

Body Dimensions of Elite Handball Players With Respect To Laterality, Playing Positions and Playing Standard --Manuscript Draft--

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Abstract:	<p>Purpose: The aim of the present study was to examine, using a large player database, between-playing positions and playing standard differences in body dimensions.</p> <p>Methods: We compared stature and body mass of 1295 male elite handball players from different playing positions, i.e., backs (left and right), center backs, goalkeepers, pivots, wings (left and right) and playing standards (European championship, Champions league matches and national leagues from Germany, Spain and France).</p> <p>Results: When all playing standards were pooled together, wings (left 185±6cm, right 185±6cm) were almost certainly slightly-to-moderately shorter than center backs (188±5 cm), which were slightly-to-largely shorter than backs (left 196±5cm, right 194±5cm), pivots (194±6cm) and goalkeepers (193±5cm). Pivots (100.1±9.1kg) were almost certainly slightly-to-very-largely heavier than the other positions, with backs (left 95.1±7.6kg, right 92.5±8kg) and goalkeepers (93.5±8.5kg) being moderately-to-largely heavier than wings (left 83.3±7.8kg, right 82.1±7kg) and center backs (88±7.6kg). Center, left and right backs were almost certainly slightly-to-moderately taller in the European championships, goalkeepers and right wings in Champions league, left backs in the German first league and pivots in the Spanish first league. Center and left backs were almost certainly slightly-to-moderately heavier in the European championship. Left wings were almost certainly slightly heavier in the German first league and pivots in the Spanish first league.</p> <p>Conclusions: These data show the importance of considering players' laterality when assessing their body dimensions. They might also serve as anthropometric benchmarks when profiling talented young players.</p>

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**BODY DIMENSIONS OF ELITE HANDBALL PLAYERS
WITH RESPECT TO LATERALITY, PLAYING POSITIONS
AND PLAYING STANDARD**

Running head: Body dimensions and laterality in elite handball

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Abstract

Purpose: The aim of the present study was to examine, using a large player database, between-playing positions and playing standard differences in body dimensions.

Methods: We compared stature and body mass of 1295 male elite handball players from different playing positions, i.e., backs (left and right), center backs, goalkeepers, pivots, wings (left and right) and playing standards (European championship, Champions league matches and national leagues from Germany, Spain and France).

Results: When all playing standards were pooled together, wings (left 185 ± 6 cm, right 185 ± 6 cm) were almost certainly slightly-to-moderately shorter than center backs (188 ± 5 cm), which were slightly-to-largely shorter than backs (left 196 ± 5 cm, right 194 ± 5 cm), pivots (194 ± 6 cm) and goalkeepers (193 ± 5 cm). Pivots (100.1 ± 9.1 kg) were almost certainly slightly-to-very-largely heavier than the other positions, with backs (left 95.1 ± 7.6 kg, right 92.5 ± 8 kg) and goalkeepers (93.5 ± 8.5 kg) being moderately-to-largely heavier than wings (left 83.3 ± 7.8 kg, right 82.1 ± 7 kg) and center backs (88 ± 7.6 kg). Center, left and right backs were almost certainly slightly-to-moderately taller in the European championships, goalkeepers and right wings in Champions league, left backs in the German first league and pivots in the Spanish first league. Center and left backs were almost certainly slightly-to-moderately heavier in the European championship. Left wings were almost certainly slightly heavier in the German first league and pivots in the Spanish first league.

Conclusions: These data show the importance of considering players' laterality when assessing their body dimensions. They might also serve as anthropometric benchmarks when profiling talented young players.

Key words: stature; body mass; anthropometric benchmarks; talent identification; players selection.

Introduction

In elite handball, playing at each playing position (i.e., goalkeeper, center and lateral backs, pivot and wing) requires specific physical attributes and technical and tactical skills [1, 2]. The ability to perform a large amount of high-intensity actions (e.g., jumps, throws, sprints or contacts [2]) is a prerequisite for all on-court players. Body dimensions are also believed to be determinant to make the elite level [1]. While being tall is generally perceived as an advantage for most positions both during attacking (e.g., to shoot over a defender) and defensive (e.g., to cover the goal) phases, the importance of body mass is likely position-specific. In elite athletes with low body fat, body mass is often largely correlated with general strength and speed qualities [3]. Body mass is also important for contact sports such as handball, as it may improve the ability to block opponents in defense and, conversely, overtakes defenders in attack. However, for some players such as wings, who have very limited space to move in and are required to perform long jumps over the 6-m area [2], excessive body dimensions can become detrimental for performance. To date however, body dimension data are limited in elite players and the expected average and range of stature and body mass for each position is unclear. Previous studies in elite players included limited sample size (38 to 71 players per position [4]) and have reported conflicting results. Additionally, the dominant hand of the players was not considered (despite the fact that left-handed players represent only 10% of the general population [5]), and not all playing positions were examined.

The aim of this brief report was therefore to examine, using a large player database, the differences in players' stature and body mass between playing positions and playing standards, and examine the effect of laterality on these potential differences. These data may then serve as anthropometric benchmarks for talent identification and players selection.

Methods

The stature and body mass of 1295 elite male handball players (29 ± 4.2 years) were retrieved from an internet database [6]. These were preexisting anonymized data from the annual testing that these teams perform for training purposes, so no informed consent was obtained. While the validity and reproducibility of the variables collected could be questioned (i.e., measures undertaken by different individuals using different equipment), the large sample

size examined and the fact that stature and body mass show generally low inter- and intra-observer variability (<2% [7]) may partly overcome these limitations. Moreover, considering that potential methodological variations between clubs/teams may increase the noise of measurement and in turn, decrease our ability to differentiate playing positions and standards, the differences actually reported in the present study are likely meaningful (i.e., greater than the noise of measurement). The sample included goalkeepers (29.6±6 years), center (27.4±4.8 years), left (27.6±4.9 years) and right (27.3±4.8 years) backs, , pivots (28.6±4.6 years), and left (27.4±4.8 years) and right (26.4±4.4 years) wings. They all played for their respective countries during the 2012 European championship and/or in Champions league matches and/or national leagues from Germany, Spain and France during the 2011-2012 season. All data in the text and in the table are expressed as mean and standard deviation in cm for stature and kg for body mass. Data were then analyzed for practical significance using magnitude-based inferences. Confidence intervals (90%) for the standardized (Cohen's effect size) between-group differences were estimated [8]. Probabilities were used to make a qualitative probabilistic mechanistic inference about the true changes: if the probabilities of the differences being substantially greater and smaller than the smallest worthwhile difference (0.2 of the between-player SD) were both >5%, the effect was reported as unclear; the effect was otherwise clear and reported as the magnitude of the observed value.

Results

Body dimension's (stature, upper panel, and body mass, lower panel) mean, maximum, minimum and distribution of all elite players (all playing standards pooled) with respect to playing positions are presented in Figure 1 and 2. Body dimensions of elite players with respect to playing positions and competition standards are shown in Table 1.

Playing positions.

All the standardized differences for stature were rated as almost certain (Figure 1), except for right backs vs. pivots, and pivots vs. goalkeepers, which were likely, and for left backs vs. pivots, which were possible. All the standardized differences in body mass are shown in Figure 2 and were almost certain.

Playing standards.

Between-position differences in stature related to playing standards are presented in Table 1. Center, left and right backs were almost certainly slightly-to-moderately taller in the European championships, goalkeepers and right wings in Champions league, left backs in the German first league and pivots in the Spanish first league. Center and left backs were almost certainly slightly-to-moderately heavier in the European championship. Left wings were almost certainly slightly heavier in the German first league and pivots in the Spanish first league.

Discussion

In the sample of players analyzed in the present study, between-positions differences in height and body mass were meaningful (e.g. up to very large differences in stature between right wings and left backs, 185 ± 5 vs. 196 ± 6). In contrast, the differences between playing standards were of lower magnitude, with only up to moderate differences between the center backs playing in the European championship vs. those playing the first French league. We also observed small differences for both stature and body mass between left- and right-handed players in back positions, although body dimensions were similar for left vs right wings. The present data provide for the time some anthropometric benchmarks representative of the highest playing standards, which might be useful for talent identification and players selection in top teams.

Playing positions. As already described [1, 4, 9-12], wings were the smallest and lightest players of the team (moderate-to-very large differences vs. all the other playing positions). Laterality was unlikely to affect stature (Figure 1) and body mass (Figure 2) in wings. However, left-backs were slightly taller and heavier than right-backs. The shorter stature of the right backs could be explained by the fact that left-handed people represent only 10% of the general population; there is therefore less candidates for these positions. While previous studies have reported controversial results on whether backs may be taller [1, 10, 12] or smaller [9, 11] than pivots, this could be explained by the fact that center backs were sometimes included with lateral backs for analysis [1, 9-12]. When all the playing positions were compared separately (Figure 1), we found the left backs to be the tallest players, followed by pivots, right backs, goalkeepers, center backs and wings. These latter results are in agreement with a previous study, where lateral and center backs were also examined separately [4].

Our findings are also in agreement with some studies showing that pivots were the heaviest players [1, 4, 9-12]. When considering all positions, left backs were the second

heaviest, followed by goalkeepers, right backs, center backs, left wings and right wings. Having a few left-handed players in a team is very important to improve the quality of ball transmission on the right side of the court (especially in back positions). Due to the lower number of players available, left back and wing positions are likely less competitive than right positions. This may explain why the discriminative importance of body dimensions might be less pronounced for these latter players. Therefore, it is paramount to consider players' laterality when considering body dimension benchmarks.

Body dimensions are also likely influenced by the different playing position-specific demands [2]. For instance, being taller likely allows shooting over the defense in a back position or covering more space as a goalkeeper. Since heavier players might better tolerate contacts and duels, it is not surprising that pivots, which were shown to display the greater number of contacts per game [2], were also found to be the heaviest on the court. Anecdotally, most teams today have also a 'defender specialist' [2], which has also a very specific anthropometric profile (i.e., ~2-m tall involved in repeated contacts). In contrast, the smaller body dimensions observed for the wings are in agreement with their reduced playing area. Further than the aforementioned average values, it is however worth considering the important range of anthropometric profiles observed in each position (e.g. left wings range: 169 to 200 cm and 64 to 102 kg). This suggests that players with atypical anthropometric profiles can still make the elite level. It is therefore important not to discard too early the players not presenting with the 'optimal' anthropometric profile for a given position.

Playing standard. When we considered the differences in stature and body mass between each playing standard, between-positions followed the same trends as for pooled data for most of the leagues, except in the first Spanish League where pivots (instead of left backs) were the tallest and heaviest (Table 1). These differences could be explained by different playing styles and/or some different choices regarding playing position profiles from Spanish coaches.

Players from the first French league were the smallest and had the largest differences with the other playing standards (9 moderate differences in a total of 10 for stature and 15/16 for body mass, Table 1). These differences could be explained by a myriad of factors such as the economic power of the different leagues, which indirectly influence players' recruitment (mean 2011-2012 budget in the French league: €2.7m (1.5-6.7), vs. €4.2m (1-9.5) and €5.3m (2.5-15) in Germany and Spain, respectively, personal data). Anthropological considerations

in height (in France 1.5% of the population is taller than 190cm vs. 8.5% in Germany [13]), the number of people playing handball (~100.000 in Spain vs. ~800.000 in Germany, personal data), or some country-specific playing styles may also explain these differences. However, the differences in body dimensions between the different competition standards were in general only trivial-to-moderate, and the heaviest and tallest players did not always belong to the highest playing standards (Table 1). This may also suggest that while a certain (and minimum) anthropometric profile is likely required, extremely large body dimensions might not be necessary/appropriate.

Practical implications

While some goalkeepers and backs as short as 175 cm may still be selected in national teams, 77% of the goalkeepers, 75% of the right backs, and 82% of the left backs were taller than 190cm. The smallest pivot in the European championship was 184-cm tall, however, 93% of the other elite pivots were taller than 185 cm. Taken together, present data suggest that minimal body dimensions might be required, or at least may be facilitators, to make the elite level in handball; however these body dimension requirements may be less for left-handed players, especially right backs. The wide range of body dimensions for each position suggests nevertheless that players with untypical body dimensions can still make the elite level; a combination of other variables such as technical and tactical skills, and physical qualities may provide other benefits for some of these 'atypical' players. Finally, the consistent smaller body dimensions of left-handed players (especially backs) suggests that it is paramount to consider players' laterality when considering body dimensions benchmarks.

Conclusions

The present data show clear and substantial differences in body dimensions between playing positions and standards of play. They also show the importance of considering players' laterality when assessing their body dimensions. These results might serve as anthropometric benchmarks when profiling talented young players.

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Figures legends

Figure 1. Mean, maximum, minimum and distribution of stature in elite players with respect to playing positions, for the players from all leagues/championships pooled together. The magnitude of the standardized differences between the different positions is indicated by the number of symbols: 1 symbol stands for a moderate difference, 2 for a large difference, 3 for a very large difference. \diamond stands for a substantial difference vs. left wings, \ddagger vs. center backs, \circ vs. right backs, \bowtie vs. right wings and \P vs. goalkeepers.

Figure 2. Mean, maximum, minimum and distribution of body mass in elite players with respect to playing positions, for the players from all leagues/championships pooled together. The magnitude of the standardized differences between the different positions is indicated by the number of symbols: 1 symbol stands for a moderate difference, 2 for a large difference, 3 for a very large difference. \diamond stands for a substantial difference vs. left wings, \ddagger vs. center backs, \circ vs. right backs, \bowtie vs. right wings and \P vs. goalkeepers.

1 **Table 1.** Body dimensions of elite players with respect to playing positions and competition standards.

2

	Stature (cm)					Body mass (kg)				
	European championship	Champions league	Bundesliga	Liga	LNH	International	Champions league	Bundesliga	Liga	LNH
Center backs	191±5 ^{bb,ϕ,‡}	189±4 ^{bb,ϕ}	189±5 ^{b,ϕ,‡}	188±5 ^b	187±4	91.8±7.8 ^{bb,ϕ,‡,ϕ}	90±6.1 ^{bb,ϕ}	89±7.2 ^{bb,ϕ}	86±6.6 ^b	84±6.7
	179-200	18-196	175-198	178-198	176-192	73-113	73-101	73-105	71-100	73-105
Goalkeepers	193±5 ^{b,ϕ}	194±5 ^{b,ϕ}	194±5 ^{b,ϕ}	191±5	191±5	94.3±6.1 ^{b,ϕ}	96±10.2 ^{b,ϕ}	95±7.3 ^{b,ϕ}	91±7.9	91±7.4
	181-203	184-212	185-210	182-201	181-203	75-108	77-135	80-120	75-119	78-108
Left backs	197±5 ^{b,ϕ,‡}	195±5 ^b	197±4 ^{bb,ϕ,‡}	195±6 ^b	194±5	98.6±6.2 ^{bb,ϕ,‡}	96±8.9 ^b	98±6.9 ^{bb,ϕ}	95±6.5 ^b	92±7.2
	175-211	180-208	186-210	185-211	182-204	85-118	70-121	80-115	82-109	77-107
Left wings	185±5 ^b	186±6 ^{b,ϕ}	187±6 ^{bb,ϕ,ϕ}	184±6 ^b	183±6	83.3±7.2 ^b	84±8.8 ^b	86±7 ^{bb,ϕ,ϕ,‡}	83±7.1 ^b	79±7.6
	177-196	172-200	175-200	169-198	173-199	74-102	68-101	75-102	71-100	64-92
Pivots	195±5	194±6	194±5	196±4 ^{ϕ,‡,ϕ,b}	194±7	101.6±8.2 ^{bb,ϕ}	101±8.5 ^{b,ϕ}	100±7.1 ^b	104±10.6 ^{bb,ϕ,‡,ϕ}	96±9
	184-203	179-203	184-203	186-208	178-209	81-118	80-129	87-118	82-130	81-123
Right backs	196±5 ^{bb,ϕ,ϕ}	195±7 ^{bb,ϕ}	193±5 ^b	194±5 ^b	191±5	94.7±8.5 ^{bb}	95±8.4 ^{bb}	94±6.7 ^{bb}	94±7.8 ^{bb}	87±8.4
	185-210	183-210	183-203	184-209	173-198	78-115	80-115	80-110	78-110	60-102
Right wings	185±4 ^{bb,ϕ}	187±6 ^{bb,ϕ,ϕ}	186±5 ^{bb,ϕ}	184±6 ^b	182±5	83.3±4.5 ^{bb}	85±6.7 ^{bb,ϕ,ϕ}	83±5.2 ^{bb,ϕ}	82±7.4 ^{bb}	77±6.2
	178-194	173-210	173-201	174-194	171-195	73-92	68-104	71-99	70-98	68-94

3

4 Values are mean ± SD (first row) and range (2nd row). The magnitude of the standardized differences between the different positions is
5 indicated by the number of symbols: 1 symbol stands for a small difference, 2 symbols for a moderate difference, 3 for a large difference. ϕ
6 stands for a substantial difference vs. European championship, ‡ vs. Champions league, ϕ vs. the first German league, ϕ vs. the first Spanish
7 league and b vs. the first French league.



