The Correlation Between Decreased Leptin Levels and the Onset of Menarche

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Objective

Many female adolescents experience delayed menarche for a variety of reasons, one being lack of sufficient leptin levels. Leptin is made in the adipocytes, and it is predicted that a threshold of leptin is required for the initiation of menarche. In underweight premenarcheal females, there is a very low level of leptin. The purpose of this project is to understand the correlation between the onset of menarche and levels of leptin in young females.

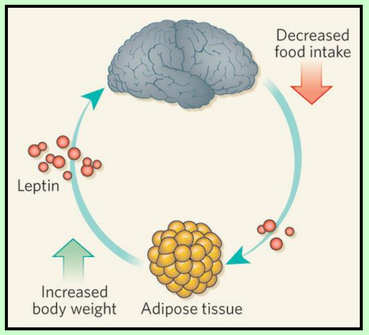

Figure 1 shows how leptin interacts with the brain and adipose tissue to regulate food intake. Leptin levels rise after food intake telling the brain no more food is necessary. Then after using the stored energy, the leptin levels decrease telling the brain that more food is needed.

Abstract

Leptin is a hormone made by adipocytes to regulate food intake and energy expenditure.[3] Some also consider leptin to be the hormone signaling the hypothalamus to begin puberty.[4] Several researchers have proposed that a specific threshold of leptin is required for menarche to occur because a mature body needs enough fat to potentially support a growing fetus.[5,6] In adolescents with anorexia nervosa, delayed menarche commonly occurs due to lack of leptin.[2] The purpose of this study was to discover how low leptin levels alter the age of menarche. With insufficient levels of leptin, it can be hypothesized that adolescents will have delayed menarche. One study followed the leptin levels of 40 random kids from age 8.6-16.6.[1] Every six months, the method included taking body measurements, collecting serum samples, and calculating body compositions. The results indicated it was a consistent level, rather than a sudden spike, in leptin that signaled menarche. In another study, 789 normal children age 5-15 years were studied.[3] Leptin levels, as well as gonadal and gonadotropins levels, were analyzed during this research. The researchers discovered that leptin levels began rising before other hormones related to puberty appeared. This shows that a specific amount of leptin is necessary for the onset of puberty. In conclusion, both studies agreed the timing of menarche correlates with the amount of leptin in the body. Once a level of leptin is achieved, the onset of menarche typically occurs.[1,5,6] To help prevent decreased leptin levels and problems with menstruation, it should be explained to young girls that a healthy diet and amount of exercise is important for a fit lifestyle.

Methods and Materials

One study was conducted by Velimir Matkovic and colleagues using 343 Caucasian girls aged 8.3-13.1 from school districts in central Ohio. The longitudinal study lasted for four years and researched how leptin levels in girls altered the age of menarche. Every 6-12 months, the girls menstrual history, nutritional status, energy expenditure, body compositions, and blood samples were attained. The relationship between leptin levels and menarche was also studied by dividing the girls into five groups from group 1: still premenarcheal after 4 year follow up, group 2: menarche achieved in 4th year of study, group 3: achieved menarche in 3rd year, group 4: achieved menarche in 2nd year, to group 5: developed menarche during the first year follow up. All girls were premenarcheal entering this study.

Results

The research done by Matkovic found that the levels of leptin in the young females strongly correlated with their body mass index and percent body fat. When the levels of body fat went up, so did the levels of leptin. In the 332 girls that reached menarche, Matkovic found that a threshold of 12.2 ng/mL leptin was obtained. The 11 girls in group 1 that failed to reach menarche during the study continued to have leptin levels lower than 12.2 ng/mL as shown in **Figure 2** below. This proves that lack of sufficient leptin levels in young females delays the onset of menarche.

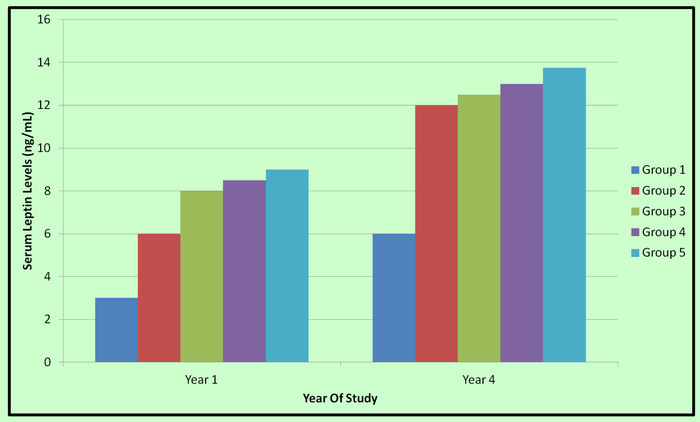

Figure 2 demonstrates the amount of serum leptin in all five groups during year one and year 4. The girls in group one never achieved 12.2 ng/mL of leptin and therefore menarche did not occur during the four years of study.

Discussion

Leptin levels need to reach a specific threshold for the onset of menarche to occur. In girls that are underweight, a pregnancy could be life-threatening because the girl already does not have adequate fat storage to feed her own body, and certainly not enough to feed a growing fetus. The correlation between leptin, which is made in the fat cells, and menarche helps ensure potential mothers are healthy for a pregnancy. The threshold in this study was found to be a serum leptin level of 12.2 ng/mL, related with a body mass index of 22.3, a relative body fat of 29.7%, and a body fat of 16.0 kg. The results of this study showed that once 12.2 ng/mL of leptin was attained, the girls achieved menarche, regardless of age.

Relevance Applications to Biotechnology

Through advances in biotechnology, researchers today can store serum samples from adolescents in -80°C and then test the serum for levels of leptin. Having sufficient leptin levels is important because lack of leptin and leptin deficiency have shown to lead to obesity and infertility. Late onset of menstruation is also considered a risk factor for osteoporosis. One way to help prevent problems with menstruation in young girls is to talk with them about a fit lifestyle including exercise and a healthy diet.

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