



CHARACTERISTICS OF GIRLS' PUBERTAL MATURATION PATTERNS IN UZBEKISTAN AND KARAKALPAKSTAN

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Abstract

Background. Environmental conditions are a major contributor to pubertal maturation indicators in child population, particularly in girls.

Object: identifying pubertal maturation characteristics of girls living in different cities of the republic.

Materials and methods. A total of 1284 girls aged between 7 and 17 years living in territory of Tashkent city, the Republic of Karakalpakstan and 4 regional cities of the Uzbekistan (Samarkand, Syrdarya, Kashkadarya and Khiva) were studied. The initial, middle and final periods of secondary pubertal patterns development as well as menstrual function were determined.

Results and discussion. Girls in Karakalpakstan are on average 8-14 months behind their peers in regional cities and Tashkent in the main characteristics of pubic and axillary hair development, while they are 2-16 months ahead in mammary gland development. Compared to girls in Tashkent and other provincial cities of the republic, girls in Karakalpakstan have a longer period of puberty.

Conclusion. Delayed puberty in girls is caused by adverse environmental factors in Karakalpakstan.

Keywords: girls, pubertal maturation, secondary pubertal characteristics, environmental factors, Karakalpakstan

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Highlights

- Children's health, especially changes in the rate at which children reach puberty, is the most sensitive indicator of the impact of environmental factors.
- A total of 1284 girls aged between 7 and 17 years living in the territory of the city of Tashkent, the Republic of Karakalpakstan and 4 regional cities of Uzbekistan (Samarkand, Syrdarya, Kashkadarya and Khiva) were identified as having periods of pubertal maturation.
- Girls in Karakalpakstan have a longer period of puberty.
- Delayed puberty in girls is caused by adverse environmental factors in Karakalpakstan.

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Introduction.

The problem of the protection of children's reproductive health is a priority in the fulfilment of the tasks set by the Government of the Republic in order to ensure the upbringing of a harmoniously developed generation. In the system of health monitoring, timely treatment and preventive measures aimed at preventing reproductive disorders, systematic monitoring of puberty in girls is the most important task.

Reproductive health of the younger generation, especially changes in the rate of pubertal maturation in children, is the most sensitive indicator of environmental factors influence that determine the well-being of the population (Baranov A.A., Shcheplyagina L.A., 2006).

The health status of the population of Karakalpakstan, especially children, faces a complex of unfavourable exogenous factors. The Aral Sea region is the most environmentally vulnerable (Esimbetov A.T., Ametov Y.I., Allamuratov K.K., 2018). Thus, among the child population of Karakalpakstan, the greatest increase has been noted in morbidity, underweight, growth retardation and puberty (Kenzhebaev A.Y., 2001; Mazhitova Z., 2001; Nazarov Ch.M., 2001; Rakhmanov A., 2001).

There are different methods to assess puberty in children, but there is a common

approach, such as in the study of puberty in girls, the main signs of pubic hair formation (P) and axillary hair formation (Ax), the growth of mammary glands (Ma - mammillary), the occurrence of regulars (Me - menarhe) and additionally assess the nature of menstrual function (Guarneri A.M., Kamboj M.K., 2019).

In the study of the pubertal maturation of the growing organism a lot of attention has been paid to the determination of the time of the beginning of puberty, to the determination of the middleage of the appearance of secondary pubertal characteristics, which do not develop simultaneously in children. Great importance is attached to the time when secondary pubertal characteristics final appearing and the time when adolescent puberty ends (Ananyeva N.A., Bondarenko N.M., Veremkovich L.V., 1993).

According to the generally accepted view, the age at which at least 5, 50 and 95 per cent of the children examined have one or another stage of maturation of secondary pubertal characteristics, respectively, should be considered as the initial, middle and final periods of puberty. The age at which at least 95 per cent of the examined children have a high degree of secondary pubertal characteristics (completion) should be considered as the age at which at least 95 per cent of them have a high degree of secondary pubertal characteristics (Kamilova R.T., 1996; Kamilova R.T., Abdusamatova B.E., Salikhova N.S., Isakova L.I., Kasimova R.A., Basharova L.M., 2015).

In this regard, research to study the biological and morphofunctional maturity of the child population, especially females living in environmentallyunfavorable conditions, is particularly relevant.

The main part.

A comparative characterization of the indicators of pubertal maturation of girls living in different cities of the Republic was the **main objective of the study.**

Materials and methods. Research Methods. A total of 1284 girls aged 7-17 years were studied. They lived in Tashkent city, Karakalpakstan, Samarkand, Syrdarya, Kashkadarya and Khorezm provinces of the republic. The initial, middle and final periods development of secondary pubertal characteristics and characteristics of menstrual function were

determined. The study results were statistically processed using Excel-2016. Comparison of means was performed using Student's t-criterion. Differences were considered reliable ($p \leq 0.05$) when $t \geq 1.97$.

Results and discussion. When comparing the pubertal stages of girls, it was found that the maturation of the mammary gland begins 1 year and 3 months earlier in Karakalpak girls than in Uzbek girls ($Ma_1 - 7.1\%$ at the age of 8). In the girls of the comparison groups living in different cities of Uzbekistan and Karakalpakstan, a gradual levelling of the formation of this trait begins at the age of 12, and the mature stages of mammary gland development (Ma_{3-4}) were reached by almost 100% of girls at the age of 17, i.e. the final development of the mammary glands terminates equally in Uzbek and Karakalpak girls.

Signs of hair formation in the axillae and on the pubis of girls in Nukus are noticeably lagging behind and lower stages are observed in almost all age groups. The definitive stage of pubic hair growth (P_3) in Tashkent girls reached 99 per cent by age 17, in other cities of Uzbekistan - 96.2 per cent, while in Karakalpak girls - 56.9 per cent. In the 17-year-old age group, girls in Nukus had 24.8 per cent of hair in the axillae (Ax_3), compared to 90.5 per cent for Uzbek girls.

The comparative analysis showed that the age (initial, middle and final) of menstruation was practically the same for girls living in Tashkent, regional cities and Nukus (the difference was 1-3 months). The age at which the girls surveyed begun menstruating was 11 years and 4 months. The middle age of beginning of menarche among the survey girls is 13 years and 3 months (the difference is 1-5 months). The average age of final of puberty was 15 years and 8 months (difference - 1-2 months). The number of menstruating girls was higher in Tashkent between the ages of 11 and 14 than in Nukus and the regional towns. However, the difference becomes smaller by the age of 15, and by 16-17 age 100% of girls in the compared towns had menstruated.

The most common forms of menstrual disorders in girls were heavy (15.2 per cent) and prolonged (12.3 per cent) bleeding, irregularity of rhythm (10 per cent) and severe pain (9.1 per cent), which were more pronounced in Karakalpak girls.

The table shows the normative values for the initial, middle and final age of puberty in girls, as well as the final timing of puberty, i.e. the presence of high levels of development of secondary pubertal characteristics and the presence of menarche.

Table
Periods of development of the secondary pubertal characteristics of girls at different ages in different towns and cities

Patterns	Tashkent city	Regional towns of Uzbekistan	Nukus city
age at which secondary pubertal characteristics begin to appear			
P	9 years 7 month	9 years 10 month	10 years 7 month
Ax	10 years 1 month	10 years 3 month	11 years 1 month
Ma	8 years 11 month	9 years 1 month	7 years 9 month
Me	11 years 2 month	11 years 5 month	11 years 4 month
middle age at which secondary pubertal characteristics appear			
P	11 years 6 month	11 years 10 month	12 years 6 month



Ax	11 years 11 month	12 years 3 month	13 years
Ma	10 years 9 month	10 years 9 month	10 years 5 month
Me	13 years 2 month	13 years 7 month	13 years 3 month
age at which secondary pubertal characteristics finally appear			
P	13 years 3 month	14 years 1 month	14 years 5 month
Ax	14 years	15 years	14 years 11 month
Ma	12 years 10 month	13 years	12 years 11 month
age at which secondary pubertal characteristics become advanced and menarche occurs			
P ₃	15 years 8 month	16 years	unfinished
AX ₃	unfinished	unfinished	unfinished
Ma ₃₋₄	15 years 10 month	15 years 11 month	16 years 9 month
Me	15 years 7 month	15 years 9 month	15 years 7 month

The obtained data confirm the theory of Western scientists about the influence not only of endogenous factors, such as genetics, body mass index, the level of mental and physical development of the child, the mother's state of health, but also of exogenous factors of the external and ambient conditions, in particular, ecologically harmful living conditions, inadequate intake of nutrients and vitamins with food, and so on. Children who live in environmentally stressful and unfavorable conditions have delayed pubertal maturation and prolonged formation of secondary puberty signs (Christensen K.Y., Maisonet M., et al., 2010; Dinh T., Haselton M.G., Gangestad S.W., 2022; Krasniqi E., 2024; Litovchenko O.G., Vinokurova I.V.G.G., Vinokurova I.V., 2008; Mi Ra Kim, Mo Kyung Jung, Eun-GyongYoo, 2023; Mouritsen A., Damm J., Aksglaede L., Sørensen K., Juul A., 2010; Pham H.T., DiLalla L.F. et al., 2022; Richardson G.B., Bates D., 2024; Rowe D.C., 2000; Safari F., Rostamian M. et al., 2012; Yun Liu, 2017).

Conclusion. The girls from Nukus city were on average 8-14 months behind their counterparts from regional towns and Tashkent city in terms of initial, middle and final periods of completion

of pubic and axillary hair formation. Whereas in terms of mammary gland development, the initial, middle and final periods are determined 2-16 months earlier. There was no difference between Karakalpak and Uzbek girls at menarche.

This suggests that their puberty is not complete due to the unfavorable environmental factors specific to Karakalpakstan, as the number of girls in Nukus who reached a high degree of pubic and axillary hair development by the age of 17 was less than 95 per cent.

A pediatric endocrinologist and a gynecologist were consulted for girls with accelerated or delayed development of secondary pubertal characteristics and menstrual irregularities. It is recommended that annual check-ups for girls be carried out with the involvement of pediatric gynecologists and endocrinologists to ensure reproductive health in the future.

Compliance with ethical standards. The study approved by the Local Ethical Council of the Research Institute of Sanitation, Hygiene and Occupational Diseases (Protocol of ethical review №7 from 15.07.2024). Before the beginning of the research, explanatory work

about the purpose and methods of the research conducted, then a voluntary written consent obtained from each parents (legal representatives).

Author contributions. All authors contributed substantially to the research and analysis and to the preparation of the article, and read and approved the final version before publication.

Conflict of interests. Authors declare that there are no obvious and potential conflicts of interest related to the publication of this article.

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