

THE EFFECT OF BMI DURING MENARCHE ON SELECTED MARKERS OF ADOLESCENT GROWTH SPURT IN GIRLS

Szwed A, Durda-Masny M, Hanć T, Czapla Z

Department of Human Biological Development, Institute of Anthropology, Faculty of Biology, Adam Mickiewicz University
Umultowska 89, 61-614 Poznań, Poland
aniszwed@amu.edu.pl

Background

In addition to genes controlling the pace of growth and sexual maturation, both growth and rate of pubertal development are affected by many non-genetic factors, with nutritional status being one of the most important.

Aim

To evaluate the relationship between BMI at menarche and selected growth spurt parameters, such as age at take-off of the pubertal growth spurt (ATO), age at peak height velocity (APHV), growth spurt duration (APHV-ATO), and the pubertal growth rate.

Methods

The study group consisted of 243 girls aged 10-16 years. Several measurements of body height and weight have been taken for each girl during the girls' development (longitudinal study). Nutritional status has been assessed using the IOTF. Girls were asked about their age at menarche. To investigate the growth rate, the age at TO and PHV for each girl was calculated using AUXAL.3 software and a structural model JPA2. Other statistical analyses were made in Statistica 12.0 using Kruskal-Wallis test.

$$y(t) = A \left[1 - \frac{1}{1 + \left(\frac{t+E}{D_1} \right)^{C_1} + \left(\frac{t+E}{D_2} \right)^{C_2} + \left(\frac{t+E}{D_3} \right)^{C_3}} \right] + \varepsilon$$

where

t = postnatal age; Y = height reached at age t ; A = adult height; E = estimated prenatal duration of growth; D_1, D_2, D_3 = time-scale factors; C_1, C_2, C_3 = dimensionless exponents

Results

The average age at menarche for the entire group was 12.59 (Me = 12.52, Min = 9.9, Max = 16.0). There was a significant statistical correlation between the level of nutritional status and age at menarche. The age at menarche decreased significantly with increasing levels of nutritional status ($H = 33.2, p < 0.001$). Also, TO and PHV occurred earlier in girls with higher values of BMI (TO: $H = 12.25, p < 0.05$; PHV: $H = 12.25, p < 0.05$) (Tab. 1 and Fig. 1).

Table 1. Mean values of age at menarche, TO and PHV in individual BMI categories of studied girls

	Underweight (n=33)	Norm (n=172)	Overweight/ obese (n=38)	H	p
Menarche (years)	13.90 (SD=0.13)	12.48 (SD=0.92)	12.33 (SD=1.46)	28.22	<0.001
ATO (years)	8.72 (SD=0.72)	8.42 (SD=0.69)	8.27 (SD=0.89)	8.85	0.012
PHV (cm/year)	11.86 (SD=0.50)	11.50 (SD=0.68)	11.29 (SD=0.89)	11.71	0.003
APHV-ATO (years)	3.14 (SD=0.52)	3.08 (SD=0.69)	3.02 (SD=0.66)	22.6	<0.001

ATO – age at take off, APHV – age at peak height velocity, Δ APHV-ATO – growth spurt duration

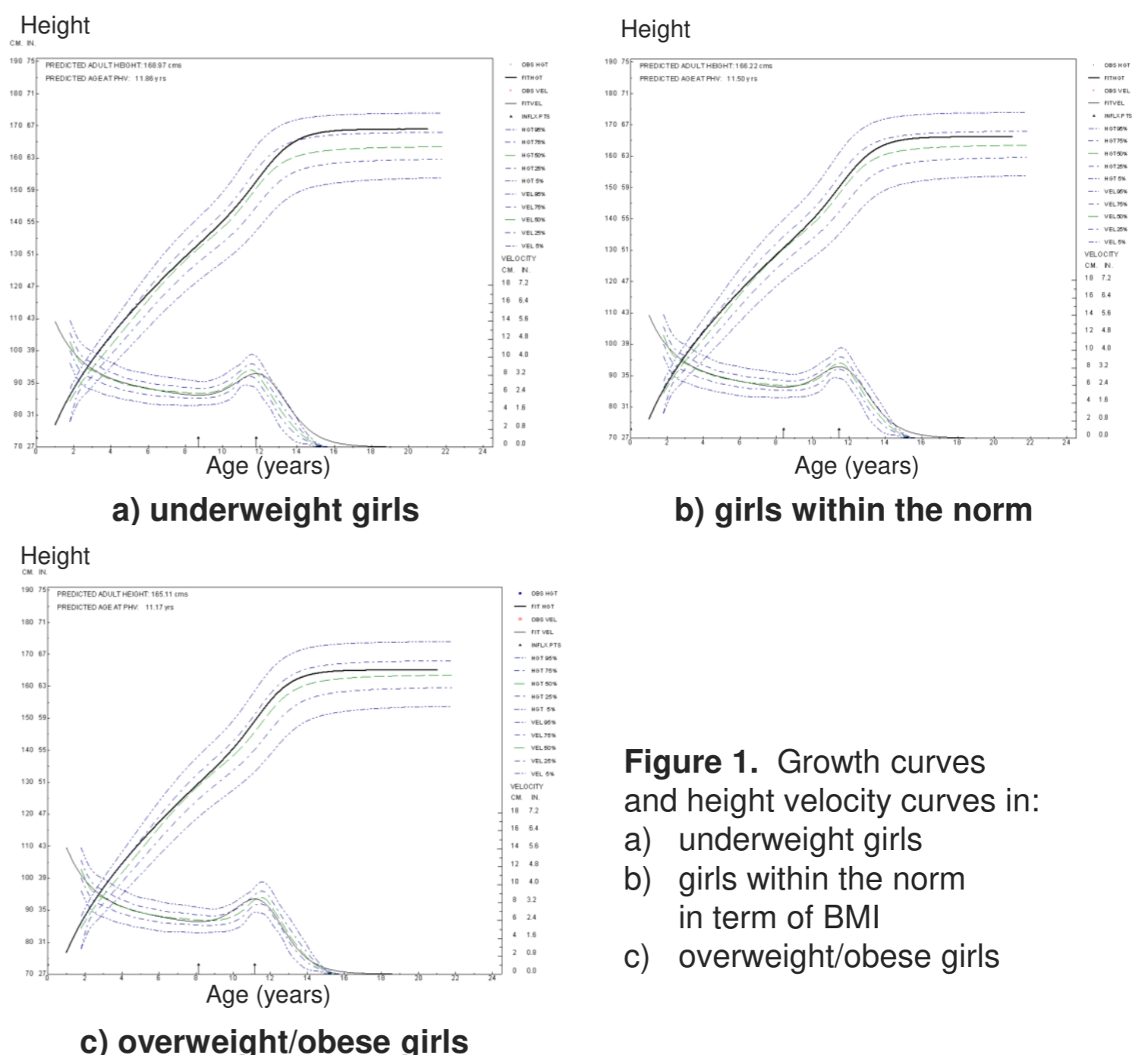


Figure 1. Growth curves and height velocity curves in: a) underweight girls b) girls within the norm in term of BMI c) overweight/obese girls

Conclusions

BMI at menarche is related with the course of growth during puberty. The higher BMI values in girls are related to the earlier start of growth spurt, its shorter duration, and the earlier peak growth rate. In overweight and obese girls, the first menstrual period occurs at the earliest, whereas it is observed in underweight girls at the latest.