Toward an Anthropometric Pattern in Elite Male Handball

Florin Valentin Leuciuc 1,2,*, Ileana Petrariu 1,2, Gheorghe Pricop 1,2, Dan Mihai Rohozneanu 3 and Ileana Monica Popovici 4

1 Department of Physical Education and Sport, Stefan cel Mare University of Suceava, 13 University Street, 720229 Suceava, Romania; ileana.petrariu@usm.ro (I.P.); gheorghe.pricop@usm.ro (G.P.)
2 The Interdisciplinary Research Center for Human Motricity and Health Sciences, 13 Universitatii Street, 720229 Suceava, Romania
3 Department of Collective Games, Babes Bolyai University of Cluj-Napoca, 1 Mihail Kogalniceanu Street, 400084 Cluj-Napoca, Romania; dan.rohozneanu@ubbcluj.ro
4 Department of Physical Education and Sport, Alexandru Ioan Cuza University of Iasi, 30 Toma Cozma Street, 700554 Iasi, Romania; ileana.popovici@uaic.ro
* Correspondence: florin.leuciuc@usm.ro; Tel.: +40-746-852-974

Abstract: We investigated the anthropometric characteristics associated with specific handball skills in competition. The body anthropometric profiles differ significantly among the playing positions in handball due to the specific tasks. The aim of this study is to identify the anthropometric patterns for each playing position by collecting data from elite male handball players. To determine the anthropometric profile of the elite handball players for each playing position, we used descriptive statistics for every indicator in order to identify the optimal patterns for elite handball players from the top-four ranked teams at the most important competitions over a period of 18 years (2004–2021). Over time, the anthropometric indices evolved: the average height increased (from 190 to 192.6 cm) but less than weight increased (from 90.5 to 95.28 kg), and these affected the body mass index (increase from 25.2 to 25.67). The novelty of our study is that we identified an anthropometric pattern for each playing position and for all teams in elite male handball. Our study also covered a period of 18 years to give our results more accuracy and reliability.

Keywords: handball; pattern; anthropometry; performance

1. Introduction

Currently, along with good sport preparation for elite athletes, the specific anthropometry indices are essential in order to achieve performance in top competitions in collective sports where others are also important: maturity status [1], capacity to be trained [2], body composition [3–5], somatotype [6–8], physiological performance characteristics [9], specific skills [10,11], playing position [12–14] and specifics of the sport branches [8,15–18].

In elite sport, the anthropometric indices have a major impact on performance [19–22] and additionally, there are other factors, such as the preparation level [23–25], specific preparation [26–28] and competition experience [29,30], that influence elite sport outcomes.

Handball has a complex character due to the acyclic movements and situations that appear asking players performing tasks according to the playing position both in attack and in defense. The modern handball game requires players to perform a high number of short, high-intensity specific actions. Based on these considerations, we can state that the features of anthropometric and motor particularities have a high degree of individualization according to the playing position, and it is interesting to determine how personal predispositions can compensate or substitute particular requirements of the playing position.

Somatic and skills indicators of the players can be essential in achieving certain tasks within the game, as in other game situations, they can be a barrier having a limited effect [31,32]. The anthropometric characteristics are determinant in order to efficiently apply the specific handball skills in competitions [33].
Body anthropometric profiles differ significantly among the playing positions in handball due to the specific tasks. From the anthropometric point of view, the wing players were found to be lighter (79.7–81.7 kg) and shorter (177.1–178.3 cm) than backcourt players (193.5–201.9 cm; 90.7–102.3 kg), goalkeepers (192.5–197.6 cm; 82.3–88.1 kg) and pivots (188.6–201.7 cm; 105–121.4 kg); pivots were heavier than centers (83.6–90.5 kg); backcourt players and pivots had higher muscular mass than wings; backcourt players had higher hand-grip values; and the line players (pivots) were the heaviest players.

The majority of elite handball players are part of the mesomorph and endomorph somatotypes; however, according to the playing positions, the backcourt players are mesomorphic, wings and pivots showed an endomorph–mesomorph somatotype, and goalkeepers were in the ecto-endomorph somatotype zone [32,34,35]. The players having a higher skill level are usually taller, and their level of fat-free mass is higher, meaning more muscular mass and a better physiological level are required in modern elite handball in order to achieve performance [36–38].

From 1960 and 1970, there was information concerning the anthropometric characteristics of the elite handball players for each playing position, and, at least for weight, there are some differences compared to the current requirements [39]. In the study conducted by Taborsky, they presented data on anthropometric indices for players participating in the handball World Championships (W.C.) and Olympic Games (O.G.) in the 1970s and for W.C. and European Championships (E.C.) for the period 1998–2007. There is a visible but slight increase of height through the years, from an average of 184 cm in the 1970s to over 190 cm after the year 2000 [31].

A study concerning the anthropometric indices at senior handball teams participating in the competition E.H.F. Champions League, Final Four 2012 showed average values higher than in previous periods (height—192.48 cm, weight—94.63 kg and body mass index—25.51); however, there were only a small number of handball players (62) compared to O.G., W.C. and E.C., and it is important to mention that all of them are elite players of the best four teams in Europe and possibly of the world [40]. Another study conducted at W.C. in 2013 indicated the following values for anthropometric indicators for male handball players: height—190.10 ± 6.82 cm, weight—92.37 ± 9.80 kg and BMI—25.53 ± 2.09 [41].

Over time, there have been studies concerning physical characteristics of the male handball players with different numbers of participants and performance levels (national vs. elite) (Table 1).

| Authors, Year | Level/No. of Participants | Height (cm) | Weight (kg) | BMI |
|---------------|---------------------------|-------------|-------------|-----|
| Ghermănescu, Gogaltan, Jianu, Negulescu, 1983 [39] | Elite/-                   | 188         | 86          | 24.36 1 |
| Bayios et al., 2001 [42] | National/15               | 181 ± 6     | 83.1 ± 5.2  | 25.41 1 |
| Gorostiaga et al., 2005 [43] | Elite/15                  | 189 ± 8     | 95.2 ± 13   | 26.66 1 |
| Marques, Gonzalez-Badillo, 2006 [44] | Elite/16                  | 184 ± 13    | 84.8 ± 13.1 | 25.01 1 |
| Asci, Acikada, 2007 [45] | National/16               | 185 ± 6     | 86.1 ± 8.9  | 25.17 1 |
| Marques et al., 2007 [46] | Elite/14                  | 182 ± 7     | 82.5 ± 12.2 | 24.92 1 |
| Buchheit et al., 2009 [47] | National/9                | 181         | 78.4        | 23.97 1 |
| Sibila, Pori, 2009 [48] | National/78               | 188.44 ± 5.46 | 89.56 ± 8.41 | 25.23 1 |
| Leuciuc, 2012 [40] | Elite/62                  | 192.48      | 94.63       | 25.51 |
| Ghobadi, Rajabi, Farzad, Bayati, Jeffreys, 2013 [41] | Elite/409                 | 190.10 ± 6.82 | 92.37 ± 9.80 | 25.53 ± 2.09 |
| Michalsik, Madsen, Aagaard, 2015 [49] | National/157              | 188.7 ± 6.1 | 90.5 ± 7.9  | 25.42 1 |
| Pireva, 2019 [50] | National/133              | 186.84 ± 5.99 | 91.41 ± 10.31 | 26.19 1 |

1 Data not presented in study and calculated by us.
In the studies with a small number of participants, the anthropometric data were collected directly by measuring handball players [42–48]. In the studies with a large number of subjects [41,49], the anthropometric data were obtained indirectly, without involving the researchers in the assessment process.

Based on the somatic requirements on high performance selection in handball, we can say that, in terms of height, only 25% of the population would meet the standard. The weight and the essential skills (coordination, speed and power) can compensate for a lower height [31]. The aim of this study is to identify the anthropometric patterns for each playing position by collecting data from elite male handball players.

2. Materials and Methods

2.1. Data Collection

This is a cross-sectional study where we use a descriptive analysis of the anthropometric indices of players at handball top competitions (E.C., W.C. and O.G.). The information concerning the anthropometric characteristics (weight and height) was collected from the EHF and IHF websites that present all information, including the team roster (age, anthropometric data, club and international matches). The data were obtained through an informative portal (EHF and IHF website; these two entities being the organizers of the competitions) without the necessary knowledge about the methodology of its collection in order to assess its reliability and validity [50–64].

2.2. Subjects

Our study collected data from 974 players participating at O.G., W.C. and E.C., as components of the teams ranked in the first four places at each competition. Each team had between 16 and 18 players listed for competition.

Inclusion criteria: male handball players from top-four ranked teams at O.G., W.C. and E.C. in the period 2004–2021. Exclusion criteria: female or male handball players from teams ranked out of the top four at O.G., W.C. and E.C. Due to the fact that this covers a period of 18 years, the data for the same player were used as long as he participated in these top handball competitions.

2.3. Statistics

Descriptive statistics were applied in order to identify the anthropometric patterns (height, weight and body mass index) for each playing position (wing, backcourt, center back, pivot and goalkeeper). The study collected information for almost 20 years (2004–2021). At O.G., there were 12 teams involved in the final stage; at W.C., 24 teams/32 teams (since 2021); and at E.C., the number rose from 16 to 24 teams (since 2020). The data were collected only from the players of the teams placed in the first four places at each analyzed competition.

To determine the anthropometric profile of the elite handball players for each playing position, we used descriptive statistics by applying the average, standard deviation, minimum value and maximum value for every indicator in order to identify the optimal patterns for elite handball players. We applied linear regression to find significant relationship between the variables used in our study using IBM SPSS Statistics 26. The coefficients for regression equation and tests of significance were the most important data obtained by applying this statistical method.

3. Results

Starting with O.G. 2004, data were collected for anthropometric characteristics of the male handball players who participated at O.G., W.C. and E.C. in order to identify the specific patterns for each playing position. We calculated the means for each parameter, standard deviation, minimum value and maximum value for each playing position and for all players. All collected data are presented in Table 2.
Table 2. The anthropometric indices for male handball players (2004–2021).

| Competition | Playing Position /Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Overall |
|-------------|---------------------------------------------------|-------|------------|-------------|--------|-------------|---------|
| O.G. 2004   | H(m) X ± S                                        | 1.872 ± 0.033 | 1.995 ± 0.054 | 1.903 ± 0.035 | 1.994 ± 0.072 | 1.926 ± 0.043 | 1.940 ± 0.069 |
|             | MAX                                               | 1.92  | 2.11       | 1.95         | 2.14   | 2.00         | 2.14    |
|             | MIN                                               | 1.82  | 1.86       | 1.84         | 1.90   | 1.85         | 1.82    |
|             | W(kg) X ± S                                       | 86.98 ± 4.833 | 100.83 ± 7.883 | 91.17 ± 4.104 | 109.20 ± 14.19 | 93.78 ± 3.456 | 95.64 ± 10.3 |
|             | MAX                                               | 95    | 118        | 98          | 132    | 100          | 132     |
|             | MIN                                               | 76    | 88         | 87          | 92     | 89           | 76      |
|             | BMI X ± S                                         | 24.84 ± 1.344 | 25.33 ± 1.741 | 25.19 ± 1.154 | 27.52 ± 3.539 | 25.29 ± 1.000 | 25.41 ± 1.995 |
|             | MAX                                               | 26.88 | 29.50      | 28.06       | 33.67  | 27.17        | 33.67   |
|             | MIN                                               | 22.63 | 21.79      | 23.91       | 22.55  | 24.16        | 21.79   |
| O.G. 2008   | H(m) X ± S                                        | 1.834 ± 0.048 | 1.941 ± 0.026 | 1.899 ± 0.043 | 1.970 ± 0.045 | 1.950 ± 0.034 | 1.913 ± 0.066 |
|             | MAX                                               | 1.91  | 1.99       | 1.97        | 2.04   | 2.00         | 2.04    |
|             | MIN                                               | 1.76  | 1.90       | 1.85        | 1.90   | 1.91         | 1.76    |
|             | W(kg) X ± S                                       | 83.86 ± 5.331 | 97.13 ± 6.019 | 92 ± 4.359  | 104.1 ± 6.008 | 95.88 ± 4.941 | 93.93 ± 9.146 |
|             | MAX                                               | 114   | 107        | 98          | 114    | 105          | 114     |
|             | MIN                                               | 95    | 85         | 86          | 97     | 90           | 85      |
|             | BMI X ± S                                         | 24.94 ± 1.224 | 25.79 ± 1.350 | 25.52 ± 1.943 | 26.82 ± 1.245 | 26.21 ± 0.883 | 25.67 ± 1.367 |
|             | MAX                                               | 27.17 | 26.824     | 28.025      | 29.079 | 26.25        | 29.079  |
|             | MIN                                               | 23.735 | 23.546     | 22.933      | 25.250 | 23.467       | 22.933  |
| W.C. 2009   | H(m) X ± S                                        | 1.816 ± 0.043 | 1.964 ± 0.047 | 1.898 ± 0.049 | 1.951 ± 0.043 | 1.954 ± 0.045 | 1.913 ± 0.076 |
|             | MAX                                               | 1.92  | 2.10       | 1.97        | 2.02   | 2.01         | 2.10    |
|             | MIN                                               | 1.73  | 1.89       | 1.81        | 1.89   | 1.90         | 1.73    |
|             | G(kg) X ± S                                       | 79.06 ± 4.123 | 97.86 ± 4.704 | 92.00 ± 7.566 | 100.9 ± 6.619 | 97.63 ± 6.927 | 92.47 ± 9.917 |
|             | MAX                                               | 85    | 106        | 100         | 111    | 109          | 111     |
|             | MIN                                               | 72    | 85         | 78          | 91     | 90           | 72      |
|             | BMI X ± S                                         | 23.97 ± 1.542 | 25.38 ± 1.041 | 25.54 ± 1.085 | 26.49 ± 1.545 | 25.58 ± 1.189 | 25.26 ± 1.459 |
|             | MAX                                               | 26.396 | 26.846     | 26.593      | 28.189 | 27.525       | 28.189  |
|             | MIN                                               | 21.267 | 23.129     | 23.809      | 23.212 | 23.467       | 21.267  |
| W.C. 2011   | H(m) X ± S                                        | 1.856 ± 0.063 | 1.950 ± 0.029 | 1.895 ± 0.057 | 1.951 ± 0.040 | 1.951 ± 0.051 | 1.914 ± 0.064 |
|             | MAX                                               | 2.00  | 2.00       | 1.96        | 2.00   | 2.00         | 2.00    |
|             | MIN                                               | 1.76  | 1.91       | 1.78        | 1.87   | 1.86         | 1.76    |
|             | W(kg) X ± S                                       | 83.17 ± 6.758 | 96.88 ± 4.559 | 91.36 ± 7.256 | 103.7 ± 5.461 | 98 ± 9.661    | 93.32 ± 9.770 |
|             | MAX                                               | 98    | 106        | 100         | 113    | 119          | 119     |
|             | MIN                                               | 73    | 92         | 80          | 98     | 91           | 73      |
|             | BMI X ± S                                         | 24.14 ± 1.128 | 25.48 ± 1.251 | 25.43 ± 1.424 | 27.25 ± 1.078 | 25.73 ± 2.096 | 25.47 ± 1.662 |
|             | MAX                                               | 25.661 | 27.633     | 28.038      | 28.928 | 29.750       | 29.750  |
|             | MIN                                               | 22.531 | 23.232     | 22.819      | 25.252 | 23.467       | 22.531  |
| H(m)        | X ± S                                             | 1.854 ± 0.073 | 1.982 ± 0.062 | 1.924 ± 0.052 | 1.953 ± 0.043 | 1.929 ± 0.047 | 1.928 ± 0.075 |
|             | MAX                                               | 2.00  | 2.10       | 1.98        | 2.03   | 2.00         | 2.10    |
|             | MIN                                               | 1.76  | 1.89       | 1.83        | 1.87   | 1.85         | 1.78    |
Table 2. Cont.

| Competition | Playing Position /Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Overall |
|-------------|--------------------------------------------------|-------|------------|--------------|--------|--------------|---------|
|              |                                                   | X ± S |            |              |        |              |         |
| O.G. 2012   | W(kg)                                            | 88.25 ± 8.250 | 103 ± 7.458 | 95.43 ± 5.968 | 102.8 ± 5.412 | 95.38 ± 6.589 | 96.98 ± 9.123 |
|              | MAX                                              | 102   | 115        | 102          | 114   | 110          | 115     |
|              | MIN                                              | 75    | 93         | 83           | 93    | 90           | 75      |
|              | X ± S                                            | 25.68 ± 1.770 | 26.22 ± 1.097 | 25.77 ± 1.770 | 26.95 ± 0.897 | 25.64 ± 1.453 | 26.10 ± 1.292 |
|              | BMI                                              | 27.727 | 27.633     | 28.666       | 28.025 | 27.701       | 28.666  |
|              | MIN                                              | 23.148 | 24.984     | 22.992       | 24.967 | 23.467       | 22.992  |
| W.C. 2013   | H(m)                                             | 1.847 ± 0.047 | 1.976 ± 0.077 | 1.911 ± 0.049 | 1.978 ± 0.034 | 1.950 ± 0.057 | 1.933 ± 0.079 |
|              | MAX                                              | 1.93  | 2.12       | 1.98         | 2.03  | 2.01         | 2.12    |
|              | MIN                                              | 1.78  | 1.84       | 1.84         | 1.92  | 1.86         | 1.78    |
|              | X ± S                                            | 83.65 ± 4.471 | 99.23 ± 6.436 | 89.63 ± 10.35 | 108.3 ± 5.610 | 99.13 ± 10.03 | 95.73 ± 11.17 |
|              | W(kg)                                            | 90    | 110        | 100          | 114   | 119          | 119     |
|              | MAX                                              | 75    | 90         | 74           | 100   | 90           | 74      |
|              | MIN                                              | 24.52 ± 1.142 | 25.42 ± 1.631 | 24.54 ± 2.333 | 27.66 ± 1.369 | 26.07 ± 2.050 | 25.63 ± 1.941 |
|              | BMI                                              | 26.827 | 29.879     | 27.147       | 29.675 | 29.455       | 29.879  |
|              | MIN                                              | 21.914 | 22.472     | 20.074       | 25.252 | 23.514       | 20.074  |
| E.C. 2014   | H(m)                                             | 1.829 ± 0.045 | 1.935 ± 0.055 | 1.920 ± 0.044 | 1.976 ± 0.039 | 1.942 ± 0.046 | 1.921 ± 0.072 |
|              | MAX                                              | 1.90  | 2.10       | 1.98         | 2.03  | 2.00         | 2.10    |
|              | MIN                                              | 1.78  | 1.84       | 1.86         | 1.92  | 1.88         | 1.78    |
|              | X ± S                                            | 82.63 ± 5.123 | 98.50 ± 7.288 | 92.44 ± 10.44 | 106.5 ± 6.072 | 96.33 ± 5.874 | 94.93 ± 10.49 |
|              | W(kg)                                            | 93    | 110        | 102          | 114   | 119          | 119     |
|              | MAX                                              | 75    | 85         | 74           | 99    | 92           | 74      |
|              | MIN                                              | 24.71 ± 0.985 | 25.82 ± 1.667 | 25.08 ± 2.574 | 27.28 ± 1.346 | 25.54 ± 1.274 | 25.71 ± 1.775 |
|              | BMI                                              | 26.827 | 30.840     | 28.597       | 29.117 | 27.500       | 30.840  |
|              | MIN                                              | 23.148 | 23.669     | 20.074       | 25.252 | 23.750       | 20.074  |
| W.C. 2015   | H(m)                                             | 1.832 ± 0.049 | 1.952 ± 0.0450 | 1.896 ± 0.064 | 1.991 ± 0.056 | 1.930 ± 0.032 | 1.917 ± 0.075 |
|              | MAX                                              | 1.92  | 2.03       | 1.98         | 2.08  | 2.00         | 2.08    |
|              | MIN                                              | 1.77  | 1.83       | 1.80         | 1.92  | 1.89         | 1.77    |
|              | X ± S                                            | 81.12 ± 6.314 | 96.96 ± 6.779 | 90.63 ± 8.088 | 106.60 ± 7.764 | 92.22 ± 3.528 | 92.84 ± 10.62 |
|              | W(kg)                                            | 97    | 107        | 102          | 120   | 100          | 120     |
|              | MAX                                              | 70    | 82         | 80           | 99    | 87           | 70      |
|              | MIN                                              | 24.16 ± 1.434 | 25.44 ± 1.660 | 25.20 ± 0.946 | 26.88 ± 1.439 | 24.76 ± 0.739 | 25.25 ± 1.626 |
|              | BMI                                              | 26.870 | 28.782     | 26.551       | 29.117 | 26.035       | 29.117  |
|              | MIN                                              | 21.605 | 20.870     | 23.872       | 24.750 | 23.356       | 20.870  |
**Table 2.** Cont.

| Competition | Playing Position /Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Overall |
|-------------|--------------------------------------------------|-------|------------|--------------|--------|--------------|---------|
| H(m)        | X ± S                                            | 1.859 ± 0.053 | 1.974 ± 0.057 | 1.918 ± 0.046 | 1.961 ± 0.041 | 1.960 ± 0.049 | 1.936 ± 0.067 |
|             | MAX                                              | 1.96  | 2.10       | 1.98         | 2.04   | 2.02         | 2.10    |
|             | MIN                                              | 1.78  | 1.87       | 1.82         | 1.91   | 1.89         | 1.78    |
|             | X ± S                                            | 83 ± 3.305 | 99 ± 7.148  | 92 ± 4.837   | 105.92 ± 7.292 | 100 ± 11.95 | 95.82 ± 10.28 |
| E.C. 2016   | W(kg)                                            |       |            |              |        |              |         |
|             | MAX                                              | 90    | 115        | 100          | 121    | 119          | 121     |
|             | MIN                                              | 78    | 88         | 85           | 96     | 80           | 78      |
|             | X ± S                                            | 24.03 ± 1.525 | 25.41 ± 9.67 | 25 ± 0.927   | 27.55 ± 2.602 | 26.03 ± 2.371 | 25.56 ± 1.963 |
|             | W(kg)                                            |       |            |              |        |              |         |
|             | MAX                                              | 26.841 | 27.803     | 27.171       | 33.168 | 29.750       | 33.168  |
|             | MIN                                              | 21.085 | 23.428     | 23.796       | 24.27  | 22.161       | 21.085  |
| O.G. 2016   | H(m)                                             |       |            |              |        |              |         |
|             | X ± S                                            | 1.863 ± 0.044 | 1.972 ± 0.055 | 1.893 ± 0.043 | 1.993 ± 0.046 | 1.938 ± 0.048 | 1.936 ± 0.067 |
|             | MAX                                              | 1.94  | 2.10       | 1.94         | 2.07   | 2.01         | 2.10    |
|             | MIN                                              | 1.79  | 1.86       | 1.84         | 1.92   | 1.86         | 1.79    |
|             | X ± S                                            | 87.08 ± 4.071 | 101.53 ± 7.010 | 99.29 ± 7.566 | 107.30 ± 5.599 | 98.75 ± 5.445 | 98.47 ± 9.078 |
|             | W(kg)                                            |       |            |              |        |              |         |
|             | MAX                                              | 94    | 115        | 106          | 118    | 110          | 118     |
|             | MIN                                              | 79    | 92         | 87           | 100    | 93           | 79      |
|             | X ± S                                            | 24.92 ± 0.916 | 26.11 ± 1.509 | 27.71 ± 1.488 | 27.01 ± 1.628 | 26.31 ± 1.403 | 26.26 ± 1.617 |
|             | BMI                                              |       |            |              |        |              |         |
|             | MAX                                              | 26.57 | 30.35      | 29.99        | 29.84  | 28.06        | 30.35   |
|             | MIN                                              | 24.99 | 23.96      | 25.70        | 24.99  | 24.98        | 22.99   |
|             | X ± S                                            | 1.840 ± 0.044 | 1.962 ± 0.049 | 1.881 ± 0.073 | 1.976 ± 0.036 | 1.922 ± 0.045 | 1.923 ± 0.067 |
|             | W(kg)                                            |       |            |              |        |              |         |
|             | MAX                                              | 93    | 110        | 107          | 115    | 112          | 115     |
|             | MIN                                              | 74    | 86         | 77           | 95     | 92           | 74      |
|             | X ± S                                            | 24.96 ± 1.304 | 25.24 ± 1.133 | 25.79 ± 1.460 | 27.59 ± 1.863 | 26.75 ± 1.658 | 25.90 ± 1.672 |
|             | BMI                                              |       |            |              |        |              |         |
|             | MAX                                              | 26.841 | 27.633     | 27.853       | 29.839 | 30.068       | 30.068  |
|             | MIN                                              | 22.84 | 23.669     | 23.574       | 24.729 | 24.984       | 22.84   |
| W.C. 2017   | H(m)                                             |       |            |              |        |              |         |
|             | X ± S                                            | 1.881 ± 0.066 | 1.943 ± 0.047 | 1.914 ± 0.040 | 1.965 ± 0.051 | 1.956 ± 0.054 | 1.930 ± 0.060 |
|             | MAX                                              | 2.02  | 2.03       | 1.96         | 2.05   | 2.02         | 2.05    |
|             | MIN                                              | 1.78  | 1.86       | 1.84         | 1.88   | 1.89         | 1.78    |
|             | X ± S                                            | 87.41 ± 5.051 | 96.83 ± 6.813 | 94.00 ± 4.497 | 104.62 ± 9.332 | 100.30 ± 7.056 | 96.11 ± 8.850 |
| E.C. 2018   | W(kg)                                            |       |            |              |        |              |         |
|             | MAX                                              | 100   | 112        | 104          | 116    | 115          | 116     |
|             | MIN                                              | 78    | 85         | 87           | 88     | 90           | 78      |
Table 2. Cont.

| Competition | Playing Position /Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Overall |
|-------------|-----------------------------------------------------|-------|------------|--------------|--------|-------------|---------|
| BMI         | X ± S                                               | 24.72 ± 1.415 | 25.63 ± 1.255 | 25.66 ± 1.156 | 27.10 ± 1.842 | 26.22 ± 1.837 | 25.79 ± 1.637 |
|             | MAX                                                | 28.09 | 28.058     | 28.06        | 29.839 | 29.115      | 29.839  |
|             | MIN                                                | 22.877 | 23.872     | 24.195       | 24.414 | 24.262      | 22.877  |
|             | MAX                                                | 28.16 | 28.098     | 28.12        | 29.965 | 29.182      | 29.885  |
|             | MIN                                                | 22.94 | 23.942     | 24.215       | 24.515 | 24.285      | 22.942  |
| H(m)        | X ± S                                               | 1.872 ± 0.054 | 1.966 ± 0.061 | 1.913 ± 0.035 | 1.974 ± 0.041 | 1.958 ± 0.045 | 1.935 ± 0.063 |
|             | MAX                                                | 1.98  | 2.12       | 1.96         | 2.03   | 2.01        | 2.12    |
|             | MIN                                                | 1.79  | 1.90       | 1.84         | 1.92   | 1.89        | 1.79    |
|             | MAX                                                | 86.25 ± 4.740 | 98.26 ± 5.858 | 95.50 ± 6.474 | 104.64 ± 7.541 | 98.50 ± 5.043 | 96.32 ± 8.612 |
|             | MIN                                                | 97    | 115        | 109          | 115    | 105         | 115     |
| W(kg)       | X ± S                                               | 24.62 ± 0.829 | 25.43 ± 1.054 | 26.11 ± 1.947 | 26.87 ± 1.857 | 25.71 ± 0.772 | 25.72 ± 1.546 |
|             | MAX                                                | 25.96 | 27.33      | 30.84        | 29.94  | 26.78       | 30.84   |
|             | MIN                                                | 22.91 | 22.47      | 23.91        | 23.67  | 24.72       | 22.47   |
| BMI         | X ± S                                               | 1.861 ± 0.048 | 1.965 ± 0.044 | 1.888 ± 0.060 | 1.961 ± 0.039 | 1.967 ± 0.067 | 1.928 ± 0.067 |
|             | MAX                                                | 1.93  | 2.03       | 1.97         | 2.02   | 2.06        | 2.06    |
|             | MIN                                                | 1.79  | 1.87       | 1.77         | 1.90   | 1.85        | 1.77    |
|             | MAX                                                | 85.56 ± 4.56 | 98.38 ± 5.51 | 89.82 ± 6.29 | 105.25 ± 9.26 | 98.56 ± 7.44 | 95.26 ± 9.42 |
|             | MIN                                                | 96    | 110        | 99           | 120    | 110         | 120     |
|             | X ± S                                               | 24.73 ± 1.23 | 25.47 ± 1.08 | 25.17 ± 0.95 | 27.35 ± 1.99 | 25.46 ± 0.91 | 25.58 ± 1.53 |
| E.C. 2020   | MAX                                                | 27.45 | 28.06      | 27.17        | 29.68  | 27.14       | 29.68   |
|             | MIN                                                | 22.71 | 23.67      | 24.19        | 24.41  | 24.26       | 22.71   |
| BMI         | X ± S                                               | 1.862 ± 0.048 | 1.942 ± 0.037 | 1.893 ± 0.033 | 1.970 ± 0.044 | 1.931 ± 0.066 | 1.921 ± 0.059 |
|             | MAX                                                | 1.97  | 2.02       | 1.96         | 2.04   | 2.03        | 2.04    |
|             | MIN                                                | 1.79  | 1.86       | 1.84         | 1.91   | 1.82        | 1.79    |
|             | MAX                                                | 84.630 ± 4.609 | 96.731 ± 5.903 | 93.900 ± 4.977 | 107.867 ± 8.709 | 96.833 ± 9.581 | 95.634 ± 10.044 |
|             | MIN                                                | 92    | 110        | 105          | 120    | 120         | 120     |
| W(kg)       | X ± S                                               | 24.43 ± 1.15 | 25.65 ± 1.32 | 26.22 ± 1.50 | 27.78 ± 1.85 | 25.96 ± 1.99 | 25.87 ± 1.95 |
|             | MAX                                                | 27.17 | 28.63      | 29.71        | 31.80  | 31.56       | 31.56   |
|             | MIN                                                | 21.75 | 23.47      | 24.90        | 25.50  | 24.27       | 22.27   |

H—height. W—weight. BMI—body mass index. X—average. S—standard deviation. MAX—maximum value. MIN—minimum value.
All the collected data allowed us to find useful information concerning anthropometric characteristics of the elite handball players for each playing position. The synthetic information for all analyzed competitions is presented in Table 3.

| Playing Position/Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Team |
|--------------------------------------------------|-------|------------|--------------|--------|-------------|------|
| H(m) X ± S                                       | 1.852 ± 0.051 | 1.962 ± 0.050 | 1.903 ± 0.048 | 1.971 ± 0.046 | 1.944 ± 0.048 | 1.926 ± 0.068 |
| MAX                                             | 2.00  | 2.12       | 1.98         | 2.14   | 2.06        | 2.14 |
| MIN                                             | 1.76  | 1.83       | 1.77         | 1.87   | 1.85        | 1.76 |
| W(kg) X ± S                                      | 84.477 ± 5.199 | 98.553 ± 6.404 | 92.697 ± 6.830 | 105.096 ± 7.482 | 97.315 ± 6.953 | 95.280 ± 9.798 |
| MAX                                             | 114   | 118        | 106          | 132    | 120         | 132  |
| MIN                                             | 70    | 82         | 74           | 88     | 80          | 70   |
| BMI X ± S                                       | 24.625 ± 1.278 | 25.588 ± 1.317 | 25.609 ± 1.510 | 27.207 ± 1.762 | 25.745 ± 1.417 | 25.677 ± 1.647 |
| MAX                                             | 27.727 | 30.84      | 30.84        | 33.67  | 31.56       | 33.67 |
| MIN                                             | 21.085 | 20.87      | 20.074       | 22.55  | 22.161      | 20.074 |

We applied linear regression to determine the significance of the collected data for the indicators used in our study for each playing position and for all players. The coefficients for regression used to identify the degree of significance are shown in Table 4. This statistical method was applied for a total of 18 situations. The statistical significance was achieved in 16 out of 18 situations: three for \( p < 0.05 \), 6 for \( p < 0.01 \), three for \( p < 0.001 \), and four for \( p < 0.0001 \). Statistical significance (Table 4) was not obtained only in two situations (both for goalkeepers).

| Playing Position/Anthropometric Indices/Statistics | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Team |
|--------------------------------------------------|-------|------------|--------------|--------|-------------|------|
| Height (m) t                                      | 3.02 ** | 6.17 ****  | 5.54 ***     | 3.98 ** | 2.08        | 3.73 ** |
| \( p \)                                           | 0.009 | 0.0001     | 0.001        | 0.003  | 0.076       | 0.002 |
| Weight (kg) t                                     | 3.88 ** | 5.20 ****  | 3.50 **      | 3.08 ** | 1.74        | 6.18 **** |
| \( p \)                                           | 0.002 | 0.001      | 0.008        | 0.009  | 0.13        | 0.0001 |
| BMI t                                             | 4.01 *** | 9.42 ****  | 3.27 *       | 2.88 *  | 2.82 *      | 8.30 **** |
| \( p \)                                           | 0.001 | 0.0001     | 0.011        | 0.016  | 0.026       | 0.0001 |

Significance for * \( p < 0.05 \), ** \( p < 0.01 \), *** \( p < 0.001 \), **** \( p < 0.0001 \).

In this context, we were able to identify the anthropometric pattern for each playing position, including all players as a whole by determining the lower and the upper limits for each of them (Table 5).

| Playing Position/Anthropometric Indices | Wings | Backcourts | Center Backs | Pivots | Goalkeepers | Team |
|----------------------------------------|-------|------------|--------------|--------|-------------|------|
| Height (m)                             | 1.80–1.90 | 1.91–2.01 | 1.85–1.95    | 1.92–2.02 | 1.90–1.99   | 1.86–2.00 |
| Weight (kg)                            | 79–90 | 92–105     | 86–99        | 98–113  | 90–104      | 86–105 |
| BMI                                    | 23.3–25.9 | 24.2–27   | 24.1–27.1   | 25.5–29 | 24.3–27.2   | 24–27.3 |

Table 3. Synthetic information for the anthropometric indices obtained in our study.

Table 4. The significance of the anthropometric patterns for male elite handball players by applying linear regression.

Table 5. Anthropometric patterns for male elite handball players.
4. Discussion

The wings were shorter (average height—1.852 m, lower limit—1.80 m and upper limit—1.90 m) and also the lightest players (84.477 kg, minimum—79 kg and maximum—90 kg). The BMI average was 24.625, meaning they were normo-ponderal with a lower limit of 23.3 and an upper limit of 25.9. For all wing indicators, there were obtained statistical significance for \( p < 0.01 \) and \( p < 0.001 \) (Figure 1) [14,35,41,42,65,66].

![Figure 1](image_url)

**Figure 1.** The average values for anthropometric indicators for each playing position.

Pivots (1.971 m average height, minimum—1.92 m and maximum—2.02 m) and backcourts (1.956 m, minimum—1.91 m and maximum—2.01 m) were the tallest and also the heaviest players, pivots—105.096 kg with accepted limits between 98 and 113 kg and backcourts—98.553 kg with optimal values between 92 and 105 kg. The average BMI for pivots was 27.207 and 25.588 for backcourts. For pivots, there was significance for \( p < 0.01 \) (height) and for \( p < 0.001 \) (weight and BMI) (Figure 1) [14,35,41,43,65,66].

Goalkeepers were close in value to pivots and backcourts (height average—1.944 m and accepted limits between 1.90 and 1.99 m, weight average—97.315 kg and optimal values between 90 and 104 kg and BMI average—25.745). At linear regression, we obtained statistical significance only for the BMI of goalkeepers (Figure 1) [14,35,45,48,65,66].

Backcourts were close in height to pivots (1.962 m), but lighter (98.553 kg) and the limits for BMI are between 24.2 and 27. The highest values of coefficients at linear regression were achieved at backcourts indicators (\( p < 0.0001 \)) (Figure 1) [14,35,44–46,65,66].

Centerbacks are shorter than pivots, backcourts and goalkeepers but higher than wings with an average value of 1.903 m for height (limits between 1.85 and 1.95 m); the weight average was 92.697 kg (minimum—86 kg and maximum—99 kg); and the BMI average values was 25.609 (accepted range between 24.1 and 27.1). The level of
significance for centerback indicators were for $p < 0.01$ (weight and BMI) and $p < 0.001$ (height) (Figure 1) [14,35,41,42,65,66].

The overall analysis of the pattern for a top handball player found that the average height was 1.926 m with optimal limits between 1.86 m and 2 m; the weight average was 95.28 kg with 86 to 105 kg accepted limits; and the average BMI was 25.677 with recommended limits between 24 and 27.3. We also obtained statistical significance for $p < 0.001$ (height) and $p < 0.0001$ (weight and BMI) (Figure 1) [14,47–49,67,68].

We consider the identified pattern in our study for each playing position valid as, in 16 out of 18 situations, we obtained statistical significance at linear regression, and the data were collected for a period of almost 20 years from 974 top male handball players (Figure 2).

Figure 2. Linear regression model for anthropometric pattern indicators of the male handball players: (a)—height, (b)—weight and (c)—BMI.

Over time, the anthropometric pattern changes for each playing position compared to those in 1970 and 1980. The values for height and weight increased with an average value of 5%. The most important evolution trend was for pivots where the height increased by 7% and the weight by 20% [31,39].
Comparing the results to recent studies concerning the anthropometric pattern for top male handball players, there are no differences [32,35,40,67,68], and the players belonging to teams from the first half of the final ranking in top competitions are in the optimal limits for each indicator [41,58].

An interesting fact is that the pivots were the tallest (197 cm) and heaviest handball players (105 kg), as the backcourts (196 cm) are usually associated as the highest handball players. To identify the anthropometric pattern in our study, only players from the top four were included for each analyzed competition from the best male handball teams for period 2004–2021.

Every year, the I.H.F. awards the world’s best players; five goalkeepers, four center-backs and two backcourts were nominated for the analyzed period. In that period of time, Nicola Karabatic and Mikkel Hansen were nominated three times. The world’s best players were in the limits of the anthropometric pattern identified in our study. The exception being the goalkeeper Arpad Sterbik, who exceeded the upper limits. This aspect confirms the validity of the anthropometric pattern determined by our study (Table 6).

Table 6. Anthropometric characteristics for handball players designated by I.H.F. as world players of the year.

| Year | Player         | Playing Position | Height | Weight | BMI  |
|------|----------------|------------------|--------|--------|------|
| 2004 | Henning Fritz  | Goalkeeper       | 1.89   | 90.5   | 25.34|
| 2005 | Árpád Sterbik | Goalkeeper       | 2      | 120    | 30.00|
| 2006 | Ivano Balić   | Center back      | 1.90   | 96     | 26.59|
| 2007 | Nikola Karabatić | Center back      | 1.96   | 104    | 27.07|
| 2008 | Thierry Omeyer | Goalkeeper       | 1.92   | 93     | 25.23|
| 2009 | Slavomir Szmajl | Goalkeeper      | 1.90   | 90     | 24.93|
| 2010 | Filip Jicha   | Left back        | 2.01   | 105    | 25.99|
| 2011 | Mikkel Hansen | Left back        | 1.92   | 93     | 25.23|
| 2012 | Daniel Narcisse | Center back     | 1.89   | 93     | 26.04|
| 2013 | Domagoj Duvnjak | Center back    | 1.98   | 100    | 25.51|
| 2014 | Nikola Karabatić | Center back    | 1.96   | 104    | 27.07|
| 2015 | Mikkel Hansen | Left back        | 1.92   | 93     | 25.23|
| 2016 | Nikola Karabatić | Center back    | 1.96   | 104    | 27.07|
| 2018 | Mikkel Hansen | Left back        | 1.92   | 93     | 25.23|
| 2019 | Nikklas Landin | Goalkeeper       | 2.01   | 105    | 25.99|

5. Conclusions

The anthropometric pattern was found to evolve over time: the average height increased (1.4%) but less than the average weight (4.5%), thereby, influencing the average body mass index (2.7%). More weight in the case of elite handball players typically means more muscular mass required by the modern handball player in order to be effective in game actions during the competitions.

Anthropometric characteristics, including the body composition and the somatotype of the elite handball players, are specific to the playing position in order to allow them to efficiently act in competitions. Among these indicators, the specific preparation of handball players is essential to achieve competition goals and to be efficient in specific actions during the game.

The limitations of the study include access to data concerning only height and weight and indirect data collection from the official website of the International Handball Federation and European Federation. For the future, it will be important to collect data for other variables, such as the body composition, skinfold thickness and body circumference. Among other factors, the anthropometric pattern is essential when a coach wants to select a player for his team, and it is optimal to choose a player that meets these requirements concerning anthropometric patterns.
The novelty of our study is that we identified an anthropometric pattern for each playing position and for all teams in elite male handball, and our study covered a period of 18 years to give our results more accuracy and reliability. These identified patterns will be subject to change over time, and further studies are necessary in order to keep these anthropometric models updated.

**Author Contributions:** Conceptualization, F.V.L., I.P., G.P., D.M.R. and I.M.P.; methodology, F.V.L., I.P., G.P., D.M.R. and I.M.P.; software, I.M.P.; validation, F.V.L. and G.P.; formal analysis, G.P. and D.M.R.; investigation, F.V.L. and I.M.P.; resources, F.V.L., I.P. and D.M.R.; data curation, F.V.L.; writing—original draft preparation, F.V.L., I.P. and D.M.R.; writing—review and editing, G.P. and I.M.P.; visualization, I.M.P.; supervision, G.P. and D.M.R.; project administration, F.V.L.; funding acquisition. All authors have read and agreed to the published version of the manuscript.

**Funding:** The APC was funded by Stefan cel Mare University of Suceava.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

**References**

1. Di Credico, A.; Gaggi, G.; Ghinassi, B.; Mascherini, G.; Petri, C.; Di Giminiani, R.; Di Baldassarre, A.; Izzicupo, P. The influence of maturity status on anthropometric profile and body composition of youth goalkeepers. *Int. J. Environ. Res. Public Health* **2020**, *17*, 8247. [CrossRef] [PubMed]

2. Viero, V.; Triossi, T.; Bianchi, D.; Campagna, A.; Melchiorri, G. Physical and performance variables for talent identification in water polo. *J. Sport Med. Phys. Fit.* **2020**, *60*, 1309–1316. [CrossRef] [PubMed]

3. Siquier-Coll, J.; Grijota, F.J.; Bartolome, I.; Montero, J.; Munoz, D. Anthropometric and physical condition analysis of young female handball players. Difference between categories. *J. Sport Health Sci.* **2020**, *12*, 364–372.

4. Martins, N.C.; Alves, F.D.; Sehl, P.; Schneider, C.D.; Souza, G.C. Comparison between body composition assessment methods in elite water polo. *J. Sport Med. Phys. Fit.* **2020**, *60*, 1360–1367. [CrossRef] [PubMed]

5. Kaplanova, A.; Sagat, P.; Gonzalez, P.P.; Bartik, P.; Zvonar, M. Somatotype profiles of Slovak and Saudi Arabian male soccer players according to playing positions. *Kinesiology* **2020**, *52*, 143–150. [CrossRef]

6. Campa, F.; Silva, A.M.; Talluri, J.; Matias, C.N.; Badicu, G.; Toselli, S. Somatotype and bioimpedance vector analysis: A new target zone for male athletes. *Sustainability* **2020**, *12*, 4365. [CrossRef]

7. Campa, F.; Silva, A.M.; Talluri, J.; Matias, C.N.; Badicu, G.; Toselli, S. Somatotype and bioimpedance vector analysis: A new target zone for male athletes. *Sustainability* **2020**, *12*, 4365. [CrossRef]

8. de la Fuente, F.P.; Gonzalez-Jurado, J.A.; Garcia-Gimenez, A.; Tobon, F.G.; Otin, C.C. Anthropometric characteristics of elite paddle players. Pilot study. *Rev. Int. Med. Y Cienc. Act. Fis. Y Del Deporte* **2019**, *19*, 181–195.

9. Bogfild, C.; Jensen, K.; Kvarning, T. Physiological performance characteristics of Danish national team handball players 1990–2016: Implications on position-specific strength and conditioning training. *J. Strength Cond. Res.* **2020**, *34*, 1555–1563. [CrossRef]

10. O’Brien-Smith, J.; Bennett, K.J.M.; Fransen, J.; Smith, M.R. Same or different? A comparison of anthropometry, physical fitness and perceptual motor characteristics in male and female youth soccer players. *Sci. Med. Footb.* **2020**, *4*, 37–44. [CrossRef]

11. Clemente, F.M.; Conte, D.; Sanches, R.; Moleiro, C.F.; Gomes, M.; Lima, R. Anthropometry and fitness profile, and their relationships with technical performance and perceived effort during small-sided basketball games. *Res. Sports Med. 2019*, *27*, 452–466. [CrossRef]

12. Sebastia-Amat, S.; Pueo, B.; Villalon-Gasch, L.; Jimenez-Olmedo, J.M. Anthropometric profile and conditional factors of U21 Spanish elite beach volley players according to playing position. *RETOS Nuevas Tend. En Educ. Fis. Deportre Recreacion* **2020**, *38*, 620–625.

13. Rodriguez-Rodriguez, F.; Lopez-Fuenzalida, A.; Holway, F.; Aguilera, C.J. Anthropometric differences per playing position in Chilean professional footballers. *Nutr. Hosp.* **2019**, *36*, 846–853.

14. Lijewski, M.; Burdukiewicz, A.; Pietraszewska, J.; Stachon, A.; Andrzejewska, J.; Chronik, K. Anthropometric and strength profiles of professional handball players in relation to their playing position-multivariate analysis. *Acta Bioeng. Biomech.* **2019**, *21*, 147–155. [CrossRef]

15. Chino, K.; Inoue, N.; Iizuka, T.; Masuda, K.; Park, J.B. Comparison of anthropometric characteristics between elite singles and doubles badminton players. *Gazz. Med. Ital.* **2019**, *178*, 781–784. [CrossRef]

16. Calleja-Gonzalez, J.; Mielgo-Ayuso, J.; Lekue, J.A.; Leibar, X.; Eratzkin, J.; Jukic, I.; Ostojic, S.M.; Ponce-Gonzalez, J.G.; Fuentes-Azpíroz, M.; Terrados, N. Anthropometry and performance of top youth international male basketball players in Spanish national academy. *Nutr. Hosp.* **2018**, *35*, 1331–1339. [CrossRef] [PubMed]
17. Tomaszewski, P.; Keska, A.; Tkaczyk, J.; Nowicki, D.; Sienkiewicz-Dianzenza, E. Somatic characteristics and motor fitness of elite and sub-elite Polish male badminton players. J. Sport Med. Phys. Fit. 2018, 58, 1456-1464. [CrossRef] [PubMed]

18. Neogi, A.; Chakraborty, C.; Chatterjee, S.; Dey, S.K. Anthropometric profiles and pulmonary function parameters of male Football & Hockey players according to their specific playing position: A Comparative Study. Int. J. Appl. Exerc. Physiol. 2018, 7, 10-23.

19. Mallett, A.; Bellinger, P.; Derave, W.; Osborne, M.; Minahan, C. The age, height, and body mass of Olympic swimmers: A 50-year review and update. Int. J. Sports Sci. Coach. 2020, 16, 210–223. [CrossRef]

20. Senseg, M.; Muller, W.; Storchle, P.; Furhapter-Rieger, A. Competitive performance of Kenyan runners compared to their relative body weight and fat. J. Sports Med. 2020, 42, 323-335. [CrossRef]

21. Sanchez Munoz, C.; Muros, J.I.; Belmonte, O.L.; Zabala, M. Anthropometric characteristics, body composition and somatotype of elite male young runners. Int. J. Environ. Res. Public Health 2020, 17, 674. [CrossRef] [PubMed]

22. Leon-Guero, P.; Urdampilleta, A.; Zourdos, M.C.; Mielgo-Ayuso, J. Anthropometric profile, body composition and somatotype in elite traditional bowlers: A cross-sectional study. Rev. Esp. De Nutr. Hum. Y Diet. 2018, 22, 279-286. [CrossRef]

23. Prieske, O.; Chaabene, H.; Gabler, M.; Herz, M.; Helm, N.; Markov, A.; Granacher, U. Seasonal changes in anthropometry, body composition, and physical fitness and the relationships with sporting success in young sub-elite judo athletes: An exploratory study. Int. J. Environ. Res. Public Health 2020, 19, 7169. [CrossRef]

24. Giles, D.; Barnes, K.; Taylor, N.; Chidley, C.; Chidley, J.; Mitchell, J.; Torr, O.; Gibson-Smith, E.; Espana-Romero, V. Anthropometry and performance characteristics of recreational advanced to elite female rock climbers. J. Sports Sci. 2020, 39, 49-56. [CrossRef]

25. Nichas, A.; Shaw, B.S.; Millard, L.; Breukelman, G.J.; Shaw, I. Kinanthropometric attributes of elite South African male kata and kumite karateka. Arch. Budo 2020, 16, 181–194.

26. Mostaert, M.; Laureys, F.; Vansteenwinkel, P.; Pion, J.; Deconinck, F.J.A.; Lenoir, M. Discriminating performance profiles of cycling disciplines. Int. J. Sports Sci. Coach. 2021, 16, 110–122. [CrossRef]

27. Chaabene, H.; Prieske, O.; Lesinski, M.; Sandau, I.; Granacher, U. Short-term seasonal development of anthropometry, body composition, physical fitness, and sport-specific performance in young Olympic weightlifters. Sports 2019, 7, 242. [CrossRef]

28. van der Zwaard, S.; de Ruiter, C.J.; Jaspers, R.T.; de Koning, J.J. Anthropometric clusters of competitive cyclists and their sprint and endurance performance. Front. Physiol. 2019, 10, 1276. [CrossRef]

29. Dessalew, G.W.; Woldeyes, D.H.; Abebay, B.A. The relationship between anthropometric variables and race performance. Open Access J. Sports Med. 2019, 10, 209-216. [CrossRef]

30. Wazir, M.R.W.N.; Mostaert, M.; Pion, J.; Lenoir, M. Anthropometry, physical performance, and motor coordination of medallist and non-medallist young fencers. Arch. Budo 2018, 14, 33–40.

31. Taborsky, F. The Body Height and Top Team Handball Players. EHF Web Period. 2007, 1, 1–3. Available online: http://home.eurohandball.com/ehf_files/Publikation/WP_Taborsky-Body%20height.pdf (accessed on 3 March 2016).

32. Nikolaidis, P.T.; Ingebrigtsen, J.; Povoas, S.C.; Moss, S.; Torres-Luque, G. Physical and physiological characteristics in male team handball players by playing position—Does age matter? J. Sport Med. Phys. Fit. 2015, 55, 297–304.

33. Fieseler, G.; Hermassi, S.; Hoffmeyer, B.; Schulze, S.; Irjenbusch, L.; Bartels, T.; Delank, K.S.; Laudner, K.G.; Schwesig, R. Differences in anthropometric characteristics in relation to throwing velocity and competitive level in professional male team handball: A tool for talent profiling. J. Sport Med. Phys. Fit. 2017, 57, 985–992. [CrossRef]

34. Chouauchi, A.; Brughelli, M.; Levin, G.; Boudhina, N.B.; Cronin, J.; Chamari, K. Anthropometric, physiological and performance characteristics of elite team-handball players. J. Sports Sci. 2009, 27, 151–157. [CrossRef] [PubMed]

35. Ramos-Sanchez, F.; Camina-Martin, M.A.; Alonso-de-la-Torre, S.R.; de-Mateo-Silleras, B. Body composition and somatotype in professional men’s handball according to playing positions. Rev. Int. Med. Cienc. Act. Fís. Deporte 2018, 18, 91–102.

36. Manchado, C.; Tortosa-Martinez, J.; Vila, H.; Ferragut, C.; Platen, P. Performance factors in women’s team handball: Physical and physiological aspects: Review. J. Strength Cond. Res. 2013, 27, 1708-1719. [CrossRef]

37. Debanne, T.; Lafayye, G. Predicting the throwing velocity of the ball in handball with anthropometric variables and isotonic tests. J. Sports Sci. 2011, 29, 705–713. [CrossRef]

38. Wagner, H.; Fuchs, P.X.; von Duvillard, S.P. Specific physiological and biomechanical performance in elite, sub-elite and in non-elite male team handball players. J. Sport Med. Phys. Fit. 2018, 58, 73–81. [CrossRef]

39. Ghermănescu, I.K.; Gogaltan, V.; Jianu, E.; Negulescu, I. Teoria si Metodica Handbalului (Theory and Methodic of Handball), 1st ed.; Editura Didactica și Pedagogică: București, Romania, 1983; p. 164.

40. Leuciu, F.V. Somatic model and performance age in elite handball (study case: Male Champions League final four 2012). GymnasiuM 2012, 13, 113–125.

41. Ghobadi, H.; Rajabi, H.; Farzad, B.; Bayati, M.; Jeffreys, I. Anthropometry of world-class elite handball players according to the playing position: Reports from men’s handball world championship 2013. J. Hum. Kinet. 2013, 39, 213–220. [CrossRef]

42. Bayios, I.A.; Anastasopoulou, E.M.; Sioudris, D.S.; Boudolos, K.D. Relationship between isokinetic strength of the internal and external shoulder rotators and ball velocity in handball. J. Sport Med. Phys. Fit. 2001, 41, 229–235.

43. Gorostiaga, E.M.; Granados, C.; Ibarra, J.; Izquierdo, M. Differences in physical fitness and throwing velocity among elite and amateur male handball players. Int. J. Sports Med. 2005, 26, 225–232. [CrossRef] [PubMed]

44. Marques, M.C.; Gonzalez-Badillo, J.J. In-season resistance training and detraining in professional team handball players. J. Strength Cond. Res. 2006, 20, 563–571.
45. Asci, A.; Acikada, C. Power production among different sports with similar maximum strength. *J. Strength Cond. Res.* 2007, 21, 10–16.

46. Marques, M.C.; van den Tillaar, R.; Vescovi, J.D.; GonzalezBadillo, J.J. Relationship between throwing velocity, muscle power, and bar velocity during bench press in elite handball players. *Int. J. Sports Physiol. Perform.* 2007, 2, 414–422. [CrossRef] [PubMed]

47. Buchheit, M.; Lepretre, P.M.; Behaegel, A.L.; Millet, G.P.; Cuvelier, G.; Ahmaidi, S. Cardiorespiratory responses during running and sport-specific exercises in handball players. *J. Sci. Med. Sport* 2009, 12, 399–405. [CrossRef] [PubMed]

48. Sibila, M.; Pori, P. Position-Related Differences in Selected Morphological Body Characteristics of Top-Level Handball Players. *Coll. Antropol.* 2009, 33, 1079–1086.

49. Michalsik, L.B.; Madsen, K.; Aagaard, P. Technical match characteristics and influence of body anthropometry on playing performance in male elite team handball. *J. Strength Cond. Res.* 2015, 29, 416–428. [CrossRef]

50. Official Results Book, Handball, 14–29 August, Atena 2004. Available online: http://www.ihf.info/files/Uploads/Documents/8294_HB.pdf (accessed on 3 March 2016).

51. Official Results Book, Handball, 9–24 August, Beijing 2008. Available online: http://www.ihf.info/files/Uploads/Documents/8238_HB_Results_Bookoverall%20team%20statistics.pdf (accessed on 3 March 2016).

52. Official Results Book, Handball, 28 July–12 August, London 2012. Available online: http://www.ihf.info/files/Uploads/Documents/11388_Handball20%20HB%20Results%20Book%20V1[1].pdf (accessed on 3 March 2016).

53. Official Results Book, Handball, 6–21 August, Rio de Janeiro 2016. Available online: http://ihf.info/files/Uploads/Documents/43056_Rio_2016_Handball_Results_Book_v1.0.pdf (accessed on 7 December 2016).

54. Available online: http://www.ihf.info/enus/ihfcompetitions/worldchampionships/mensworldchampionships/menshandballworldchampionship2009/teaminfo.aspx (accessed on 3 March 2016).

55. Available online: http://www.ihf.info/enus/ihfcompetitions/worldchampionships/mensworldchampionships/mensworldchampionships/menshandballworldchampionship2011/teaminfo.aspx (accessed on 3 March 2016).

56. Available online: http://www.ihf.info/enus/ihfcompetitions/worldchampionships/mensworldchampionships/mensworldchampionships/menshandballworldchampionshipspain2013/teaminfo.aspx (accessed on 3 March 2016).

57. Available online: http://www.ihf.info/enus/ihfcompetitions/worldchampionships/mensworldchampionships/menshandballworldchampionshipqatar2015/teaminfo.aspx (accessed on 3 March 2016).

58. Available online: http://www.ihf.info/enus/ihfcompetitions/worldchampionships/mensworldchampionshipfrance2017/teaminfo.aspx (accessed on 12 May 2017).

59. Available online: http://www.handball19.com/#teams (accessed on 28 April 2019).

60. Available online: http://www.ihf.info/competitions/men/308/27th-ihf-mens-world-championship-2021/22415/groups-rankings (accessed on 1 February 2021).

61. Available online: http://den2014.ehf-euro.com/#teams/ (accessed on 3 March 2016).

62. Available online: http://pol2016.ehf-euro.com/teams/ (accessed on 3 March 2016).

63. Available online: https://cro2018.ehf-euro.com/teams/ (accessed on 9 March 2018).

64. Available online: https://www.m20ehfeuro.com/en/teams (accessed on 17 December 2020).

65. Burdukiewicz, A.; Pietraszewska, J.; Andrzejewksa, J.; Stachon, A.; Lijewski, M. Variability in professional athletes: Secular changes in the anthropometry of elite handball players. *Homo* 2020, 70, 163–170. [CrossRef]

66. Hermassi, S.; van den Tillaar, R.; Khliifa, R.; Chelly, M.S.; Chamari, K. Comparison of in-season-specific resistance vs. A regular throwing training program on throwing velocity, anthropometry, and power performance in elite handball players. *J. Strength Cond. Res.* 2015, 29, 2105–2114. [CrossRef] [PubMed]

67. Cichy, I.; Dudkowski, A.; Kociuba, M.; Ignasiak, Z.; Sebastian, A.; Kochan, K.; Koziel, S.; Rokita, A.; Malina, R.M. Sex differences in body composition changes after preseason training in elite handball players. *Int. J. Environ. Res. Public Health* 2020, 17, 3880. [CrossRef] [PubMed]

68. Ziv, G.; Lidor, R. Physical characteristics, physiological attributes, and on-court performances of handball players: A review. *Eur. J. Sport Sci.* 2009, 9, 375–386. [CrossRef]