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Research Article

Characteristics of a Number of Anthropometric Indicators and Morphofunctional Index Values of the Bone Pelvis in Handball Players of Different Age Groups

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Abstract

The article contains research materials devoted to the study of a number of individual features of the anatomical structure of the bone in athletes of puberty and adolescence who are actively involved in handball. Additionally, in these studied groups of young handball players, a number of morphological and functional index values were determined in order to determine the morphological somatic changes in their body structure and, in particular, the processes of formation of their bone pelvis. Sportswomen of puberty, according to the results of the study, have normal physiological processes corresponding to their age group, associated with the formation of their bone pelvis. In female athletes of the adolescent age group, all external dimensions of the bone pelvis are less than the generally accepted parameters, which indicates that they have an anatomically narrow pelvis. Also, in the group of youth handball players (n = 119), it was found that normal pelvic sizes are present in 4 (3.36%), generally evenly narrowed pelvis – in 49 (41.18%) athletes, a simple flat pelvis – in 29 (24.37%), transversely narrowed pelvis – in 37 (31.09%) young female handball players. Accordingly, I degree of pelvic narrowing was determined in 28 (23.53%) young handball players, II degree of narrowing – in 4 (3.36%) athletes.

According to the results of the study, it was found that athletes of both groups have normal body mass index values. In the group of handball players of pubertal age, a gynecomorphic sexual somatotype was determined, and in young handball players - a transitional, mesomorphic sexual somatotype. The obtained results of other index values indicate that young handball players have a narrow pelvis, with an almost completely completed process of its formation. According to the results of the study, taking into account the experience and intensity of training of young athletes, it can be argued that the identified somatic changes are a direct result of adaptive processes in athletes.

Keywords: *Female Athletes; Puberty Age; Young Age; Handball; Bone Pelvis; Anthropometric Indicators; Morphological and Functional Values*

Abbreviations

BMI: Body Mass Index; PBI: Pelvic Bone Index; PI: Pelvic Index; RPWI; Relative Pelvic Width Index; SDI: Sexual Dimorphism Index; SI: Soloviev index / Diameter of the Wrist Joint

Introduction

Modern women's sports attract a significant number of young women of different age groups to its ranks. Starting from childhood and adolescence, and then in adolescence, girls and girls are actively involved in various sports. Among them are team playing sports, in particular handball. In Ukraine, playing handball for young women has a long-standing glorious tradition and is a very popular sport [1]. Thousands of sportswomen, of different age groups, in amateur or professional handball, train and take part in competitions of various levels [2-4]. At the same time, despite the fact that each athlete in handball has her place in the team and performs her own special game function and her own volume of actions performed during the game, intense physical and psycho-emotional stress affecting each of the young athletes are reflected on the formation of their adaptive, their individual sexual somatotypes [4-8]. The study of somatic rearrangements occurring in their bodies, concerning both anthropometric and morphofunctional changes in each of the age groups of young athletes, is very relevant and in demand among scientists around the world studying this problem.

As you know, adolescence and adolescence are very important periods in the formation of both physiological and pathological changes in the life of every person. At the same time, loads that are intense in frequency and volume, when playing sports, do not always benefit the young, forming body of girls and girls [1,9-13]. Sometimes, excessive passion for sports and physical activity inadequate in strength, volume and frequency can lead to illness, injury, and sometimes even death of athletes. In this regard, I would like to note the research work of a number of authors who are actively involved in the study of anatomical changes and anthropometric indicators in young athletes, both in handball and in other sports. Also, the problems associated with adaptive processes in athletes of different age groups, leading to morphological and functional changes in athletes, incl. and in women's handball. In this regard, the presented study is a fragment in the study of the impact of intense physical activity on the musculoskeletal system and somatic adaptive restructuring of the body of youth female athletes of a number of age groups [1,9-13].

Materials and Methods

The study was conducted with the involvement of 121 female athletes of puberty (adolescence girls) and 119 youth age (young people (women), total 240 female athletes, players handball from sports clubs in a number of regions of Ukraine. The age of female athletes of pubertal age (adolescence girls) involved in handball was 13.87 ± 1.24 years. In the second group of female athletes, there were girls of youthful age (young people (women). Their average age was 20.37 ± 1.12 years. The level of sports paternity of handball players – from girls with I sports category to the level of a candidate for master of sports and master of sports. Handball experience – from 2.5 to 10 years. The intensity of the workouts is 4-6 times a week, 2.5-3.5 hours per workout.

The age periods of female athletes were determined according to generally accepted criteria. Puberty, from the Latin word pubertas, pubertatis - maturity, puberty, synonyms – adolescence), the transitional time from childhood, during which the body reaches biological puberty. Adolescence, transitional phase of growth and development between childhood and adulthood. The World Health Organization (WHO) defines an adolescent as any person between ages 10 and 19. This age range falls within WHO's definition of young people, which refers to individuals between ages 10 and 24 [1,5,7,14]. Many periodizations hold the upper limit of adolescence in the region of 20 - 23 years. Youth is the period of a person's life between adolescence and adulthood (maturity), the last period of childhood and the first period of adulthood, the period of early youth. Adolescence lasts for girls from 16 to 20 - 21 years.

In our study, these are female athletes (adolescence girls) from 12 to 15 years old. The second group of female athletes was of an older age. In our study, young people (women) are female athletes aged 16 and over (20 - 23 years). In Ukraine, to divide athletes into age groups, such division by age is most often used [1,5,7,14].

Such research methods as the literary analysis of available information sources, the anthropometry method using classical methods for determining a number of athletes' body sizes necessary for the study, pelviometry with the determination of three longitudinal and

two transverse external dimensions are applied. bone pelvis, the method of indices, with the determination of the values of morphological and functional indices, such as: body mass index (BMI), relative pelvic width index (RPWI), pelvic index (PI), bone index (PBI), sexual dimorphism index (SDI), which was determined by the method of J. Tanner – in total – 5 values of morphofunctional indices.

For a better understanding of the reader of specific medical and morphological and functional terms, their characteristics and technique of definition will be given.

Relative pelvic width index (RPWI)

Relative Pelvic Width Index (RPWI) – the index of the relative width of the pelvis = (IDx100)/L, where ID is the intercrestal diametr (distantia cristarum)cm; L - body length, see Index value less than 15.9 was assessed as stenopyelia (narrow pelvis), from 16.0 to 17.9 - metropielia (middle pelvis), value 18.0 and more - euripielia (wide pelvis) [1,17,18].

Pelvic index (PI)

The Pelvic Index (PI) e is an indicator that is determined by summing up the three external indicators of the bone pelvis, determined by pelviometry, plus the values of the external conjugate, in cm.Values less than 100-105 indicate a woman has a narrow pelvis, from 105 to 107 – the presence of normal the size of the pelvis, and more than 105 – for the presence of a large and short pelvis [1,17,18].

Pelvic bone index (PBI)

To determine the degree of maturity of the pelvic bones, we determined the index of the pelvic bone index (PBI), as an integral indicator of the formation of the pelvic bones, according to the method of N.I. Kovtyuk [14,18]. According to her research, the peak of the increase in the main dimensions of the bone pelvis occurs, on average, at 12 - 13 years old, and coincides with the appearance of menarche (first menstruation) in girls. In this regard, the age period falling on puberty and adolescence are critical periods of ontogenesis, in the process of formation and maturation of the pelvic bones. N.I. Kovtyuk, it was found that for adolescent girls, the PBI value is from 30.0 to 40.0 cu, which corresponds to their age norm. PBI values from 27.5 to 29 cu indicates the still ongoing process of maturation of the pelvic bone structures. Values above 30.0 (from 31 to 54 cu) indicate that the process of maturation and formation of their pelvic bone structures is complete. For athletes of pubertal age, the value of ICT for their age norm ranges from 20.0 to 29.5 cu, which indicates that the process of maturation of the bone structures of the pelvis is still going on in them [14,18].

Sexual dimorphism Index (SDI) which was determined by the method of J. Tanner

The somatotype was determined with the use of J. Tanner's index of sexual dimorphism (1951). To achieve the goal of the study, anthropometric methods were used, such as determining the width of the shoulders (biacromial diameter), measured in cm and the width of the pelvis intercrestal diametr (distantia cristarum), measured in cm, which are necessary to determine such a morphological index value as the sexual dimorphism index (SDI) according to J. Tanner. The values of the sexual dimorphism index (SDI) are calculated according to their own formula: triple biacromial diametr, minus the intercrestal diametr (distantia cristarum). We, as a basis, took such normative index values for women, namely: gynecomorphic somatotype – less than 73.1; mesomorphic somatotype – 73.1–82.1 and andromorphic somatotype – more than 82.1. In the somatotyping of women according to J. M. Tanner, the principle of determining the somatic type of a person's sex is laid, therefore, this index, using the width of the pelvis and shoulders, allows women to be classified as gynecomorphs, mesomorphs and andromorphs [1,6,7,11,14]. Mesomorphic and andromorphic sex somatotypes refer to inversions, or pathological displacements that are not characteristic of the basic, gynecomorphic sexual somatotype. The results of anthropometric measurements with allowance for the body type of women involving J. Tanner's index of sexual dimorphism reflect their adaptive capabilities and can serve as markers (predictors) of nonspecific somatic diseases [1,6,7,11,14].

Soloviev index / diameter of the wrist joint, (SI)

The author of the definition of this index is the Russian anthropologist Solovyov F.A. Values of the Solovyov index from 14 to 15 cm are considered normal.Values less than 14 cm indicate thin pelvic bones and an increase in the volume of the pelvic cavity, and more than 15 cm - about thickening of the pelvic bones and a decrease in the volume of the pelvic cavity. This method is actively used in obstetrics and sports morphology. To calculate this parameter, you need to measure the circumference of the wrist at its thinnest point, near the hand, using a measuring tape or other device like a tape measure. The Solovyov index is an indicator that allows you to determine the type of physique. The Soloviev index is equal to the girth of the wrist in centimeters. The body type determines the constitution of a person, the proportions and shape of his body, so this indicator must be taken into account when analyzing the physical condition of a person [1,6,7,11,14].

Pelviometry – clinical pelvimetry (external pelvimetry)

Pelviometry was carried out according to the conventional, worldwide, classical technique, with the determination of the external dimensions of the pelvis, using Martin's Pelvimeters [14-16]. The following external dimensions of the bone pelvis were measured in the female athletes of both study groups:

- Interspinous diametr (distantia spinarum) – between the anterior superior iliac spines. It has 25-26 cm [14-16].
- Intercrestal diametr (distantia cristarum) – distance between iliac crista; between the most far points on the outer bordes of the iliac crests. It has 28-29 cm [14-16].
- Intertrochanteric diametr (distantia trochanterica) – distance between trochanter major from both sides. It has 31-32 cm [14-16].
- External conjugate diametr (conjugata externa) – the anteroposterior diameter of the pelvic inlet measured externally; the distance from the skin over the upper part of the symphysis pubis to the skin over a point corresponding to the sacral promontory. It has 20 cm [14-16].
- Anatomical antero-posterior diameter (true conjugate) – from the tip of the sacral promontory to the upper border of the symphysis pubis. It has 11 cm [14-16].

Results and Discusion

The following data were obtained: the average body length in the study group female youth athletes (n = 119) was 177.68 ± 1.34 cm, body weight 68.347 ± 1.17 kg. In the study group female athletes of puberty (n = 121) was 166.37 ± 1.14 cm, body weight 57.86 ± 1.24 kg. Also, in each of the surveyed groups, the measurements of the width of the shoulders (biacromial) size were made. Its average value in the group of female athletes of pubertal age was 28.24 ± 1.03 cm, and in the group of handball players of youthful age – 33.49 ± 1.02 cm. According to the results of the study, it was found that athletes of both groups have normal body mass index values.

Pelviometric data in athletes of both study groups, taking into account three transverse and two longitudinal, external dimensions of the bone pelvis are presented in the table 1.

External dimensions of the pelvis	Female Athletes of puberty (n=121)	Female Youth Athletes (n=119)
Interspinous diametr (d. spinarum), cm	22.59 ± 0.79	23.75 ± 0.67
Intercrestal diametr (d. cristarum), cm	25.21 ± 0.63	27.48 ± 0.74
Intertrochanteric diametr (d. trochanterica), cm	29.14 ± 0.78	30.59 ± 0.83
External conjugate diametr (c. externa), cm	18.63 ± 0.54	19.52 ± 0.72
Anatomical antero-posterior diameter|True conjugate (c. vera), cm	6.78 ± 0.39	10.26 ± 0.44

Table 1: *External Dimensions of the Bone Pelvis in the Studied Group of Female Handball Players (n = 240).*

The analysis of the obtained results of external measurements of the bone pelvis shows that in the group of athletes of pubertal age, with short periods of sports, the age parameters of its formation are mainly preserved. The obtained sizes are consistent with the available data, both Ukrainian and a number of foreign researchers of this issue [14-16]. As for the obtained results of pelviometry in the group of young handball players (n = 119), a different picture is recorded here. All transverse and longitudinal external dimensions of the bone pelvis, in this group of athletes, are less than physiological normative parameters typical for the population, and used in obstetrics, anatomy and morphology, as normative [14-16]. Also, in accordance with the classification of narrow pelvis used in Ukraine, in the group of adolescent handball players (n = 119), it was found that normal pelvis sizes are present in 4 (3.36%), generally evenly narrowed pelvis – in 49 (41.18%) athletes, simple flat pelvis – in 29 (24.37%), transversely narrowed pelvis – in 37 (31.09%) young handball players. Accordingly, the I degree of pelvic narrowing was determined in 28 (23.53%) young handball players, the II degree of narrowing – in 4 (3.36%) athletes.

To assess the morphological and morphofunctional changes in the structure and functional significance of their bony pelvis occurring in athletes, a method was used to determine a number of index and anthropometric values. In each studied age group of female handball players, the values of the shoulder width (biacromial diameter) and the width of the pelvis (intercrestal diametr (d. cristarum), cm). Also, to determine all morphofunctional index values, mathematical recalculations were carried out to obtain the research result. The results obtained are presented in table 2.

Indicator name	Female Athletes of puberty (n=121)	Female Youth Athletes (n=119)
Body Mass Index (BMI)	21.03 ± 0.32	21.69 ± 0.18
Relative Pelvic Width Index (RPWI)	15.43 ± 0.22	15.25 ±0.31
Pelvic Bone Index (PBI)	36.48 ± 0.75	54.38 ± 0.92
Pelvic Index (PI)	93.11 ± 1.03	97.02 ± 0.77
Sexual Dimorphism Index (SDI)	70.67 ± 1.12	78.96 ± 1.09
Soloviev index / diameter of the wrist joint, (SI)	13.43 ± 0.39	14.37 ± 0.46

Table 2: *Obtained Values of Morphofunctional Indices in the Studied Groups of Athletes (n = 240).*

The analysis of the obtained morphological and functional index values showed the following: the obtained values of the body mass index in both groups of handball players correspond to normal indicators. The obtained results of determining the relative pelvic width (RPWI) in athletes of both groups of the index are within the limits of less than 15.9, which refers to the manifestations of stenopyelia, or narrow pelvis [1,17,18]. At the same time, in the group of athletes of puberty age, the bone pelvis is still in the process of its formation, and in athletes of adolescence, the processes of ossification and formation of the pelvis are in the process of completion and, practically, will not change. Indicators of the pelvic bone index (PBI), in the group of handball players of puberty age, have values that are acceptable for their age group. In the group of adolescent athletes, the PBI indicators obtained indicate that the process of ossification and maturity of the bone pelvis is almost complete [1,17,18]. The analysis of the obtained values of such an informative morphofunctional index value as the pelvic index (PI) showed that its average value in the group of female athletes of pubertal age was 86.31 ± 0, 12, which indicates a narrow pelvis. For this age group of female athletes, which is still undergoing the process of forming the bone pelvis, this value is within the permissible age norm [1,17,18]. In youth handball players, the PI value was 94.76, which corresponds to the presence of a narrow pelvis in the group.

After the carried out mathematical recalculations necessary to determine the sexual dimorphism index (SDI) and determine the sex somatotypes of the studied athletes, the following results were obtained: in the group of athletes of puberty age, the average SDI value

was 64.54 ± 0.28, which corresponds to the physiological values for women, gynecomorphic sexual somatotype (normal, for women – less than 73.1) [1,6,7,11,14]. In the group of female athletes of adolescence, the average value of SDI in the study group was 75.31, which corresponds to the values of the transitional from physiological, mesomorphic sexual somatotype, according to the classification of J. Tanner [1,6,7,11,14]. The values of the Soloviev index (SI), in the group of athletes of puberty age, are less than the minimum permissible limit (14 cm) of this indicator, which indirectly indicates the thin structure of the bones of the bones, including the pelvic bones, which are in the process of their formation [1,6,7,11,14]. In the group of young handball players, the values of the Soloviev index (SI) are within the permissible age norm [1,6,7,11,14].

When considering the size of the pelvis, especially in the group of athletes of pubertal age, it is necessary to take into account that in their body, intensive processes of the formation of the skeleton of the pelvic bones, determined in the age aspect, still occur [12]. According to classical studies, the formation of pelvic bones, in adolescence, when the process of puberty in girls is quite active, the process of ossification of the pelvic bones accelerates and intensifies, additional points of ossification appear, for example, the pubic symphysis and acetabulum [1,6,7,11,14].

At the same time, the adolescent period is the period of time in which the process of physical and sexual formation of the girls' bodies is practically completed. This, directly, applies to the process of formation of the bone pelvis and bone maturity, which make up its pelvic bones. In order to determine the process of bone maturity of the pelvic bones of athletes of both age groups, we used such a morphological index as the index of the pelvic bones. It was proposed for practical application by the Ukrainian researcher N.I. Kovtyuk [14,18].

Conclusion

- Sportswomen of puberty, according to the results of the study, have normal physiological processes corresponding to their age group, associated with the formation of their bone pelvis.
- In female athletes of the adolescent age group, all external dimensions of the bone pelvis are less than the generally accepted parameters, which indicates that they have an anatomically narrow pelvis.
- Also, in the group of youth handball players (n = 119), it was found that normal pelvic sizes are present in 4 (3.36%), generally evenly narrowed pelvis – in 49 (41.18%) athletes, a simple flat pelvis – in 29 (24.37%), transversely narrowed pelvis – in 37 (31.09%) young female handball players.
- Accordingly, I degree of pelvic narrowing was determined in 28 (23.53%) young handball players, II degree of narrowing – in 4 (3.36%) athletes.
- According to the results of the study, it was found that athletes of both groups have normal body mass index values.
- In the group of handball players of pubertal age, a gynecomorphic sexual somatotype was determined, and in young handball players – a transitional, mesomorphic sexual somatotype.
- The obtained results of other index values indicate that young handball players have a narrow pelvis, with an almost completely completed process of its formation.
- According to the results of the study, taking into account the experience and intensity of training of young athletes, it can be argued that the identified somatic changes are a direct result of adaptive processes in athletes.

Conflict of Interest

The author notes the complete absence of any conflicts of interest.

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