THE IMPACT OF VITAMIN D DEFICIENCY ON THE REPRODUCTIVE HEALTH OF ADOLESCENT GIRLS IN THE REPUBLIC OF KARAKALPAKSTAN

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Introduction: Vitamin D plays an essential physiological role in the regulation of reproductive function, acting through specific vitamin D receptors (VDR) expressed in the hypothalamus, pituitary gland, ovaries, and endometrium. During puberty, adequate vitamin D status supports ovarian steroidogenesis, folliculogenesis, anti-Müllerian hormone regulation, and the timely establishment of the hypothalamic-pituitary-ovarian axis. Adolescent girls residing in the Republic of Karakalpakstan represent a particularly vulnerable population due to the complex environmental conditions of the Aral Sea region, micronutrient deficiencies in the daily diet, and seasonal variations in ultraviolet insolation. Hypovitaminosis D during adolescence can disrupt menarche timing, contribute to menstrual cycle irregularities and primary dysmenorrhea, and adversely affect future fertility. Therefore, early assessment of vitamin D status and reproductive health indicators in adolescent girls is a key priority in preventive pediatric gynecology and endocrinology.

Keywords: vitamin D, vitamin D deficiency, reproductive health, adolescent girls, Republic of Karakalpakstan, menstrual cycle disorders, dysmenorrhea, 25-hydroxyvitamin D, prevention, pediatric gynecology.

Objective: To investigate the impact of vitamin D deficiency on the reproductive health of adolescent girls in the Republic of Karakalpakstan, determine the prevalence and clinical structure of menstrual cycle disorders depending on serum 25-hydroxyvitamin D [25(OH)D] levels, and substantiate preventive strategies for the timely correction of hypovitaminosis D.

Materials and Methods: The study model included 100 adolescent girls aged 14 to 18 years residing in the Republic of Karakalpakstan, divided into two groups according to their vitamin D status. The main (study) group comprised 50 adolescent girls with laboratory-confirmed vitamin D deficiency or insufficiency, whereas the control group included 50 girls with sufficient vitamin D levels. Vitamin D status was evaluated by measuring serum 25-hydroxyvitamin D [25(OH)D] concentrations in accordance with Endocrine Society clinical guidelines (deficiency <20 ng/mL, insufficiency 20–29 ng/mL, sufficiency ≥30 ng/mL). Clinical examination encompassed collection of somatic and gynecological history, assessment of physical and sexual development (Tanner staging), age at menarche, menstrual cycle regularity, bleeding duration and volume, presence of primary dysmenorrhea, and pelvic ultrasound findings. Additionally, dietary habits, outdoor sunlight exposure, and prophylactic vitamin D supplementation were analyzed. The obtained data were processed in absolute values and percentages.

Results: According to the model data, menstrual cycle disorders were identified in 58% of adolescent girls in the main group (29 out of 50), compared to 24% in the control group (12 out of 50). Thus, the prevalence of menstrual dysfunction among girls with low vitamin D levels was 34 percentage points higher. Within the structure of menstrual disturbances in the main group, oligomenorrhea was observed in 26% of girls (13 cases), primary dysmenorrhea in 22% (11 cases), irregular menstrual cycles of the opsomenorrhea and polymenorrhea types in 16% (8 cases), and delayed menarche in 10% (5 cases), with a proportion of patients exhibiting combined clinical manifestations.

The mean serum 25(OH)D concentration in the main group was 14.6 ± 3.8 ng/mL, with severe deficiency (<10 ng/mL) recorded in 24% of examined adolescents, whereas in the control group the mean

level reached 34.2 ± 4.5 ng/mL. Pelvic ultrasound assessment revealed functional ovarian and endometrial alterations—most notably multifollicular ovarian structure and delayed endometrial thickness relative to cycle phase—in 30% of girls in the main group (15 out of 50) versus 10% in the control group (5 out of 50). Moreover, adolescents with pronounced vitamin D deficiency experienced higher menstrual pain intensity and more frequent manifestations of premenstrual syndrome.

Analysis of anamnestic and nutritional data showed that insufficient dietary intake of foods rich in vitamin D and calcium (dairy products, fish, eggs) occurred in 66% of girls in the main group, limited outdoor physical activity in 54%, and absence of preventive cholecalciferol intake in 78%. The obtained model findings indicate a substantial association between hypovitaminosis D and impaired reproductive system maturation in adolescent girls living in the Republic of Karakalpakstan. At the same time, menstrual disorders are multifactorial in origin and are also influenced by regional ecological factors, iron and iodine status, and psycho-emotional stress.

Conclusions: Vitamin D deficiency represents a significant modifiable risk factor negatively affecting the establishment of menstrual function and reproductive health in adolescent girls in the Republic of Karakalpakstan. The model results demonstrate a markedly higher frequency of oligomenorrhea, primary dysmenorrhea, and functional ovarian changes among adolescents with reduced serum 25(OH)D levels compared to their vitamin D-sufficient peers. Timely laboratory screening of 25(OH)D in adolescent girls with menstrual irregularities, balanced nutrition, adequate sunlight exposure, and individualized correction of vitamin D deficiency under medical supervision are essential components of preventive healthcare. Strengthening interdisciplinary cooperation among pediatricians, adolescent gynecologists, endocrinologists, and parents will help preserve the reproductive potential of young girls in the region.

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