

Analysis of the Identified Features of the Bony Pelvis in Sexual Somatotypes in Female Students

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ABSTRACT

This research article presents the results of a study conducted by the author and provides a critical analysis. The study focused on identifying a number of morphological, anatomical, and morphological features of the pelvic bone in a study group of female students during adolescence and early adulthood, all first-year medical students. The aim of the study was to determine individual characteristics of pelvic size, structure, and existing changes, as well as a number of anthropometric and morphological index values in the sex somatotypes of female students, according to the classification of sex somatotypes defined by the methodology and classification of J. Tanner and W. Marshall. Data obtained from anthropometry, pelvimetry, and determination of special index values indicate existing anatomical, morphological, and functional changes in the pelvic bones of the female students studied, ranging from adolescence to early adulthood. These changes include an increased prevalence of various types of contracted pelvises, most commonly grades I and II. The results of the author's study, and their analysis, indicate the presence of pathological processes affecting the skeletal, endocrine, and reproductive systems in the female students in the study group.

Keywords: Bone pelvis, Sex somatotypes, Anthropometry, Pelvimetry, Morphological indices, Female students

Aim of the article

The purpose of this study is to determine the individual characteristics of the size, structure and existing changes of the pelvis, as well as a number of anthropometric and morphological index values, in the identified sexual somatotypes in female students of adolescence and the beginning of the first reproductive age, according to the classification of sexual somatotypes determined by the method and classification of J. Tanner and W. Marshall.

The objectives of the study

To identify and analyze the anatomical, anthropological, and morphological/morphofunctional features of the size of the pelvic bones and existing individual changes in a group of young female students with different somatometric characteristics, in their identified sex somatotypes, in accordance with the classification of J. Tanner and W. Marshall.

To achieve this, the following tasks were undertaken

1. Conduct anthropometry and somatotyping in the study group, followed by an analysis of the identified features of anthropometric and morphological indicators and the necessary morphofunctional index values.
2. To use the classical version of pelvimetry, using Martin's calipers, in the study groups of female students, in three sex somatotypes determined in them, with subsequent analysis of the obtained data.

Hypothesis of the article

During the preparation period for this study, its author put forward a working hypothesis that a number of young female students, in their teens and early reproductive years, in their first years of university, from different regions of the country, could exhibit changes in a number of anatomical, anthropological, and morphofunctional

index values, often combined, including the presence of cases of different types of narrow pelvis, with phenomena of the first and/or second degree of narrowing of their bony pelvis.

Introduction

The study of issues related to various aspects of human health, including that of student youth, is a problem that is not only medical, but also social and pedagogical. Monitoring the study of the health status of female students in the education quality management system is one of the most important and pressing issues in modern medical and pedagogical science [4,11]. This problem is an important component of the educational process and is directly related to the number of students in higher education institutions, their ability to study, perform professional and social functions, and to the process of stability in the activities of educational institutions of different levels and profiles [4,11]. Most modern girls, especially female students, in adolescence, youth, and even in the first reproductive age, experience the influence of significant physical and psycho-emotional stress associated with maladjustment, both psychological and physical, during the first years of study at modern universities [2,4,11]. Therefore, it is relevant to study the health of female students as an important link in the pedagogical process and a special social group with a high risk of functional disorders of the body [2,3,4,11,19].

Of particular interest is a comprehensive study of the anatomical, anthropological, and morphofunctional parameters, in particular, the characteristics of the size and structure/maturation of the bones and joints of the pelvis in girls of different age groups. Great importance is attached to the development of the pelvis in girls of these age groups, since, on the one hand, its structure affects the outcome of childbirth, and on the other, the rate of its development is one of the indicators of the dynamics of their physical and sexual development [5,6,17]. Therefore, from the point of view of medical science, the conducted studies devoted to the process of formation of the pelvis at this age, taking into account the sexual constitution and distribution by sexual somatotypes, including according to the classification of J. Tanner and W. Marshall, are relevant.

This opinion is consistent with the findings of many leading experts (T.F. Abramova 2009; Yu.S. Afanasievskaya, 2010; L.A. Lopatina, 2015; D.B. Nikityuk, 2015), the importance of the human constitution and, in particular, its somatotype in the process of adaptation to a large number of unfavorable exogenous and endogenous factors belongs to. Knowledge of the characteristics of the pelvic dimensions in representatives of different somatotypes can serve as a reliable prognostic criterion, ensuring the most rational management of labor in each specific case, timely implementation of preventive and therapeutic measures [11,13]. The development of the pelvis as a whole and its individual dimensions in girls occurs unevenly at different age periods. In this regard, the state of the pelvic bone, its dynamics and stages, its ontogenetic maturation and formation, is a fairly sensitive indicator of the dynamics of sexual development in young women [5,11,13,17].

Abbreviations

- » SHW - shoulder width
- » PW - pelvic width
- » SDI – index of sexual dimorphism according to the method of J.M. Tanner and W. Marshall (1979)
- » RShWI - relative shoulder width index
- » RPWI - relative pelvic width index, or morphine index
- » PI - pelvic index
- » PBI - pelvic bone index, according to the method of N.I. Kovtyuk (2003)
- » ANT - anatomically narrow pelvis.

Method and materials of the study

In conducting this study, the author used the following research methods: analysis of available literary sources on the issue under study, anthropometric measurements, determination of morphological indicators, index method, pelvimetry, and mathematical statistics. The following anthropometric measurements were taken: measuring body length while standing, body weight, shoulder width (SW), and pelvic width (PW). The ratio of individual anthropomorphological features was assessed as a series of index values: sexual dimorphism index, pelvic index, pelvic bone index, indices of relative pelvic width and shoulder width, and body mass index. Pelvimetry was also performed using standard methods [6,14,17]. In case of detection of one or another form of narrowing of the bony pelvis, narrow pelvises were divided into types and degrees of their narrowing [14,17]. After completing the study, all necessary calculations were performed, statistical processing was performed using the Statistica 7.0 software package, and the results were analyzed. Data reliability was assessed using the Student's t-test. Differences were considered statistically significant at $p < 0.05$.

Results of the study and discussion

In order to conduct the study, during the medical examination of 1st-2nd year students of Zaporizhzhya State Medical University, we selected a group of female students ($n=130$). The female students belonged to two age periods: adolescence and the beginning of the first reproductive age. They had no reliable differences in age (20.73 ± 0.20 years), but differed in body length and weight ($p < 0.05$). The body length in the group was 165.05 ± 0.55 cm, body weight - 57.92 ± 0.89 kg. The value of the body mass index in the group corresponded to the norm - 21.25 ± 0.31 kg/m² ($p < 0.05$) [8,9,16]. Based on the results of anthropometry, somatotyping was performed in the study group, using the values of sex somatotypes according to the classification proposed by J. Tanner and W. Marshall. To determine a number of additional morphological index indicators, we determine such anthropometric values as shoulder width (SW) and pelvic width (PW) (d. cristarum). We obtained the following indicators: in the group, the value of the PW corresponded to 25.74 ± 0.21 cm ($p < 0.05$), which is less than the acceptable anatomical norm, which is 28-29 cm [15,16,18,19].

In this case, in the group of female students with a mesomorphic sexual somatotype according to J. Tanner's classification, it is 25.87 ± 0.32 cm, in the andromorph group - 26.18 ± 0.48 cm, in

gynecomorphs - 25.37 ± 0.32 cm ($p < 0.05$). During pelvimetry, an anatomically narrow pelvis (ANP) was reliably determined in all morphological groups, with I-III degrees of its narrowing [14,17]. As for the shoulder width sizes, the following indicators were obtained: in the group ($n=130$), the shoulder width values were 37.21 ± 1.79 cm ($p < 0.05$). Based on the results of the anthropometry, it was reliably determined ($p < 0.05$) that in the study group, the width of the shoulders in relation to the width of the pelvis corresponds to the male body structure; the girls have an android body type - with broad shoulders and a narrow pelvis [1,8,9,19].

To determine the body type, the somatotype diagnostic scheme according to J.M. Tanner and W. Marshall (1979) or the sexual dimorphism index (SDI) was used, which allows us to determine the correspondence between the proportions of the human body and its gender [1,7,10,18]. This index, using the values of ShW and PW, allows us to classify women as gynecomorphs, mesomorphs and andromorphs [7], and also allows us to identify gender-specific features of the metabolic and hormonal status and establish the correspondence between the development of the skeletal system and the gender of a person [18]. According to the criteria of this method, the SDI values in women less than 73.1 correspond to the gynecomorphic type; from 73.1 to 82.1 – to the mesomorphic type; values exceeding 82.1 are characteristic of the andromorphic body type [1,7,10,18]. The following results of the distribution of sexual somatotypes were obtained in the entire ($n=130$) study group: gynecomorphic (physiological) sexual somatotype

was determined in 54 (41.54%) of the examined female students; intermediate, transitional, mesomorphic sexual somatotype was determined in 42 (32.31%) of the studied female students; pathological, opposite to physiological, inverse, andromorphic sexual somatotype was determined in 34 (26.15%) of the studied female students.

The average value of the SDI index in the entire study group was 76.42 ± 1.05 ($p < 0.05$), which generally corresponds to the standard indicators of the mesomorphic (transitional) type of sexual constitution. Thus, T.A. Lopatina, who studies the prevalence and values of the sexual dimorphism index, believes that the mesomorphic somatotype is a “mild sex dysplasia” [7]. In the study, this “mild dysplasia” was detected in almost every third female student (32.31%), which is additionally confirmed by the obtained values of most special morphological indicators. That is, out of 130 female students who participated in the study, more than half - 76 (58.46%) had indicators that do not correspond to the typical female (gynecomorphic) sexual somatotype according to the classification of J. Tanner and W. Marshall [7]. Almost every fourth female student who participated in the study, or 34 (26.15%), was found to have an andromorphic sexual somatotype of constitution according to the classification of J. Tanner [1,7,10,18]. After conducting somatotyping, with the identification of three sexual somatotypes in accordance with the classification of J. Tanner and W. Marshall, pelvimetry was carried out in the study group. The data from these measurements are presented in the table 1.

NO	Name of indicator	Andromorphic somatotype (n=42)	Mesomorphic somatotype (n=34)	Gynecomorphic somatotype (n=54)
1.	D. spinarum, cm	$23,71 \pm 0,45^*$	$23,39 \pm 0,33^*$	$23,10 \pm 0,32^*$
2.	D. cristarum, cm	$26,18 \pm 0,48^*$	$25,87 \pm 0,32^*$	$25,37 \pm 0,32^*$
3.	D. trochanterica, cm	$31,79 \pm 0,43^*$	$31,29 \pm 0,29^*$	$31,30 \pm 0,27^*$
4.	C. externa, cm	$19,62 \pm 0,39^*$	$18,70 \pm 0,28^*$	$18,97 \pm 0,35^*$
5.	C. vera, cm	$11,44 \pm 0,53^*$	$10,35 \pm 0,21^*$	$10,49 \pm 0,27^*$

Table 1. Pelvimetry data in the identified somatotypes ($M \pm m$) with a value of ($p < 0.05$) *

The analysis of the obtained pelvimetry results with the determination of three transverse (d. spinarum, d. cristarum, d. trochanterica) and two direct sizes (c. externa and c. vera) reliably ($p < 0.05$) indicates that in representatives of all three sexual somatotypes, the obtained indicators are less than the anatomical norms of external dimensions of the bone pelvis generally accepted in morphology, anthropology and obstetrics, which have the following values: d. spinarum - 25-26 cm; d. cristarum - 28-29 cm; c. externa - 20-21 cm [5,17]. The only exception is the indicators of the intertrochanteric distance (d. trochanterica), which in all three somatotypes corresponds to normal values (30-32 cm) [5,17].

The data on the values of the true conjugate (c. vera), obtained indirectly through recalculation of the values of the external conjugate (c. externa), reliably indicate ($p < 0.05$) that in the groups of female students with mesomorphic and gynecomorphic somatotypes, they are less than the generally accepted norm - 11 cm [5,13,17], and

in the group with the andromorphic sexual somatotype, they are slightly larger. In all three groups of somatotypes, as well as in the entire group as a whole, phenomena of anatomically narrow pelvis were reliably determined ($p < 0.05$) in 97 (74.62%) cases, mainly with I-II degrees of its narrowing in 56 (43.08%) female students.

Determination of the relative shoulder width index (RSWI) values indicates the degree of proportionality of the ratio of the shoulder diameter sizes to body length. RWI in the entire group was 15.61 ± 0.13 cm ($p < 0.05$), which corresponds to the dolichomorphic type [8,12,13]. However, upon closer examination, it was determined that in 36 (27.69%) female students, RWI values correspond to the dolichomorphic type (> 19.1), the mesomorphic type ($19.1-21.7$) was determined in 56 (43.08%) girls. The brachymorphic type (< 21.7) was determined in 38 (29.23%) female students. That is, it was reliably determined ($p < 0.05$) that in more than half (56.92%) of the female students, RSWI values differ from the nor-

mative values of the degree of proportionality of body shape. The index of relative pelvic width (RSWI), or morphia index (A.I. Kozlov, B.A. Nikityuk, 2007) in the entire group was 15.61 ± 0.13 cm ($p < 0.05$), which corresponds to a narrow pelvis (stenopyelia) – up to 15.9 cm [8,10,13,15].

We also used such an informative morphological indicator as the pelvic index (PI) in our study [10,15]. In the entire group, its value was 99.44 ± 0.65 ($p < 0.05$), corresponding to the presence of a narrow pelvis [14,17]. In female students with an andromorphic somatotype ($n=34$), the PI was 101.15 ± 1.48 , with a mesomorphic somatotype ($n=42$) – 99.13 ± 0.96 , with a gynecomorphic somatotype ($n=54$) – 98.61 ± 1.01 . As a result of the analysis of the obtained PI values, both in the entire group ($n=130$) and in the three somatotypes, it was reliably established that they are within the limits below the permissible standard indicators, especially in the group of female students with a gynecomorphic somatotype.

The pelvic index (PI) values in all identified sex somatotypes correspond to those of a narrow pelvis. This further confirms the data obtained as a result of pelvimetry, indicating the presence of anatomically narrow pelvis (ANP) values in the entire study group ($n=130$). The variations of the various types of bony pelvis in the entire study group are as follows: a narrow pelvis was determined in the majority of female students – 87, or 66.92%; normal pelvic dimensions – in 33 (25.39%), i.e., in almost every fourth student; and a “wide” pelvis – in 10 (7.68%) female students.

An analysis of the identified variants of narrow pelvises with different degrees of narrowing showed that in the group with an andromorphic sexual somatotype ($n=34$), it was determined that 22 (64.71%) of the girls in this group had normal c. vera dimensions (11 cm). More than 11 cm and increased external pelvic dimensions (wide pelvis) were found in 2 (5.88%) students, normal pelvic dimensions – 3 (8.82%), generally uniformly narrowed pelvis – 4 (11.77%), simple flat pelvis – 4 (11.77%) and transversely narrowed pelvis – 21 (61.77%). Anatomically narrow pelvis was determined in 29 (85.29%), “erased” pelvic shapes – 17 (50.00%), 1st degree of pelvic narrowing – 4 (11.77%), 2nd degree – 5 (14.71%), 3rd degree – 1 (2.94%).

In the group of gynecomorph girls ($n=54$) we obtained the following data: normal pelvic dimensions were determined only in 2 (3.70%) students, 3 (5.56%) had a wide pelvis, and 49 (90.74%) had various types of narrow pelvis. Thus, a generally uniformly narrowed pelvis was determined in 3 (5.56%) students, a simple flat pelvis – in 16 (29.63%), and a transversely narrowed pelvis – in 30 (55.56%). Among all the students with a narrow pelvis, in this sex somatotype ($n=49$), 37 (75.51%) had degree I pelvic narrowing, 11 (22.45%) had degree II, and 1 (2.04%) had degree III. Anatomically narrow pelvis (ANP), with a decrease of 1 to 4 external pelvic dimensions, was determined in all 49 (100.00%) female students with a narrow pelvis, “erased” pelvic shapes were found in 43 (87.76%) female students with a narrow pelvis and in 79.63% of gynecomorphic female students.

In the group of mesomorph female students ($n=42$), it was found that 23 (54.76%) of them had the value of c. vera corresponding to the norm of 11 cm [11,13,17]. At the same time, all normal pelvic dimensions were established only in 2 (4.76%), a wide pelvis – in 1 (2.38%) student. A simple flat pelvis – in 5 (11.91%), a generally uniformly narrowed pelvis – in 4 (9.52%), a transversely narrowed pelvis – in 30 (71.43%). Anatomically narrow pelvis was determined in 39 (92.86%), “erased” pelvic shapes – in 19 (45.24%) students with a mesomorphic somatotype. The first degree of pelvic narrowing was found in 17 (40.48%), the second degree – in 11 (26.19%), and the third degree – in 2 (4.76%). The variants of the first to third degrees of pelvic narrowing, determined in accordance with the decrease in the size of the direct entrance to the lesser pelvis (c. vera), its normal and increased values in the entire study group of female students ($n=130$) were as follows:

- » Grade I pelvic stenosis was determined in 58 female students (44.62%).
- » Grade II pelvic stenosis was determined in 27 female students (20.77%).
- » Grade III pelvic stenosis was determined in 4 female students (3.08%).

C. vera value of 11 cm or more (without any degree of pelvic stenosis) was determined in 41 female students (31.54%).

In all three groups, with different somatotypes according to the classification of J. Tanner ($n=130$), the following statistics are observed: students with normal pelvis sizes – 7 (5.39%), with a wide pelvis – 6 (4.62%), with anatomically narrow pelvis – 97 (74.62%), with “erased” pelvic shapes – 79 (60.77%). We determined a generally uniformly narrowed pelvis in 11 (8.46%) students, a simple flat pelvis – in 25 (19.23%), and a transversely narrowed pelvis – in 81 (62.31%) students. A more detailed examination of the obtained data revealed the following variations in pelvic anatomical structure: only one in four female students had normal pelvic dimensions, while 66.92% of all female students had stenopyelitis, or a narrow pelvis. This means that for the majority of female students, shoulder width was reliably greater than pelvic width. This corresponds to an android, rather than feminine, body type [8,9,15,19].

Of great importance for determining the degree of maturity and formation of the pelvic bones is the determination of the values of a new morphological indicator – the pelvic bone index (PBI) proposed by N.I. Kovtyuk (2003) [6]. In order to identify deviations in the formation of the pelvic bones, the PBI values were determined as an integral indicator of the formation of the pelvic bones in girls of adolescence and the first reproductive age [6]. As a result of our study, the average PBI value obtained in the entire group was 41.09 ± 0.55 cm, which corresponds to the norm (from 30 to 50) [6]. The obtained PBI values were as follows: out of the total number of female students ($n=130$), 129 (98.15%) female students had PBI values that corresponded to the normative values and/or were higher than them. Only 1 girl (1.85%), a representative of the gynecoid somatotype, had an index of 29.00, which is slightly below the norm, although her age was 21.5 years. This

PBI value, taking into account her age, indicates that the process of completion of pelvic ossification is not yet complete [6]. In the entire group (n=130), we obtained the following ICT values: 41.09 ± 0.55 ($p < 0.05$). Moreover, the ICT value was less than 30 in 1 (1.85%), from 30 to 39 – in 61 (46.92%), from 40 to 49 – in 55 (42.31%), from 50 and more – in 13 (10.00%).

In sexual somatotypes, the distribution of the PBI values was as follows: in the group of andromorphic female students (n=34), the PBI was 42.24 ± 1.08 ($p < 0.05$). At the same time, there were no PBI values less than 30 in the group, 13 (38.24%) from 30 to 39, 17 (50.00%) from 40 to 49, and 4 (11.77%) from 50 and above. In the group with the mesomorphic somatotype (n=42), the indicator was 40.63 ± 0.90 ($p < 0.05$).

There were no PBI values less than 30 in the group, 20 (47.62%) had PBI values from 30 to 39, 19 (45.24%) had ICT values from 40 to 49, and 3 (7.14%) had PBI values from 50 and above. In the group of female students representing the gynecomorphic somatotype, the following values were obtained: in the entire group (n=54), PBI was 40.72 ± 0.91 ($p < 0.05$). 1 (1.85%) had PBI values less than 30, 28 (51.85%) had PBI values from 30 to 39, 19 (35.19%) had PBI values from 40 to 49, and 6 (11.11%) had PBI values greater than 50. The most stable PBI values were found in the group with the mesomorphic sex somatotype, followed by the female students in the andromorphic and gynecomorphic sex somatotype groups. The obtained PBI values allow us to conclude that in these age groups, the process of maturation and ossification of the pelvic bone structures is virtually complete in 98.15% of female students [6].

Conclusions

1. The negative changes in the health of female students identified in the study are an important and pressing issue in modern education, pedagogy, and medicine.
2. The results of the study showed that 58.46% of the female students in the special medical group did not correspond to the gynecoid somatotype based on the obtained values of the sexual dimorphism index according to the classification of J. Tanner and W. Marshall.
3. Our analysis of the obtained pelvic index values reliably established that they are below acceptable normative values, particularly in female students with a gynecomorphic somatotype, and correspond to values for a narrow pelvis.
4. In all three somatotype groups, as in the entire group as a whole, manifestations of an anatomically narrow pelvis were reliably identified – in 74.62%, primarily with indicators of degrees I (36.92%) and II (20.77%) of its narrowing.
5. Among the variants of pathological forms of a narrow pelvis, the transversely narrowed pelvis predominates – in 62.31%, and “erased” pelvic forms – in 60.77%.
6. In 98.15% of all female students, in all three somatotypes, the process of pelvic bone maturity is complete and corresponds to their age aspect.

7. An increase in the identified pathological changes in the values of morphological and anthropometric indicators in all morphotypes and the tendency for these indicators to approach andromorphic values in the group with a mesomorphic sexual somatotype according to the classification of J. Tanner and W. Marshall is a prognostically unfavorable phenomenon in the prospect of developing the reproductive health of female students in this group.

Ethical Approval and Informed Consent

All participants voluntarily provided written and verbal informed consent to participate in this study. All ethical standards, both local and generally accepted, were fully observed.

Conflict of Interest and Funding

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