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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**ANATOMICAL FEATURES OF THE BODY STRUCTURE
AND ANTHROPOMETRIC INDICATORS OF PHYSICAL
DEVELOPMENT OF GIRLS AGED 16-20 YEARS IN THE
NORM**

Speciality: 3241.01 «Human Anatomy»

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CHARACTERISTICS OF THE RESEARCH WORK

One of the most important issues in the development of medical science is the individualization of the object it studies, that is, the human factor. The patient-centered individual approach of doctors is considered a strategy and tactics of prevention, diagnosis, treatment, and rehabilitation of a specific patient. In such cases, all individual characteristics of the body (biochemical, molecular-genetic, hematological status, metabolism, and other individual characteristics) are taken into account. However, it should be considered that the main basis for such an individual approach to patients can be the constitutional-typological analysis method of the body. It makes it possible to determine the belonging of different individuals to different somatotypes (ST-s) through this method.¹

According to the scientific literature, it is already known that body constitution types anatomically differ from each other.² Also, it is known that the body constitution types of each organism have a constitutional tendency towards the development of a number of nosological forms, and in this regard, treatment and rehabilitation of different representatives of different somatotypes do not have the same effectiveness.³

The abundance of optimal adaptation potential, a number of STs distinguished by the low probability of developing some nosological forms, as well as the level of tendency to non-communicable diseases, can be considered more resistant STs in

¹Буравкова, Е.Н. (Buravkova, E.N.) Динамика изменений антропометрических показателей у детей Самарского региона в постнатальном периоде онтогенеза: / Автореферат диссертации кандидата медицинских наук / – Оренбург, 2017. – 27 с.

²Bubas, M. Tracking variability: recent antropometric data for Croatian population and comparison with other world populations / M.Bubas, K.Zahariev-Vuksinig, M.Milosevik // Collegium Antropologicum, – 2012. 36(2), – p. 585-592.

³Сенаторова, А.С., Чайченко, Т.В., Бойченко, А.Д. (Senatorova, A.S., Chauchenko, T.V., Boychenko, A.D.) Антропометрические предикторы ремоделирования миокарда у подростков с избыточной массой тела и ожирением // – Москва: Здоровье ребенка, – 2011. №8, – с. 25-29.

terms of the success factor

This allows applying the constitutional analysis method to clinical practice and creates a direct basis for it.⁴

There is almost no determination of the distribution of 16–20-year-old girls according to their belonging to different STs in the existing scientific literature.⁵

In the diagnosis of various nosological forms, in the prediction of their course, and in the development of preventive measures, it is critical to consider the constitutional approach *to* with respect to each individual.⁶ In this respect, studies on the determination of *the* of STs features, which identify the inclination toward non-infectious diseases, never lose their importance.

Therefore, scientific research studies, which are expected to be important in terms of the prevention and control of non-communicable diseases, have been planned and conducted to solve the afore-mentioned issues, guiding the importance of measures to be taken within the framework of the implementation of the “Strategy for the fight against non-infectious diseases in the Republic of Azerbaijan for the period of 2015-2020”, approved by the Decree of the President of the Republic of Azerbaijan, Ilham Aliyev, as per December 23, 2015.

The aim of the study was to reveal the anatomical features of relatively healthy Azerbaijani girls aging between 16 and 20 years old, belonging to different body types, and to determine and assess the anthropometric and bioimpedanciametry indicators of their physical development.

⁴Пузаткина, Е.А., Николаев, В.Г. (Puzatkina, E.A., Nikolaev, V.G.) Особенности конституции и состава тела девушек 17-18 лет по данным антропометрии и биоимпедансометрии // –Москва: Вестник антропологии, – 2011. №20, – с. 105-112.

⁵Негашева, М.А. (Negasheva, M.A.) Морфологическая конституция человека в юношеском периоде онтогенеза (интегральные аспекты); / Автореферат диссертации кандидата медицинских наук / – Москва, 2008. – 48 с.

⁶Крамерова, А.Ф. (Kramerova, A.F.) Динамика гастроэнтерологической патологии у детей и подростков с разными типами конституции // Сборник «Конституция и здоровье человека», – Ленинград: – 1991. – с. 67 -77

The tasks of the study include:

1. To study anthropometric indicators of the physical development of 16–20-year old girls under conditions of relative norm.
2. To analyze the distribution of 16–20-year-old girls according to their belonging to different constitutional groups and STs.
3. To determine the minimum and maximum complex of changes in the anatomo-anthropometric indicators of their body structure during the transition period from 16–17 years old to 18–20 years old in the studied groups of women.
4. To characterize the features of anatomo-anthropometric indicators of the human body, the Body Mass Index (BMI) in 16–20-year-old girls with different body structure types.
5. To evaluate the absolute and relative capacity of bone, muscle, and fat components of the body, body surface area depends on STs in 16–17 and 18–20-year-old girls.
6. In terms of determining body structure types in 16–20-year-old Azerbaijani girls, to compare the correlations between the relevant classifications put forward by M.V. Chernorutsky and I.B. Galant, B.A. Nikityuk, and V.P. Chtetsov

Research methods. In the research, the study of circular dimensions and diameters of various sites of the human body is anthropometric, the measurement of the skinfold thickness the body is called caliperometry, the study of the component composition of the body is bioimpedanciometry, the study of the Body Mass Index (Kettle-2 index) and the body surface sites, the study of somatotyping according to the classification by Chernorutsky M.V., studying somatotyping based on the somatic development index (Pinier index) formula, stratifying into constitutional groups and carrying out somatotyping according to the diagnostic scheme of Nikityuk B.A.- Chtetsov V.P., statistical processing of numerical indicators were used. The numerical indications have been calculated using the variational statistical method.

The main provisions of the thesis (dissertation) defended:

- The body structure of Azerbaijani girls is characterized by noticeable changes in the constitutional features, which are

manifested by drastic changes in the anthropometric indications of the development of physical characteristics and the component composition of their body.

- The mesosome and megalosome constitutional groups are prevalent in the studied groups among girls aged 16 to 20, and this figure was exposed up to 32.9% on average. In a few cases, leptosomal (on average, 21.45%) and non-determined (on average, 10.4%) constitutional groups were revealed. ST-s were mostly stenoplastics (71.7%) in the examined girls belonging to the leptosome constitutional group, and in rare cases, ST-s with asthenic narrow-boned (21.1%) and asthenic broad-boned (7.2%) were identified. Among young girls with mesosomal constitutional group, mesoplastic ST-s was prevalent, and picnic body type was exposed in a few cases (32.4%). In the megalosome constitutional group, euryplastic tall (30.1%) and relatively less euryplastic short stature (28.9%), as well as subathletic (28.2%) ST girls, predominated. Athletic STs belonging to the megalosomal constitutional group (12.8%) were exposed in the fewest cases.

- Body circumferences are minimum in girls belonging to asthenic and stenoplastic ST and maximum in girls with picnic and euriplastic somatotypes. The thickness of the skin-fat fold in all sites of the body was exposed with the lowest indicators in the asthenic, athletic, and subathletic categories and the highest in the picnic ST. The transverse diameters of the circumferences were the least in girls belonging to the asthenic narrow-boned ST, that is, minimum; they had the maximum individual values in the girls belonging to the athletic and euryplastic somatotypes.

- During the youth period, insignificant modifications occur in the constitutional belongings of girls. In girls belonging to all somatotypes, a slight increase in body mass, skin-fat fold thickness (back, inner, and back parts of the arms, leg areas), as well as in circumference of the chest, lumbar area, buttocks, arm, and thigh are observed in the youth period.

Scientific innovation of the research work. Based on the research conducted with complex anthropometric and bioimpedancemetry methods, the body composition characteristics

and the body mass components were evaluated in 16-20-year-old Azerbaijani girls under relative normal conditions. As a result of the research work conducted, an anatomico-anthropometric database was established that characterizes the physical development indicators of 16-20-year-old Azerbaijani girls' group. It has been justified that the absolute amount of the body fat component is highest in girls belonging to the megalosomal and indeterminate constitutional groups and lowest in women belonging to the leptosomal constitutional group.

The percentage capacity of the body fat component is maximum in the megalosome and mesosome constitutional groups and minimum in the leptosome constitutional group. It was revealed that the absolute capacity of the body fat component tends to increase in girls of all constitutional groups during the youth period.

The indicator of the maximum percentage capacity of the body muscle mass is considered typical for girls belonging to the asthenic somatotype, while this indicator is minimum for girls belonging to the picnic ST group.

Theoretical and practical significance of the research work.

The theoretical importance of the research is determined by the fact that the obtained evidence can be important in the development of preventive measures, which are considered important in the operation of treatment and prevention institutions as well as in the assessment of health level and nutritional status. Based on this evidence, appropriate additions can be made to the generally accepted age periodization applied to the youth period.

The practical significance of the research is that the findings can be used in the diagnosis and prevention of a number of non-communicable diseases, in indications for bariatric surgery, in higher and secondary educational institutions, in periodic monitoring of athletes and other population groups, in the compilation of textbooks and teaching aids, and in monographs on morphological subjects.

Approbation of thesis (dissertation) materials. The key findings of the dissertation work were discussed at the: scientific conference with international participation dedicated to the 85th anniversary of Honored Scientist, Professor R.A.Askerov (Baku,

2018); All-Russian Scientific-Practical Conference with International Participation dedicated to the 90th anniversary of the establishment of the Department of Anatomy of the Moscow Institute of Physical Education and the 85th anniversary of Honored Scientist of the Russian Federation, corresponding member of Russian Academy of Natural Sciences (RTEA), Professor B.A. Nikityuk (Moscow, 2018); IV Congress of the International Association of Morphologists (Astrakhan, 2018), International Scientific Conference dedicated to the 90th anniversary of the establishment of the Azerbaijan Medical University (Baku, 2021); International Scientific Conference dedicated to the 100th anniversary of Honored Scientist, Professor Tamerlan Aliyev (Baku, 2021); joint meeting of the academic staff of the Departments of Human Anatomy and Medical Terminology, Normal Physiology, and Forensic Medicine of Azerbaijan Medical University (Baku, 18.03.2022, protocol No5); Scientific Seminar of FD 2.08 Dissertation Council of the Supreme Attestation Commission Under the President of the Republic of Azerbaijan functioning in Azerbaijan Medical University (Baku, 21.09.2022, protocol No4).

Application of research findings. The research findings were applied in the Department of Human Anatomy and Medical Terminology of Azerbaijan Medical University, the 1st Department of Surgical Diseases of Azerbaijan Medical University, and the Department of Medical and Biological Sciences of the Azerbaijan State Academy of Physical Education and Sports.

Published scientific work. 9 of the 18 research works published on the dissertation topic are scientific articles, and 9 are conference materials. 2 of the journal articles were published in the international press (The Journal of Anatomy and Histopathology) published in Voronej, Russian Federation, and 3 of them were published in periodical scientific publications included in International Indexing and Summarizing Systems (SCOPUS, PИИЛ).

The volume and structure of the thesis. The thesis has been compiled on a computer and annotated on 187 pages (206023 characters) and comprises sections as “Introduction” (volume: 16073

characters), "The main content of the dissertation" (volume: 155278 characters), "Conclusion" (volume: 30309 characters), "Results" (volume: 2926 symbols), "Practical recommendations" (volume: 1439 symbols), and "References".

"The main content of the dissertation section is divided into 5 chapters: Chapter I, "Summary of Literature" (volume: 30585 characters), Chapter II, "Materials and Methods" (volume: 11337 marks), Chapter III, "Characterization of Body Structure Types of 16-20-year-old Azerbaijani Girls" (volume: 8724 marks), Chapter IV, "Findings of the Study on the Physical Development of the Body of Azerbaijani Girls among 16-20 Years Old Under Conditions of Relative Normality" (volume: 85103 characters), and Chapter V, "The Research Findings on Body Mass Components among 16-20 Year-old Girls" (volume: 19029 characters).

"References" include 229 sources, 23 of which are in Azerbaijani, 149 in Russian, and 57 in other foreign languages.

RESEARCH MATERIALS AND METHODS

To carry out the research work, the research study was conducted among 755 Azerbaijani girls belonging to the age group between 16 and 20 (youth age); 329 of them belong to the age group between 16 and 17, and 426 of them belong to the age group between 18 and 20 years old. The reason for dividing the subjects of the study into two age groups is the importance of determining the dynamics of their physical development during the youth period.

Such gradation is also associated with the fact that during the transitional period from 16–17 years to 18–20 years, serious hormonal changes in the body (especially the estrogen hormone) excel up to the norm and the complete formation of secondary sexual characteristics occurs.⁷ The health condition of girls is evaluated as a "relative norm" against maintaining the stability of homeostasis.

⁷Никитюк, Б.А. (Nikityuk, В.А.) Морфология человека / Б.А.Никитюк, В.П.Чтецов – Москва: Издательство Московского университета, – 1990. – 320с.

Exclusion criteria include pathologies of the kidneys and adrenal glands, hyperparathyroidism, hypoparathyroidism, malignant tumors, chronic diseases of the digestive tract and liver, diabetes, Paget's disease, hypogonadism, rheumatoid arthritis, and long-term immobilization that can affect the morphology of the musculoskeletal system. In such cases, the formation of the body's entire physical development was excluded from the list of research objects.

All the examined girls subject to study are Azerbaijani girls who live in Baku, as well as those who come from different regions of the country and study at the Azerbaijan Medical University, partially at the Azerbaijan State Academy of Physical Education and Sports, and partially at secondary schools located in Baku.

The research was conducted with the help of the bio-impedance meter "InBody 770" (Bioelectrical Impedance Analysis) device, which is commonly used in modern anthropology and studies body components (picture 1), a caliper measuring the thickness of the skin-fat fold of the body, height metering, a protractor, a sliding scale, a goniometer, and other tools (Figure 2).

We determined a wide range of anthropometric indices characterizing the physical development of girls using the complex anthropometric method. During the research conducted by us, 23 parameters were measured, and for this purpose, the landmarks applied by Bunak V.V.(1941)⁸ were used. Circular measurements were determined on a horizontal surface using centimeter tapes. Among them: to measure the circumference of the chest - after placing the tape on the back of the chest under the lower angles of the scapulae, it is carried slightly above this level on the sides and brought to the upper edges of the mammary glands on the front; the circumference of the waist belt - in the middle of the distance between the 10th rib and the middle of the iliac crest; the circle of the buttock- according to their most rearward points; the circle of the

⁸Бунак, В.В. (Bunak, V.V.) Антропометрия (практический курс) / В.В.Бунак, – Москва: учебно-педагогическое издательство Наркомпроса РСФСР, – 1941. – 368 с



Figure 1. “InBody 770” BioImpedance Meter (Bioelectrical Impedance Analysis) device used in the research

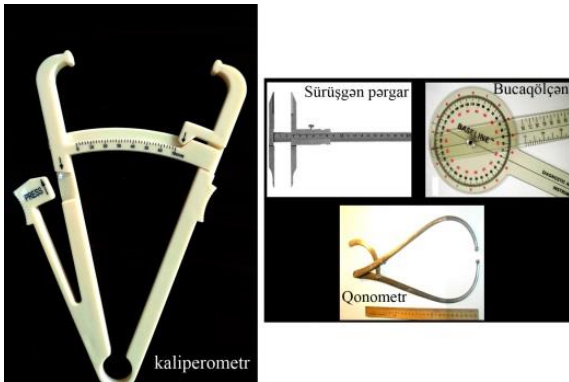


Figure 2. Measuring tools used in the research

forearm - in the thickest part of the muscles in a relaxed state with arms hanging to the sides (in right-handed people on the right side, in left-handed people - on the left side); wrist circumference – in the lower third of the forearm, above the hand; thigh circumference - slightly below the gluteal fold; circle of the leg - in the most

developed place of the triceps surae muscle; supramalleolar circle - performed above the malleoli in the thinnest part of the leg.

The thickness of the skin-fat folds was analyzed by the caliper method. A caliperometer was used for this purpose. The thickness of the skin-fat fold was measured in the following zones: behind the body - under the lower angle of the back (the direction of the fold is oblique and taken at an angle of 45° with the horizontal surface); in the chest - at the level of the outer edge of the pectoralis major muscle, in the middle of the distance between the mammary gland and the anterior axillary line; on the front wall of the abdomen - on a horizontal line, 5 cm to the right of the navel; on the back side of the leg - in the area of the triceps surae muscle *of the leg*, with the arm hanging freely and relaxed - the fold is in the vertical (longitudinal) direction, on the inside of the arm - in the area of the biceps brachii muscle, at the level of the upper third of the leg, with the arm hanging loosely - the fold is vertical (longitudinal) in the direction; on the inside of humerus - in its densest place, in the longitudinal direction; in the thigh - near its base, the fold is parallel to the inguinal ligament and lies in the left direction (the examiner sits on the measuring box in such a way so that the buttocks are bent at a right angle at the knee joint); when performing this examination on the calf, the measurement was taken on the back-outside of the calf, under the knee joint, in a sitting position, and the fold was taken in the transverse direction. The measurements of the diameters were taken in the below-mentioned sites of the body. Thus, the width of the shoulders (in the shoulder girdle; acromial diameter) – the distance between the tips of the right and left shoulder protrusion; pelvic width (pelvic diameter) – is the distance between the right and left front upper hip bones. Transverse diameter of the distal part of the arm—the distance between the medial and lateral epicondyle of the humerus; transverse diameter of the distal part of the forearm – the distance between the styloid processes of the forearm (radius and ulna) bones; transverse diameter of the distal part of the thigh—the distance between the medial and lateral epicondyles of the femur. The transverse diameter of the distal part of the leg is determined by

measuring the distance between the most protruding points of the medial and lateral malleoli.

The amount of fat and muscle tissue of the body is determined by absolute weight (in kg) and percentage (in relation to the total body mass).⁹ According to the description of those authors, $0=1.2 \times H \times (\text{total (1-4) muscle}/4) / 100$. where 0 denotes - weight of bone tissue (in kg), H denotes - height (in m), sum (1-4) muscle - the sum of the transverse diameters of the distal parts of the thigh, leg, arm, forearm (in cm).

The bone mass of the body was determined by the calculation method (with Kettle-2 index or body mass index). It has been determined that it is possible to identify risk groups with chronic energy deficiency, excess body mass, and obesity. In such cases, if the Body Mass Index is 18.5 kg/sq. or less, it indicates a body mass deficit; the value of the Body Mass Index is between 18.5-24.9 kg/sq. - indicates that the body mass is normal (healthful weight); between 25.0-29.9 kg/sq. - indicates an excess of body mass (overweight); If BMI is greater than or equal to 30 kg/sq., this is an indicator of alimentary obesity (obese status).

To determine the body mass index (I), a commonly accepted formula was used - $I=P/L^2$: where P indicates a body mass (in kg), and L indicates height (in m).

Having regard that the constitutional diagnostics scheme of B.A.Nikityuk – V.P.Chtetsov used in somatotyping is not sufficiently applied in the clinic, we also classified the examined girls according to the diagnostic scheme proposed by M.V. Chernorutskiy (1925)¹⁰ which is commonly used in medical practice.

All girls were subdivided into 3 somatotypes: normosthenic, asthenic and hypersthenic. We classified the girls to one or another

⁹Buendia, R., Seoane, F., Gil-Pita, R. Novel approach for removing the hook effect artefact from electrical bioimpedance spectroscopy measurements / – Bristol: Journal of Physics: Conference Series, – 2010. 224(1), – p. 121-126.

¹⁰Черноруцкий, М.В. (Chernorutskiy, M.V.) Учение о конституции в клинике внутренних болезней // Труды 7-го съезда российских терапевтов. – Ленинград: – 1925. – с.345-364

constitutional type according to the formula indicating the magnitude of the somatic development index (Pinier index).¹¹

Pinier index (PI) is calculated according to the mentioned formula: $PI = L - (P + T)$, where: L – body height (in cm); P – body mass (in kg); T - indicates the circumference of the chest (in cm). This formula mainly implies that the value of the somatic development index is greater than 30 for asthenics, ranging between 10-30 for normosthenics, and less than 10 and even negative for hypersthenics.

We conducted somatotyping among the studied girls, that is, they were divided into constitutional groups, which was performed in consistent with the diagnostic scheme of B.A. Nikityuk - V.P. Chtetsov (1990)⁷. When compiling a standard schedule for somatotypical diagnosis in female, 10 measurement signs were used. Deviations (errors) from the signs of normal distribution were taken into account, which features the capacity of the body fat component.

The scheme takes into account height (body length) and reduces the assessment of skeletal muscle development. The corresponding developmental scores of individual traits are collected during somatotyping according to the above-mentioned categories, which also characterize the development of bone and adipose tissue. Average scores are calculated for each category. These average scores are also used as a basis for determining the diagnosis of a somatic type.

Quantitative and qualitative indicators obtained during the study were analyzed by modern biostatistical methods. Statistical analysis was conducted in MS EXCEL-2019 and IBM Statistics SPSS-26 programs with the application of variation methods¹².

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¹¹Парфенова, И.А. (Parfenova, I.A.) Возрастные изменения минеральной плотности костей скелета, массы мышечной, соединительной и жировой тканей у людей с разными типами конституции развития: / Автореферат диссертации кандидата медицинских наук / – Курган, 2007. – 22 с.

¹²Боровиков, В.П. (Borovikov, V.P.) Популярное введение и современный анализ данных в системе СТАТИСТИКА / В.П.Боровиков. – Москва: Телеком, – 2015, –288с.

All measurements were recorded and included in the general statistical map. In the analysis of indicators, average ($M \pm m$) and average structural (min, max) indicators were calculated for the description of variational series. The variability of the averages was assessed by both percentage and time for age groups, constitutional types, and ST subgroups. Non-comparable rows parametric U-Mann-Whitney (2 groups) and KU-Kruskal-Wallis (3 and more groups) criteria were used. When the statistical accuracy of the difference was $p < 0.050$, the "0" hypothesis was rejected. To study the normal range of anatomical change, when the value of the range of variation is in the range $M \pm o$, this sign is the average of the magnitude, the signs of variation in the range $M \pm a - M \pm 2a$ - as the deviation of the mean from the limit of $M \pm 2a$ is perceived as a sharp deviation from the extreme.

47 tables, 8 diagrams and 14 photographs were used to illustrate the evidence obtained in the dissertation.

RESEARCH RESULTS AND THEIR DISCUSSION

By solving these issues, we obtained materials on the state of physical development of Azerbaijani girls aged 16–20, who are considered practically healthy. Thus, informative evidence was obtained on the characteristics of girls' body structure and component composition, i.e., capacity of bone, muscle, and fat mass. According to the Chernorutsky classification⁷, 21.1% of girls aged 16–20 years were diagnosed with asthenics, 43.3% with normostenics, and 35.6% with hyperstenics (diagram 1). According to the scheme of Galant I.B.–Nikityuk B.A.–Chesov V.P.¹⁰ most mesoplastic somatotypes, rarely uncertain constitutional groups, subathletic, and athletic somatotypes were found in normostenics.

Representatives of girls belonging to different constitutional groups and different STs (asthenic, stenoplastic, picnic, mesoplastic, and euryplastic short STs predominated in hyperstenics, and indefinite group and euryplastic tall STs were observed (diagram 2).

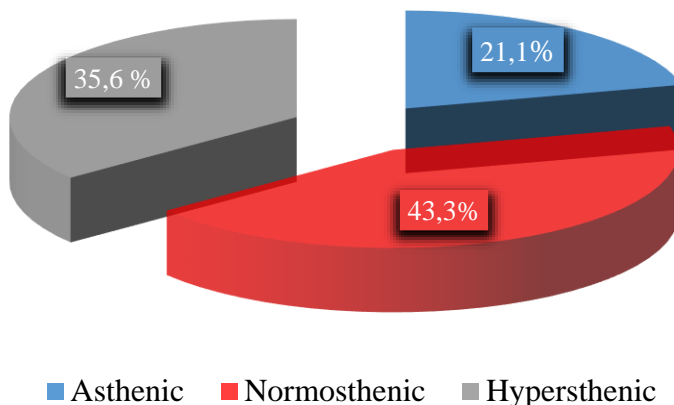


Diagram 1. M. B. Chernorutsky classification of body types found.

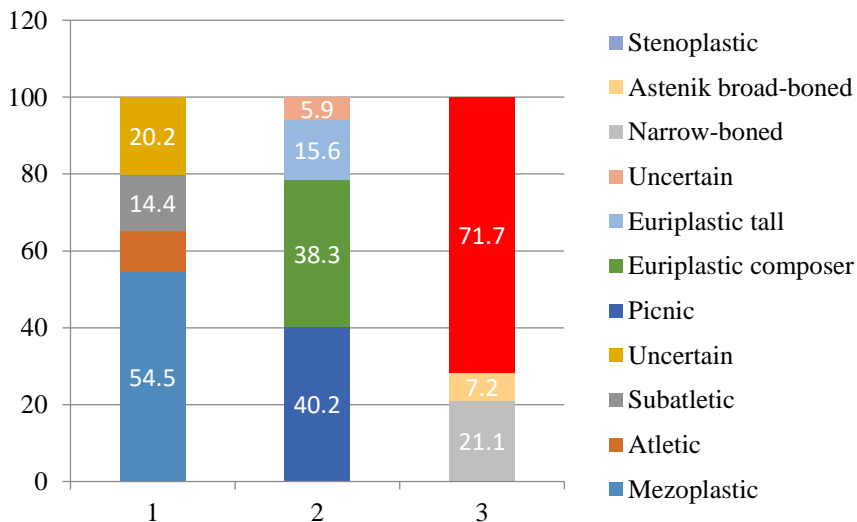


Diagram 2. Galant I.B. - Nikityuk B.A. - Chtetsov V.P. body structure types found in the classification (Comparison with the classification of Chernorutsky M.V.): 1. Normosthenic, 2. Hypersthenic, 3. Asthenic)..

In asthenics, stenoplastic ST-s were predominant, with rarely narrow and broad-boned asthenic body types (diagram 2). It was revealed that according to this scheme, the girls belong to the indefinite constitution in the M. B. Chernorutsky classification, all cases can be attributed to the types of normosthenic or hypersthenic body structures.

In the study population, representatives of girls belonging to different constitutional groups and different ST-s (asthenic, stenoplastic, picnic, mesoplastic, athletic, subathletic, and euryplastic) were identified quantitatively, both in proportion and assessed in absolute numbers.

Athletic, subathletic, euryplastic) in the studied population were found both in proportion and in absolute numbers.

The complex research allowed us to obtain information about the specificity of the anatomical and anthropometric parameters of the body and the composition of the components, depending on the constitutional type of the studied girls. The study revealed significant individual and constitutional changes in neck length, weight, body surface area, the thickness of the skin and fat folds of all studied areas (back, chest, abdomen, and extremities), transverse (diameters), and circular dimensions of the extremities.

We found that during the transition of girls from 16-17 years of age to 18-20 years of age, their body structure was the least and the most both labile and persistent anatomic-anthropometric indicators.

The importance of such a transition period is due to the discrete nature of extrauterine ontogenesis, which manifests itself in the presence of very serious hormonal changes in girls throughout adolescence.⁷ The importance of such a transition period is due to the discrete nature of extrauterine ontogenesis, which manifests itself in the presence of very serious hormonal changes in girls throughout youth. We have shown that in girls during the transition from 16–17 years of age to 18–20 years of age, there is an increase in body weight, thickness of skin and fat folds (back, abdomen, arms, thighs, and legs), and circumferences of the chest, lumbar region, arms, wrists, buttocks, thighs, and legs.

Thus, it was found that body weight (69.2 ± 0.6 kg) in girls aged 18–20 years is 1.07 times ($P_u < 0.001$) more than in girls aged 16–17 years. In the same age range (18–20), the thickness of the skin and fat folds increases in the back (14.7 ± 0.2 mm) 1.08 times ($P_u < 0.001$), in the abdomen (31.7 ± 0.6 mm) 1.06 times ($P_u < 0.001$), on the back of the arm (18.6 ± 0.3 mm) 1.17 times ($P_u < 0.001$), on the medial side of the arm (12.9 ± 0.3 mm) 1.19 times ($P_u < 0.001$), on the medial side of the forearm (11.6 ± 0.2 mm) 1.13 times ($P_u < 0.001$), on the thigh (22.2 ± 0.4 mm) 1.09 times ($P_u < 0.001$), and on the leg (18.1 ± 0.2 mm) 1.17 times ($P_u < 0.001$) (table 1).

According to our evidence, the circular size of the chest (86.2 ± 0.4 cm) in girls aged 18–20 years was 1.06 times ($P_u < 0.001$) compared to the parameters in girls aged 16–17 years: the lumbar circumference (70.4 ± 0.5 cm) was 1.07 times ($P_u < 0.001$) and 1.05 times ($P_u < 0.001$) more than the circular size of the buttocks (101.0 ± 0.5 cm). During the transition from the age group of 16-17 years to the age group of 18-20 years, the age changes in the remaining anthropometric indicators of physical development of women's bodies either do not exist or are manifested in the form of inaccuracies only in the form of growth.

We obtained evidence on the constitutional and somatotypical characteristics of 16–20-year-old Azerbaijani girls and found that among them were representatives of all known constitutional groups. According to our evidence, in the population we studied, there are representatives of girls belonging to the leptosome, mesosome, megalosome, and indefinite constitutional groups. In each of these constitutional groups, ST-s are distinguished. Our evidence shows that mesosome (32.5-39.0%) and megalosome (31.5-33.3%) are the predominant constitutional groups among all examined girls in the 16-17 and 18-20 age groups belong to constitutional groups. In rare cases, leptosomal (18.6-24.3%) and undetermined (9.1-11.7%) constitutional groups are found.

Table 1
Anthropometric, calliperometric and bioimpedance
indicators (absolute capacity; in %) of girls aged 16-17 (group 1)
and 18-20 (group 2).

Indicator	Age group										Pu
	16-17 years old					18-20 years old					
	N	M	m	min	max	n	M	m	min	max	
Body length	329	163,1	0,4	142	188	426	164,4	0,3	142	185	0,009
Body mass	329	62,9	0,6	36	83	426	69,2	0,6	40	98	<0,001
Body Mass Index (BMI)	329	23,6	0,2	15,1	32,4	426	25,6	0,2	15,8	36,3	<0,001
The thickness of the skin-fat fold of the back	329	12,6	0,2	4,3	21,9	426	14,7	0,2	5,4	24,8	<0,001
Chest skin-fat fold thickness	329	13,1	0,3	4,2	25,8	426	16,5	0,2	4,8	27,4	<0,001
Abdominal skin-fat fold thickness	329	26,6	0,6	6,7	53,9	426	31,7	0,6	7,8	54,3	<0,001
The thickness of the skin-fat fold of the back surface of the arm	329	15,0	0,3	5,1	27,8	426	18,6	0,3	4,6	34,2	<0,001
The thickness of the skin-fat fold of the inner surface of the arm	329	10,0	0,2	2,8	22,0	426	12,9	0,3	3,0	28,6	<0,001
The thickness of the skin-fat fold of the inner surface of the forearm	329	9,4	0,2	2,0	19,5	426	11,6	0,2	2,2	22,6	<0,001
Thigh skin-fat fold thickness	329	19,1	0,4	6,2	37,1	426	22,2	0,4	6,7	41,4	<0,001

Continuation of the table 1

Leg skin-fat fold thickness	329	15,5	0,2	6	26	426	18,1	0,2	6	32	<0,001
Body surface area	329	166,1	78,8	1329	2017	426	17029	62,2	1347	2045	0,001
The width of the shoulder girdle	329	36,3	0,3	24,9	47,0	426	37,1	0,3	24,5	52,7	0,036
The width of the pelvis	329	27,23	0,17	18,2	36,7	426	34,11	0,17	24,8	45,7	<0,001
Distal diameter of the arm	329	5,72	0,04	3,4	8,3	426	5,90	0,04	3,3	7,8	0,001
Distal diameter of the forearm	329	4,94	0,03	3,4	6,5	426	5,09	0,03	3,4	6,8	<0,001
Distal diameter of the thigh	329	8,85	0,05	6,5	11,5	426	9,03	0,04	6,4	11,8	0,009
The distal diameter of the leg	329	7,7	0,1	4,4	11,2	426	8,1	0,1	4,6	11,3	<0,001
Chest circumference	329	84,2	0,4	67,3	102,6	426	86,2	0,4	68,2	103,0	0,001
Lumbar circumference	329	64,5	0,4	48,8	84,0	426	70,4	0,5	48,0	96,1	<0,001
Circle of the gluteal region	329	96,5	0,5	69,5	116,4	426	101,0	0,5	76,9	127,7	<0,001
Arm circumference	329	28,7	0,2	21,7	35,9	426	31,9	0,2	21,4	40,4	<0,001
Wrist circumference	329	16,1	0,1	13,4	19,4	426	17,0	0,1	13,9	20,8	<0,001
Thigh circumference	329	57,6	0,4	37,0	79,1	426	62,0	0,4	39,2	81,5	<0,001
Proximal circumference of the leg	329	34,8	0,2	25,0	43,6	426	37,1	0,2	28,0	46,4	<0,001
Distal circumference of the leg	329	33,2	0,2	24,5	43,1	426	33,6	0,2	25,1	47,0	<0,001

Note: Pu - statistical integrity of the difference between the indicators of age groups (by the Mann-Whitney criterion).

It is impossible to agree with the opinion of Cononova I.V (2011)¹³ about the classification features of constitutional groups (she mistakenly changes these groups by ST-s). According to her, the criterion for belonging to the constitutional group of megalosomes is that the height is more than 165 cm. This idea cannot be considered logical because the representatives of the athletic ST-s belonging to the megalosome constitutional group are relatively short. In addition, it is known that among the girls belonging to the constitutional group of megalosomes, euryplastic short STs with a height of less than 16cm are also distinguished. He also believes that the length of the neck is taken as a limiting factor to detect the leptosome constitutional group and that the author claims that asthenics belonging to this constitutional group, ST girls, are less than 165 cm tall, which is a misconception. According to our data, stenoplastic ST (71.7%) is the most common among girls belonging to the leptosomal constitutional group, and asthenic thin-boned (21.1%) and asthenic wide-boned ST (7.2%) are found. According to our evidence, the mesoplastic body structure type (67.6%) predominates in the structure of the mesosomal constitutional group, and picnic ST (32.4%) is relatively rare. The dominant STs in the megalosomal constitutional group are euryplastic tall (30.1%) and euryplastic short (28.9%). In this constitutional group, subathletic (28.2%) and athletic (12.8%) body types are rare (table 2). Anthropometric indicators of body structure in girls of the studied age group (16–20 years) are characterized by significant somatotypological changes.

Thus, according to our evidence, the circular measurements (in thigh, leg, arm, forearm, etc.) were the lowest in girls with asthenic and stenoplastic ST-s, minimal, and maximum in picnic and euryplastic body types. Thus, according to our evidence, the circular size of the chest in girls aged 16–17 years with asthenic narrow-boned ST is 72.2 ± 0.50 cm, and in girls aged 18–20 years, it is

¹³. Кононова, И.В. (Cononova I.V.) Особенности иммунной реактивности женского организма в зависимости от соматотипа в условиях проживания в республике Саха (Якутия): / Автореферат диссертации кандидата медицинских наук / –Москва, 2011. – 24 с.

Table 2

Characteristics of body height-weight and body mass index indicators in girls of different constitutions in terms of age.

		16-17 years old					18-20 years old					PH
		n	M	m	min	max	n	M	m	min	max	
Body length	Leptosome	74	158,8	0,6	142	165	78	61,6	0,4	142	165	<0,001
	Mezosome	99	161,0	0,4	150	171	160	63,0	0,5	154	183	
	Megalosome	126	167,0	0,7	151	188	140	67,7	0,6	147	185	
	Uncertain	30	164,2	1,2	152	178	48	64,0	0,7	153	175	
Body mass	Leptosome	74	47,1	0,6	36	53	78	50,7	0,4	40	56	<0,001
	Mezosome	99	64,4	0,5	54	74	160	68,9	0,3	60	77	
	Megalosome	126	70,9	0,4	60	83	140	80,5	0,8	63	98	
	Uncertain	30	63,1	0,5	58	68	48	67,2	0,5	60	74	
Body Mass Index (BMI)	Leptosome	74	18,7	0,3	15,1	22,8	78	19,4	0,1	15,8	21,5	<0,001
	Mezosome	99	24,9	0,2	21,1	28,8	160	26,0	0,2	20,7	29,7	
	Megalosome	126	25,6	0,3	19,6	32,4	140	28,8	0,3	19,8	36,3	
	Uncertain	30	23,5	0,4	19,9	27,2	48	25,0	0,3	20,7	28,1	

Note: 1. Among girls 16–17 years old (I), 74 people with a leptosomal constitution, 99 people with a mesosomal constitution, 126 people with a megalosomal constitution, and 30 people with an uncertain constitution were examined. Among girls aged 18–20 years (II), constitutional leptosomes were examined: 78 people; mesosomes: 160 people; megalosomes: 140 people; and indeterminate: 48 people. 2. PH: statistically significant difference between indicators of different types (according to the Kruskal-Wallis criterion).

73.3 ± 1.07 cm, which is 1.17 and 1.18 times (PH <0.001) compared to the corresponding indicators in the representatives of the athletic body type of the same age group, and 1.27 times higher than in the case of girls with euryplastic ST, respectively, and 1.28 times (pH <0.001) less.

According to our evidence, the circumference of the lumbar region was 42.2 ± 0.47 cm in girls aged 16–17 years with asthenic narrow-boned body types and 43.0 ± 0.51 cm in girls with similar ST at the age of 18–20 years. This is 1.52 and 1.54 times (PH <0.001) lower than in girls of the same age group and 1.81 and 2.08 times (PH <0.001) lower than in girls of the same age group and euriplastic, respectively. The circular size of the buttocks in girls aged 16–17 years with asthenic narrow-boned ST was 81.1 ± 0.74 cm, and in girls aged 18–20 years, it was 84.4 ± 1.47 cm. This is 1.20 and 1.17 times (PH <0.001), respectively, compared to the corresponding indicators in girls of the same age group with an athletic body type, and 1.30 and 1.35 times compared to the indicators in girls with euryplastic ST (PH <0.001) were less. According to the evidence obtained, the circular size of the thigh was 44.3 ± 0.91 cm in girls aged 16–17 years with asthenic narrow-boned ST and 44.3 ± 0.61 cm in girls of the same age group of 18–20 years. These are lower by 1.29 and 1.36 times (PH <0.001), respectively, compared to the same indicators in girls of athletic ST from the relevant age groups, and 1.39 and 1.51 times, respectively, compared to girls of euriplastic body type (PH <0.001).

The circumference of the proximal region of the leg in girls aged 16–17 years (30.0 ± 0.36 cm) with asthenic narrow-boned body type was respectively 1.17 and 1.21 times lower (PH <0.001) than in girls with athletic body type, and 1.25 and 1.26 times (PH <0.001) than in girls of the same age group with euryplastic ST.

In girls with asthenic, narrow-boned body types, the value of the circular size of the arm is minimal in both the 16–17 age group (22.2 ± 0.48 cm) and the 18–20 age group (22.2 ± 0.53 cm). It was observed that these indicators were lower by 1.27 and 1.46 times, respectively (PH <0.001), compared to similar indicators in girls of the same age group of athletic body type, and 1.42 and 1.56 times, respectively, compared to indicators of girls of euriplastic body type (PH <0.001). In girls with asthenic narrow-boned ST, the circumference of the wrist was measured in both the 16–17 age group (14.0 ± 0.36 cm) and the 18–20 age group (14.6 ± 0.53 cm). The value of these indicators is 1.16 and 1.14 times (PH <0.001),

respectively, compared with the values of girls of the same age group belonging to the athletic body type, as well as the value of the indicator of girls belonging to the euryplastic body type, 1.21 and 1.23 times less ($PH < 0.001$).

Evidence for a constitutional analysis of body surface area, one of the most important indicators of physical development status, is also new evidence from us. In girls aged 16–20 years, this parameter has significant constitutional differences; body surface area (13290–17210 cm²) is minimal in girls belonging to the leptosomic constitutional group and maximum in girls belonging to the megalosomic constitutional group (16120–20450 cm²). In girls belonging to the mesosomal constitutional group (14000–18640 cm²), the value of this indicator was taken as an intermediate price. The somatotypological features of this indicator are minimal in asthenic (141000 cm²) and stenoplastic (14900–15400 cm²) body types, and maximum in euryplastic ST (18500–18900 cm²).

The evidence we obtained in this area is slightly less than the value of the evidence obtained by Vayner A.B. (2014)¹⁴, as according to the scientist, the body surface area in women is 1.96–2.19m².

Apparently, the achievement of such an indicator is due to the fact that the author studied this parameter in women of puberty, who are considered to be typical for the studied population, overweight and older age groups. We also analyzed the body mass index value in girls aged 16–17 and 18–20 years, taking into account their somatotypological affiliation. According to the evidence we obtained for the first time, the value of the body mass index in the norm absolutely depends on the body type of girls and their constitutional features. According to our evidence, the body mass index is minimal (17.3–17.7) in girls belonging to the leptosomal constitutional type and maximal in girls belonging to the mesosomal (25.2–26.2) and megalosomic (25.3–25.5) constitutional types. According to our

¹⁴. Вайнер, А.Б. (Vayner, A.B.) Антропометрическая характеристика женщин при коррекции избыточного веса: / Автореферат диссертации кандидата медицинских наук / – Саратов, 2014. – 22 с

evidence, the value of body mass index is the lowest (minimum) in representatives of the asthenic somatotype (15.7–16.9) in both age groups (16–17 and 18–20), and in girls belonging to the euryplastic somatotype (27.6–28.8), it has the highest (maximum).

It was found that the individual minimum and individual maximum body weight in girls aged 16–17 and 18–20 years is increasing from the leptosomal constitutional group to the indeterminate and megalosomic constitutional groups, while in the mesosomal constitutional group, this indicator is intermediate. We also analyzed the body's bone component capacity in girls in terms of age. Thus, according to our evidence, the absolute and relative capacity of the bone component of the body does not change significantly in girls aged 18–20 years or in girls belonging to other bodytypes, except for euryplastic ST, compared to girls aged 16–17 years. In the case of girls with euryplastic body type, due to a significant increase in total body weight during the transition from 16–17 years to 18–20 years, they have a decrease in the relative (percentage) value of the bone component of the body.

In girls aged 16–17 and 18–20 years, the amount of fat in the body has significant constitutional differences. The absolute value of the body fat component is the maximum in the representatives of girls belonging to the constitutional group of mesosome (15.8–16.3 kg) and indefinite (15.7–16.5 kg), while in girls belonging to the leptosome it is minimal (7.3–7.5 kg). The relative (percentage) capacity of body fat tissue in girls of the indefinite (24.4–24.6%) and mesosome groups (23.8–28.0%) is the maximum. In girls belonging to the constitutional group of leptosomes (14.8–15.1%), this parameter is minimal. In the girls we studied, the indicators of the absolute capacity of the body fat mass are characterized by somatotypological changes. Thus, the value of this indicator is minimal in girls belonging to asthenic (5.0–6.2 kg) and stenoplastic (10.8–11.3 kg) ST-s, euriplastic (11.0–15.2 kg) and uncertain (15.7–16.5 kg) is maximum in girls of body structure types.

In girls aged 16–20 years, the relative (percentage) capacity indicator value of the body fat component in picnic (22.7–22.8%), uncertain (24.4–24.6%) and mesoplastic (24.1–25.6%) is observed to

be maximal in the representatives of girls belonging to body structure types. According to our evidence, the value of the absolute capacity index of the muscle component of the body is minimal in girls belonging to the leptosomal constitutional group (19.4-19.7kg), and maximal in girls belonging to the megalosomal constitutional group (27.3-38.4kg) aged 16-20 years. The somatotypological characteristics of this indicator in girls belonging to the asthenic body type (18.8-18.9kg) are minimal. In athletic (28.6-30.2kg), euriplastic (28.0-38.0kg), and uncertain (36, 5-38.4 kg) somatotypes value is maximum. The relative value of that parameter is maximal in girls of asthenic body type (42.8-45.8%), and minimal in picnic ST (35.8-36.9%). In girls belonging to different somatotypes, a slight change in the value of the muscle component capacity of the body is observed during the transition from the age group of 16-17 to the age group of 18-20.

It is also known in science that the increase in body fat mass due to age has a constitutional specificity. It is noted by individual authors that in 16- to 20-year-old girls of the hypersthenic body type, there is no percentage (relative) increase in adipose tissue, but during the period from 21 to 70 years of age, the rate of such an increase is 5%.¹⁵

Panahova G.I. (2018)¹⁶ notes that the inadequacy of the structural-functional development of the body in 11-14-year-old schoolchildren of both sexes during puberty, revealed by somatometric parameters, is reflected in the uneven formation of neuroendocrine and neurochemical regulatory mechanisms. The above is reflected in the value of the somatometric indicators of schoolchildren and the proportional distribution of the subcutaneous fat layer in the body.¹⁶

¹⁵Самородская, И.В. (Samorodskaya, I.V.) Индекс массы тела и парадокс ожирения // - Москва: Российский медицинский журнал. - 2014. №2, - с. 170-175

¹⁶Pənahova, G.İ. 11-14 yaşlı məktəblilərdə bədənin müxtəlif somatometrik göstəriciləri ilə arterial təzyiç və miokard indikatorunun dispersiya göstəriciləri arasında asılılıç // - Bakı: Sağlamlıç jurnalı, – 2018. №1, – s. 129-133.

Thus, based on comprehensive anthropometric, caliperometric and bioelectrical research, along with the analysis of the physical development of 16-20-year-old Azerbaijani girls, we obtained evidence about the component composition of their bodies. We discovered that they have serious constitutional differences and, for the first time, we identified, characterized and evaluated the numerically different somatotypological affiliations of girls of the studied age group.

THE RESEARCH FINDINGS

1. According to the results of the study, among the 16–20-year-old Azerbaijani girls studied, mesosome and megalosome constitutional groups are prevalent, leptosome in relatively few cases, and non-determined groups exposed in fewer cases. In terms of somatotypes, leptosoma (stenoplastic), mesosome (mesoplastic), megalosome (tall and short euriplastic), as well as subathletic somatotypes, are predominant. In rare cases, athletic somatotypes have been identified in the mesosome, or picnic, in the megalosome[3,6,7,9,10,11].
2. The body surface sities of girls between 16 and 20 years old were minimal in leptosomes, maximum in megalosomes, and average in mesosomes, and this indication was represented as a minimum value in asthenic and stenoplastic cases in the somatotypological approach and a maximum value in euriplastic types. The tendency for body surface area-based growth was observed during the transitional period from 16–17 years to 18–20 years. According to anthropometric indices, it was observed that the skin fat fold thickness of the body is the smallest in asthenic, athletic, and subathletic somatotypes and the greatest in picnic somatotypes. The minimum and maximum individual of the Body Mass Index (BMI) gradually increases from the leptosomal constitutional group to the indeterminate and megalosomal constitutional groups, while in the representatives of the mesosomal constitutional group, this indicator has a moderate state [4,5,8,11,13,14,17].

3. The absolute capacity of the bone component of the body was minimum among girls with narrow-boned asthenic ST, maximum in euryplastic, and its percentage capacity was the highest in asthenic and stenoplastic ST-s. Except for euryplastic somatotype, the absolute and percentage capacity of the bone component did not change among 18–20-year-old girls, as compared to 16–17-year-old girls. It was identified as a decrease in the relative value of the euryplastic somatotype [16].
4. The absolute value of the body's fat mass capacity is expressed by the maximum values in megalosome and indeterminate groups and the minimum values in leptosome groups. Its percentage capacity was prevalent in indeterminate and mesosomal constitutional groups and reached the minimum level in leptosomes. In the transitional period from 16–17 years to 18–20 years, there was a tendency to increase in the absolute fat mass capacity, but the relative capacity did not change [1,15].
5. The absolute capacity of the muscle component of the body was expressed as minimum in leptosomes, maximum in megalosomes, minimum among girls belonging to the asthenic ST-s, maximum in athletic and euryplastic ST-s, as well as in the indeterminate group. The relative value of this parameter was found to be maximum in asthenic and minimum in picnic types [2,11,12].
6. According to the classification by M.V. Chernorutsky, we identified 21.1% asthenic, 43.3% normosthenic, and 35.6% hypersthenic body types among 16–20-year-old Azerbaijani girls. However, according to the I.B. Galant-B.A. Nikityuk-B.P. Chtechov scheme, the mesoplastic somatotype was primarily found in normosthenic body types. The indeterminate constitutional group, subathletic, and athletic somatotypes were found in the fewest cases. Picnic and euryplastic short ST-s are predominant in hypersthenic body types, and indeterminate group and euryplastic tall somatotypes were observed only in a few cases. In asthenic body types, stenoplastic ST was predominant; narrow-boned and wide-boned asthenic STs were noted in a few cases. It was identified that according to this scheme, girls belonging to an indeterminate constitutional group in all cases can

be attributed to normosthenic or hypersthenic body composition types according to the classification of M.V. Chernorutsky [3,4,6,10,18].

PRACTICAL RECOMMENDATIONS

1. Having regard to a substantial change in physical development indicators (anthropometric parameters, body mass composition) in girls during the transition period from 16–17 years to 18–20 years, it is appropriate to include an appropriate chronological rubric in the commonly accepted age periodization applied to the youth period.
2. In the implementation of preventive measures and recommendations for preventing the inclination to nutrition-related diseases (obesity, body mass deficit, diabetes, hypertension, and some cardiovascular and lung diseases) at an early stage, in the selection of instructions for bariatric surgery performed on the stomach, in nutritionology it can be of great practical importance in the scientific proof of the diet, having regard to the somatotypological specificity.
3. Materials obtained related to the body mass index can be included in the program in Human Anatomy and Medical Terminology, Surgical Diseases, Public Health and Organization of Health Care, Normal Physiology, Nutrition and Communal Hygiene Departments of the Azerbaijan Medical University, Department of Medical and Biological Sciences of the Azerbaijan State Academy of Physical Education and Sports, and in other programs under relevant subjects.
4. The I.B. Galant, B.A. Nikityuk, and V.P. Chtetsov diagnostic scheme, which is deemed to be prevailing over many other existing schemes for the purpose of determining the somatotype in girls and is considered relatively easy to perform, is more optimal, and the classification of M.V. Chernorutsky is clinical, can be recommended for use due to its convenience in terms of practical application.

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