

Endocrine Disorders in Adolescent and Young Female Athletes: Impact on Growth and Menstrual Cycles

Yaseen Haq*

Department of General Surgery, Rawalpindi Medical University, Rawalpindi, Pakistan

Description

Delayed puberty is when a person lacks or has incomplete development of specific sexual characteristics past the usual age of onset of puberty. The person may have no physical or hormonal signs that puberty has begun. In the United States, girls are considered to have delayed puberty if they lack breast development by age 13 or have not started menstruating by age 16. Boys are considered to have delayed puberty if they lack enlargement of the testicles by age 14. Delayed puberty affects about 2% of adolescents.

Most commonly, puberty may be delayed for several years and still occur normally, in which case it is considered constitutional delay of growth and puberty, a common variation of healthy physical development. Delay of puberty may also occur due to various causes such as malnutrition, various systemic diseases, or defects of the reproductive system (hypogonadism) or the body's responsiveness to sex hormones.

Initial workup for delayed puberty not due to a chronic condition involves measuring serum FSH, LH, testosterone/estradiol, as well as bone age radiography. If it becomes clear that there is a permanent defect of the reproductive system, treatment usually involves replacement of the appropriate hormones (testosterone/dihydrotestosterone for boys, estradiol and progesterone for girls). Puberty is considered delayed when the child has not begun puberty when two standard deviations or about 95% of children from similar backgrounds have.

In North American girls, puberty is considered delayed when breast development has not begun by age 13, when they have not started menstruating by age 16, and when there is no increased growth rate. Furthermore, slowed progression through the Tanner scale or lack of menarche within 3 years of breast development may also be considered delayed puberty. In the United States, the age of onset of puberty in girls depends heavily on their racial background. Delayed puberty means the lack of breast development by age 12.8 years for White girls, and by age 12.4 years for Black girls. The lack of menstruation by age 15 in any ethnic background is considered delayed.

In North American boys, puberty is considered delayed when the testes remain less than 2.5 cm in diameter or less than 4 mL in volume by the age of 14. Delayed puberty is more common in males. Although absence of pubic and axillary hair is common in children with delayed puberty, the presence of sexual hair is due to adrenal sex hormone secretion unrelated to the sex hormones produced by the ovaries or testes.

The age of onset of puberty is dependent on genetics, general health, socioeconomic status, and environmental exposures. Children residing closer to the equator, at lower altitudes, in cities and other urban areas generally begin the process of puberty earlier than their counterparts. Mildly obese to morbidly obese children are also more likely to begin puberty earlier than children of normal weight. Variation in genes related to obesity such as FTO

or NEGR1 have been associated with earlier onset of puberty. Children whose parents started puberty at an earlier age were also more likely to experience it themselves, especially in women where onset of menstruation correlated well between mothers and daughters and between sisters.

Childhood cancer survivors can also present with delayed puberty secondary to their cancer treatments, especially males. The type of treatment, amount of exposure/dosage of drugs, and age during treatment determine the level by which the gonads are affected with younger patients at a lower risk of negative reproductive effects.

Excessive physical exercise and physical stress, especially in athletes can also delay pubertal onset. Eating disorders such as bulimia nervosa and anorexia nervosa can also impair puberty due to under nutrition. A carbohydrate-restricted diet for weight loss has also been shown to decrease the stimulation of insulin which in turn does not stimulate kisspeptin neurons vital in the release of puberty-starting hormones. This shows that carbohydrate restricted children and children with diabetes mellitus type 1 can have delayed puberty.

If a child is healthy with a constitutional delay of growth and puberty, reassurance and prediction based on the bone age can be provided. No other intervention is usually necessary, but repeat evaluation by measuring serum testosterone or estrogen is recommended. Furthermore, the diagnosis of hypogonadism can be excluded once the adolescent has started puberty by age 16-18 [1-4].

Conclusion

Boys aged >14 years old whose growth is severely stunted or are experiencing severe distress secondary to their lack of puberty can be started on testosterone to increase their height. Testosterone treatment can also be used to stimulate sexual development, but it can close bone plates prematurely stopping growth altogether if not carefully administered. Another therapeutic option is the use of aromatase inhibitors to inhibit the conversion of androgens to estrogens as estrogens are responsible for stopping bone growth plate development and thus growth. However, due to side effects, therapy with testosterone alone is most often used. Overall, neither growth hormone nor aromatase inhibitors are recommended for constitutional delay to increase growth. Girls can be started on estrogen with the same goals as their male counterparts. Overall, studies have shown no significant difference in final adult height between adolescents treated with sex steroids and those who were only observed with no treatment.

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*Address for Correspondence: Yaseen Haq, Department of General Surgery, Rawalpindi Medical University, Rawalpindi, Pakistan, E-mail: Yaseenh@gmail.pk

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