n: 10; 24.57±5.44 years, 170.40±4.96 cm, 66.19±5.52 kg, 22.79±1.63 kg/m²) and male group (n:18; 25.67±4.51 years, 191.38±6.85 cm, 102.00±14.99 kg, 22.78±3.33 kg/m²). In this research study body components of the participants such as body fat, protein, mineral, muscle mass and basal metabolic rate were measured by Tanita TBF-300 body composition analyser. The collected data were analysed using the IBM SPSS Statistics 24 software package. Variable distributions were examined based on sex. To assess the normality of the data and the homogeneity of variances, the Shapiro-Wilk test was employed. Descriptive statistics and independent samples t-tests were used to compare the participants' data, with the significance level. There was a high significant difference in body water (p=0.00**; t=-11.54), protein (p=0.00**; t=-11.83), mineral (p=0.00**; t=-10.36), core muscle mass (p=0.00**; t=-11.93) and basal metabolic rate (p=0.00**; t=-11.93) in favour of male group. It was observed that data of the male group was higher than the female group for each body components. There was no significant difference in body fat mass values (p=0.88; t=-0.10). In conclusion, it was observed that sex have effects on body components of professional league handball players. It can be said that male handball players have high levels of body components such as body fat, protein, mineral, muscle mass and basal metabolic rate according to female players. Further research is also needed to assess the body components of professional players.

Keywords Body Components, Body Fat, Mineral, Muscle Mass, Protein.

Öz

Cinsiyet farklılıklarının vücut bileşenleri üzerindeki etkileri, bilim adamları tarafından yıllardır araştırılmaktadır. Bu araştırmanın amacı, birinci lig elit hentbolcularında cinsiyete dayalı vücut bileşenleri analizini incelemektir. Araştırmaya 28 katılımcı dahil edilmiştir. Katılımcılar cinsiyete göre iki farklı gruba ayrılmıştır. Kadın grubu (n: 10; 24,57±5,44 yaş, 170,40±4,96 cm, 66,19±5,52 kg, 22,79±1,63 kg/m²) ve erkek grubu (n:18; 25,67±4,51 yaş, 191,38±6,85 cm, 102,00±14,99 kg, 22,78±3,33 kg/m²). Bu araştırma çalışmasında, katılımcıların vücut yağı, protein, mineral, kas kütlesi ve bazal metabolizma hızı gibi vücut bileşenleri Tanita TBF-300 vücut kompozisyon analizörü ile ölçülmüştür. Toplanan veriler IBM SPSS Statistics 24 yazılım paketi kullanılarak analiz edilmiştir. Değişken dağılımları cinsiyete göre incelenmiştir. Verilerin normalliği ve varyansların homojenliği değerlendirmek için Shapiro-Wilk testi kullanılmıştır. Katılımcıların verilerini karşılaştırmak için tanımlayıcı istatistikler ve bağımsız örneklem t-testleri kullanılmıştır. Vücut suyu (p=0,00**; t=-11,54), protein (p=0,00**; t=-11,83), mineral (p=0,00**; t=-10,36), çekirdek kas kütlesi (p=0,00**; t=-11,93) ve bazal metabolizma hızı (p=0,00**; t=-11,93) açısından erkek grubu lehine yüksek anlamlı bir fark gözlenmiştir. Erkek grubunun verilerinin her bir vücut bileşeni için kadın grubundan daha yüksek olduğu gözlenmiştir. Vücut yağ kütlesi değerlerinde anlamlı bir fark gözlenmemiştir (p=0,88; t=-0,10). Sonuç olarak, cinsiyetin profesyonel lig hentbolcularının vücut bileşenleri üzerinde etkisi olduğu belirlenmiştir. Erkek hentbolcuların kadın oyunculara göre vücut yağı, protein, mineral, kas kütlesi ve bazal metabolizma hızı gibi vücut bileşenleri açısından daha yüksek seviyelere sahip olduğu söylenebilir. Profesyonel oyuncuların vücut bileşenlerini değerlendirmek için daha fazla araştırma yapılması gerekmektedir.

Anahtar Kelimeler: Vücut Bileşenleri, Vücut Yağı, Mineral, Kas Kütlesi, Protein.

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Introduction

Handball is a dynamic team sport that requires high levels of physical endurance, strength and agility. Success in this sport is closely related to the physical characteristics and body components of the players. Body components are one of the important factors affecting the athlete's performance and may differ depending on gender (Yel et al., 2023).

Research has shown that there are significant differences in body composition between male and female handball players. For example, in a study of Polish elite handball players, an increase in lean mass and muscle mass and a decrease in fat mass were observed in both genders during a five-week pre-season training camp. However, the rate of these changes differed by gender; the increase in lean mass and muscle mass was more pronounced in female athletes, while the decrease in fat mass was greater in male athletes (Cichy et al., 2020). Similarly, another study on Italian female handball players found that elite level players had lower fat percentage and higher bone mineral content than sub-elite level players. In addition, differences in body components were also found according to playing positions; for example, significant differences were found between wingers and goalkeepers in measures such as height, body mass and fat percentage (Milanese et al., 2011).

In this context, it is important to examine gender-related body component differences in handball players at the professional league level, both in terms of personalization of training programs and performance optimization. This study aims to better understand the effects of gender-specific physical characteristics on sports performance by comparing the body composition of male and female professional handball players. Body composition refers to the ratios related to fat, muscle, water, bone and other tissues that make up an individual's body composition and are the basic components. This parameter is used to understand the distribution of different tissues in the body, rather than just total body weight, and provides important information about an individual's general health status, physical fitness, and sports performance (Kuriyan, 2018).

Body component analysis is used to assess the health status of individuals, develop weight management strategies and optimize sports performance. Especially in athletes, a high proportion of lean mass (muscle and bone) positively affects performance indicators such as strength and endurance. Furthermore, controlling body fat percentage plays a critical role in reducing the risk of obesity and metabolic diseases (Lemos and Gallagher, 2017).

The main aim of this study was to investigate the body components of professional league handball players according to gender variable.

Materials and Methods

Research Model

This study had an experimental design. In the study, causal comparison method was used.

Research Group

The research group of this study consists of 25 professional elite first-league handball players who participated in the Turkish Super League of the Turkish Handball Federation in 2025. The athletes were divided into two groups as male and female subjects. The study was conducted with the principles in Declaration of Helsinki to ensure the rights, safety, and well-being of the participants.

Data Collection Tools

Height, Body Weight Measurements:

The body weight of the participants was measured by an electronic scale with a sensitivity of 0.1kg. Height was measured to the nearest 1 cm using a portable stadiometer (Holtain Ltd, UK). During the measurement, data were obtained by keeping the participants' hands and feet still and in contact with the measurement points. Body weight and height were measured and used to calculate body mass index (BMI). Body mass index (BMI) was calculated in kg/m².

Body Component Measurements:

Body components of the participants were measured with Tanita body composition analyser. Tanita bioelectrical impedance analysers (BIA) are portable and practical tools that are widely used in the assessment of body composition. These devices measure the electrical resistance of tissues by sending a low-level electric current through the body and use this data to estimate parameters such as body fat percentage, fat-free mass and total body water (Kelly and Metcalfe, 2012).

Scientific research has examined the validity of Tanita devices in body composition assessment. In a study by Jebb et al. (2000), body fat mass measurements obtained with the Tanita device were compared with the four-component model and the mean difference was found to be 0.8 kg. This result suggests that the Tanita device provides reasonable accuracy in estimating body fat mass.

Data Analysis

The participants' data in the study were analysed using the IBM SPSS Statistics 21 software package. The distributions of the variables were evaluated based on gender. The Shapiro-Wilk test was used to assess the normality of the data and the homogeneity of variances. To compare participant data, descriptive statistics and independent samples t-tests were applied. A significance level of $p < 0.05$ was considered for statistical analyses.

Results

Table 1: Descriptive statistics of the participants.

Variable	n	$\bar{x}$	$\pm$	SD	Min	Max
Age (years)	28	25.28	$\pm$	4.79	17.00	34.00
Height (cm)	28	183.89	$\pm$	11.94	164.00	210.00
Body Weight (kg)	28	89.21	$\pm$	21.37	57.60	144.60
BMI (kg/m ²)	28	26.00	$\pm$	3.72	20.70	37.60

According to the descriptive information data presented in Table 1. 28 participants took part in the study. According to the descriptive information the mean age, height, weight

and BMI of the participants were 25.28 ± 4.79 years, 183.89 ± 11.94 cm, 89.21 ± 21.37 kg, 26.00 ± 3.72 kg/m².

Table 2: Comparison of the descriptive information in terms of group variable.

Variable	Group	n	$\bar{X}$	$\pm$	SD	t	df	P
Age (years)	Female	10	24.57	$\pm$	5.44	-0.57	26	0.57
	Male	18	25.67		4.51			
Height (cm)	Female	10	170.40	$\pm$	4.96	-8.49	26	0.00**
	Male	18	191.38		6.85			
Body weight (kg)	Female	10	66.19	$\pm$	5.52	-7.23	26	0.00**
	Male	18	102.00		14.99			
BMI (kg/m ²)	Female	10	22.79	$\pm$	1.63	-4.42	26	0.00**
	Male	18	27.78		3.33			

**p<0.01

As shown in Table 2 the participants in the study were separated into two groups, as female (n:10) and male (n:18). According to the descriptive information in terms of group variable the mean age, height, weight, BMI of the female group were 24.57 ± 5.44 years, 170.40 ± 4.96 cm, 66.19 ± 5.52 kg, 22.79 ± 1.63 kg/m² and the mean age, height, weight, BMI of the Male group were 25.67 ± 4.51 years, 191.38 ± 6.85 cm, 102.00 ± 14.99 kg, 22.78 ± 3.33 kg/m². There was high significant difference found in terms of height, body mass, and BMI values between the groups in favour of male participants (p<0.01).

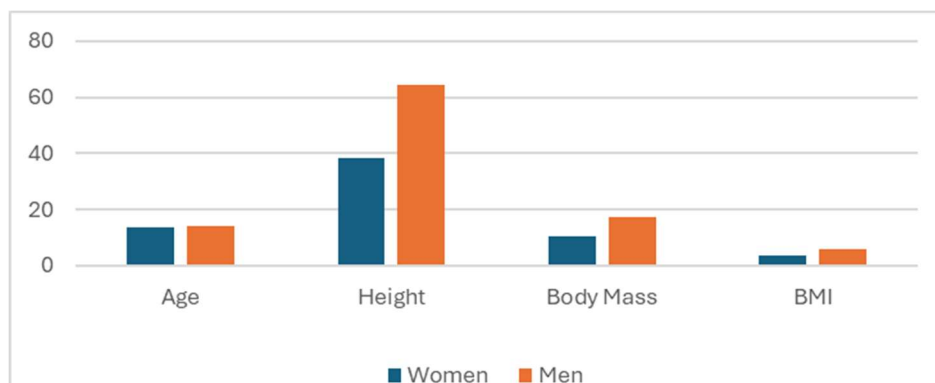
Table 3: Comparison of the body components in terms of group variable.

Variable	Group	n	$\bar{X}$	$\pm$	SD	t	df	P
Body Fat Mass (kg)	Female	10	13.76	$\pm$	3.61	-0.10	26	0.88
	Male	18	14.21		9.02			
Body Water (L)	Female	10	38.37	$\pm$	2.75	-11.54	26	0.00**
	Male	18	64.30		6.75			
Protein (kg)	Female	10	10.40	$\pm$	.75	-11.83	26	0.00**
	Male	18	17.45		1.78			
Mineral (kg)	Female	10	3.65	$\pm$	.99	-10.36	26	0.00**
	Male	18	6.03		1.50			
Core Muscle Mass (kg)	Female	10	23.20	$\pm$	1.90	-11.93	26	0.00**
	Male	18	37.77		3.56			
Basal Metabolic Rate (kcal)	Female	10	1501.70	$\pm$	80.85	-11.56	26	0.00**
	Male	18	2265.77		198.62			

**p<0.01

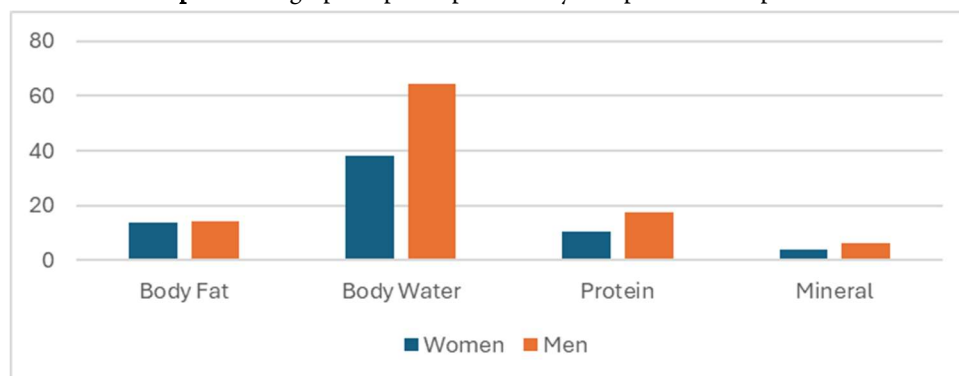
As shown in Table 3 there was a high significant difference in body water (p=0.00**; t=-11.54), protein (p=0.00**; t=-11.83), mineral (p=0.00**; t=-10.36), core muscle mass (p=0.00**; t=-11.93) and basal metabolic rate (p=0.00**; t=-11.93) in favour of male group. It was observed that data of the male group was higher than the female group for each body components except for body fat mass. There was no significant difference in body fat mass values (p=0.88; t=-0.10).

Graph 1: The graph of participants' descriptive information.



According to Graph 1 the mean age, height, weight, BMI of the Female group were 24.57 ± 5.44 years, 170.40 ± 4.96 cm, 66.19 ± 5.52 kg, 22.79 ± 1.63 kg/m² and the mean age, height, weight, BMI of the Male group were 25.67 ± 4.51 years, 191.38 ± 6.85 cm, 102.00 ± 14.99 kg, 22.78 ± 3.33 kg/m².

Graph 2: The graph of participants' body components comparison.



According to Graph 2 the mean body fat, body water, protein and mineral of the Female group were 13.76 ± 3.61 kg, 34.87 ± 2.75 l, 10.40 ± 0.75 kg, 3.65 ± 0.99 kg, 23.60 ± 1.90 kg and the mean body fat, body water, protein and mineral of the Male group were 14.21 ± 9.02 kg, 64.30 ± 6.75 l, 17.45 ± 1.78 kg, 6.03 ± 1.50 kg, 37.77 ± 3.56 kg.

Discussion and Conclusion

The results showed that male handball players had significantly higher values than female players for body components such as body water, protein, minerals, muscle mass and basal metabolic rate, while there was no significant difference between the sexes for body fat mass. This suggests that although male handball players have more muscle mass and a higher metabolic rate, body fat percentage may not differ significantly between the sexes in elite athletes.

Due to physiological and hormonal differences between the sexes in handball athletes, male athletes are generally considered to have higher levels of lean body mass and metabolic activity compared to female athletes (Malina et al., 2004; Nikolaidis and Ingebrigtsen, 2013). A study by Cichy et al. (2020) analyzed the change in body composition of elite handball players and found that male players had higher levels of components such as body water, lean body mass and muscle mass than female players.

These findings are consistent with the existing literature, which reports that male players generally have higher levels of lean body mass and metabolic activity (Malina et al., 2004; Nikolaidis and Ingebrigtsen, 2013). Similarly, a study by Radke (2022) analyzed the body composition of handball players at university level according to the position they played. In this study, significant differences were found between goalkeepers, wingers and defenders in terms of body fat percentage and total body fat. These findings suggest that body composition may vary not only according to gender, but also according to the position a player plays. In the study looking at the body composition of athletes from different sports, handball and weightlifters were found to have more subcutaneous body fat than footballers, wrestlers and taekwondo players in terms of body fat content.

Wilmore et al (2004) attributed the significantly higher basal metabolic rate (BMR) in male participants in their study to the close relationship between muscle mass and BMR rate, arguing that higher BMR values would occur in male athletes because increased muscle tissue requires more energy at rest. Previous studies have shown that there are sex differences in skeletal structure and body composition, with protein and mineral levels also observed to be significantly higher in male players due to greater lean mass and bone density, while men generally have higher mineral content, which contributes to strength and performance advantages in sports that involve frequent physical contact and power movements, such as handball (Astrand, 2003; Silva et al., 2013).

It has been observed that elite female handball players tend to maintain a similar or slightly higher body fat percentage than male handball players (Reilly et al., 2009). The fact that there was no significant difference in body fat mass between the sexes in our study is consistent with studies in the body composition assessment literature. In particular, the high proportion of fat in male handball players is an advantage in terms of mass ratio. Within the framework of this evaluation, there is no study in the literature that defines the specific effects of body components of handball athletes on performance. When analyzing body composition, it is recommended that inter-sport differences are considered, and that body fat percentage alone is not always a sufficient indicator of athletic fitness or performance capacity. (Ziv & Lidor, 2009).

The results showed that the body composition of professional handball players differs according to gender and that these differences should be considered in training and performance assessment. Tailoring training plans to the individual characteristics of players using body composition analysis applications may increase the effectiveness of training and allow a more accurate assessment of the health status of players. Training programs should be tailored according to the sex-specific differences in body composition observed among elite handball players. Regular monitoring of body composition is important to guide adjustments in training and nutrition effectively.

Additionally, it is essential to consider playing position-related variations in body components when designing conditioning and skill training. Further research is recommended to explore how body composition influences performance, injury risk, and rehabilitation outcomes over time.

Kısaltmalar / Abbreviations

SD	Standart sapma (Standard deviation)
X	Ortalama (Mean)
SPSS	Sosyal bilimler için istatistik paketi (Statistical package for the social sciences)
p value	Anlamlılık değeri (Significant value)
t value	T değeri (T value)
N	Katılımcı sayısı (Number of participant)
Min	Minimum (Minimum)
Max	Maksimum (Maximum)
BMI	Vücut kütle indeksi (Body mass index)
Kg	Kilogram (Kilogram)
Cm	Santimetre (Centimeter)

L Litre (Liter)
Kcal Kilokalori (Kilocalorie)
W Wat (Watt)

Beyanlar / Declarations

Etik Onay ve Katılım Onayı / Ethics approval and consent to participate

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During the preparation and writing of this study, scientific, ethical and citation rules were followed in accordance with the ‘Higher Education Institutions Scientific Research and Publication Ethics Guidelines’; no alterations were made to the collected data, and this study has not been submitted for evaluation to any other academic publication medium. The author is solely responsible for any violations that may arise in connection with this article. The Ethical approval for the study was granted by the Ethical approval for the study was granted by the Scientific Research and Publication Ethics Committee of Kütahya Dumlupınar University, Faculty of Social and Human Sciences (document no. 28/07/2025-2025/07). All participants voluntarily participated in this study.

Veri Ve Materyal Erişilebilirliği / Availability of data and material

Bu çalışmanın bulgularını destekleyen veriler, makul talepler üzerine sorumlu yazardan temin edilebilir. Veri seti yalnızca akademik amaçlar için erişilebilir olacak ve verilerin herhangi bir kullanımı, orijinal çalışmayı referans gösterecek ve katılımcıların gizliliğini koruyacaktır.

The data that support the findings of this study are available from the corresponding author upon reasonable request. The dataset will be accessible only for academic purposes, and any use of the data will recognize the original study and maintain the confidentiality of the participants.

Çıkar Çatışması / Competing interests

Yazarlar, bu makalede sunulan çalışmayı etkileyebilecek herhangi bir çıkar çatışması veya kişisel ilişkiye sahip olmadıklarını beyan etmektedirler.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Yazar Katkıları / Authors’ Contribution Statement

Çalışmanın tasarımı ve planlanması: S.Ö., S.A.; Veri toplama, analizi veya yorumlanması: S.Ö., S.A.; Makalenin yazımı: S.Ö., S.A.; Veri düzenleme, yöntem belirleme, yazım – özgün taslak, yazım – gözden geçirme ve düzenleme: S.Ö., S.A.; Tüm yazarlar, makalenin önemli noktalarını eleştirel bir şekilde gözden geçirmiştir. Tüm yazarlar makalenin son halini onaylamıştır. /

Design and planning of the study: S.Ö., S.A.; Data collection, analysis or interpretation: S.Ö., S.A.; Manuscript preparation: S.Ö., S.A.; Data organization, methodology development, writing - original draft, writing – review and editing: S.Ö., S.A.; All authors critically reviewed the key points of the manuscript and approved the final version.

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This Bu çalışma, kamu, özel veya kar amacı gütmeyen sektörlerdeki fon sağlayıcı kurumlardan herhangi bir özel destek almamıştır.

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