

Appearance of Menarche in Actively Training and Non-training Girls

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The article summarizes the data about the important role of sport on the sexual maturity in girls. The survey encompasses totally 481, 11-17 years old girls. The active training girls are 326. Non-training girls (155) at the same age (controls), 73 with obesity have been studied, too. Their sexual maturity, the appearance of menarche and the interdependence of these from the level of the fat tissue is examined. No acceleration has been found in their sexual maturity and in the appearance of menarche. The menarche in the actively training girls delays from 2 months up to 3 years in comparison with the non-training ones. Depending on the appearance of menarche, the authors offer the following classification of the girls: Non-training girls with normal body weight — menarche at 12 years and 3 months (12, 3); Non-training girls with overweight and obesity — menarche at 12 years and 1 months (12,1); Actively training girls: Sports Shooting and Volleyball — menarche at 12 years and 10 months (12,8); Basketball — menarche at 13 years and 1 month (13, 1); Feld athletics — menarche at 13 years and 3 months (13,3); Rowing and swimming — menarche at 13 years and 10 months (13,8); Sports gymnastics — menarche at 15 years and 8 months (15,7).

A scheme of the hormonal and enzyme mechanisms, explaining the puberty development and the menarche in the girls, is suggested and their dependence from the level of the fat tissue is proven.

Key words: menarche, actively training and non-training girls.

Introduction

The intensive physical exercises exert a versatile impact on young girl's organism. Her adaptation to big physical efforts is connected with series of changes in her organs and systems and it is an object for study in age physiology, sport medicine and other sciences.

The aim of the present study is to determine relationship between systematically physical loadings and the appearance of menarche in actively training girls.

Materials and Methods

The survey encompasses totally 481, 11-17 years old girls (Table 1). The active training girls are 326. Non-training girls (155) at the same age (controls), 73 with obesity have been studied, too. The appearance of menarche was specified by inquiry.

The per cent of the fat mass was measured with body fat monitor "Tanita". Comparisons between the different girls-group were made by Student's t-test ($p < 0.05$).

Results and Discussion

In the present study, we paid attention especially to the appearance of menarche in young sportswomen because this indicator is considered the most objective in the evaluation of sex development in females. The results for the time of appearance of the first menstruation in sportswomen actively training different sports are presented in Table 1. No significant difference between these groups (for the appearance of menarche) was observed (the per cent of body fat mass was from 11 to 23 for different sports).

The appearance of menarche in the actively training girls in comparison with the non-training ones with normal body weight shows that the first menstruation in young sportswomen in various sports shows a delay. The delay is 2-5 months in Marksmanship, Volleyball and Basketball, 7-10 months in Track-and-field athletics and almost a year in Rowing, and Swimming. The delay of menarche appearance (three years) is established in Sport gymnastics and we suppose that other yet uninvestigated by us sports will be added to this group. In order to describe the influence of sport on sex development and appearance of menarche we should know their features in non-training girls where the differences in the biological development are of utmost importance.

Table 1. Age of menarche in actively training girls and non-training girls depending on their body weight

No	n	Groups	Menarche
1	73	Control group with obesity	12.1
2	82	Control group with normal body weight	12.3
3	34	Sport Shooting	12.8
4	48	Volleyball	12.8
5	57	Basketball	13.1
6	69	Field and track events	13.3
7	39	Rowing	13.8
8	46	Swimming	13.8
9	33	Sport gymnastics	15.7

It is difficult to explain the arrangement of the sports groups in the table. Perhaps, together with the per cent of the fat mass in the girls for the appearance of menarche is important also the total body mass, and another factors, connected with kind of physical activity, nutrition and specific characteristics of the concrete sport.

Stanimirova (1998) determined that in Bulgaria menarche appears at the mean age of 12.7 years, body weight 47.7 kg and fat weight 12.22 kg (25.5%), in case of obesity — at the age of 12.1 years, body weight 57.2 kg and fat weight 18.4 kg (32.1%). In case of emaciation, it appears at the age of 13.3 years, body weight 40.6 kg and fat weight 7.3 kg (18%). These data coincide with those of foreign authors who establish that the critical body weight for appearance of menarche is about 47 kg [5]. This body weight supposes the presence of the critical fat weight, which is a precondition for a normal metabolism of female sex hormones to take place [13]. This necessity explains the early appearance of menarche in girls with obesity and its delay in girls with emaciation [10, 11 and 12].

The lower level of fat weight is a factor for the delay of appearance of menarche in actively training girls with advanced biological development independently from their high stature and enough body weight. Our studies showed that the fat weight of actively training girls seldom exceeds 20 % with a mean value of 11-17 % [10].

The comparison shows that these per centages are even lower than the critical 18 % for appearance of menarche in the group of the girls with emaciation [10 and 11]. The low per cent of fat weight in the actively training girls is due to increased energy consumption. The trained muscles show a higher activity of the enzymes lipoprotein lipase, muscle lipase and creatine-acyltransferase, which lead to an easy metabolism of fatty acids [3]. Besides, the physical exercises and systematic trainings make β -adrenergic receptors more sensitive, thus increasing the lipolysis in the adipocyte [6 and 7] (Fig. 1). All these mechanisms are in the base of better use of fats by actively training girls and are the reason for the low percent of their fat weight [8].

When a girl's organism reaches the critical adipose depot, the adipocytes already synthesize enough quantity of the hormone leptin. It is the necessary signal for the brain (hypothalamus) to produce the first quantities of the gonadotropin-releasing hormone (GnRH) [9]. GnRH stimulates the anterior part of the pituitary gland to secrete the gonadotropic hormones: the follicle-stimulating hormone (FSH) and the luteinizing hormone (LH). The cells of theca interne in the ovaries possess many receptors for LH. LH increases cAMP and accelerates the conversion of cholesterol into androstendion. The enzyme aromatase catalyzes the conversion of androstendion into estrone as well as that of testosterone into 17 — β -estriol [1]. The granulosa cells in the ovaries have receptors for FSH. The latter increases cAMP, which stimulates estradiol secretion there due to aromatase activity increase. The granulosa cells have receptors for LH, which stimulates estradiol secretion, too. Estradiol and the other estrogenic hormones (estrone and estriol) switch on the menstrual cycle with the appearance of the first menstruation and at the same time increase the density of the 6-2-receptors in the adipocytes. This is a precondition for an intensive lipogenesis and a local accumulation of fatness in the region of the "woman's pool" in girls [1 and 14].

B r a y [2] and D u c l o s [4] showed that the leptin level decreases after physical training and it is this hormone from the periphery, which modulates estrogen expression and serves as a signal from adipocytes to the brain [2 and 4].

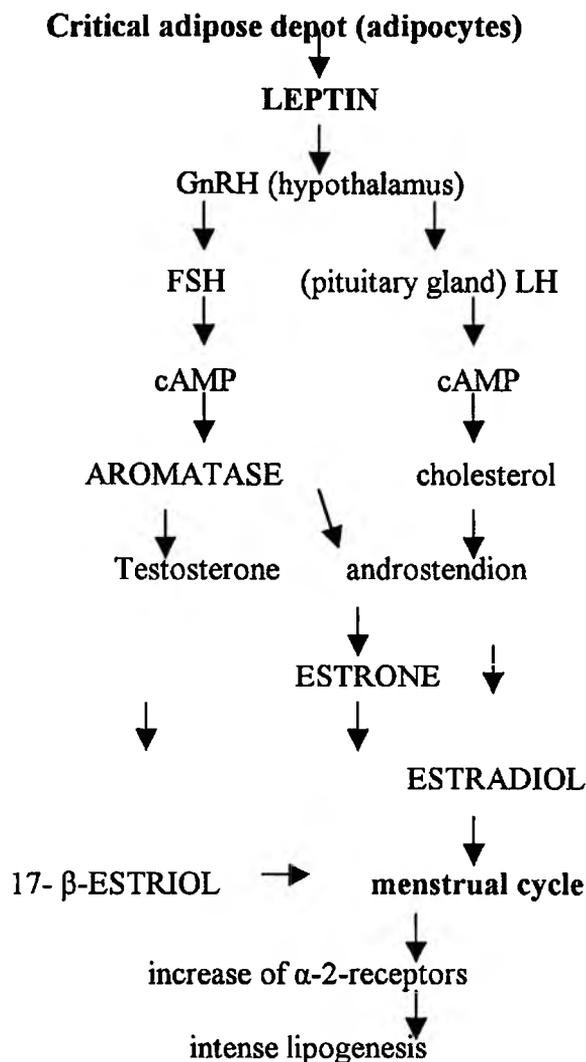


Fig. 1. Hormonal and enzyme mechanisms related to puberty development and menarche appearance in girls.

F r i s c h [5] noticed the dependence of estrogen activity from adipose tissue 20 years before the discovery of leptin.

Clinical practice constantly proves the dependence of the menstrual cycle on the level of the peripheral adipose tissue. The excessive loss of weight due to different factors, which include intensive physical training and hypo energy diets, is a frequent reason for disturbances in normal menstrual cycle.

In our practice, we have encountered similar cases with sportswomen who were on a strict diet in order to maintain low body weight. We would like to share one case. The acrobat A. M. (a peak in a pyramid) at the age of 17 and body weight of 33-34 kg and stature 141 cm had not yet received menarche. At the preparation for the next competition, she got a tetanic convulsion and was transported to the

Endocrinology clinic by emergency. The tests showed serious disturbances of the ionic and hormonal balance. Due to the timely infusions and appropriate feeding, she recovered very fast and after increasing her body weight to 41 kg, she received menarche. Later she resumed her sport but with another part in the pyramid, which allowed her a higher body weight and thus she went on competing for a long time. We think that this particular case proves once more the significance of body and fat weight for insuring a normal metabolism of female sex hormones and normal homeostasis of the organism as a whole.

Conclusion

The systematic physical training exerts a serious impact on the organism of sports-women. It influences their puberty development and especially the appearance of menarche by delaying it. These processes in young girl's organism depend directly upon the levels of their fat weight, which as a rule is lower for actively training girls. These girls reach later the critical level of fat weight, which switches on female sex hormone metabolism thus causing a delaying menarche. The decrease of fat weight under defined levels can cause hormonal and metabolic disturbances even in cases of normal menstrual cycle. The trainers and sport doctors should not ignore this fact but should try to combine it with the ever lasting striving for new sport attainments.

References

1. Arner, P. Adrenergic receptor function in fat cells. — *Amer. J. Clin. Nutr.*, 55, 1992, 228-236.
2. Bray, G. Leptin and leptinomania. — *Lancet*, 348, 1996, No 1, 140.
3. Brouns, Fr., Ger J. van der Vusse. Utilization of lipids during exercise in human subjects: metabolic and dietary constraints. — *Brit. J. of Nutrition*, 79, 1998, 117-128.
4. Duclos, M. Rapid Leptin decrease in immediate post exercise recovery. — *Clin. Endocr.*, 50, 1999, No 3, 337-342.
5. Frisch, R. E. Delayed menorrhoea and amenorrhoea in ballet dancers. — *N. Engl. J. Med.*, 1980, 303, 17-19.
6. Saltin, B., P. O. Astrand. Free fatty acid and exercise. — *Amer. J. of Clinical Nutrition*, 57, 1993, 752-758.
7. Wahenberg, H., P. Engfeldt, J. Bolinder, P. Arner. Acute adaptation in adrenergic control of lipolysis during physical exercise in humans. — *Amer. J. of Physiology*, 253, 1987, 383-390.
8. Wendling, P. S., S. J. Peters, G. F. Heigenhauser, L. L. Spriet. Epinephrine infusion does not enhance net muscle glycogenolysis during prolonged aerobic exercise. — *Canadian J. Appl. Physiology*, 21, 1996, 271-284.
9. Бонева, Ж., Д. Николовска, П. Йовчевски. Лептинът — отправни точки, Ендокринни заболявания, 28, 1999, № 4, 8-14.
10. Савов, Сл., Ив. Топузов, Ив. Наков. Особенности в половото съзряване при момичета, активно-занимаващи се със спорт. — В: Научно-практ. конференция на НДСМЛФК (Ловеч), 13-15 октомври 1989 г. Сборник резюмета, с. 56.
11. Станимирова, Н., Ив. Топузов, Ч. Петрова. Сравнително проучване на затлъстяването в детско-юношеската възраст в Плевен, 1973-1988. IV симпозиум по затлъстяване. Варна, 13-15.V. 1988. Сборник резюмета, с. 39.
12. Станимирова, Н. Растеж и пубертетно развитие — норми и физиологични отклонения. Дисерт. труд (Плевен, 1998 г.).
13. Топузов, Ив. Затлъстяването при подрастващи — разпространение, характеристика и лечебен подход. Дисерт. труд (София, 1997 г.).
14. Топузов, Ив.. Целулитът — характеристика и комплексно лечение. С., Грация-М, 2000.