Features of Physical and Generative Development of Modern Teenagers Living in Uzbekistan

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Abstract

The publication examines the anthropometric and sex characteristics of adolescents with autonomic dystonia syndrome, depending on gender and place of residence (city, village). Analysis of the health status of children and adolescents in the Youth Center of the city of Tashkent in dynamics for the period 2018-2020 revealed the patterns of physical, sexual development, as well as the level of secretion of hormones, which were characterized by age "peaks", indicating a high individualization of the adolescent organism.

Key Words: Adolescents, Autonomic Dystonia Syndrome, Gender.

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Introduction

The state of health of a nation is largely determined by the level of population health of adolescents, which form its cultural, intellectual, production and reproductive potential (Astakhova, 2015; Baranov, 2012; Gaskova, 2010; Kazakova, 2008; Kozlov, 2010). In recent decades, research has been carried out to study the mechanisms of functioning of the neuroendocrine, cardiovascular, respiratory systems, the blood system, as well as psychosomatic status, compensatory-adaptive reactions of a growing organism to the action of various factors (Abubakirova, 2014; Baranov, 2012). The data obtained by the authors confirm the high frequency of deviations in the physical and sexual development of adolescents, a decrease in adaptive capabilities and, as a result, a progressive decrease in the health level of modern adolescents.

Adaptive restructuring caused by the impact of the environment significantly displaces traditional ideas about norm and pathology, since in many cases they contribute to both negative and positive changes in the human body. The state of the organism between norm and pathology differs in the degree of adaptation of the organism to environmental conditions. It is important to assess the degree of adaptation of the organism in specific conditions, because in this case, the state of the body is determined, which precedes the development of certain nosological forms of the disease. Based on this, the health of a growing organism cannot be considered without taking into account its adaptive capabilities (Kozlov, 2010; Antonov, 2012; Polunina, 2013).

The foregoing served as the rationale for carrying out this ecological and physiological study of the physiological mechanisms of adaptation of adolescents in Uzbekistan, taking into account gender and geographic affiliation.

Purpose of the Study

To study the features of the physical and sexual development of modern adolescents living in Uzbekistan.

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Material and Research Methods

We examined 412 adolescents who underwent preventive examination, examination and treatment in 2019 in the Teenage Center of the city of Tashkent, Republic of Uzbekistan. According to the results of the questionnaire survey by Wayne's questionnaire, the syndrome of vegetative dystonia (SVD) was found in 243 adolescents (58.9%). Of these, there were 87 adolescent boys, with an average age of 15.0 ± 2.2 years, and adolescent girls 156, with an average age of 15.3 ± 2.6 years. The selection criterion was the adolescent's place of residence - a city or a rural area.

Among the surveyed adolescents with SVD, 69.5% lived in urban conditions, 30.5% - in the region (Table 1).

Table 1. Geographic distribution of adolescents with SVD

Place of residence		Girls, n=156	Boys, n=87	Total, n= 243
City	abc.	115	54	169
	%	73,7% *	62,1% *	69,5% *
Region	abc.	41	33	74
	%	26,3%	37,9%	30,5%

* - p <0.01 (significance between boys and girls)

The surveyed adolescents were divided into four groups: Group I consisted of 54 urban boys, Group II - 33 rural boys, Group III - 115 urban girls, and Group IV - 41 rural girls. In the study of peripheral blood parameters and hormone levels, 28 urban and 26 rural boys, 27 urban and 26 rural girls (with an established ovarian-menstrual cycle) took part.

The anthropometric method included measurement of height (H, cm), body weight (BW, kg), chest circumference (CHC, cm), waist (W, cm) and hips (H cm). Based on the obtained anthropometric data, the body type of adolescents was determined by the Pignet index and the body mass index (BMI) was calculated.

The assessment of sexual development was carried out according to the Tanner method during routine medical examinations by a urologist and gynecologist according to the severity of secondary sexual characteristics and the integration of indicators into the sexual formula VPLAxF - for boys and MaAxPMe for girls, where V is the voice mutation, L is the growth of the thyroid cartilage of the larynx, F is the hair on the face, P is the hair on the pubis, Ax is the hair on the armpits, Ma is the development of the mammary gland, Me is the menarche.

Physiometric methods included the determination of heart rate (heart rate, beats / min) by palpation, systolic (SBP, mm Hg) and diastolic blood pressure (DBP, mm Hg) by the method of N.S. Korotkov, vital capacity of the lungs (VC, ml) by spirometry, calculation of cardiorespiratory tests: Stange's test, Rufier's index, Skibinskaya's index.

Determination of the level of cortisol (nmol / L), testosterone (nmol / L) (for boys), estradiol (pg / ml), progesterone (nmol / L) (for girls) in blood serum was carried out using an enzyme-linked immunosorbent assay on a Benchmark microplate reader using the sets "Diagnostic systems" (Russia). Blood sampling from adolescent girls was carried out in the folliculin phase (FF, 7-8 days) and the luteal phase (LF, 21-22 days) of the ovarian-menstrual cycle (OMC).

The results were processed as follows: calculation of the mean, standard deviation, Mann-Whitney U-test, correlation analysis. Programs used: Microsoft Office Excel, Stadia.

Research Results

Taking into account the obtained morphological indicators, urban adolescent boys were ahead of their peers living in rural areas in all indicators of physical development (Table 2).

Table 2. Morphological indicators of urban and rural adolescents

Indicator (M±m)	Height, cm	Weight, kg	OGK, cm	OT, cm	OB, c,
I group (n=54)	164,2±1,2	53,1±1,2	81,3±0,7	70,9±0,6	88,4±0,8
II group (n=33)	161,6±1,4	50,7±1,3	79,6±0,9	69,7±0,8	87,1±0,9
r1	r=0,13	r=0,17	r=0,17	r=0,30	r=0,23
III group (n=115)	158,8±0,7	49,7±1,1	82,1±1,1	67,1±0,9	89,5±1,2
IV group (n=41)	159,0±0,9	47,02±1,2	81,9±0,8	66,3±0,7	89,9±1,4
r2	r=0,82	r=0,37	r=0,86	r=0,75	r=0,52

Note: p1 - reliability of differences in results among adolescent boys of I and II groups; p2 - reliability of differences in results among adolescent girls of III and IV groups; Group I - urban teenage boys; Group II - rural teenage boys; Group III - urban teenage girls; Group IV - rural teenage girls.

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Among adolescent girls, the average body weight was higher in the group of urban girls (49.72 ± 1.05 kg). We found a decrease in body weight below 44 kg in 21.5% of urban and 28.1% of rural girls.

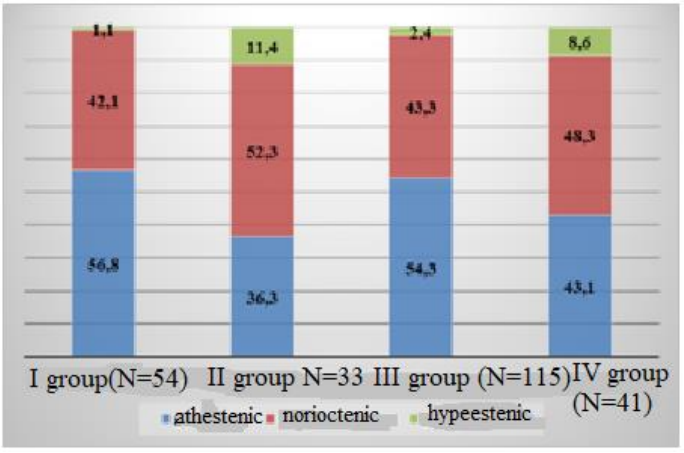


Figure 1. Distribution of body types among urban and rural adolescents

Dominance of the asthenic type was revealed in urban boys (56.8%) and urban girls (54.3%) over their rural peers - boys (36.3%) and girls (43.1%). Significantly larger gap in indicators was observed among adolescent boys. The hypersthenic type was more common among rural adolescents - boys (11.4%) and girls (8.6%).

The analysis of the sexual formula in the groups of boys revealed a mismatch in the rates of development of signs. In urban boys, the average values of the sexual formula were V1.47P3.09L1.38Ax2.98F0.85, and in rural boys - V1.38P3.13L1.13Ax3F0.94. Among girls, harmonious sexual development was established, while the average values of the sexual formula turned out to be higher in the group of rural schoolgirls (Ma3.16Ax3.13P3.21Me2.13) in comparison with urban (Ma2.18Ax2.07P2.16Me2.09). The average timing of the onset of menarche in the group of urban girls was 12.68 ± 0.11 years and 12.57 ± 0.08 years for rural girls.

Comparative analysis of the main hemodynamic parameters did not reveal significant differences in the groups of adolescents, however, relatively high values of heart rate, SBP and DBP among boys were found in urban adolescents, and in groups of girls, the average values of heart rate were higher in rural women, SBP and DBP in urban girls.

The average values of VC in the groups of rural adolescents turned out to be higher in comparison with urban ones (rural boys - 2803.33 ± 94.01 ml, rural girls - 2563.33 ± 114.01 ml, urban boys - 2780.0 ± 111.66 ml and urban girls - 2480.0 ± 64.03 ml).

We analyzed the distribution of constitution types in urban and rural adolescents (Figure 1).

The results of cardiorespiratory tests (Shtange's, Skibinskaya's and Rufier's tests) illustrate relatively high reserve capacities in the group of rural adolescent boys in comparison with other groups of adolescents (Figure 2).

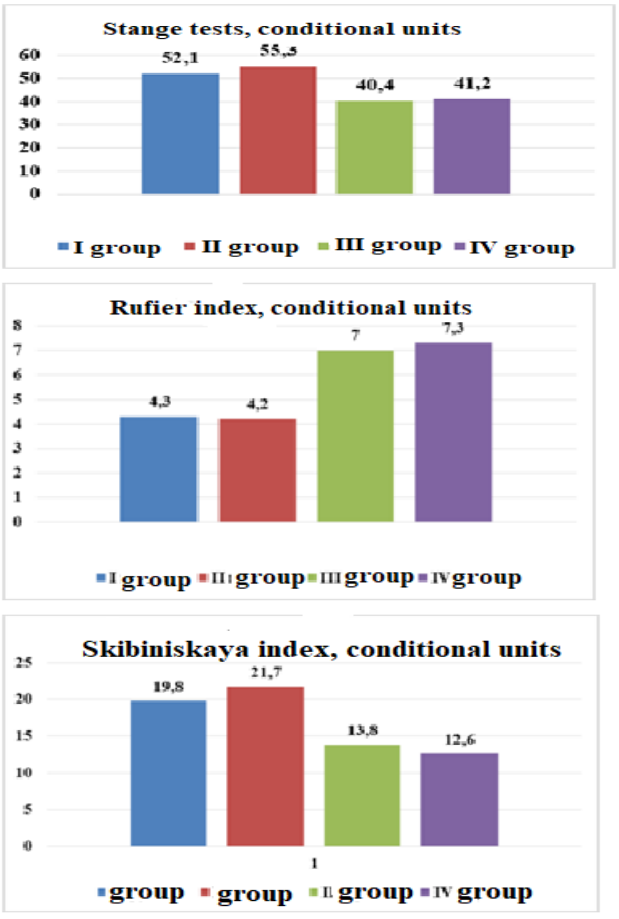


Figure 2. Indicators of the Stange test (A), the Rufier index (B) and the Skibinskaya index (C) in the groups of urban and rural adolescents

The average values of the studied hormones in the

population groups of adolescent boys were within the age norm, reflecting the peculiarities of neuroendocrine regulation mechanisms (Table 3).

Table 3. Indicators of the Hormonal Profile in Adolescent Boys

Indicator (M±m)	**Cortisol, nmol / l**	**Testosterone, nmol / l**	**Estradiol, pg / ml**
I group (n=54)	377,84±34,27	7,4±1,6	2,1±1,4
II group (n=33)	236,7±25,3	6,8±1,50	1,2±0,2
R	r=0,005	r=0,188	r=0,178

Note: p - reliability of differences in results among adolescent boys of groups I and II; Group I - urban teenage boys; Group II - rural teenage boys.

The vectorial distribution of the concentration of cortisol among adolescent boys indicates a greater tension of adaptation mechanisms in the group of urban boys, in whom the level of cortisol was statistically significantly higher (p = 0.005). Relatively higher values of testosterone and estradiol were found in urban adolescents (7.4 ± 1.6 nmol / l and 2.1 ± 1.4 pg / ml).

In the group of urban girls, the concentration of cortisol in both phases of the ovarian-menstrual cycle (OMC) was higher in comparison with rural girls (table 4).

In FF OMC, higher estradiol levels were found in rural girls (17.5 ± 2.0 pg / ml). This trend continued with the onset of LF, when there was a natural increase in the secretion of this hormone (35.2 ± 3.2 pg / ml). In addition, rural girls were found to have high serum progesterone levels throughout the CMC.

The established features of the functioning of the endocrine system in ethnic groups of adolescents are very polymorphic, which determines the individuality of the adaptive reactions of the body to changing environmental conditions.

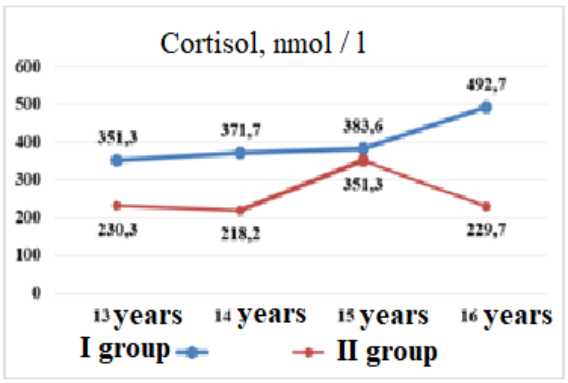
Table 4. Indicators of the hormonal profile in adolescent girls

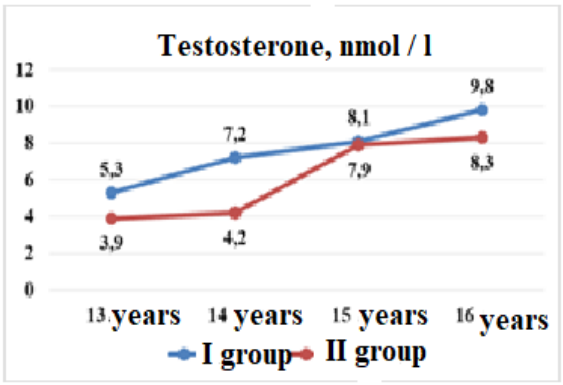
Groups	Cortisol, nmol / l		Estradiol, pg / ml		Progesterone, nmol / l	
	FP	LP	FP	LP	FP	LP
III группа (n=115)	334,1±48,0	287,6±39,6	15,8±1,5	33,1±3,5	1,2±0,1	8,6±1,8
IV группа (n=41)	320,3±29,9	265,8±30,3	17,5±2,0	35,2±3,2	1,5±0,1	10,3±4,9
R	r=0,614	r=0,312	r=0,501	r=0,605	r=1,143	r=0,704

Note: p - reliability of differences in results among adolescent girls of III and IV groups; Group III - urban teenage girls; Group IV - rural teenage girls; FF - folliculin phase (7-8 days of the OMC); LF - luteal phase (21-22 days of CMC).

For adolescence, heterochronism of development is characteristic, associated with morphological and functional characteristics at each age stage. Weight-and-height indicators in the groups of boys throughout puberty, with the exception of the age of 15, were higher in urban ones. At the same time, the rates of annual growth had “peaks” of development. The greatest increase was noted in urban boys at the age of 14 and 16, and in rural boys at 14, 15 and 16 years. Similar dynamics persisted in sexual development.

Among girls, high morphometric values at the age of 12 and 13 were observed in urban girls, at 14 years - in rural girls. At the age of 15, rural girls showed a tendency to asthenization. “Peaks” of development were observed at the age of 13, 15 years for urban girls and 13,14,15 years for rural girls. Sexual development indicators in all periods were higher in urban girls. In the period of 13-15 years, there were “peaks” in the development of secondary sexual characteristics in both groups of girls.





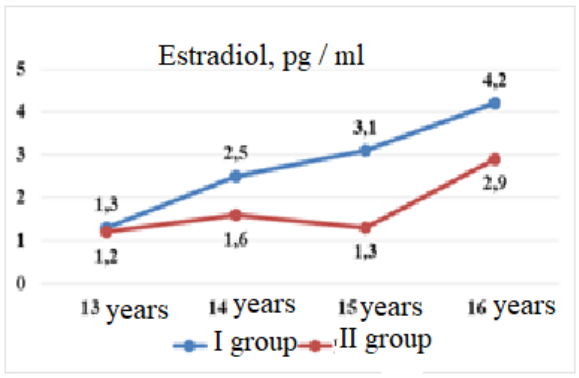
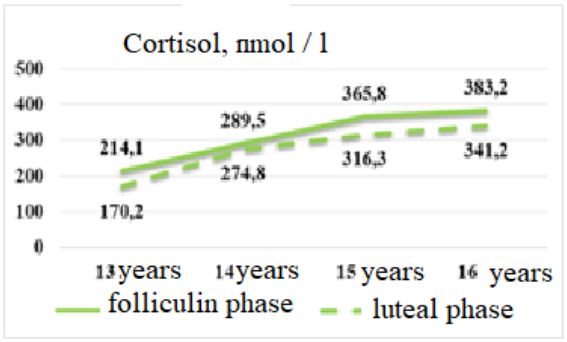


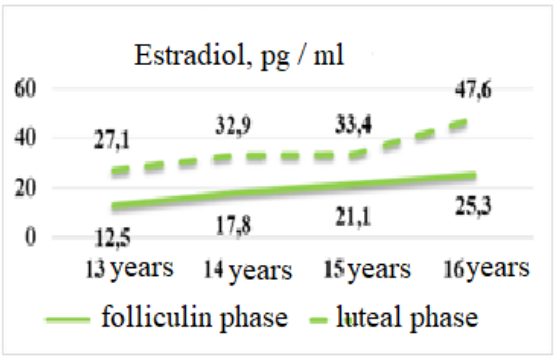
Figure 3. Age characteristics of cortisol (A), testosterone (B) and estradiol (C) levels among adolescent boys

Analysis of the age-related dynamics of hormone secretion illustrates the "peak" activity of the adrenal cortex and gonads at the age of 14, 16 years in urban boys and 15, 16 years in rural boys (Figure 3).

In the group of urban girls, the concentration of cortisol in both phases of the CMC was higher in comparison with rural girls. It should be noted that, in general, the values of this hormone in urban schoolgirls were quite high in the luteal phase (LF) (287.6 ± 39.6 nmol / l).

The study of the level of estradiol revealed its high values in the follicular phase (FF) of the CMC in general in girls of rural nationality (17.5 ± 2.5 pg / ml). This trend continued with the onset of LF, when there was a natural increase in the secretion of this hormone (35.2 ± 3.2 pg / ml). In addition, rural girls were found to have high serum progesterone levels throughout the CMC.





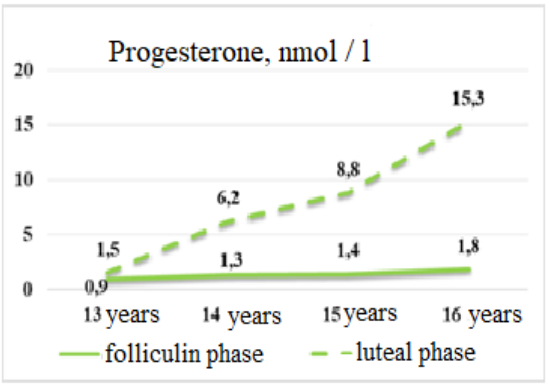
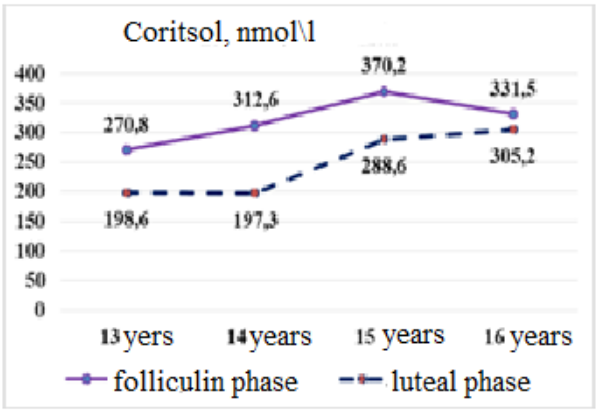
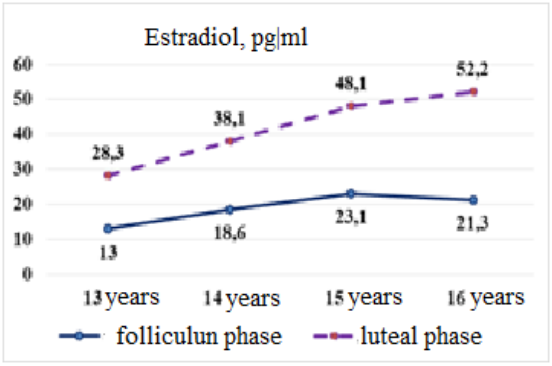


Figure 4. Age characteristics of cortisol, estradiol and progesterone levels among urban adolescent girls





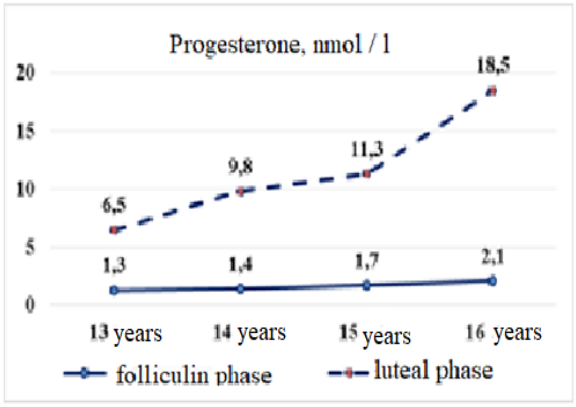


Figure 5. Age characteristics of cortisol, estradiol and progesterone levels among rural adolescent girls.

The obtained levels of hormones in the age groups of girls indicate a "peak" increase in the secretion of steroid hormones at the age of 13 and 14 years for cortisol in both groups of girls, 13 and 15 years for sex hormones in urban girls and 13, 14, 15 years in rural girls (Fig. 4.5).

Thus, a comparative analysis using the anthropometric method made it possible to establish a high level of physical development in urban adolescents of both sexes relative to rural adolescents living in Uzbekistan. Taking into account the type of constitution, the prevailing asthenization was revealed among adolescent boys living in urban conditions (56.8%) and also among urban girls (54.3%). Rural boys were characterized by a dominant normosthenic somatotype (52.3%). The least represented somatotype among adolescents in Uzbekistan was the hypersthenic type, with the highest occurrence among rural boys (11.4%).

On the basis of the obtained results of the sexual formula, the harmonious development of secondary sexual characteristics in rural girls ($Ma_{3,16}Ax_{3,13}P_{3,21}Me_{2,13}$) was established in comparison with urban ($Ma_{2,18}Ax_{2,07}P_{2,16}Me_{2,09}$), with an acceleration of rates in urban girls. The sexual formula of boys was characterized by a mismatch in the rates of development of sexual characteristics: urban boys ($V_{1,47}P_{3,09}L_{1,38}Ax_{2,98}F_{0,85}$) showed accelerated development of thyroid cartilage and voice mutations, while rural boys ($V_{1,38}P_{3,13}L_{1,13}Ax_{3}F_{0,94}$)–pronounced hair growth. Menarche in girls of Uzbekistan manifested itself at the age of 12.68 ± 0.11 years in urban girls and 12.57 ± 0.08 years in rural girls when the weight reached 44 kg (body mass index 16 kg / m2).

The functional capabilities of the cardiorespiratory system of adolescents' body, taking into account the data of the Skibinskaya, Rufier indices and the Stange test, were expressed in satisfactory adaptation in rural adolescents of both sexes and in urban girls, in rural boys - in high adaptive capabilities relative to other groups of adolescents.

The established values of the studied hormones were within the age norm, reflecting the features of neuroendocrine regulation mechanisms. Higher concentration of cortisol in blood serum in general in urban boys (377.8 ± 34.2 nmol / L) and girls (334.1 ± 48.8 nmol / L in the follicular and 287.6 ± 39.6 luteal phases) relative to their rural peers illustrates the tension of adaptation mechanisms. The average values of sex steroids were higher in urban boys (testosterone - 7.4 ± 1.6 nmol / L; estradiol - 2.1 ± 1.4 pg / ml) and rural girls (estradiol - 17.5 ± 2.5 pg / ml and 35.2 ± 3.2 pg / ml; progesterone - 1.5 ± 0.4 nmol / L and 10.3 ± 4.9 nmol / L in the follicular and luteal phases, respectively), which affects the characteristics of the genital adolescent development.

The general patterns of physical, sexual development, as well as the level of hormone secretion were characterized by age "peaks", indicating a high individualization of the adolescent organism. In the group of urban boys, the "peaks" of development corresponded to the ages of 14 and 16 years, in rural boys - to ages 14, 15, 16 years, in urban girls - 13, 15 years, in rural girls - 13, 14, 15 years.

Conclusion

The obtained modern generalizing data on the distribution of the sexual formula of urban and rural adolescents in Uzbekistan can be used for a comprehensive assessment of the state of health during preventive examinations.

For the effective operation of reproductive health centers during preventive examinations and treatment of adolescents from different geographical regions of the Republic, specialists need to take into account the peculiarities of morphological and functional indicators and the level of sex hormones.

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