

VARIABILITY OF THE QUETELET INDEX (BODY MASS INDEX OR B.M.I.) IN 3–18 YEARS OLD CHILDREN AND ADOLESCENTS FROM TWO DIFFERENT ECOLOGICAL MEDIA

MARIA ȘTIRBU, ANGELA SIMALCSIK, R. SIMALCSIK and C. FEDOR

“Fr.I.Rainer” Institute for Anthropological Researches, Iași Division

Received April 2, 2009

The paper investigates 2 groups of children and adolescents, with ages between 3 and 18 years, coming from 2 different ecological media, as follows: a former batch, including 1,546 boys and 1,686 girls, is from the city of Iași, while the latter, represented by 1,505 boys and 1,511 girls, comes from the rural area of the Iași district.

For each subject in part, the stature-weight ratio, expressed by the Quetelet index (B.M.I. or Body Mass Index), was calculated, along with its mean values and mean deviation, determined in both batches, at the level of each sex and on classes of age.

The age-induced evolution of both the mean values of the Quetelet index and of the two characteristics – stature and weight – known as entering the calculation formula of the Quetelet index (plotted in graph 1–3) evidences increasing values, generally higher in boys than in girls and also higher in the urban batch, comparatively with the rural one.

The individual distribution of the Quetelet index values was based on the percentile method, for each sex in part, in each of the two batches, on both classes of age and at the level of all ages. Estimation of the weight categories on percentiles, according to the classical scale provided in the literature of the field evidenced that, in both the urban and the rural batch, at the level of all ages, for both boys and girls, the subjects with a balanced stature-weight ratio (normo-ponderal subjects) are of majority (representing 69.15% in the boys from the urban area and 69.30%, respectively, in those from the rural one, the values recorded in girls being of 69.28% and 68.96%, respectively).

The subjects, seen as either under-or over-weight, attain a ratio of 30.85 in boys and of 30.73 in girls – in the urban medium, while the values recorded in the rural area are of 30.79 in boys and of 31.04 in girls, respectively. Out of them, approximately 11% are extremely, 5.50% subponderal, while about 5.50% are obese (significant weight excess).

Key words: Body Mass Index; Children; Adolescents; Urban; Rural; Normal; Weight; Underweight; Obesity.

INTRODUCTION

According to the World Health Organization, the Body Mass Index is a parameter expressing most faithfully the exact stature-weight ratio, which is an essential parameter in the evaluation of the health condition and, implicitly, of the normal growth and development of both children and adolescents. As generally known, both the insufficiency and the excess of weight bear pathological implications, expressed – in the case of children and adolescents – by retarded growth,

with severe consequences upon the adult, such as a higher incidence of morbidity and even of mortality.

MATERIALS AND METHOD

The experimental material is represented by 2 batches of children and adolescents, with ages between 3 and 18 years, all coming either from the city of Iași or from some of its neighboring rural communities. The urban batch includes 3,232 subjects (boys and girls), while the rural one (in which the age of 18 years is absent) consists of 3,016 children and adolescents (boys and girls). In both cases, the subjects were classified on classes of age, for each sex in part.

The stature – weight ratio-expressed by the Quetelet index – was calculated for each subject in part, after which its mean and standard deviation were calculated on classes of age and sex. Distribution of the individual B.I.M. values, based on the methodology of percentiles, was performed at the level of each sex, both on classes of age and globally, for all ages (WHO, Physical status 1995). The values obtained were attributed to the main ponderal categories, according to the classification scale recommended by the literature of the field (WHO, Physical status 1995: 7-8 and 175-176; Macovei *et al.* 2006–2007: 75; Radu *et al.* 2006-2007: 83).

RESULTS AND DISCUSSION

Analysis of the mean values, on classes of age and sex, of the two parameters: stature and weight, entering the structure of the stature-weight ratio, evidences already well-known differences between the two – rural and urban-batches. Consequently, both the boys and the girls from the urban area evidence, on the average, in all classes of age, taller stature and higher weight than their colleagues from the rural zone (with only one exception: the 17 year old girls from the rural batch evidence higher average weight than their colleagues from the city – Fig. 2).

As illustrated in graph 1 and 2, the urban-rural differences become more pronounced after the age of 12. Also, crossing on the curves, for both average stature and average weight, between boys and girls, appears at earlier ages in the urban batch, comparatively with the rural one. Indeed, the first crossing of the curves plotting the average height occurs at ages between 8 and 9 years, and the second – between 12 and 13 years, in the urban environment while, in the rural one, the first crossing is between 10 and 11 years and the second, between 13 and 14 years (Fig. 1). In the urban batch, the curves of average weight (Fig. 2) are crossed the same interval of age, which is also the case of the average height curves, that is, between 8 and 9 years – the first crossing, and between 12 and 13 years – the second. Nevertheless, in the rural batch, the first crossing of the curves expressing average weight occurs at the age of 12 years, and the second – at 14 years. The curves of the height-weight ratio, expressed but the Quetelet index, show that the mean values of this parameter are, with only few exceptions, higher in the urban than in the rural batch (Fig. 3). The exceptions refer to the fact that, after the age of 15 years (*i.e.*, at 16, 17 and – possibly – 18, which is unclear because, as already mentioned, this last category of age is not represented in the rural group), the girls from the rural area usually evidence a higher average height-weight ratio than

their colleagues from the urban area. More than that, the 17 year old girls show, on the average, a B.M.I. value higher even than those of the boys from the urban batch, of the same age with them. Having all these in view, mention should be made of the fact that the sexual differences referring to the mean B.M.I. values recorded in the two groups of children and adolescents have a slightly different evolution with age. Indeed, in the urban batch, the sexual differences are obvious and in favour of boys between 3 and 8 years, after which they are diminished and become oscillating up to 15 years while, between 16 and 18 years, they are seen as slightly increasing in favour of boys. In the rural batch, the sexual differences are in favour of boys at 3 years and between 6 and 12 years, and in favour of girls at ages between 4 and 5, and 13 and 17 years, respectively. Another important observation refers to the fact that, while the sexual differences between 4 and 5, as well as between 6 and 8 years are hardly perceptible, they become important between 9 and 11 years, as well as at ages older than 12 years (Fig. 3).

As a matter of fact, Figures 5 to 8, plotting the curves of the BMI mean values – as percentiles – during the evolution with age, on one hand, in both sexes of the two groups (Fig. 5 and 6) and, on the other, in the boys from the two ecological media (Fig. 7) and the girls from the two media (Fig. 8), evidence both sexual and urban-rural differences, which are seen as increasing both with age and with percentiles.

On analyzing the frequency of subjects from the main categories of weight according to the classification scale usually employed in the methodology of percentiles, one may observe that, at the level of all classes of age and of each sex from the two groups, the highest percent, of about 70%, was recorded – as actually expected – by the normo-ponderal subjects, followed by a percent of about 10%, of over-ponderal ones, risking obesity, by another 10% percent represented by sub-ponderal subjects and, finally, by a ratio slightly exceeding 5% – represented by obese subjects and by a ratio higher than 5% – the subponderal ones (Fig. 4). Quite interesting to mention is the almost imperceptible difference from both one sex to another and one ecological (urban) to another (rural) environment, in spite of the already-mentioned fact that the mean values of the Quetelet index evidence more or less obvious differences, both between the groups coming from from the two ecological environments and between sexes. This situation explains the reserve expressed by the authors as to the application of percentile methodology in the analysis of weight categories.

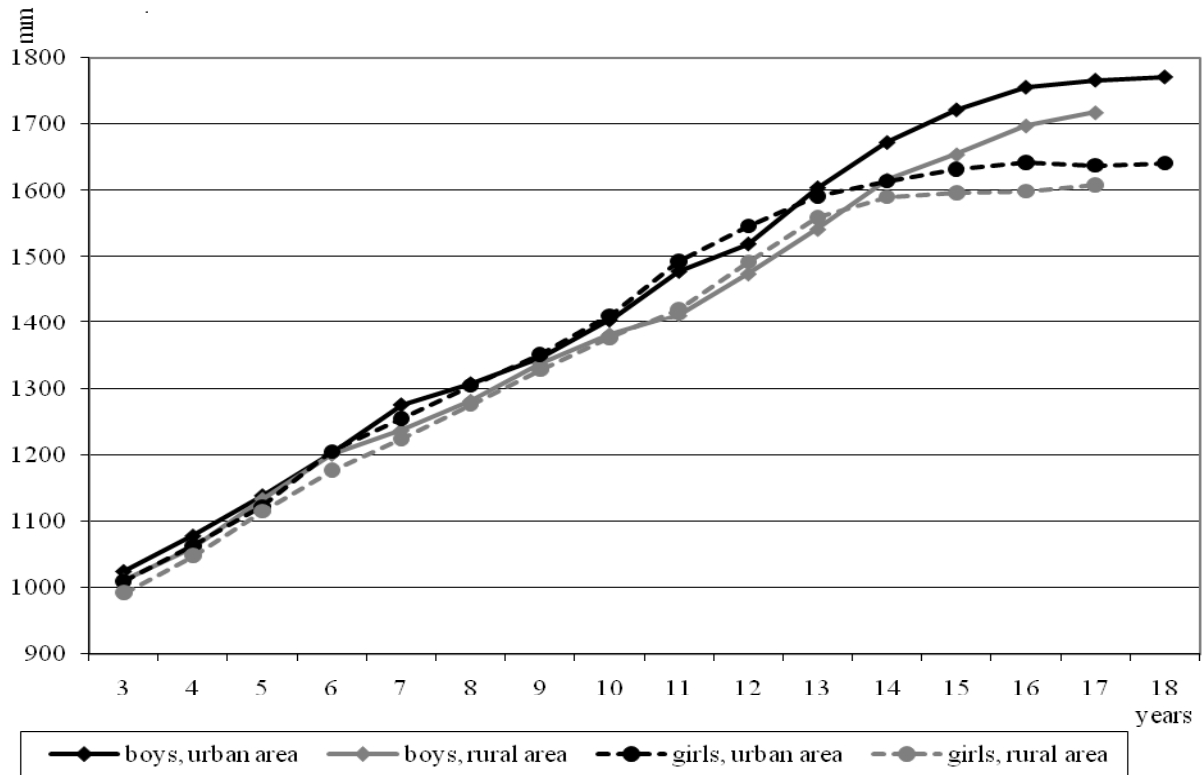


Fig. 1. Age evolution of the mean values of stature in the boys and girls from the urban area, comparatively with those from the rural one.

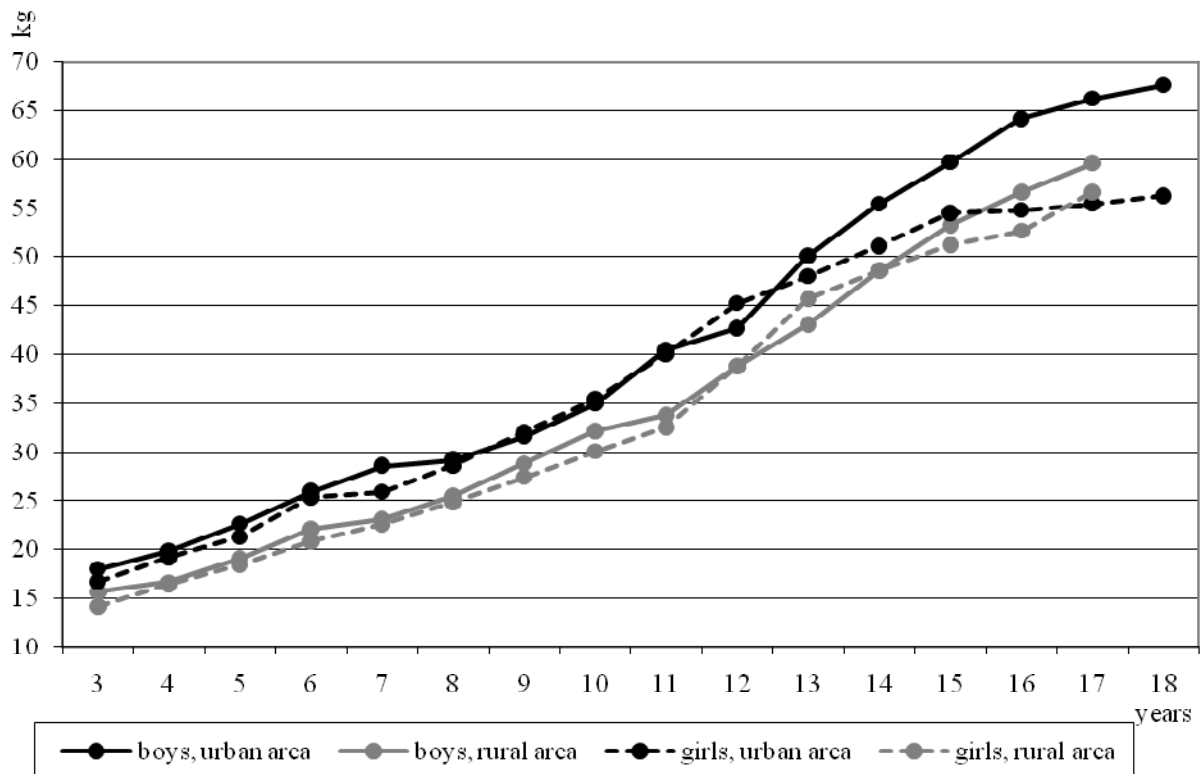


Fig. 2. Age evolution of the mean values of weight in the boys and girls from the urban area, comparatively with those from the rural one.

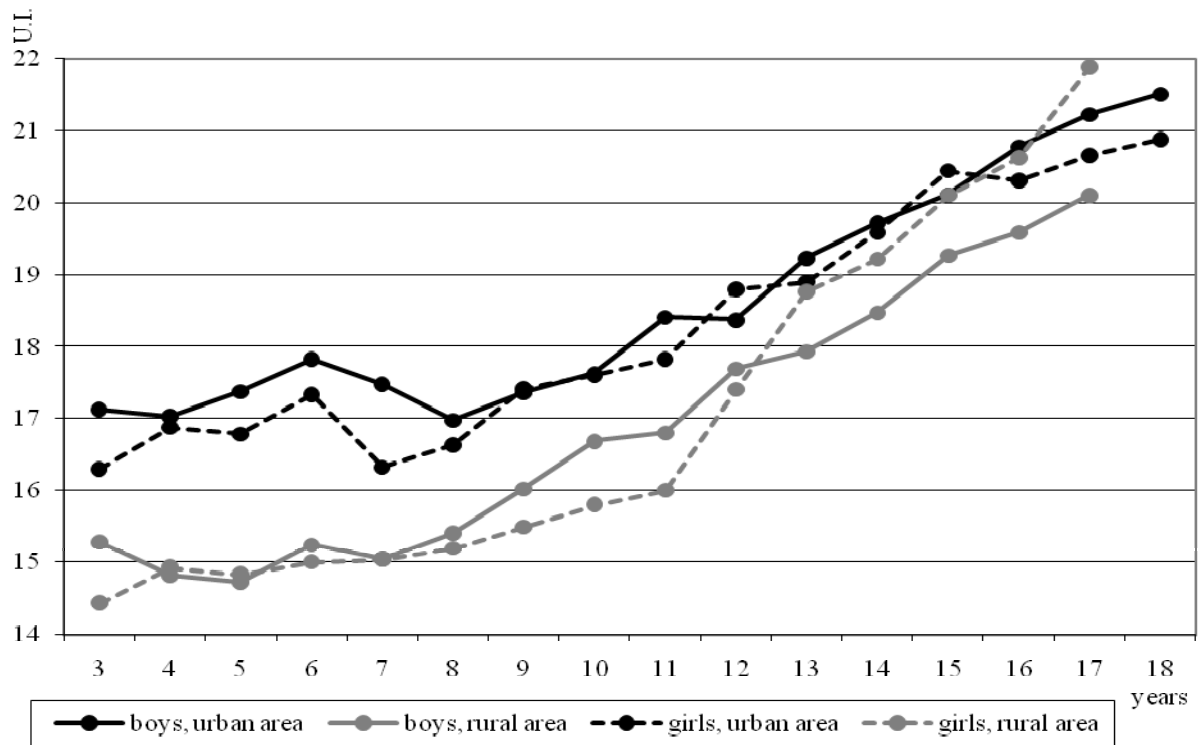


Fig. 3. Age evolution of the mean values of BMI in the boys and girls from the urban area, comparatively with those from the rural one.

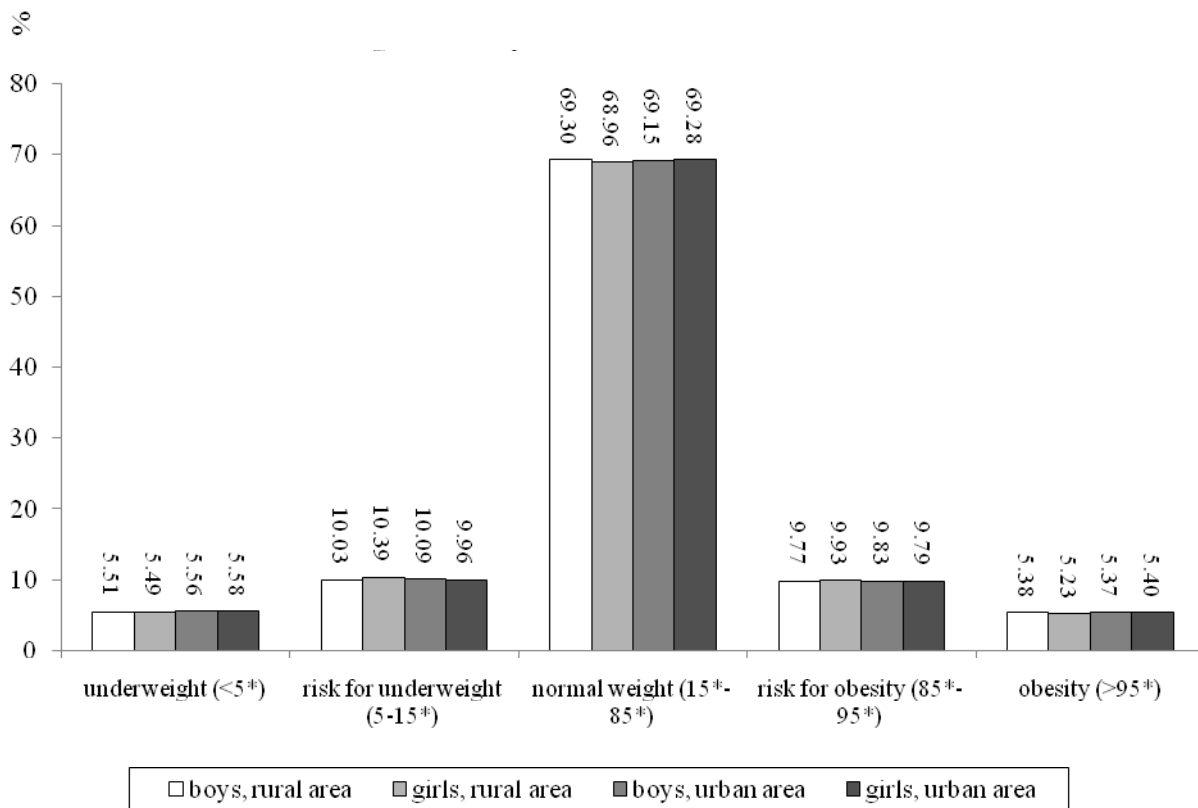


Fig. 4. Frequency on the categories (percentile scale) of the BMI values in the boys and girls of 3–18 years from the urban and rural media.

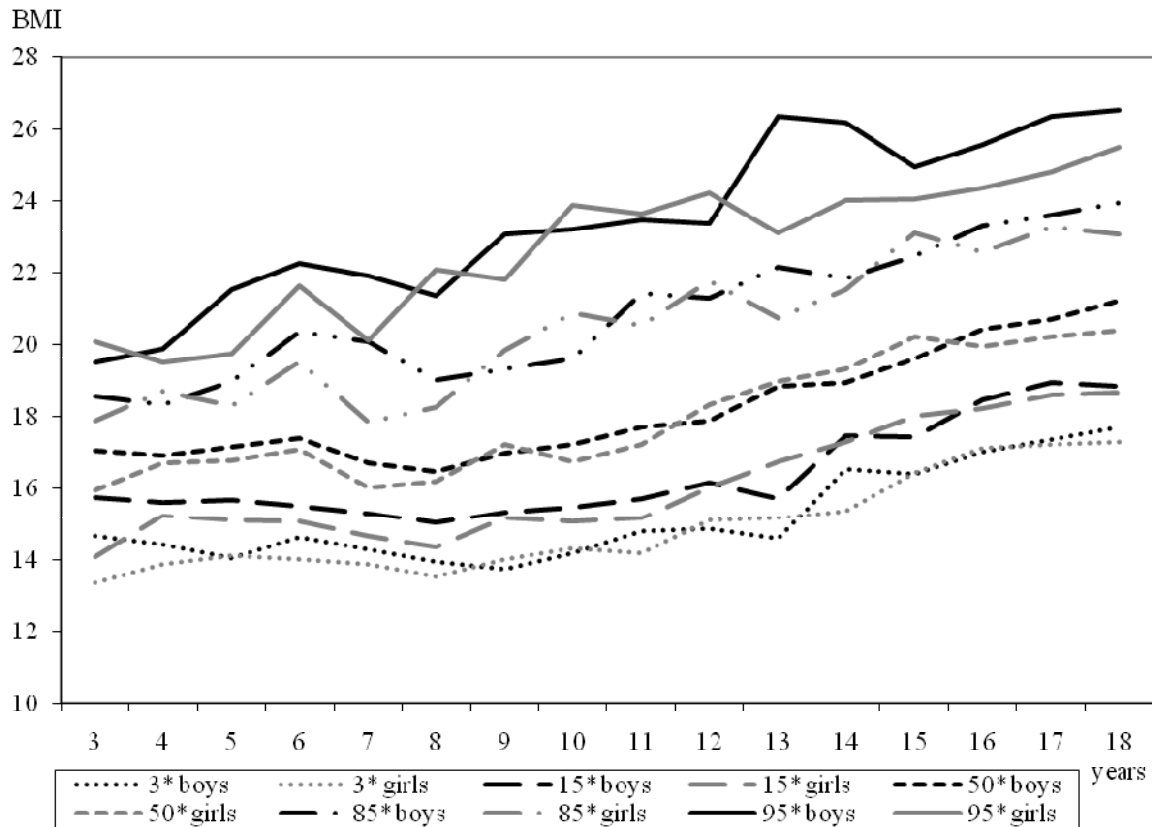


Fig. 5. Percentiles on classes of age boys and girls from the Iasi city.

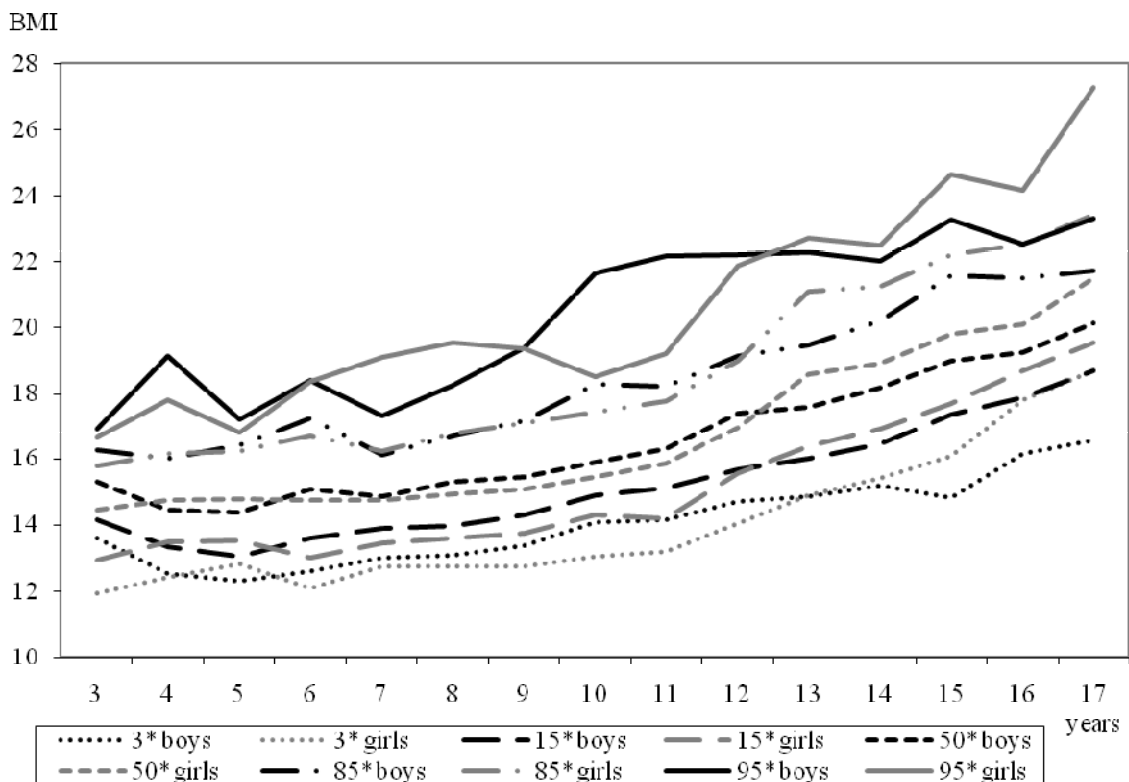


Fig. 6. Percentiles on classes of age boys and girls from the rural area of Iasi.

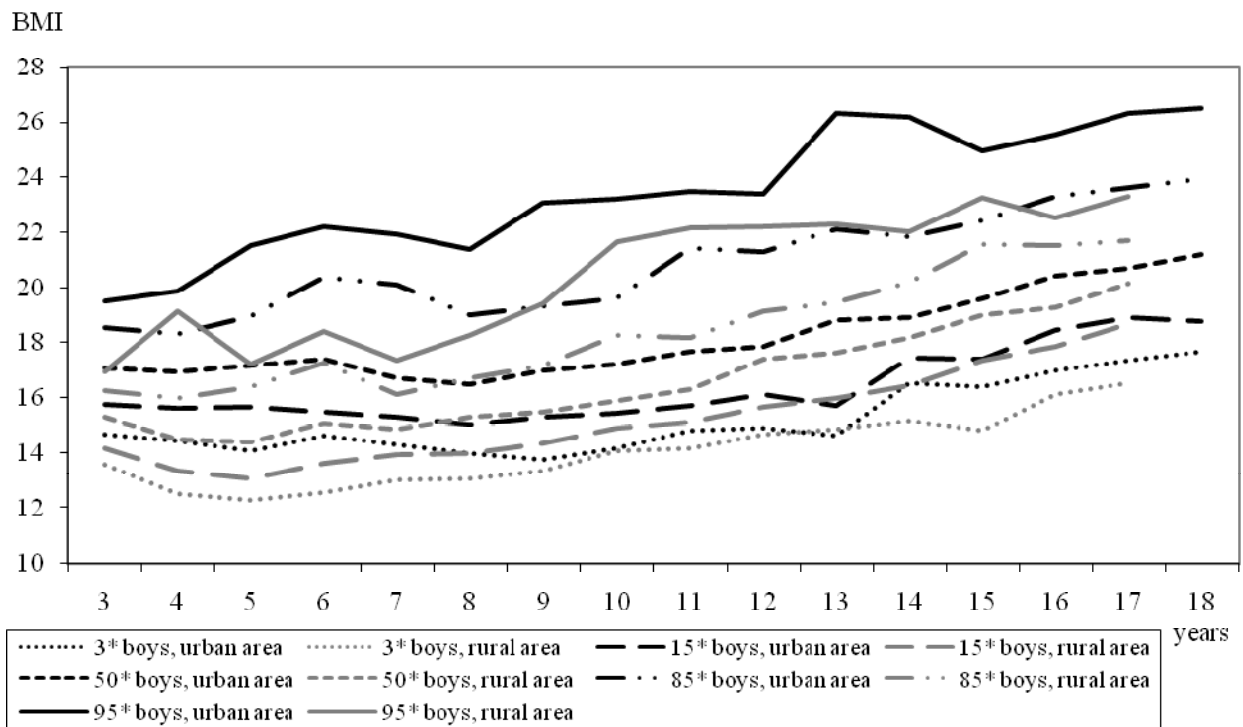


Fig. 7. Percentiles on classes of age in 3–18 year old boys from the urban medium *versus* those of the rural area.

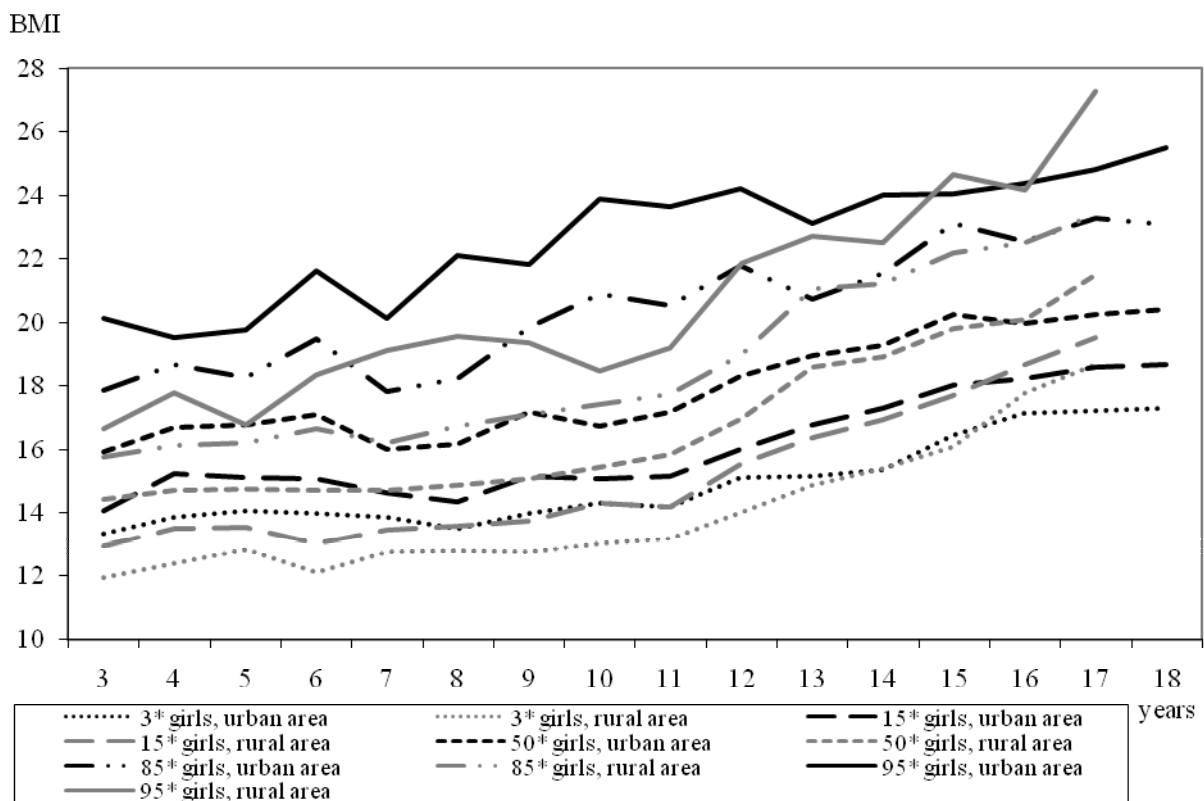


Fig. 8. Percentiles on classes of age in 3–18 year old girls from the urban medium *versus* those of the rural area.

Actually, the results obtained – plotted graphically in Figure 4 – are almost identical, if not wholly identical, with those provided by the literature of the field (Macovei *et al.* 2006–2007: 76; Radu *et al.* 2006–2007: 88–91; Radu *et al.* 2006–2007: 172).

Mention should be nevertheless made of slightly more obvious age variability in the frequency of subjects from the main weight categories, at the level of one and the same sex and group. Consequently, the largest variability in the frequency of subjects (the amplitude of which varies between 2.55 and 6.46%) is recorded – in both groups and for both sexes – in normo-ponderals. Indeed, in the urban batch, the frequency of subjects from this category varies, in boys, between a minimum ratio of 68% at 3 years and a maximum one, of 70.59%, at 12 years while, in girls, the values range between 67.27% at 3 years and 70.11 % at 18 years, respectively. In the rural batch, the variability in boy's ranges between 68.42% at 7 years and 70.97% at 16 years, respectively, the values recorded in girls being between 64.29% at 3 years and 70.75% at 5 years. This variability, slightly higher from one class of age to another than at the level of all ages from one sex to another or from one series to another is, beyond any doubt, the result of the much more reduced number on classes of age than at the level of all ages.

CONCLUSIONS

The study devoted to the stature-weight ratio, determined by the Quetelet index, and evaluated by the percentile method, put into evidence the predominance of normo-ponderal subjects both in the group of children and adolescents from both media (urban and rural), the percent value registered in both sexes being of about 70%.

At the same time, one should not neglect the quite high percent value of about 30%, or slightly over 30% of which 10% are liable of becoming sub-ponderal and 5% are already sub-ponderal, other 10% are supra-ponderal, risking of becoming obese people, and 5% are even obese. Against such a background, the main factors expected to take preventive measures – *i.e.*, parents, teachers and medical staff – should firstly consider all children, belonging not only to the normo-ponderal category (representing 30%) but also to the sub-ponderal (5%) and obese (5%) ones.

Mention should be also made, again, of the reserve of the authors on the percentile methodology

applicable for the evaluation of weight categories, because – as evidenced by the obtained results – the differences recorded between sexes, as well as those between the urban and the rural series are practically imperceptible. As a matter of fact, the same imperceptible differences have been observed, too, for other series discussed in the literature of the field (Macovei *et al.*, 2006–2007: 76, Radu *et al.* 2006–2007: 83 – 88–90 and 172).

REFERENCES

1. Cristescu Maria 1969, *Aspecte ale creșterii și dezvoltării adolescenților din România*, Editura Academiei Române, București.
2. Macovei Alexandra, Elena Radu, Luminița Oana Ciotaru 2006-2007, *Obesity and body image among high school pupils*, Ann. Roum. Anthropol., **43–44**, p. 73–82.
3. Macovei Alexandra, Elena Radu, Luminița Oana Ciotaru, Mihaela Pavel 2006-2007 *Nutritional health habits in school-children aged 11-18 years*, Ann. Roum. Anthropol., **43–44**, p. 179–199.
4. Radu Elena, Luminița Oana Ciotaru, Alexandra Macovei, Mihaela Pavel 2006–2007, *Nutritional behavior and the risk for obesity among children and teenagers*, Ann. Roum. Anthropol., **43–44**, p. 83–91.
5. Radu Elena, Luminița Oana Ciotaru, Camelia Șandru, Alexandra Macovei 2006-2007, *Body mass variability in children aged 11-18*, Ann. Roum. Anthropol., **43–44**, p. 159–178.
6. Știrbu Maria, C. Fedor, Monalisa Stupu 2001, *Noi date privind nivelul de dezvoltare fizică a copiilor de 7–10 ani*, Memoriile Secțiilor Științifice, s. IV, **XXIV**, p. 153–156.
7. Știrbu Maria, Georgeta Miu, Angela Simalcsik 2003, *Données concernant la dynamique du processus d'accélération de la croissance et du développement des adolescents et des jeunes*, Ann. Roum. Anthropol., **40**, p. 53–62.
8. Știrbu Maria, Georgeta Miu, Maria Istrate 2004, *Some aspects on the modifications – in time- of the growth and development in teen-agers from some rural communities of the Iassy county*, Ann. Șt. Univ. „Al.I.Cuza”, Iași, s. Biologie animală, **L**, p.363–373.
9. Știrbu Maria, Georgeta Miu, Maria Istrate, C. Fedor, Monalisa Stupu, R. Simalcsik 2005, *Aspecte privind creșterea și dezvoltarea copiilor de 7–10 ani din mediul rural*, Memoriile Secțiilor Științifice, s. IV, **XXV**, p. 143–152.
10. Știrbu Maria, Monalisa Stupu, R. Simalcsik, C. Fedor 2005, *Noi date privind creșterea și dezvoltarea adolescenților de 11–16 ani din unele comunități rurale ale județului Iași*, Memoriile Secțiilor Științifice, s. IV, **XXVI**, p. 175–186.
11. Știrbu Maria, Georgeta Miu, Angela Simalcsik, R. Simalcsik, C. Fedor 2008, *Aspects on the growth and development of 3–6 year old children from some rural communities of the Jassy district, comparatively with a similar sample group from the city of Jassy*, Memoriile Secțiilor Științifice.
12. *** WHO, Physical status, 1995, *The use and interpretation of anthropometry*, report of a WHO Expert Committee, Geneva.