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STUDY REGARDING THE VALUE OF THE PLAYERS ANTHROPOMETRIC INDICATORS MEMBERS OF THE ELITE EUROPEAN HANDBALL TEAMS QUALIFIED AT THE FINAL TOURNAMENTS

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ABSTRACT. Introduction. Handball players who manage to perform at the highest level have certain specific qualities. Through the results obtained in all world competitions, European national teams are considered the best teams in the world. **Aim.** The aim is to determine the current trend about the value of anthropometric indicators, primarily the body mass index, and its role in achieving performance. **Materials and methods.** The data of anthropometric parameters (age, height, weight, and body mass index - BMI) from 966 handball players who participated in 2016, 2018, and 2020 editions of the European Men's Handball Championship had been analyzed. Next, the finalist and non-finalist teams' BMI was analyzed, and then its evolution according to playing position. **Results.** The analysis shows that in the last three editions of the European Championship, an approximately constant value of the studied indicators is kept. The differences between the editions are not statistically significant. The average age is 27 years, the average weight is about 94 kg, the average height is 1.92 cm, and the BMI is 25. The body mass index did not register statistically significant differences for the same playing position in the last three editions analyzed. **Conclusions.** The data obtained from the study show what the current values of the leading anthropometric indicators of elite European handball players are. These indicators do not play an essential role in ranking in the first positions of the final tournament.

Keywords: *elite handball players, anthropometric indicators, body mass index-BMI, European Championship.*

REZUMAT. ***Studiu privind valoarea indicatorilor antropometrici ai jucătorilor de elită membri ai echipelor europene de handbal calificate la turneele finale.*** **Introducere.** Jucătorii de handbal care reușesc să performeze la

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cel mai înalt nivel au anumite calităţi specifice. Echipele naţionale europene, prin rezultatele obţinute la toate competiţiile mondiale, sunt considerate cele mai performante echipe. **Scop.** Scopul este de a determina tendinţa actuală în ceea ce priveşte valoarea indicatorilor antropometrici, în special indicele de masă corporală şi rolul său în atingerea performanţelor. **Materiale şi metode.** Au fost analizate datele parametrilor antropometrici (vârstă, înălţime, greutate şi indicele de masă corporală - IMC) de la 966 de jucători de handbal care au participat la ediţiile 2016, 2018 şi 2020 ale Campionatului European de handbal masculin. Apoi a fost analizat IMC-ul echipelor finaliste şi non-finaliste şi evoluţia acestuia în funcţie de posturile de joc. **Rezultate.** Analiza arată că la ultimele trei ediţii ale Campionatului European se păstrează o valoare aproximativ constantă a indicatorilor studiaţi. Diferenţele dintre ediţii nu sunt semnificative din punct de vedere statistic. Vârsta medie este de 27 de ani, media greutăţii este de 94 kg, înălţimea medie 1,92 cm, iar IMC-ul este 25. Indicele de masă corporală nu a înregistrat diferenţe statistic semnificative pentru acelaşi post de joc la cele trei ediţii analizate. **Concluzii.** Datele obţinute din studiu arată care sunt valorile actuale ale principalilor indicatori antropometrici ai handbaliştilor europeni. Aceşti indicatori nu joacă un rol decisiv în clasarea echipelor în primele poziţii ale unui turneu final.

Cuvinte cheie: *jucători de elită, indicatori antropometrici, indicele de masă corporală-IMC, Campionat European.*

Introduction

The game of handball, worldwide, is one of the most popular team sports. Handball has long exceeded the limits of entertainment and, in recent decades, has become an increasingly interesting topic to be explored scientifically and increasingly addressed by specialists in the field (Magnúsdóttir, 2019; Massuça et al., 2014; Moss et al., 2015; Prieto et al., 2015; Weber & Wegner, 2016). The game itself has developed a lot. It has become very fast and dynamic and continuous changes have been observed by introducing new rules of the game.

A significant increase is also observed in the number of matches in which an elite player must perform. High-performance athletes can play around 80 national and international matches (Michalsik, 2018). The specialists involved in this phenomenon have concluded that certain anthropometric parameters specific to the handball player are needed to cope with such a large number of matches and achieve outstanding results.

Vila et al. (2012), cited by Moss et al. (2015), state that achieving handball performance in addition to specific motor qualities depends on a series of factors. They refer to technical knowledge and the ability of players to apply them in different tactical situations. The mental capacity and their biological characteristics, physiological and, anthropometric are also essential. Anthropometric measurements are used worldwide as determinants in training monitoring (Leão et al., 2019).

Norton & Olds (2001) radically replaced the phrase "the typology of the ideal athlete" proposed by Bemies (1900) with that of the "model" of highly specialized sports constitution for each sports branch. Michalsik (2018), analyzing and comparing, over several years, the anthropometric indices of several generations of athletes, finds a general progressive increase in height and weight and a significant progress in elite athletes. There were also evolutional and genetical changes of the global population. The cited authors found that there is a correlation between athletes' height and weight and their sports career duration. The unanimous conclusion is that the number of centimeters and extra pounds are factors that influence the level of performance and determine the duration of a sports career.

We consider it extremely important to study and to be aware of as much information as possible about the players who manage to perform and get results at the highest level.

Taborsky (2007), quoted by Bilge (2012), considers that to determine the handball game's current evolutions, it is essential to carry out in-depth research of the bio-psycho-motor characteristics of the players participating in major competitions such as Olympic Games, World and European Championships. Bilge & Sevim (2007) point out that "teams in Europe make a significant contribution to the global development of the game of handball." European national teams have achieved outstanding results over time and they are consistently ranked first in world competitions.

The Body Mass Index (BMI) is a valuable physical parameter used to monitor body mass, respectively, the relationship between body weight and height (Arifi et al., 2019; Magnúsdóttir, 2019; Michalsik, 2018; Táborský, 2007). A gradual development of the elite player's constitution is observed. Although it has some limitations, BMI can assess the optimal body weight for a certain height and correlate with fat and fat-free body weight (Nikolaidis & Ingebrigtsen, 2013).

BMI, along with age, weight, and height, are part of anthropometric indicators which are considered constitutional factors that contribute to achieving success in the game of handball (Weber & Wegner, 2016).

Aim

The primary aim of this paper is to determine the value of BMI in elite players participating in the 2016, 2018, and 2020 editions of the European Men's Handball Championship. The second goal is to determine if this anthropometric indicator has significant importance in achieving performance (ranking first four places) in a final continental championship tournament.

To achieve what we have proposed to do, we have analyzed the anthropometric indicators of height and weight data. Then the body mass index - BMI has been calculated. Additionally, we have analyzed the BMI according to the playing position.

Materials and methods

The study includes the participating teams in 2016, 2018, and 2020 editions of the European Men's Championship. The analyzed data has been taken from the official websites of the European Handball Federation. The analysis of statistical data is calculated on a sample of 966 players.

The averages for age, weight, height, and BMI of the three editions' players are calculated. BMI is calculated according to the kg / m2 formula.

Statistical analysis

In the study, statistical analysis and graphical representations are performed using SPSS 20 (Statistical Package for the Social Sciences). SPSS is a modular line of fully integrated products for the analytical process - planning, data collection, access, data preparation and management, analysis, reporting, and presentation of results. The statistical data analysis is done on a sample of 966 handball players, participants in the last three editions of the European Men's Handball Championship. Descriptive analysis, t-test for independent samples, and Anova One-Way method are used.

Results

The results obtained in the table above show no statistically significant differences in terms of age, weight, height, and BMI in the last editions of the European Men's Handball Championship. The averages for the studied indicators are relatively constant. The average age is around 27 years old, the height-weight is approximately 1.92 m, and the BMI is around 25.

Tabel 1. Anthropometric parameters: age, height, weight and BMI

Edition	National team	n	Age	Height (m)	Weight (kg)	BMI
2016	Belarus	17	26.29±5.08	1.9176±0.05	90.12±8.22	24.52±2.15
	Croatia	17	26.59±3.48	1.9324±0.09	97.53±10.97	26.05±1.57
	Denmark	16	28.31±3.68	1.9275±0.06	95.07±8.41	25.68±1.53
	France	17	27.71±5.78	1.9059±0.06	92.71±10.34	25.46±1.84
	Germany	18	24.78±3.62	1.9572±0.06	96.83±9.03	25.23±1.35
	Iceland	17	29.65±4.25	1.9247±0.05	94.71±6.29	25.56±1.44
	FYR Macedonia	17	29.06±4.96	1.9129±0.04	96.71±11.09	26.36±2.24
	Montenegro	17	26.41±4.06	1.9312±0.07	95.41±9.61	25.60±2.48
	Norway	16	26.75±4.00	1.9281±0.04	92.63±9.12	24.89±2.08
	Poland	19	29.42±4.42	1.9363±0.08	91.53±10.31	24.34±1.42
	Russia	17	28.65±4.48	1.9176±0.08	90.53±12.24	24.53±2.19
	Serbia	17	28.12±4.79	1.9429±0.05	95.47±8.44	25.25±1.36
	Slovenia	16	28.25±5.10	1.9031±0.07	94.25±9.69	25.97±1.51
	Spain	17	29.47±3.60	1.9165±0.06	96.35±11.95	26.18±2.46
	Sweden	18	26.22±5.07	1.9111±0.06	92.94±9.27	25.40±1.64
	Hungary	16	26.19±4.65	1.9494±0.08	96.19±12.29	25.19±1.52
	Total	272	27.62±4.59	1.9260±0.06	94.29±9.94	25.38±1.88
2018	Austria	17	26.53±5.07	1.9047±0.08	91.71±13.07	25.19±2.39
	Belarus	17	24.88±4.64	1.9200±0.05	88.12±8.98	23.89±2.07
	Czech Republic	17	27.71±5.12	1.9394±0.07	97.47±11.75	25.89±2.44
	Croatia	21	28.95±4.50	1.9419±0.09	97.14±12.08	25.69±2.04
	Denmark	18	28.89±3.83	1.9306±0.05	96.76±7.71	25.88±1.80
	France	18	26.89±5.33	1.9361±0.06	98.06±10.09	26.12±2.00
	Germany	18	26.61±3.07	1.9450±0.05	95.94±9.01	25.33±1.30
	Islanda	16	27.75±5.39	1.9131±0.05	93.06±7.14	25.40±1.16
	FYR Macedonia	18	29.00±5.44	1.9111±0.06	94.72±14.65	25.84±3.11
	Montenegro	18	27.61±4.06	1.9133±0.05	97.78±9.20	26.70±2.21
	Norway	18	26.22±3.94	1.9328±0.05	96.28±9.14	25.72±1.68
	Serbia	19	26.37±3.77	1.9432±0.06	92.95±9.62	24.54±1.27
	Slovenia	19	25.74±3.41	1.9200±0.07	95.89±9.97	25.95±1.34
	Spain	19	29.63±4.65	1.9347±0.05	95.58±10.12	25.49±1.91
	Sweden	18	25.94±2.92	1.9144±0.06	95.89±8.71	26.12±1.34
	Hungary	18	26.17±4.57	1.9233±0.08	95.11±12.91	25.58±1.88
	Total	289	27.20±4.50	1.9269±0.06	95.21±10.51	25.59±1.99
2020	Austria	17	27.59±4.45	1.9106±0.08	94.47±13.22	25.77±2.15
	Belarus	16	28.00±5.21	1.9350±0.06	92.75±7.23	24.75±1.18
	Bosnia Herzegovina	18	29.56±4.75	1.9411±0.04	99.28±8.29	26.31±1.42
	Czech Republic	18	27.83±5.87	1.9294±0.05	93.00±10.14	24.94±2.00
	Croatia	17	27.35±4.45	1.9371±0.07	99.06±10.94	26.35±1.96
	Denmark	18	29.17±4.48	1.9239±0.04	96.00±7.57	25.93±1.77

Switzerland	16	27.31±3.64	1.9150±0.06	92.31±9.39	25.13±1.76
France	16	27.63±5.84	1.9300±0.05	97.38±9.57	26.10±1.87
Germany	17	27.53±4.00	1.9412±0.06	96.88±9.23	25.67±1.60
Iceland	17	27.47±6.74	1.9118±0.05	92.94±9.36	25.41±2.08
Latvia	16	30.50±4.96	1.9119±0.09	93.25±15.18	25.34±1.78
North Macedonia	16	27.50±5.83	1.9150±0.06	92.44±11.38	25.18±2.67
Montenegro	16	27.38±4.04	1.9175±0.04	93.19±5.31	25.33±0.98
Norway	16	25.19±3.20	1.9250±0.06	93.44±7.52	25.18±0.99
Netherlands	16	27.31±5.30	1.9063±0.08	89.81±9.98	24.71±2.13
Poland	18	25.17±3.82	1.9161±0.08	91.83±14.32	24.87±2.30
Portugal	17	28.53±5.31	1.9171±0.07	98.00±12.45	26.57±2.22
Russia	17	29.18±5.23	1.9212±0.07	89.94±9.30	24.31±1.47
Serbia	16	26.75±2.79	1.9219±0.07	93.75±10.38	25.31±1.67
Slovenia	18	26.89±3.54	1.9217±0.07	95.33±10.19	25.75±1.40
Spain	17	30.53±4.87	1.9341±0.05	95.12±9.20	25.38±1.67
Sweden	18	26.56±3.77	1.9172±0.06	95.89±11.03	25.99±1.56
Ukraine	17	27.76±4.02	1.9441±0.06	99.59±13.30	26.24±2.26
Hungary	17	24.71±4.10	1.9335±0.07	93.82±12.36	24.97±1.79
Total	405	27.64±4.77	1.9242±0.06	96.08±32.03	25.86±7.69

The graph above shows the evolution of BMI in the last three editions of the European Championship. The highest value was reached in 2018, but the differences between editions are not statistically significant.

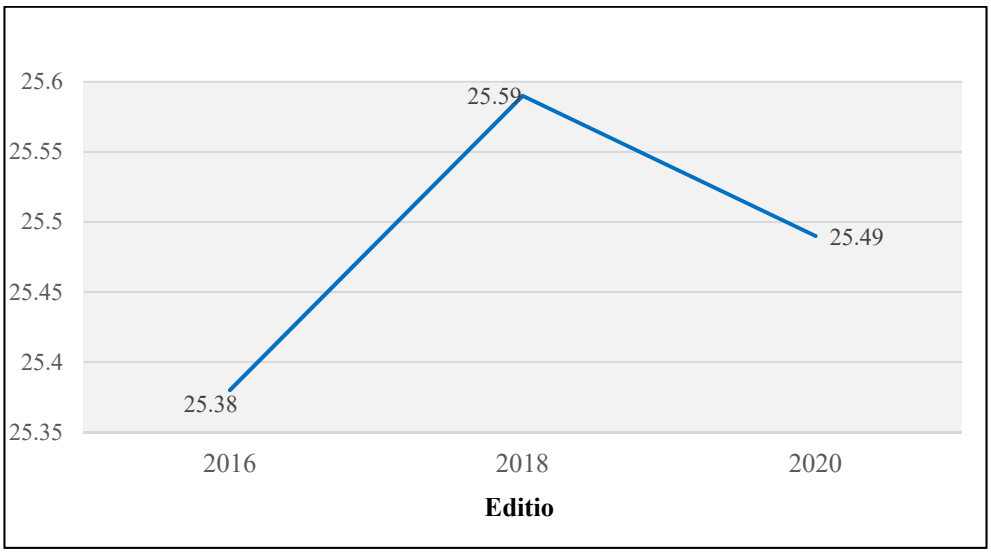

Figure 1. The evolution of BMI average

In the 2016 edition, the participating players' average BMI was 25.38 and increased to 25.59 in the 2018 edition. In the 2020 edition, there is a decrease in the average BMI to 25.49, but higher than in the 2016 edition. There are no statistically significant differences between editions in terms of BMI. For the second goal, we calculated the BMI of the first four teams of the championship (for each edition), and we have analyzed the teams ranked in the other places.

At the 2016 edition, the first four ranked teams were Norway, Croatia, Germany, and Spain. France, Denmark, Spain, and Sweden have reached the final weekend of the 2018 edition. In 2020 the teams qualified for the finals were Slovenia, Norway, Spain, and Croatia.

In 2016, Germany had won the gold medal. The same Spain team won the 2018 and 2020 editions.

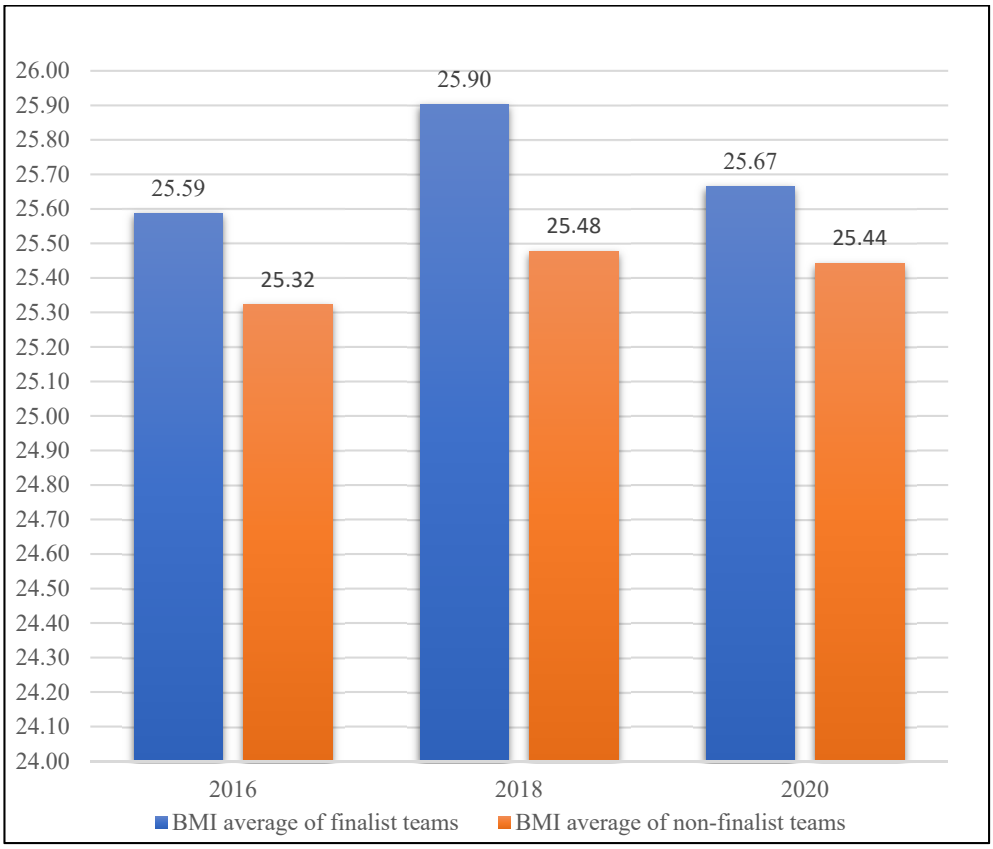

Figure 2. BMI average of finalist and non-finalist teams

The results presented in the figure above show that the finalist teams' average BMI is higher than the rest of the teams in all three editions, but the difference is not statistically significant.

The table and graph below show the BMI value for each item for all three editions.

Tabel 2. BMI average according to playing position

	Edition								
	2016			**2018**			**2020**		
	N	Average	SD	N	Average	SD	N	Average	SD
Goalkeeper (GK)	35	25.60	1.86	38	26.21	1.82	48	25.63	1.47
Left Wing (LW)	33	24.18	1.37	32	24.34	1.52	44	24.10	1.60
Right Wing (RW)	29	24.12	1.67	29	24.77	1.54	51	24.41	1.34
Left Back (LB)	45	25.21	1.60	49	25.33	1.70	75	25.38	1.44
Right Back (RB)	37	25.30	0.97	42	25.40	1.22	53	25.17	1.43
Center Back (CB)	41	25.43	1.60	45	25.02	1.69	54	25.19	1.43
Pivot (P)	51	26.86	2.21	52	27.26	2.42	79	27.38	1.95
Total	271	25.38	1.88	287	25.59	1.99	404	25.49	1.87

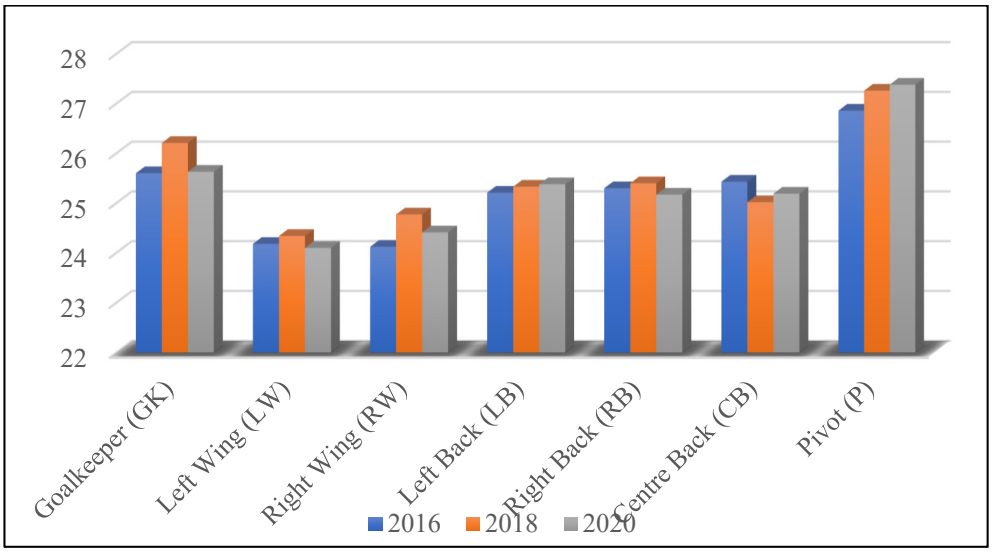

Figure 3. BMI average according to playing position

Table 2 and the graph above show the average BMI for the same playing position. The analysis is made according to all playing positions: goalkeeper, extreme left, extreme right, inter left, inter right, center, and pivot. The results show no statistically significant differences between the three championship editions for the same playing position. However, there are differences between the playing positions. This result is due to the specific requirements of each playing position.

Conclusions

The study's main purpose is to determine the actual value of BMI of elite handball players. The obtained results show that this indicator's value is approximately constant in the last three editions of the European Championship and that there are no statistically significant differences. Analyzing them individually, they show no statistically significant differences between the teams.

The second goal is to determine if this anthropometric indicator has a essential role in ranking the participating teams in the final tournament of the last three editions of the European Championship. By analyzing them, we find out that the finalist teams have a higher BMI than the rest of the teams in each edition, but the difference is not statistically significant. When analyzing the BMI according to the playing position, the results also show that this anthropometric parameter remains approximately constant for the same playing position. The differences found in comparing the BMI between different playing position are due to each position specific requirements.

The study concludes that the anthropometric indicators studied do not play a essential role in classifying a team in the first four positions of a European championship.vAchieving great performance in the handball game depends on many factors which include anthropometric indicators. However, they do not have a specific role.

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