

BODY FATNESS AND SEXUAL MATURATION STATUS

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ABSTRACT

Purpose: (1) to characterize the maturation status on the basis of breast development in the girls and genital development in the boys, resp. on occurrence or non-occurrence menarche or spermarche; (2) to study the sexual differences in body components during the puberty, (3) to analyze body components in children belonging to the same age group, but different maturation stages and to the various of maturation indicators, but differing in age.

Subjects: The subjects of the present subsample of the 2nd national cross-sectional study were such children that had already begun pubertal development. The chronological age of the girls ($n = 2673$) and boys ($n = 2869$) ranged between 10.0 and 16.0 years.

Methods: The girls were subdivided by the maturation stages of the breast, while the boys by those of the genitals. Sexual maturation was assessed visually and rated by Tanner's suggestions (1962). Percentage of body fat was estimated by model of two components (Durnin and Rahaman 1967, Siri 1956), while masses of body components (fat, bone, muscle and residual mass) were assessed by the Drinkwater and Ross' (1980) four-component anthropometric fractionation method. Multiple comparisons of the means were tested by Scheffé's formula at the 5% level.

Results: Sexual differences in body composition, present already in childhood, became more accentuated during puberty, due mainly to growing fat content in the girls and to increasing lean body mass in the boys. In the females early maturers were heavier and contained more fat than less mature girls. This increase relative and absolute fat mass was proportionate to weight gain. In the males increasing fat mass lagged behind the gain in lean body mass both with advancing age and maturity status.

Conclusion: Body composition and maturity status are closely interrelated in both genders while gender-specific tendencies increase dimorphism and the several factors making up the differences between maturation types. Fat content was greater in both sexes in the early maturers. Also the developmental rate of prepubertal fat accumulation was faster in the early maturers when compared to those maturing later. Standards for the age change of body composition can therefore inform us not only about the development of bone, muscle and fat in childhood, but also allow a short-range prediction of pubertal events.

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Key words: Body components, developmental stages of breast, developmental stages of genitals, menarche, spermarche.

INTRODUCTION

Puberty embraces all the processes leading to sexual and physical maturation that involve not only the development of sex organs and secondary sexual characteristics, but the modification of body composition and body shape too. These processes have a relatively independent trend line each but they are simultaneously mutually interrelated.

The endocrine changes in puberty have a strong impact on both the direction and rate of metabolism and on the proliferation of bone, muscle and fat. Because of the accelerated rate of growth more nutrients are needed. The specific requirements in nutrients are almost twice greater than in childhood. So the timing, rate and duration of the pubertal changes in the measurements and the sexual maturation depend on the nutrition status.

Our study dealt with the interrelations of sexual maturation and nutritional status. The goals of this study were to analyze body composition in children belonging to the same age group, but to different stages of maturation as well as displaying the same level of maturation characteristics, but varying in age.

SUBJECTS AND METHODS

Cross-sectional data were collected in Middle-Hungary in 2003. The subjects of the present subsample of the main study were such children that had already begun pubertal development (Table 1).

Age (yr.)	Girls n	Boys n
10.0	188	171
10.5	147	162
11.0	231	224
11.5	255	264
12.0	215	276
12.5	205	241
13.0	237	239
13.5	251	228
14.0	287	309
14.5	269	226
15.0	191	193
15.5	109	172
16.0	184	168
Together	2673	2869

Table 1: Cross-sectional data were collected in Middle-Hungary in 2003.

Nutritional status was estimated by different way: trunk skinfolds (sum of pectoral, subscapular, midaxillary, abdominal, suprailiac skinfolds), extremity skinfolds (sum of triceps, biceps, forearm, medial thigh, medial calf skinfolds), BMI, model of two components: percentage of body fat (Durnin and Rahaman 1967, Siri 1956), model of four components: fat, bone, muscle and residual mass (Drinkwater and Ross 1991).

The sexual characteristics (at girls: breast developmental stages, at boys: genitals developmental stages) were rated according to Tanner's suggestions (1962). Data for determining menarche and spermarche were collected by the "status-quo" method.

The girls were subdivided by using menarcheal status and stages of breast development, while the factors for grouping the boys were spermarche, and stages of genital development.

After computing descriptive statistics the subgroups were compared by one-way ANOVA following which between-group differences were tested by F-tests at the 5% level of random error. Multiple comparisons of the means were tested for significance by Scheffé's formula used at the 10% level of F. Statistical evaluation was made by using the SPSS for Windows software (v. 6.01, 1996).

RESULTS AND DISCUSSION

When we contrasted pre- and post-menarcheal girls of the same age, significant differences in body composition emerged:

Post-menarcheal girls had significantly greater trunk and extremity skinfolds (Fig. 1) as well as greater value of BMI than pre-menarcheal ones (Fig. 2) than pre-menarcheal age-peers.

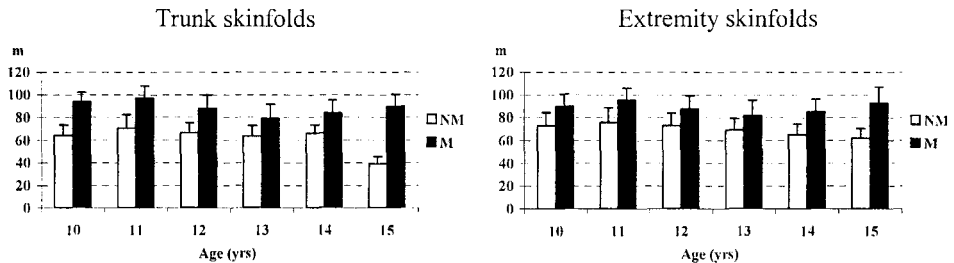


Fig. 1: Sum of trunk and extremity skinfolds of pre- (NM) and post-menarcheal (M) girls.

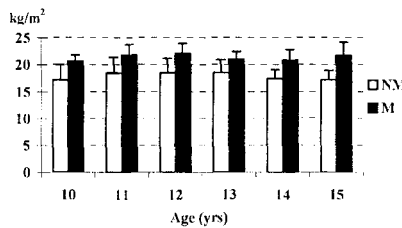


Fig. 2: BMI-values of pre- (NM) and post-menarcheal (M) girls.

The pattern of differences in percentage of body fat shows the same (Fig. 3). The percentage of body fat was practically the same in all post-menarcheal girls while the girls maturing late for their age displayed a decreasing series of relative fat content as their belatedness grew. All these observations prepare the way for the inference that the smaller the extent of fat accumulation, the later menarche would occur.

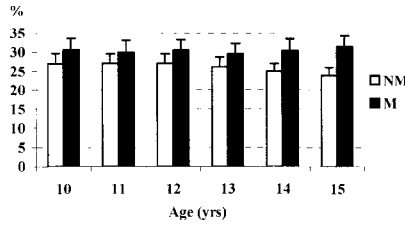


Fig. 3: Body fat percentage of pre- (NM) and post-menarcheal (M) girls (Siri-method).

Post-menarcheal girls had not only a significantly greater amount of body fat than pre-menarcheal ones, but greater bone and muscle fractions of body mass too (Fig. 4). It means that the smaller fat content the lower growth-rate of bone and muscle.

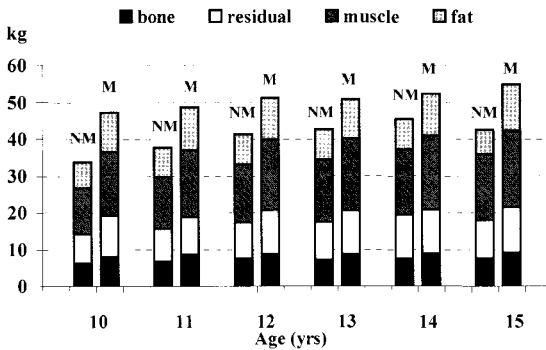


Fig. 4: Body components of pre- (NM) and post-menarcheal (M) girls (Drinkwater and Ross-method).

When pre- and post-spermarcheal boys were compared, the latter were found to have significantly greater BMI, but their trunk and extremity skinfolds, except in 11 age-group, were smaller (Figs 5–6).

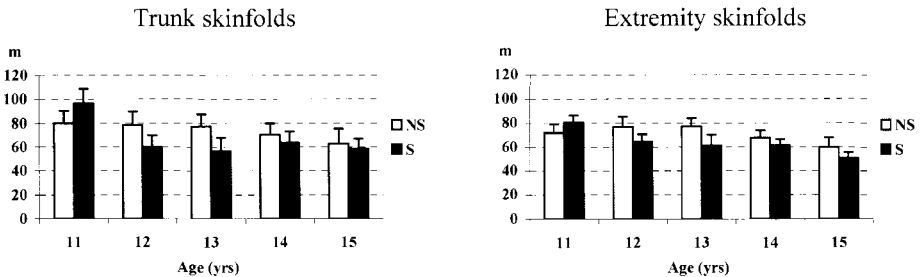


Fig. 5: Sum of trunk and extremity skinfolds of pre- (NS) and post-spermarcheal (S) boys.

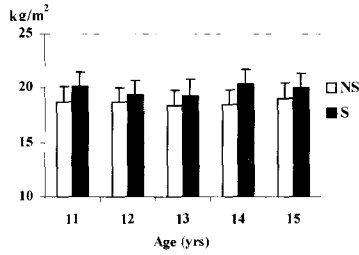


Fig. 6: BMI-values of pre- (NS) and post-spermarcheal (S) boys.

The relative body fat content of the early maturing boys also smaller than the later maturing age-peers, only boys maturing very early e.g. at age 11, have a significantly larger amount of relative fat (Fig. 7).

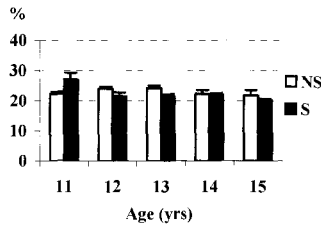


Fig. 7: Body fat percentage of pre- (NS) and post-spermarcheal (S) boys (Siri-method).

The figure 8 shows the pre - and post-spermarcheal boys differed in all body components. The post-spermarcheal boys have greater bone and muscle mass than the pre-spermarcheal boys of the same chronological age.

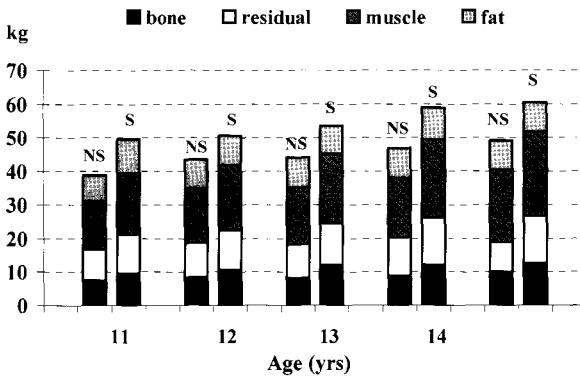


Fig. 8: Body components of pre- (NS) and post-spermarcheal (S) boys (Drinkwater and Ross-method).

In comparing the corresponding groups of sexual maturity in the two genders one obviously should be aware of the time difference when menarche, respectively spermarche occur, namely, that they take place in a different phase of adolescent growth.

Menarche occurs when pubertal growth-rate decreases, while boys' growth-rate increases after occurrence of spermarche. The relative fat content of the body is smaller around the age of peak height velocity because of the fat loss. Pre-spermarcheal boys that have not yet entered the phase of peak height velocity tend to accumulate fat and very lean ones usually mature later.

Successive stages of female breast development displayed significant differences in bone and muscle mass while there was no marked difference of relative body fat content (Figs 9–10). The only exception was between breast stage 4 and 5.

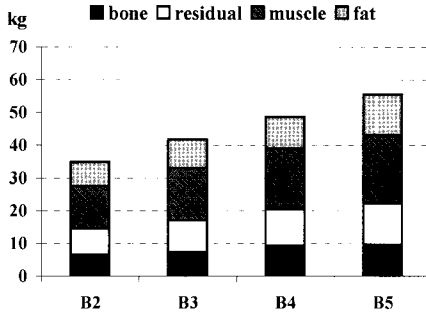


Fig. 9: Masses of body components of by stages of breast maturation.

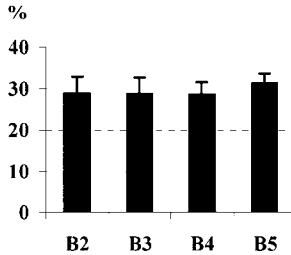


Fig. 10: Body fat percentage by stages of breast maturation.

The pattern of changes in body component the similar tendency during shows according to successive stages of male genitals. The development of genitals is associated with a relative fat lots (Figs 11–12).

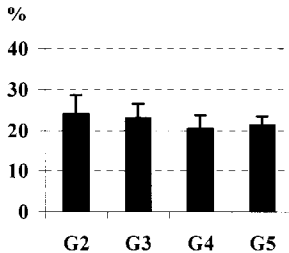


Fig. 11: Body fat percentage by stages of genitals maturation.

In summary, these observations strongly confirm the inference that maturation status is reflected by body composition and also the age change of body fat depends on it. Body composition and maturity status are closely interrelated in both genders while gender-specific tendencies increase dimorphism and the several factors making up the differences between maturation types. Fat content was greater in both sexes in the early maturers. The larger fat accumulation in prepuberty dues to earlier sexual maturation and higher rate of pubertal growth.

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POVZETEK

SESTAVA TELESA IN SPOLNO DOZOREVANJE

Cilji: 1. Opisati status spolnega dozorevanja na osnovi razvoja prsi pri deklicah in razvoja genitalij pri dečkih, upoštevaje tudi nastop menarhe oz. spermarhe. 2. Raziskati spolne razlike v telesni sestavi med puberteto. 3. Analizirati telesne komponente pri otrocih iste starosti, vendar z različno stopnjo spolnega dozorevanja.

Vzorec: Predmet razprave je vzorec otrok, ki so sodelovali v 2. nacionalni presečni raziskavi in pri katerih se je pubertetni razvoj že začel. Razpon starosti 2673 deklet in 2869 dečkov je od 10 do 16 let.

Metode: Dekleta so razdeljena glede na razvojni štadij prsi, dečki pa glede na razvojni štadij genitalij. Štadiji so ocenjeni vizualno po merilih Tannerja (1962). Odstotki telesne maščobe so ocenjeni po dvodelnem modelu (Durnin in Rahaman 1967, Siri 1956), masa telesnih komponent (maščoba, kosti, mišice in ostanek) pa je ocenjena po štiridelni antropometrični metodi Drinkwaterja in Rossa (1980). Multipla primerjava povprečnih vrednosti je testirana po Scheffelejevi formuli na nivoju 5%.

Rezultati: Spolne razlike v telesni sestavi, ki so prisotne že v otroštvu, postanejo poudarjene v glavnem zaradi naraščajočega maščevja pri deklicah in naraščajoče puste telesne mase pri dečkih. Zgodaj dozorevajoča dekleta so težja in imajo več maščobnega tkiva kot pozno dozorevajoča dekleta. Povečanje relativne in absolutne mišične mase je proporcionalna s pridobljeno težo. Z napredujočo starostjo in dozorelostjo, naraščajoča mišična masa pri fantih zaostaja za prirastom puste telesne mase.

Zaključki: Telesna sestava in zrelosti status sta pri obeh spolih tesno povezana. Spolno specifične tendence povečujejo spolni dimorfizem, posamezni faktorji pa ustvarjajo razlike med dozorevajočimi tipi. Vsebnost maščobe je pri obeh spolih večja pri zgodaj dozorevajočih otrocih. Tudi predpubertetno nalaganje maščobnega tkiva je intenzivnejše pri zgodaj dozorevajočih, če jih primerjamo s pozno dozorevajočimi otroci.

Standardi za starostne spremembe v telesni sestavi nas ne informirajo samo o razvoju okostja, mišičja in maščevja, ampak dopuščajo kratkotrajno napoved pubertetnih dogajanj.

Ključne besede: telesne komponente, razvojni štadiji prsi, razvojni štadiji genitalij, menarha, spermarha.