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POSTNATAL GROWTH OF 18-YEAR OLD STUDENTS WITH OBESITY

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ABSTRACT

The early diagnosis of obesity is a necessary precondition for the decrease of its sequallae. Increasing the knowledge of the growth of obese children would help the diagnostic procedure. The aim of the present work is to define rates of growth and maturation of obese students who have reached final height. The height and body mass from birth to 18 years of age are followed in 2195 students – 989 (45,1 %) boys and 1 206 (54,9 %) girls. As "obese" at final height were defined those with *BMI* 1,645 *SDS*, and as "overweight" – those with *BMI 1,036 SDS* for age and sex. Height is assessed through the standard deviation score (*SDS)* and compared with the reference group accordingly. Maturation parameters are compared in 2159 (969; 45 % boys) who have reached final height. Overall 253 (11,5 %) of the adolescents under study are overweight, and 133 (6.1 %) are obese. The follow-up of the postnatal growth by SDS shows significantly higher values of the index throughout childhood. There is no difference in final height for both sexes. The obese boys and girls experience peak pubertal growth and cease to grow significantly earlier compared to controls – on the average by about 5 months, p < 0,0001. The obese girls attain their first menstruation more than 8 months ahead of controls – 12,2 1,3 years *vs.* 12,9 1,1 years, p = 0,013. The routine follow-up of the linear growth from birth till the moment of clinical evaluation could be helpful in building the diagnosis of the exogenous obesity.

Key words: obesity, childhood, adolescence, growth, maturation, body mass index

INTRODUCTION

Recently, the main risk factors for the increased adulthood mortality attract growing interest in many countries in parallel with the improving economic conditions. Obesity is invariably among the leading risk (1,8,10). Its prevention and early diagnosis is a condition *sine qua non* in order to decrease its sequallae (16). On the other hand, the linear growth evaluation is a clinical routine in paediatric practice. Increasing the knowledge of the growth of obese children would help the diagnostic procedure.

Aim of the present work is to define rates of growth and maturation of obese students who have reached final height and to compare with that of their normal weight peers.

MATERIAL AND METHODS

The study is carried out from February, 1999 till March, 2000. Overall 4000 personal health files of the last-grade students from the secondary schools in Varna are screened. The present analysis includes all students who have data about birth weight and length, gestational age, more than a couple of measurements during puberty and measured weight at final height. The data of 61 students with diseases that could influence on body weight are not included. Prematurity or non-disabling chronic diseases have not been considered as exclusion criteria. The height and body mass from birth to 18 years of age are followed in 2195 students – 989 (45,1 %) boys and 1206 (54,9 %) girls. As "obese" at final height are defined those with *BMI* 1,645 *SDS* (above 95th percentile) for age and sex, which for the present study is *BMI* 27,3 kg/m^2 for the girls and 28,1 kg/m^2 for the boys (8). The students with *BMI* between 85th and 95th percentile (BMI 1,036, respectively) are defined as "overweight" students, which corresponds to BMI over 23,8 kg/m^2 for the girls and 24,5 kg/m^2 for the boys (4,15). The present data-set is used as a reference group because of the found differences with all national and regional standards available (9). Height is assessed through the standard deviation score (*SDS)* at 1, 2, 3, 5, 8 and 18 years of age and compared with the reference group accordingly.

In a subset of 2159 students (45 % boys) who have reached final height some maturation parameters are compared – age at peak pubertal height velocity and age at final height. Final height is defined as the height at least 2 years after menarche and/or after the age at peak pubertal height velocity, and when the growth velocity doesn't exceed 1 cm/year any more (2). The age at peak pubertal height velocity and the age at final height are estimated through visual inspection of every individual growth curve.

The age at menarche is investigated in a subset of 283 female students who filled in a questionnaire. In the cases

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/here only age and no exact date has been written, round-ıg off up to 3-6 months is done according to the date of irth. Only the age at menarche of the obese girls is studied ecause of insufficient data about the overweight girls.
'he data analysis is done using the SPSS for Windows. The ıethods of multiple comparisons and variation analysis are pplied. Differences at the 0,05 % level are accepted as sta-stically significant.

RESULTS AND DISCUSSION

)verall 253 (11,5 %) of all adolescents under study are verweight, and 133 (6,1 %) are obese.

163,49 6,04 cm and 163,80 6,02 cm, p = 0,672, i. e. the difference at birth has disappeared during the postnatal growth.
The analysis of the birth length data of the overweight children also doesn't reveal any significant differences.
The follow-up of the growth postpartally by SDS shows constantly higher values throughout the postnatal period till puberty with a gradual increase of the difference with the normal weight group (Fig. 1). The significance of these differences is steadily increasing after 2 years of age and is especially high after 5 years. The growth model of the overweight children is similar with the differences being significant only at 8 years of age.

abl. 1. Age (years) at peak pubertal height velocity of boys and girls with overweight (SDS_{bmi} 1.036) and obesity SDS_{bmi} 1.645) at final height

	With overweight	Without overweight	Stat. significance	Without besity	Without obesity	Stat. significance
girls	n=10411.18 ±0.92	n=81811.63 ±1.03	p<0.0001	n=5511.18 ±0.99	n=86711.65 ±1.03	p=0.001
boys	n=9313.23 ±1.07	n=69913.60 ±1.14	p=0.003	n=5213.14 ±1.17	n=74013.58 ±1.13	p=0.007
total	n=19712.14 ±1.42	n=151712.56 ±1.45	p<0.0001	n=10712.13 ±1.46	n=160712.54 ±1.45	p=0.005

'he mean BMI at final height of the obese students is 30,99 ,94 kg/m² (30,91 4,32 kg/m² for the girls and 31,10 3,49 g/m² for the boys), while it is 20,81 2,26 kg/m² for the ref-rence group.
'he mean birth length of the children who became obese ıter on is 50,83 1,50 cm and is not statistically significantly ifferent from that of the non-obese children – 50,54 1,85 m, p = 0,077. The birth length difference is slightly signifi-ant only for the girls who are obese at final height (50,69 ,44 cm vs. 50,22 1,82 cm, p = 0,037). The mean final eight of the obese boys is almost the same with that of the :ference group – 177,1 5,9 cm and 177,3 6,7 cm, p = ,893, respectively. The same is seen among the girls –

The maturation analysis in both genders includes comparison of the age at peak pubertal height velocity and the age at reaching the final height (stopping growth). The results are showed on Table 1 and Table 2. It is evident that the obese girls and boys experience the maximal pubertal growth significantly earlier compared to the normal body-weight controls.
The differences in this parameter among the overweight and the control children are also highly significant. The age at stopping growth is significantly lower among the overweight boys and girls. Only the obese boys finish growth a bit later than the reference group, the difference being insignificant (p = 0,134, see Table 2).

able 2: Age (years) at stopping growth of boys and girls with overweight (SDS_{bmi} 1.036) and obesity (SDS_{bmi} 1.645) at nal height

	With overweight	Without overweight	Stat. significance	With obesity	Without obesity	Stat. significance
girls	n=138 14.29±1.21	n=1052 14.83±1.22	p<0.0001	n=70 14.22±1.23	n=1120 14.80±1.22	p<0.0001
boys	n=114 16.29±1.17	n=855 16.58±1.14	p=0.01	n=63 16.32±1.18	n=906 16.56±1.14	p=0.104
total	n=252 15.19±1.55	n=1907 15.61±1.47	p<0.0001	n=133 15.21±1.60	n=2026 15.59±1.47	p=0.005

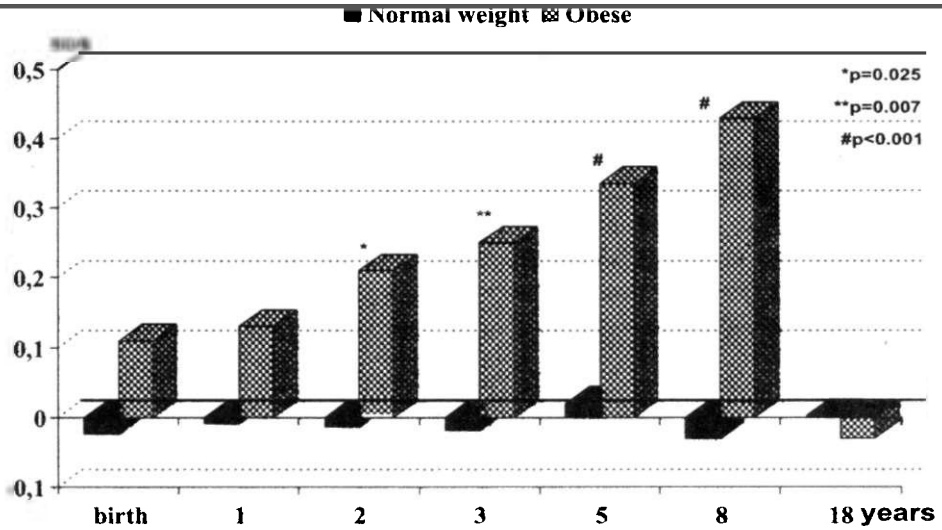

Fig. 1. Height differences (in SDS) at different ages in boys and girls with obesity and their normal weight peers

Comparative analysis of the age at menarche shows that obese girls have their first menstruation more than 8 months earlier than control girls – 12,22 1,28 years of age *vs.* 12,.91 1,06 years, p = 0,013.

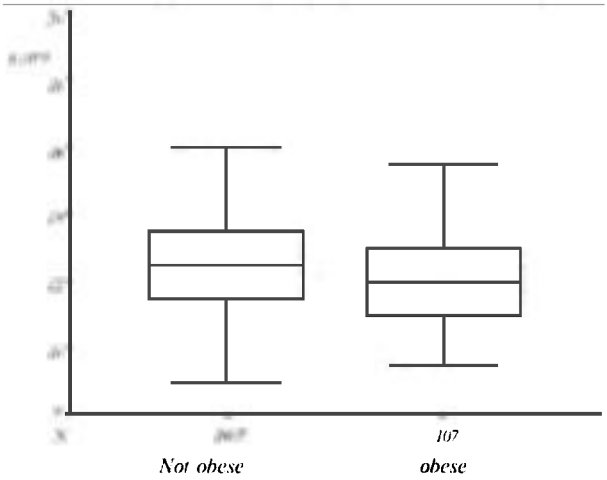

Fig. 2 Difference in the age of the maximal pubertal growth velocity according to the presence of obesity

This obesity incidence rate in adolescence is consistent with many others from the recent years in our country (1) as well as in other European countries (12). Accordingly, the augmented linear growth potential during periods of sharp weight increase is described as early as the end of 70-es (6). Already then it is established that both girls and boys with obesity are taller than children of the same age with normal weight. However, the published data about the final height of the obese are relatively few (7). Studies with longitudinal follow-up from birth to the final height are lacking that is the reason why there are no published data about the maturation and the age at stopping growth.

The inspection of the individual growth curves of the students under study shows taller stature of the overweight boys and girls throughout childhood, which is constantly rising for the obese children (over the 95th percentile for BMI for age and sex) up to 8 years of age, and is of increasing significance after 2 years of age. The linear growth assessment during puberty is exceptionally difficult, especially when group data are evaluated. This is due to the different age at the beginning of pubertal acceleration of growth, the so-called "pubertal peak". Thus it is almost impossible to analyse a set of puberty growth data, especially in a retrospective study like the present (13).

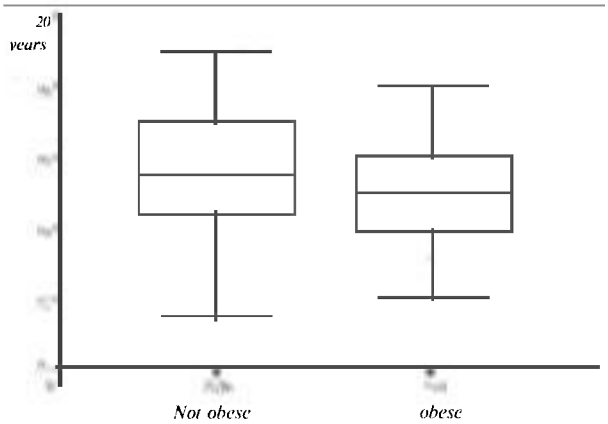

Fig. 3 Difference in the age of stopping growth in adolescents with and without obesity (p=0.005)

The final outcome in growth analyses is the reached adult height It is the "key" to the probable growth disturbances in puberty. In this case the final height of the obese and non-obese children is identical. Opposed to the highly accelerated prepubertal growth this could only be due to earlier maturation and ceasing of growth among the children with higher weight. This is confirmed by the analysis of the two parameters – the age at peak pubertal height velocity and the age, at which girls achieve menarche, that are giving good notion of the maturation processes. Furthermore, the overall linear growth stops much earlier, at an average of about 6 months, particularly among girls. A possible explanation emerges recently with the discovery of the hor-

one leptin secreted mainly by the fat tissue and suggested one of the possible factors in signalling puberty (11,14).

general, the overweight and obese children grow not ly heavier, but also taller than their peers since birth. ney keep that growth potential throughout childhood. nere follows an earlier maturation and identical final ight compared to peers. This growth model is different om all diseases that manifest obesity. They largely display owed to ceased growth (Cushing disease, growth hor- one deficit, etc.) or disturbed pubertal development ptin deficiency) (5).

nplementation of the linear growth assessment from birth the moment of clinical evaluation in a routine practice d follow-up of the growth velocity could be helpful in uilding the diagnosis of the exogenous obesity. This ould also be cost-effective and save much resource for necessary hormonal investigations.

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