



## THE ANTHROPOMETRIC CHARACTERISTICS OF FUTSAL PLAYERS COMPARED WITH PROFESSIONAL SOCCER PLAYERS

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ANNA BURDUKIEWICZ \*, JADWIGA PIETRASZEWSKA, ALEKSANDRA STACHOŃ,  
KRYSTYNA CHROMIK, DAWID GOLIŃSKI

University School of Physical Education, Wrocław, Poland

### ABSTRACT

**Purpose.** The aim of the study was to compare the morphological characteristics of experienced futsal players with professional soccer players. **Methods.** The research sample included 22 university futsal players and 22 professional soccer players. Parameters including body height and mass, skinfold thicknesses of the trunk and extremities, lower limb length, trunk width, humerus and femur bone breadths, and the circumferences of the chest, hips, thighs, and calves were used to calculate various somatic indices. Somatotyping was performed using the Heath–Carter method. Differences in the characteristics between the futsal and soccer players were analyzed using Student's *t* test. Intragroup analysis was also performed on futsal players depending on player position and compared with the arithmetic means and standard deviations of all variables of the entire sample. **Results.** Compared with their soccer-playing peers, the futsal players were shorter, weighed less, had shorter lower limbs, narrower hips, and smaller hip circumference and bone breadth values. In contrast, higher levels of body fat and endomorphy were noted in this group. The proportion of mesomorphs and ectomorphs were similar in both groups. Futsal goalkeepers were differentiated by greater subcutaneous adiposity and body mass. Defenders had the slimmest body shape, with relatively narrower shoulders and hips, smaller bone breadths, and lower levels of adiposity. The body build of wingers was slightly larger. Pivoters were characterized by greater body height and larger values for the characteristics measuring the lateral trunk dimensions. **Conclusions.** The observed morphological differences between futsal and soccer players were mainly in body height and height-associated characteristics. This indicates that no specialized approach in futsal recruitment is currently used. This points to the need to develop a specialized approach in the player recruitment stage, as the tactical and technical constructs of futsal set the game apart from other indoor soccer games, finding that futsal players share a number of morphological similarities with handball players.

**Key words:** futsal, soccer, body type, body build

### Introduction

Futsal is a five-player 'reduced' variant of soccer (association football) sanctioned by FIFA in 1988. Futsal world championships have been held regularly since the early 1980s by various sanctioning bodies. The first and current world champion (2012) is Brazil, although other top teams include Spain, Russia, Argentina, and Portugal. In recent years, futsal has seen a significant rise in popularity.

Due to the game's origins, it holds a number of similarities with the football family of sports. Easily and readily played, futsal has caught on as a training aid allowing players to perfect technique and improve aerobic and motor fitness [1, 2]. Interestingly, research has found that athletes who only play futsal are significantly faster than soccer players [3]. Even though the physiological demands of football-type sports are met by aerobic and anaerobic metabolism, experts concur that maximal oxygen uptake should be one of the main criterion in assessing physical fitness and optimizing the training process [2, 4]. Futsal games are shorter in duration than in soccer and also allow for an unlimited number of substitutions (whereas during a 90-min soccer match

only three substitutions are allowed), with futsal players spend less time playing the game and cover fewer kilometers than their soccer-playing peers [5]. As a result, the specificity of futsal is manifested in differences in lung function. Pulmonary function testing has shown that soccer players are characterized by higher levels of vital capacity, forced expiratory volume, and maximum ventilation than futsal players despite similar body height and mass [6].

It is well known that morphological structure, body composition, and posture all play a significant role in sports. Several researchers have indicated the anthropometric and physiological differences among soccer players depending on what position is played, with goalkeepers and attackers the most differentiated [7–10]. Goalkeepers were characterized by greater body mass and height and relatively greater adiposity. In turn, attackers were the slimmest of all positions. In comparison to midfielders and attackers, defenders were taller and heavier. According to Gil et al. [7], the body fat percentage of soccer players should be no more than 11.5–12%, where, similar to the conclusions of Kalapotharakos et al. [11], a relationship was found to exist between adiposity levels of a team and their ranking. Better teams were associated with significantly lower percentages of body fat compared with teams less competitively successful. This oc-

\* Corresponding author.

currence has been confirmed in studies by other authors [12, 13]. The physiological requirements of soccer competition and training causes an increase in lean body mass in players, where, according to Reilly et al. [14], soccer players' mean muscle mass percentage is approximately 62%.

However, futsal, even as an indoor variant of the most popular sport in the world, has few studies on the morphological makeup of its players. Those available, such as a study on young female futsal players, found that their somatic build is more similar to volleyball players [15] and was a variable not associated with competitive success, assessed by a team's competitive ranking [16]. Another study performed throughout a futsal training cycle found no significant changes in the body mass index of female athletes, while a significant improvement was noted in exercise capacity [17]. In male indoor soccer players, a 16-week training program did not significantly influence body fat percentage, lean body mass, or changes in the proportion of endomorphic, mesomorphic, or ectomorphic somatotypes. These results are similar to those found in a group of female indoor soccer players, where only physical fitness levels significantly improved [18]. In addition, it has been observed that young futsal players with faulty posture may cause overloading of the osteoarticular and muscle systems, increasing the risk of injury. This includes the postural deformity of flat feet, which has been linked to a higher incidence of knee injury and may be associated with knee valgus. Injuries of this sort force athletes to refrain from training and contribute to lengthened recovery periods before the player can rejoin their team [19].

In light of the above, the aim of this study is to supplement the current state of knowledge on the morphological characteristics of experienced futsal players and compare them in terms of body build with a group of professional soccer players.

### Material and methods

The study involved 22 futsal players aged  $22.9 \pm 2.44$  years belonging to the Academic Sports Association Futsal Club of the University of Physical Education in Wrocław, Poland. This sample included three goalkeepers, five defenders, nine wingers, and five pivots, some of whom were medal winners in the Polish Academic Championships. The comparative group consisted of 22 Polish League First Division professional soccer players aged  $26 \pm 3.45$  years. The futsal group was involved in competitive futsal for  $12.3 \pm 3.1$  years, whereas the competitive history of the soccer players was  $15.5 \pm 3.4$  years.

Anthropometric measures were performed by highly qualified biological anthropologists using GPM anthropological instruments (Siber Hegner Machinery, UK). The following somatic characteristics were measured: body mass (BM) [kg], body height (BH) [cm], lower limb length measured from the symphysis or superior border of the pubic symphysis (LLL) [cm], biacromial diameter

(BAD) [cm], biiliocrystal diameter (BICD) [cm], chest circumference (CHC) [cm], hip circumference (HIC) [cm], thigh circumference (THC) [cm], and calf circumference (CAC) [cm]. Trunk adiposity was calculated by the sum of skinfold thicknesses ( $\Sigma$ SFT) measured at subscapular and supraspinale sites [mm], while adiposity of the extremities was measured by summing the triceps and medial calf skinfolds ( $\Sigma$ SFE) [mm]. Measures of humerus breadth (HUB) and femur breadth (FEB) were summed to describe skeletal size (SS) [cm].

These parameters were used to calculate a number of body proportion indices, including: Rohrer's Index to calculate leanness (RI) by  $BM \times 10^5 / BH^3$ , subcutaneous fat distribution ( $\Sigma$ SFT/ $\Sigma$ SFE), and the relationship of body height to lower limb length (LLL/BH), biacromial diameter (BAD/BH), biiliocrystal diameter (BICD/BH), chest circumference (CHC/BH), hip circumference (HIC/BH), thigh circumference (THC/BH), and calf circumference (CAC/BH).

Somatotype was determined using the categorizations proposed by W.H. Sheldon as modified by Heath-Carter [20]. The somatotypes of the futsal players were assessed by visual inspection.

Differences in the characteristics between the futsal and soccer players were analyzed using independent samples *t* tests. The relatively small sample size of futsal players resulted in intragroup analysis on the differences in player position to be performed with the arithmetic means and standard deviations of all variables of the entire sample.

The study was performed in accordance with the Declaration of Helsinki and the players provided their written consent to participate in the study.

### Results

Futsal players were significantly shorter and weighed less than the soccer players (Tab. 1). In addition, they were characterized by shorter lower limb length, narrower hip diameter, and smaller bone breadths and hip circumference. In contrast, the futsal players had greater trunk and limb subcutaneous adiposity than their soccer-playing peers.

After factoring in body height, a smaller number of intergroup differences were noted and all were statistically non-significant (Tab. 2). Here, futsal players had only a slightly larger upper trunk and larger hip and calf circumferences in relation to body height. Soccer players were characterized by a slightly larger pelvis, larger skeletal breadths, and greater fat accumulation on the trunk.

When somatotypes were compared, only the endomorphic component was significantly higher in the futsal players (Tab. 3). Mean values for ectomorphy and mesomorphy were similar in both groups.

Intragroup differences, after normalizing the values for the somatic characteristics, among the futsal players per player position are presented in Figure 1. The goal-

Table 1. Descriptive statistics and intergroup differences for the somatic characteristics of the futsal and soccer players

Variable	Futsal		Soccer		<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>	
Body mass (kg)	74.9	8.16	81.1	6.04	0.0062
Body height (cm)	178.1	5.10	184.0	5.74	0.0009
Lower limb length (cm)	91.8	3.19	95.4	3.62	0.0009
Biacromial diameter (cm)	41.3	1.86	41.9	1.94	0.2803
Biiliocrystal diameter (cm)	28.4	1.24	29.5	1.46	0.0098
Humerus breadth (cm)	7.0	0.39	7.3	0.40	0.0190
Femur breadth (cm)	9.9	0.58	10.3	0.45	0.0433
Skeletal size (cm)	16.9	0.89	17.5	0.79	0.0192
Chest circumference (cm)	88.3	4.90	89.6	4.32	0.3491
Hip circumference (cm)	97.6	4.79	101.0	2.72	0.0061
Thigh circumference (cm)	58.5	4.27	59.5	2.50	0.3297
Calf circumference (cm)	37.7	2.59	38.1	1.55	0.4799
Σ trunk skinfolds (mm)	17.3	6.03	14.9	2.58	0.1024
Σ limb skinfolds (mm)	10.8	3.40	8.3	1.43	0.0027

Table 2. Descriptive statistics and intergroup differences for the body proportion indices of the futsal and soccer players

Ratio	Futsal		Soccer		<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>	
$BM \times 10^5 / BH^3$	1.33	0.16	1.30	0.07	0.5188
LLL/BH	52.21	1.10	52.44	1.17	0.5062
BAD/BH	23.20	1.06	22.81	1.10	0.2350
BICD/BH	15.94	0.63	16.04	0.76	0.6378
SS/BH	9.48	0.44	9.52	0.36	0.7788
CHC/BH	49.62	3.34	48.72	2.14	0.2931
HIC/BH	54.83	3.08	54.92	1.69	0.8997
THC/BH	32.88	2.72	32.38	1.36	0.4474
CAC/BH	21.17	1.55	20.74	0.77	0.2495
ΣSFT/ΣSFE	1.64	0.42	1.83	0.35	0.1199

BM – body mass, BH – body height, LLL – lower limb length, BAD – biacromial diameter, BICD – biiliocrystal diameter, HUB – humerus breadth, FEB – femur breadth, SS – skeletal size, CHC – chest circumference, HIC – hips circumference, THC – thigh circumference, CAC – calf circumference, ΣSFT – trunk skinfolds, ΣSFE – limb skinfolds

Table 3. Descriptive statistics and intergroup differences for the somatotypes of the futsal and soccer players

Component	Futsal		Soccer		<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>	
Endomorphy	2.12	0.78	1.66	0.35	0.0166
Mesomorphy	5.25	1.33	5.10	0.94	0.6764
Ectomorphy	2.48	1.16	2.55	0.57	0.8059

keepers were distinguished by greater subcutaneous adiposity and larger chest circumference. At the same time, they were the least tall and had the shortest lower limbs among the entire group. Pivots had larger values of body mass, shoulder and hip diameters, and skeletal size. Additionally, they were characterized by the largest circumferences of the hips, thighs, and calves. In this sample, defenders were the tallest, had the longest lower extremities, and the least trunk adiposity. Wingers' trunk size and lower limb length were similar to defenders.

Individuals playing this position were characterized by smaller skeletal size.

Figure 2 presents the intragroup differences depending on player position for the calculated body proportion indices. Defenders had the slimmest body shape, with relatively narrower shoulders and hips, smaller bone breadths, and lower levels of adiposity. In comparison, wingers had a slightly larger body build. Goalkeepers and pivots had similar values for body mass in relation to height. Compared with the other player positions, pivots

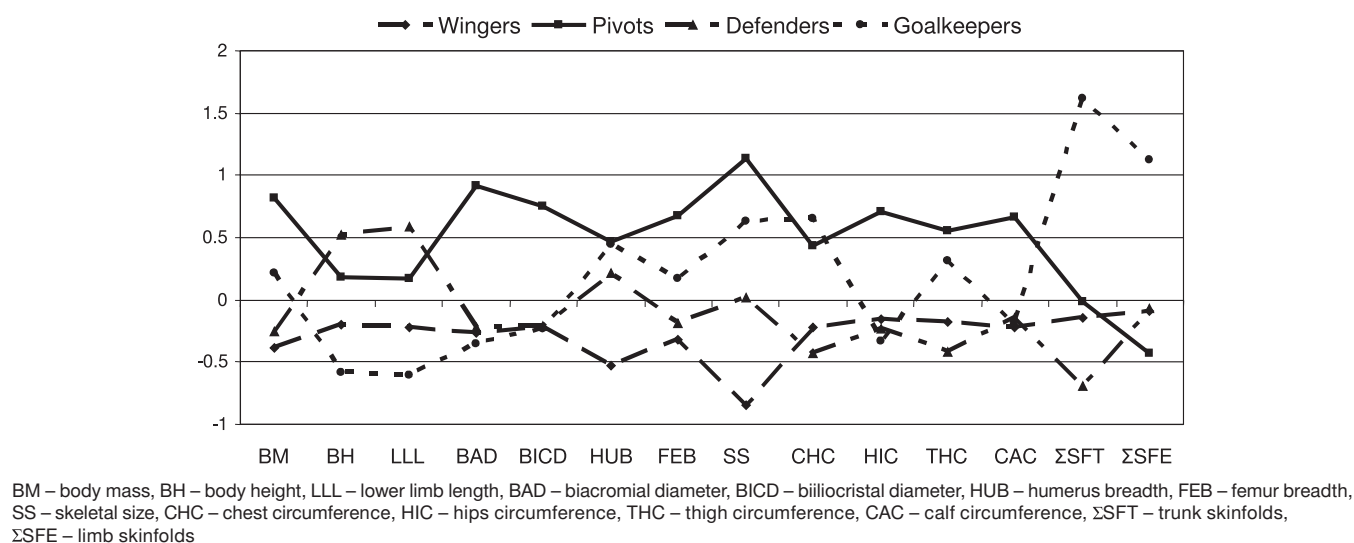


Figure 1. Normalized values for the somatic characteristics by futsal player position

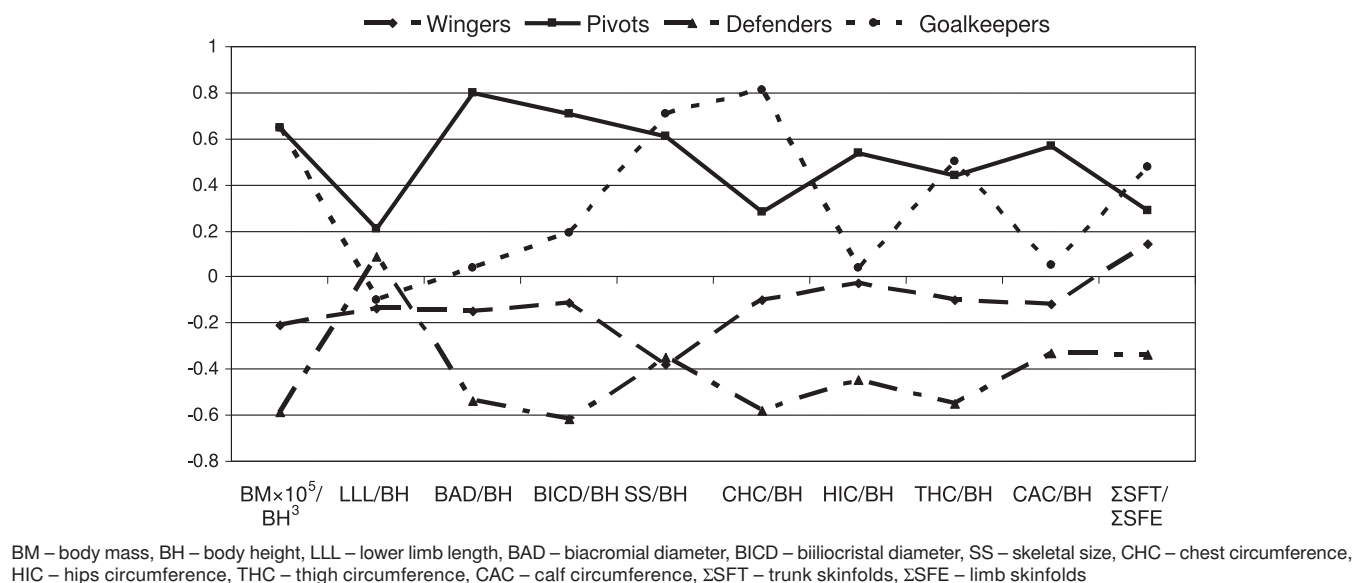


Figure 2. Normalized values for the body proportion indices by futsal player position

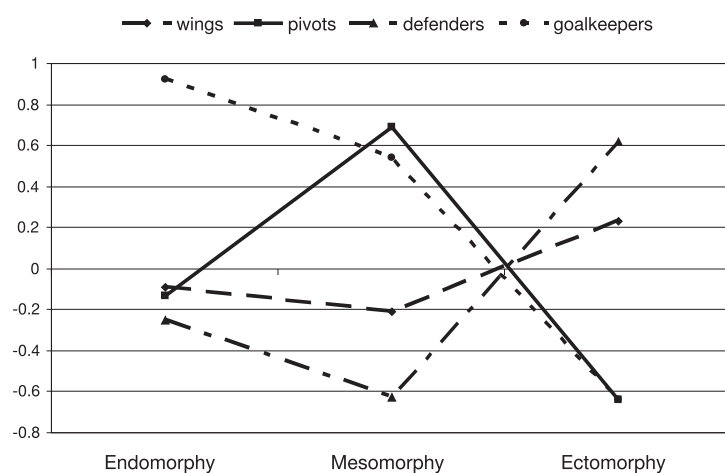


Figure 3. Normalized values for somatotype by futsal player position

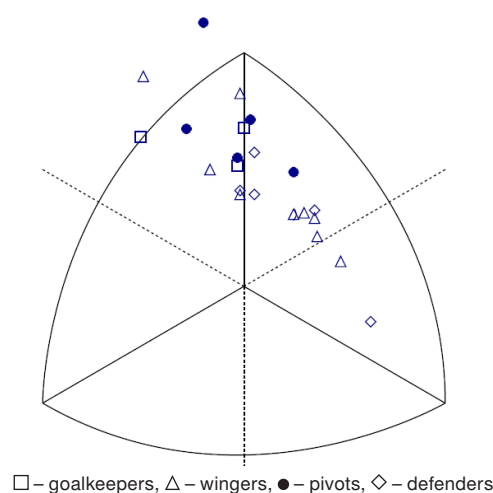


Figure 4. Futsal player somatotype by player position



had the largest values for shoulder width, hip width, hip circumference, and calf circumference. Goalkeepers were found with the largest: relative skeletal size, chest circumference, and trunk adiposity.

For goalkeepers, the most dominant somatotype was endomorphy (Fig. 3). The highest proportion of body slimness was found in defenders and wingers. Mesomorphy was highest in pivots, whereas slightly lower values of this component were observed in goalkeepers while the lowest in defenders.

The somatotype of defenders was largely dominated by mesomorphy (Fig. 4). In addition, one futsal player was found to be with an ectomorphic-mesomorphic body type. Goalkeepers featured a balance between mesomorphic and endomorphic-mesomorphic body types. The body build of wingers was the most diverse, from endomorphic-mesomorphic to ectomorphic-mesomorphic. Among pivots, two individuals were classified as endomorphic-mesomorphic, one as an ecto-mesomorphic, and the remaining two as featuring balanced mesomorphy.

## Discussion

Morphological characteristics are important factors when recruiting players in team sports [21]. In the present study, futsal players were found to have lower body height and mass compared with professional soccer players. In addition, they were also characterized by shorter lower limb length and narrower hips as well as smaller values for skeletal size and hip circumference. In turn, skinfold measurement found they featured greater amounts of fat on the trunk and extremities. The above results differed from studies conducted by other authors [22]. One study on professional Croatian futsal players found they had better developed body height, lower limb length, and hip and calf circumferences over soccer players. This was explained by possible differences in the recruiting criteria of amateur and professional sport.

Furthermore, an additional factor for these differences may be the types of loads experienced by amateur and professional athletes. However, as in our study, the width of the knee (femur breadth) was found to be at a higher in soccer players. In turn, the present results on adiposity levels were confirmed in a study on Spanish indoor and outdoor soccer players, where the outdoor players had statistically significantly higher levels of body fat [23].

The difference in the amount of subcutaneous fat was also illustrated by the significantly higher levels of endomorphic individuals playing futsal, whereas the mean mesomorphy and ectomorphy components of futsal and soccer players were similar. Large differences in body composition were found when the somatotypes of Polish indoor soccer players (2.12–5.25–2.48) were compared with their Brazilian peers (3.8–4.9–1.7) [24]. Compared with the present group of futsal players, these Brazilian players had lower levels of mesomorphy and ectomorphy while higher levels of endomorphy.

After factoring in the influence of body height on the significance of the analyzed somatic characteristics, a smaller number of intergroup differences were noted and all were statistically non-significant. The calculated body proportions found that the futsal players had only a slightly larger upper trunk and larger hip and calf circumferences in relation to body height. The soccer players were characterized by a slightly larger pelvis and more massive skeletal breadths, which may be due to the differences in the size and surface of the playing field, as both factors are associated with differences in the types of load experienced by the lower limbs. As is well known, exercise intensity during a soccer match constantly changes. Although running is the dominant form of physical activity, the need to jump, dribble, and kick the ball requires high levels of lower limb explosive strength [25].

Indoor soccer and futsal games are played on courts similar to those in handball, measuring 40 × 20 m, with total game time dependent more on the course of the match including the number of fouls, timeouts, or even cleaning activities (sweeping the floor). Overall, most games last approximately 70–80 min [26], with effective playing time lasting 40 min, divided into two halves with a 10–15 min interval. During game play, one of the most basic offensive movements is cutting. They allow players to outmaneuver opponents who are blocking them, thereby creating goal-scoring opportunities. These opportunities are almost always spontaneous actions, and as such very difficult to predict by opposing defenders. Research on futsal players [27] has determined that they are more agile and have faster response times when compared with soccer players, which was credited to the specific nature of this sport. However, regardless of some similarities between both disciplines, futsal has been found to feature a greater number of one-on-one match play, simultaneously combining elements of offensive and defensive play. This was credited as a factor for this group of players maintaining a high level of cognitive and coordination skills [3].

The differences that were found in body morphology, depending on futsal player position, were similar to those found in soccer. Overall, both disciplines' goalkeepers are distinguished by relatively large body size, increased subcutaneous adiposity, and a large chest circumference. However, opposite of that found in soccer, futsal goalkeepers are the shortest and have the shortest lower limbs compared with all player positions. Pivots had larger values of body mass, shoulder and hip diameter, and skeletal size. Additionally, they were characterized by the largest circumferences of the hips, thighs, and calves. The mass–height ratio for this group is comparable to that found in goalkeepers.

Morphologically, the values for this ratio are similar to athletes playing similar roles in the game of handball, whom are also distinguished by large body size [28]

largely due to the fact that they need to maintain a stable posture during one-on-one play, where one of the most important elements of play is blocking. A lower center of gravity allows for increased stability, while a developed upper body, larger body mass, and muscularity all help in playing against an opponent and maintaining stable and balanced posture.

Similar to what has been reported in studies on soccer players, futsal defenders were found with the slimmest body shape, with relatively narrower shoulders and hips, smaller bone breadths, and lower levels of adiposity. In comparison, wingers had a slightly larger body build. The morphological structure of these player positions may have allowed them to score the highest in the physiological tests applied herein. Moreover, these players have been found to have higher endurance, agility, speed, and strength levels [4].

### Conclusions

No large morphological differences were found between futsal and soccer players, which may be due to the fact that futsal players are often former soccer players. This points to the need to develop a more specialized approach in the recruitment stage of futsal, as the tactical and technical constructs of futsal set the game apart from other indoor soccer games, finding that futsal players share a number of morphological similarities with handball players.

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*Correspondence address*

Anna Burdukiewicz

Akademia Wychowania Fizycznego

al. I.J. Paderewskiego 35, P-2

51-612 Wrocław, Poland

e-mail: aburdukiewicz@gmail.com