



Study of Features of the Lower Limbs Belt in Athletes in A Series of Sports

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Received: July 12, 2023

Published: August 26, 2023

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Abstract

The article presents the results and analysis of the study devoted to the determination of a number of anatomical features and morphofunctional index values of the bone pelvis and lower extremities in female athletes playing basketball, volleyball and handball. It has been reliably determined that female basketball players have the highest indices of index values, in comparison with volleyball and handball players.

Keywords: Female Athletes; Team Sports; Morphological; Functional Index Values; Bone Pelvis; Lower Limb

Abbreviations

SI: Soloviev Index; LLLI: Lower Limb Length Index; PBI: Pelvic Bone Index; TriI: Trochanteric Index; BMI: Body Mass Index; SDI: Sexual Dimorphism Index; IRFL/TL: Index Ratio of Femur Length to Tibia Length; CMC: Candidates for Master of Sports; ANP: Anatomically Narrow Pelvis

Introduction

The mass participation in various sports by women of different age groups has become a common phenomenon today. Girls, starting from the prepubertal and pubertal period, actively and massively go to sports clubs, which allows the coaching team with the participation of sports doctors to conduct professional selection of female candidates for a particular sports discipline [2,3]. When selecting for team sports such as basketball, volleyball and handball, there are also their own criteria for selecting female candidates, among which the morphological features of the upper and lower limb girdle are of great importance [8,9]. It is a well-known fact that the body length of female athletes is of leading importance in team sports such as volleyball, handball and especially basketball. These sports are dominated by tall female athletes [4,8-10].

The length, thigh and shin circumference of the female athlete, length and width of the foot, and the right and/or left kicking leg are important in the technique of executing a number of specific techniques in each of these sports. Also, according to a number of researchers, of great morphofunctional importance is the relationship between each part of the athlete's body, including the upper and lower extremities, which stabilizes around 14-16 years of age as puberty, growth and maturation of the bony structures of the skeleton, including the bony pelvis and extremities [4,11-13]. Serving the ball, building a block, shooting to the basket or at the opponent's goal - this is only a small part of the game "work" that female athletes perform in the process of playing basketball, volleyball and handball. Thus, in basketball, such anthropometric parameter as the height of the body, including lower and upper limbs has a determining value for the sports role of an athlete and her place on the field - center, defense or offense [5,6,9,14].

In connection with the above-mentioned, the study of biomedical and anatomo-morphofunctional features of the bone pelvis and lower limb girdle in female athletes in these team, game sports is very relevant and in demand, both in sports morphology and in a number of other related biomedical disciplines.

Aim of the work

The purpose of this article is to present the data obtained as a result of the study and analyze them concerning the study of morphofunctional and anatomical features of the lower limb girdle in female athletes engaged in basketball, volleyball and handball.

Methods for conducting the study

To conduct this study, we used the following methods: anthropometry with determination of body length and weight; determination of the length of the lower limb, both right and left, shoulder width, length and girth of each part of the lower limb - femur and tibia, length, width and size of the foot, determination of pelvic width (intercostal diameter); determination of Solovyov index (SI) - wrist joint girth in cm. A number of additional morphofunctional index values were also determined, such as the leg (lower limb) length index (LLLI), which was defined as the percentage ratio of the total length of the lower limb to the result obtained by subtracting it from the body length, in cm - sitting body length); pelvic bone index (sum of three transverse and one longitudinal pelvic bone dimensions (IBP); pelvic bone maturity index (PBI), according to the method of N.I. Kovtyuk. Kovtyuk; index ratio of femur length to tibia length; trochanter index (TrI) as the ratio of body length in cm to the length of the lower limb; pelvic index (PI) as the sum of three transverse pelvic dimensions (intertrochanteric, intercostal and trochanteric dimensions, plus the size of the external conjugate - all in cm); sexual dimorphism index (SDI), according to the method proposed by J. Tanner (1996) with subsequent determination of sex somatotypes in each group of female athletes; body mass index - according to the classical method; shoulder width index, as a percentage ratio of shoulder width to body length; body mass index (BMI). The external dimensions of the bone pelvis of the female students who participated in the study were also additionally studied. Their normative values for these age groups, used in anatomy, morphology, obstetrics and gynecology, were taken as normative variants of the measured indicators of the external dimensions of the bone pelvis: distantia trochanterica - transverse external dimension, defined as the distance between the two greater trochanters of the femur, usually 30-32 cm [2,7,12]; conjugata externa is the external straight dimension of the bony pelvis, which is determined from the middle of the upper edge of the bosom symphysis to the suprasacral fossa and is usually 20-21 cm [2,7,12]. After obtaining the necessary results of pelvimetry and anthropometry, a mathematical calculation of the PBI values was performed according to the author's formula by N.I. Kovtyuk [2,7,12]. According to

the author's criteria, values of 30.0-40.0 were considered normative. The values less than 30.0 indicate the incompleteness of the process of formation (maturation) of bone structures of the pelvis of the subject or a decrease in the process of bone maturation. The cause of this process may be disorders of the endocrine and reproductive systems of the subjects of different genesis [2,7,12]. Values above 40.0 indicate the completion of pelvic bone maturation in the examined women [2,7,12]. We also conducted a literature-critical analysis of available sources of information, both domestic and foreign; the method of mathematical statistics when working with the obtained data of anthropometric indices and morphofunctional index values.

Object, material and methods of research, and organization of the study

The study involved 72 female athletes actively engaged in playing team sports such as basketball - 23 female athletes; volleyball - 25 female athletes; and handball - 24 female athletes. Their average age was $22,73 \pm 1,12$ years; $23,07 \pm 1,14$ years; and $21,97 \pm 1,34$ years, respectively. Duration of these sports - from 4,5 to 10 years. The level of sports qualification - from I sports category - 29 sportswomen (40,28%) of the total number of sportswomen; candidates for master of sports (CMC) - 27 (37,5%) and master of sports - 16 (22,22%). The frequency of training - 5-6 times a week, 2-2.5 hours each. This study was conducted in a number of sports sections and clubs in Mykolaiv and Kherson regions, Ukraine, under the condition of absolute voluntariness, both on the part of female athletes themselves, and with the consent and active support of coaching teams.

Results of the study and discussion

After performing the anthropometric measurements required for this study, which were carried out according to the classical methodology, the indices were obtained, which are presented in table 1, at $p < 0.05$.

The analysis of the anthropometry results showed that basketball players can be classified as very tall athletes in terms of body length, and volleyball players as tall athletes [4,6,7,13]. Basketball players also had the highest body mass, followed by volleyball players and handball players. Shoulder width of female athletes of all groups is approximately the same, but again, the widest-shouldered are female basketball players, followed by volleyball and handball players. The length of the lower limb is the longest in

Name of the indicator	Female basketball players (n = 23)	The volleyball girls (n = 25)	Handball girls players (n = 24)
Body length (standing), cm	192,77 ± 1,36	179,35 ± 1,13	177,03 ± 1,11
Body mass, kg	82,03 ± 0,74	73,23 ± 1,08	71,54 ± 1,29
Shoulder width, cm	36,43 ± 1,04	35,53 ± 1,27	35,67 ± 1,14
Length of the lower limb, cm	105,37 ± 1,93	102,17 ± 1,71	93,83 ± 1,86
Длина бедра, см	62,17 ± 1,14	61,87 ± 1,33	56,08 ± 1,21
Resting hip circumference, cm	52,89 ± 1,13	51,67 ± 1,88	53,86 ± 1,14
Shin length, cm	43,47 ± 1,66	40,47 ± 1,54	37,93 ± 1,68
Shin circumference, cm	35,47 ± 1,09	33,67 ± 1,16	34,97 ± 1,28
Length of foot, cm	28,57 ± 1,45	29,81 ± 1,68	27,85 ± 1,54
Width of foot, cm	8,56 ± 1,37	9,47 ± 1,08	8,23 ± 1,36

Table 1: Anatomico-anthropometric indices in female athletes of the studied groups.

female basketball players, exceeding the length of the lower limbs in female volleyball and handball players. In all three groups of female athletes, hip length exceeds tibia length, with handball players having the shortest hip length and basketball players having the longest, followed by volleyball players. Resting thigh circumference and shin circumference are the highest in basketball and handball players, volleyball and handball players have almost similar results. In all three groups of female athletes, the average length of the thigh exceeds the length of the shin. The highest values of foot length and width are in volleyball players, then - in basketball players, the lowest - in handball players. In female athletes of all three groups, the values of pelvic width are less than the generally accepted, normative for this age group, equal to 28-29 cm [2,7,12]. The ratio of the available shoulder width and pelvic width indicate the masculine type of the female athletes' figure - with broad shoulders and narrow pelvis [2,7,12]. Also, we performed pelviometry, conducted according to the classical method, using Martin's circular. The obtained results of measurements of 3 transverse and 2

longitudinal, external dimensions of bone pelvis of female athletes are presented in table 2, at $p < 0.05$.

The analysis of the obtained results of pelviometry showed that the athletes of all three examined groups have clinical manifestations of anatomically narrow pelvis. This is convincingly evidenced by the reduced compared to the norm all transverse and longitudinal dimensions of the bony pelvis. So, for example, d. spinarum in norm (for this age group) should correspond to 25-26 cm; d. cristarum - 28-29 cm; d. trochanterica - 30-32 cm; c. externa - 20-21 cm; c. vega - 11 cm [2,7,12]. After obtaining the anthropometric indices necessary for this study and analyzing them, we performed mathematical recalculations of six morphofunctional index values used in our study: body mass index; Solovyov index; sexual dimorphism index; lower limb length index [1]; pelvic index; relative pelvic width index; pelvic bone index; trochanter index; index value of femur length, cm/ankle length, in cm. The obtained results of nine morphofunctional index values, are presented in table 3, at $p < 0.05$.

Name of the indicator	Female basketball players (n = 23)	The volleyball girls (n = 25)	Handball girls players (n = 24)
Intercostal/Interaxial diameter (d. spinarum), cm	25,01 ± 0,24	24,81 ± 0,27	24,37 ± 0,33
Intercrestal diameter (pelvic width), d. cristarum, cm	27,14 ± 0,67	27,56 ± 0,38	27,51 ± 0,11
Trochanter size (d. trochanterica), cm	31,35 ± 0,74	31,22 ± 0,61	31,17 ± 0,88
External conjugate (c. externa), cm	20,03 ± 0,74	19,87 ± 0,21	19,31 ± 0,77
True conjugate (c. vera), cm	10,89 ± 0,67	10,45 ± 0,49	10,23 ± 0,66

Table 2: Results of pelviometry in the studied groups of female athletes.

Name of the indicator	Female basketball players (n=23)	The volleyball girls (n=25)	Handball girls players (n=24)
Solovyov index, cm	15,77 ± 1,13	15,12 ± 0,96	14,33 ± 0,54
Relative lower limb length index	55,27 ± 0,41	57,56 ± 0,53	53,72 ± 0,29
Index of relative pelvic width	14,33 ± 0,18	15,48 ± 0,47	15,52 ± 0,34
Pelvic index	105,92 ± 0,23	104,93 ± 0,27	104,45 ± 0,41
The pelvic bone index	43,14 ± 0,93	42,68 ± 0,33	41,68 ± 0,33
The Trochanter Index	1,81 ± 1,03	1,74 ± 0,66	1,86 ± 0,53
Body mass index, kg/cm ²	22,01 ± 0,97	22,94 ± 0,67	24.61 ± 0,73
Sexual dimorphism index	84,61 ± 0,13	82,46 ± 0,21	82,81 ± 0,22
Hip length to tibia length index	1,41 ± 0,08	1,52 ± 0,12	1,45 ± 0,41

Table 3: Morphofunctional indices in female athletes of the studied groups.

The analysis of the obtained morphofunctional index values is a convincing evidence of adaptive somatic changes in all three groups of sportswomen. Thus, in particular, Solovyov index values are the highest in female basketball and volleyball players, exceeding the norm (14-15 cm). This result indicates the thickening of tubular bones of the limbs [2,7,12]. The lowest values, although within the normal range, were determined in basketball and volleyball players. In handball players the body mass index on average for the group is slightly higher than the upper limit of normative values, 24.5 kg/cm² [2,7,12].

The pelvic index values indicate that the pelvises of female athletes, despite isolated cases of normal pelvic dimensions, are smaller than the normative values of 107-109. Thus, in all three study groups, pelvic index values indicate that female athletes have anatomically narrow pelvises (ANP) [2,7]. Relative pelvic width index values - its average value for all three groups, is less than acceptable, from 16.0 to 17.9 [2,7]. The values of the trochanter index, in the average values of the groups, reliably indicate that handball players have a dysevolutionary type of constitution, and volleyball and basketball players have a pathological type of constitutional development [2,7].

Reliably, the obtained data indicate stenopieliia - narrow pelvis, and the value of this morphofunctional index value is the lowest in female basketball players. Thus, if they have a very tall stature, broad shoulders, narrow pelvis and long lower limbs, we can say that they have a giant type of physique [2,7]. In handball and volleyball players, the gynoid type of physique was determined [2,7]. The

group average values of the index of the relative length of the lower limb are as follows: in basketball players - metrioskelia (from 55.0 to 56.9); in volleyball players - macroskelia - 57.0 and higher (long leg); in handball players - brachioskelia (short leg) - up to 54.9 [4,5,14]. These indices are confirmed by the indices of index relationships of femur length to tibia length [4,5,14]. The index of sexual dimorphism (average for the groups) in basketball and volleyball players indicates the reliable presence of these athletes - representatives of the inversive, andromorphic sexual somatotype, with the presence in each of these groups, a small number of athletes with transitional, mesomorphic sexual somatotype - 3 (13,04%) and 4 (16,00%) athletes, respectively. In handball players, on average for the group, values of andromorphism were obtained, but slightly higher than the upper limit of the mesomorphic sexual somatotype, equal to 82.1. This is due to the fact that in this group, there are 9 (37.5%) female athletes with mesomorphic sex somatotype. None of the three groups examined had a gynecomorphic sex somatotype, which is physiological for women [2,7,12].

Conclusions

- The results of the study have shown that basketball players differ strikingly in anthropometric parameters (primarily in the length of the lower limb and its components) and in a number of morphofunctional index values (Solovyov index, index of relative length of the lower limb, index of relative pelvic width, trochanter index, index of sexual dimorphism), depending on their playing role.
- More moderate values of the pelvis and lower limbs, have volleyball players, followed by handball players.

- The revealed anatomical and morphofunctional peculiarities in female athletes of the studied groups, in our opinion, can be caused both by the previous selection of female athletes by the coaching team and by the result of adaptive processes caused by long-term (multi-year) and intensive physical loads.

Bibliography

1. Bugayevsky KA., Danilchenko SI., Starodubtsev SG. Features of the distribution of sex somatotypes in handball players of different age groups // Bulletin of Poltava Dental Academy. 2018. Vol. 1. 154:36-39.
2. Zhunisbek DN., Kudashova LR., Kefer NE., Mavrudieva N. Construction of model characteristics of handball players of high qualification // Izvestiya natsional'naya Akademiya nauki Respubliki Kazakhstana. Series of social humanities. 2017. 3:80-87.
3. New in the system of sports training in handball: foreign experience. Issue 19: scientific and methodological manual / author-composer. AI. Pogrebnoy, IO. Komlev, translator: E.V. Litvishko. Krasnodar: KSUFKST, 2019. 68 p.
4. Popichev MI., Chizhenok TM. Selection of young volleyball players taking into account anthropometric indicators. Pedagogy, psychology and medical and biological problems of physical education and sport // collection of scientific works edited by Prof. Ermakov SS. -Kharkiv: XDADM (XXIII), 2007. 6:228-229.
5. Martirosov EG., Rudnev SG., Nikolaev DV. Application of anthropological methods in sport, sports medicine and fitness // M. : Izdvo "Physical Culture". 2010. 119 p.
6. Serdyuk DG. Analyses of anthropometric indexes of handball players of GC "ZTR" // Visnik Zaporizky National University. Physical education and sports. - 2014. 2:107-113.
7. Oleinik EA. Anatomico-anthropological characteristics of female athletes of game sports // Scientific Notes of P.F. Lesgaft University. 2013. Pp. 94-98.
8. Oleinik EA., Bugaevskiy KA. Features of sex somatotypes and a number of anthropometric indicators in female athletes in pair female acrobatics // Man. Sport. Medicine. 2020. Vol. 20. 2:22-28.
9. Ushakov AS., Nenasheva AV., Kleshchenkova NE. Comparative analysis of physical development indicators of 11th grade students and 1st year students. // Man. Sport. Medicine. Izdvo: South Ural State University (Chelyabinsk). 2014. 4:73-79.
10. Matveev SD., Uspensky AK., Uspenskaya YuK., Didur MD. Anthropometric criteria, somatotype and functional fitness of basketball players at different stages of sports training // Sports Medicine: Science and Practice, 2020. - Vol. 10. № 1. <https://doi.org/10.17238/ISSN2223-2524.2020.1.5>
11. Matvienko OV. Physical training and morphophysiological indices of 15-16 years old basketball players // Pedagogical-psychological and medical-biological problems of physical culture and sport. Publishing house: Naberezhnochelnsky State Pedagogical University (Naberezhnye Chelny). 2007. - 2(3)Ж185-192.
12. Shchegoleva TN., Krikun EN., Martirosov EG. Structure of physique of high-skilled basketball players of different game roles // Scientific Vedomosti. Series Medicine. Pharmacy. 2011. Issue 13. 4(99):112-115.
13. Nikityuk DB., Nikolenko VN., Klochkova SV. Body mass index and other anthropometric indicators of physical status with regard to age and individual-typological features of the constitution of women // Nutrition Issues. -2015. 4:47-54.
14. Borutskaya SB., Vasiliev SV. Osteological study of the population of the city of Polotsk XVII-XVIII centuries // Paleoanthropology of Belarus / Scientific ed. II. Salivon, SV. Vasiliev. I. Salivon, SV. Vasiliev. Minsk: Belaruskaya nauvuka, 2015. 147 p.