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# BODY COMPOSITION OF FIELD HOCKEY PLAYERS IN VIEW OF THE ENVIRONMENTAL INDEX METHOD

Key words: field hockey, body build, environment Perkal indexes, sport anthropology.

## ABSTRACT

The aim of the paper was to examine the significance of athletes' body height in the final sort ranking as well as differences in body height between field hockey teams participating in a field hockey tournament. The study consisted of measurement of 11 selected somatic features in 83 hockey players representing five countries. The complex of Perkal's method for environmental index in Milicer's modification was employed in the analysis. The results reveal that the presented method can be useful in sport practice. The obtained results will make it possible to create a hypothetical player's model to help coaches in their selection of individual training loads, which combined with an adequately balanced diet will assure achievement of expected training and sport results.

#### INTRODUCTION

Factors conditioning success in sport can be physiological, psychological, technical and tactical [2]. Body size and build are also significant factors in some sports [4, 13]. The importance of morphology varies from sport to sport and depends on one's given training stage. The literature on the subject has placed a considerable emphasis on size per se and physique, most often assessed as the Heath-Carter anthropometric somatotype [8]. Such studies have been largely focused on adult athletes. In contrast, the literature on youth competitors representing different sports is more varied. Some studies concentrate on changes connected with physical growth and maturation, while others follow the adult athlete model, i.e., physical characteristics of young athletes in different sports [15, 16]. Several problems visible in studies of young athletes should be noted. Sport success at a young age is no guarantee of success at an older, more specialized age. Dropping out of a sport is common as young athletes progress from childhood through adolescence. Dropping out may be a youngster's own choice, or it may be related to the specific sport system, i.e., systematic selection and exclusion of young athletes during the developmental process [17].

Although the literature on the size and physique of athletes is reasonably extensive, some sports are less represented than others. A case in point is field hockey. Representative studies of this sport include research by Toriola et al. [24], Scott [20], Reilly and Borrie [19], and Elferink-Gemser et al., [6, 7]. Less known are studies of Polish field hockey players by Drozdowski [3], Drozdowski and Michałowska [4], Strzelczyk [21], Strzelczyk et al. [22] and Krzykała [11].

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An important influence on the development of field hockey has been the replacement of the natural playing surface with the synthetic one [19]. Although the player's forward leaning position is common in field hockey, the extent of the forward lean is far greater on the artificial turf. This change was related, in part, to the running technique, stick length and changes in tactics. On an artificial surface, the characteristic position of a player features a greater lean forward for most of the game. This results from specific defensive tactics and the use of a shorter stick, held generally with the left hand in the upper part and the right hand in the middle. The changes of the grip position depend on specific game situations. Field hockey has also become faster and more dynamic, resulting in new tactics and changes in selection, development and preparation of players [20, 10].

The purpose of this study was twofold: (1) to compare the physique of field hockey players from different countries taking part in an international tournament; and (2) to assess the relationship, if any, between the players' somatic characteristics and the team's position in the final tournament ranking.

#### **METHODS**

The sample included 83 players from teams participating in the 9<sup>th</sup> Elimination Tournament for the Field Hockey Men's European Championship, which took place in Poznań on 8-14 July 2002. The players came from five countries: Poland, Sweden, France, Slovenia and Croatia. Players from two other countries competing in the tournament, i.e. Scotland and Hungary, did not participate in the study.

The study was approved by the ethics committee of the University School of Physical Education in Poznań. Permission to conduct the study was granted by the tournament organizing committee and team representatives; individual players gave their informed consent.

The following dimensions were measured following the protocol described in Drozdowski [5]: body height (cm) and body mass (kg); flexed arm and calf circumferences (cm); subscapular, abdominal, triceps and medial calf skinfold thicknesses (mm); and biepicondylar (humerus) and bicondylar (knee) widths (cm). Body height was measured using a field anthropometer; body mass was measured using an electronic scale to 500 mg. Circumferences, skinfold thicknesses and skeletal breadths were measured in the standard way.

In addition to the body size, the selected dimensions provided indexes of three components of body build [13, 14]: linearity  $(m_1)$ : body height; muscularity  $(m_2)$ : flexed arm and calf circumferences, elbow and knee widths; and adiposity  $(m_3)$ : four skinfold thicknesses. Each dimension was converted to a z-score (standard score) as follows:

$$z = (X_i - X_m) / SD,$$

where:  $X_i$  was the individual trait value, Xm - the mean value of the trait for the total sample of players, and SD was standard deviation of the trait for the total sample of athletes.

Perkal indexes were calculated as follows:

$$\sum Z/P$$
,

where: Z was the normalized value and P was the number of traits in one factor.

The general dimension index (M) was also calculated as follows:

$$M = m_1 + m_2 + m_3 / 3$$

It is the arithmetic average of three components of body build (structural factors) – length muscularity and adiposity. First, individual characteristics were calculated and then traits of the whole team.

The index presented in standard deviation units indicated the general dimension (build) of a given team relative to the other teams in the sample. A positive value of M index means that the examined team is generally larger than the control team; negative – that it is generally smaller.

The internal variability index was calculated. Milicer's modification [18, 14] of Perkal's Environmental Index allows the estimation in internal proportions of the players – in this case combined for each given team. Perkal's index was calculated by subtracting from every structural factor for each individual the general value:

$$m_1 - M; m_2 - M; m_3 - M.$$

where: M – general dimension index,  $m_1$  – linearity,  $m_2$  – muscularity,  $m_3$  – adiposity.

The indexes were assigned three-point values (internal proportion code) which provided an

indication of the share of each structural factor in the overall body build. A positive sign of enviindicated ronmental index the dominant development of the respective factor in the body build of an individual; a negative sign indicated less significant development of the respective factor in the body build of an individual. A harmonic or balanced body build approximated the mean for the group, i.e., the value of environmental index close to zero. Environmental indexes were also transformed into distribution points for each specified factor (Table 2).

#### RESULTS

Means and standard deviations for age and all anthropometric dimensions for each of the five teams and for the total sample are summarized in Table 1.

The index of general body build (M) for each team is summarized in Table 2.

Table 1. Point scales of environmental indexes

Points	Perkal's environmental index						
1	-x to -1.07						
2	-1.06 to -0.57	< mean					
3	-0.56 to -0.18						
4	-0.17 to 0.18	mean					
5	0.19 to 0.57						
6	0.58 to 1.06	> mean					
7	1.07 to x						

The index of body build was quite similar for the teams from France, Slovenia and Croatia. The indexes of general body size were close to each other and at the same time higher than the group average, i.e. 0.

The lowest value of M index (-1.03) and also the lowest internal variability (0.29) was characterristic of the Polish team (Table 2). The Polish team was characterized by low body height, low fat adiposity and better development of muscularity. All structural factors (length, muscularity, adiposity) were relatively similar in the Polish team. By transforming the environmental index value for the Polish team into distribution points of every specified factor a value of 2-2-1 (see Tab. 1) was noted.

For the Swedish team, the distinctive element was lack of deviation from the reference range, i.e., the average of all teams. The Swedes also had the highest bracket values for body height, as did the Croatian and Slovenian players. Using the environmental point scale this team was characterized as 5-4-3.

Players from France featured the highest level of skeleton robustness, while the team from Slovenia demonstrated the highest adiposity (in addition to low body height). The Slovenian competitors were also characterized by a large general body size, as represented by the M index. Players from Croatia were the tallest and had relatively high body mass with large arm and calf circumferences, as compared to those of other teams (Figure 1).

**Table 2.** Arithmetic averages of players' age, training periods, final places in the competition and environmental indexes of structure factors and inner – personal variability index of the studied teams

National team	n	Age (year)	Training period (year)	Final ranking place	M index	Linearity index	Muscularity index	Adiposity index	Point scale	Inter- personal changeability index
Scotland <sup>*</sup>	_	_	_	Ι	_	_	_	_	_	-
Poland	18	26.2	14.6	II	-1.03	-0.90	-1.01	-1.19	2 - 2 - 1	-0.29
France	17	24.9	17.9	III	0.37	-0.03	0.55	0.59	3-5-5	0.62
Sweden	18	26.2	11.8	IV	-0.06	0.15	-0.09	-0.25	5-4-3	0.40
Hungary*	_	_	_	V	_	_	_	_	_	_
Croatia	15	25.3	13.2	VI	0.41	0.82	0.19	0.22	6-5-5	0.60
Slovenia	15	21.7	9.4	VII	0.52	0.19	0.52	0.84	5-5-6	0.65

Seven teams participated in the tournament but two teams (Scotland and Hungary) did not give their consent to participate in anthropometric measurement.



**Figure 1.** Morphological features of studied teams (after normalization on M and SD of all teams)

Perkal's index describes the relationship between features of each player or team. Large differences suggest disproportions in body build. If the index value is close to zero it describes weighted body proportions of a player or a team. The point of using Perkal's index in this analysis (and not finishing the analysis on the stage-specific factors or general body build M index) was clear, especially in the case of the teams from France and Croatia. The figures of general body value M index were 0.37 and 0.41. Body dimensions in the control group were similar. The value of M index in this case does not differentiate between those teams, but even makes them similar, while the discussed teams are completely different (see Tab 2). The estimation of structural internal proportions showed several differences (Fig. 2).



Figure 2. Components of body build for each team after normalization

The French team featured a slight reduction of length factor (-0.03) and a high positive index values for adiposity (+0.59) and muscularity (+0.55). The Croatian team was greater in length (+0.82) but at a similar level of adiposity and muscularity. For the Polish team, all the structural features bore a negative sign (Tab. 2).

## DISCUSSION

Perkal's environmental indexes differ from team to team. There is, however, a clear trend. Positioning in the general classification is thought to be 'forced' by the reduction of the linearity factor. The above dependencies find their reflection in a player's morphologic image, which is probably combined with the hockey players' position during the match. The player's speed factor combined with the linear dimensions of equipment used in the game, i.e. the stick, causes a preference of medium and short players over tall ones. Additionally, large body height may be an unfavorable factor as it may overload the spinal column [20].

Łaska-Mierzejewska [14] suggests that, in general, top-level competitors feature a very high advantage of one structural factor over another, whereas among lower level players this difference is insignificant. In the case of the studied teams, no significant differences at the level of specific factors were noted even though all the teams were competing at a high sport level. Common sense suggests that some body build components may present a potential risk. For example, a relatively low body height and a high fat mass are potential limitations in professional sport. In a 70-minute game, excess adipose tissue is an unwanted load for the player and presents an additional energetic burden [23]. Distances of 8,500 - 12,000 m are regularly covered in field hockey matches [10], and the burden of excess fatness can be magnified under such conditions.

Polish field hockey players featured the lowest general body size relative to the reference group (M = -1.03). The Swedish players also had a negative score for general body size (M = -0.06), but further analysis indicated this was due only to muscularity and adiposity. In contrast, players from France, Slovenia and Croatia were generally bigger than the reference group (0.37, 0.52, 0.41, respectively). However, all three teams differed in

the proportional contributions of specific structural elements.

In summary, the body build of the studied players may potentially influence the final result. Although the observed differences in body build are not consistently clear, those that are apparent appear to be related to the ranking place of the respective teams in the final results.

In conclusion, at this sports level, even a small deviation from the 'model' (required set of proportions of all structural elements) may affect the final results. The presented method allows us to perceive the differences of individual factors when general body build is similar among the teams or players. A potentially confounding factor is experience. Players on the Polish and French teams were the most experienced ones and were also older, on the average, as compared with the other three teams. The potential interaction of experience and somatic characteristics needs further consideration. The obtained results enable development of a universal model of a player, allowing a better targeted choice of talented sports participants at an early level of their sports development. Coaches using this approach can simplify their choice of individual training levels, which combined with an appropriate balanced diet should ensure better training and sports results contributing to the player's or the team's sports success.

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