Morphological Characteristics and Obesity Indicators in Primary School Children in Slavonija: Cross-Sectional Study

Zvonimir Tomac[1], Mara Šumanović[1] and Ivan Prskalo[2]
[1] Faculty of Teacher Education, University of Josip Juraj Strossmayer in Osijek,
[2] Faculty of Teacher Education, University of Zagreb

Abstract

The aim of the study was to determine the growth rate, nutritional status, as well as possible differences between children from different demographic areas in Slavonia. The sample consisted of 801 children (407 boys and 394 girls) from grades 1 to 4 in several primary schools in Slavonia. The sample was divided into two subsamples urban/rural, which were thereafter classified within each subsample according to gender. A sample of variables consisted of two anthropometric recordings of body height and body weight, after which a body mass index – BMI was calculated.

The basic descriptive parameters were calculated and the t-test was used for determining the difference between the observed variables. A two-factor multivariate analysis of variance (MANOVA) tested the significance of differences between the two subsamples.

No significant differences were observed between anthropometric characteristics of children from urban and rural areas. There is a noticeable trend of steady growth in body height and body weight for both genders. BMI also shows a negative trend of increase for both genders, and there are also more children who are at risk of obesity during the first four grades. Significant differences were observed only between genders in grades 1 and 2 in which boys are more dominant in body height and body weight.

Systematic monitoring of anthropological characteristics should be an integral part of children's growth and development in order to ensure timely and adequate precaution measures and prevent negative health effects.

Key words: *anthropometry, BMI, children, growth, nutritional status*

Introduction

The phenomena of growth and development and their specific features are determined by exogenous and endogenous factors. Children's growth and development can be indicators of health as well as of the quality of life and nutrition. Furthermore, it is a well-known fact that anthropometric characteristics vary in time depending not only on endogenous factors, but also on ethnic, socio-economic, and other exogenous factors (Zsidegh et al., 2007; Jones et al., 2009). All of these characteristics condition the interaction of genetic and environmental factors influencing growth and development. Children's growth and development usually occur simultaneously and complement each other, but there are periods in which one of them independently slows down or accelerates. Today the term "growth" implies quantitative anatomical and physiological changes, that is, morphological maturation, while development implies functional maturation or development of psychological and motor skills. In studying the growth process, it was determined that it does not develop linearly, but during extrauterine development, depending on age, a person goes through two stages of rapid growth and two phases of slow growth (according to Mišigoj - Duraković, 2008). Studies have shown that early school age (6-10 years) is a relatively stable phase in which there are no drastic changes or deviations in growth between genders, but individual differences may be observed (Malina and Bouchard, 1991). Body height and weight vary in different geographic regions of the world (Launer and Harris, 1996; Janssen et al., 2005), but also in different demographic areas of the same region (Aberle et al., 2009). Also, over the last few decades many studies have identified increasing trends in the incidence of overweight and obese children worldwide (Reilly and Dorosty, 1999; Ogden et al., 2002; Janssen et al., 2005; Ogden et al., 2006; Reilly, 2007). Since anthropometric characteristics may be an indicator of health status, diet quality and nutritional status of a population (WHO, 1995; de Onis & Blossner, 2003; Hansen et al., 2005), research on anthropometric characteristics has become increasingly widespread among researchers. Thus, according to WHO recommendations (Cole, 2000; WHO, 2006), the most common indicator for assessing nutritional status is the BMI (body mass index).

Studies on anthropological characteristics, especially anthropometric characteristics, have systematically been carried out for many years, and with more frequent incidence of obesity in children and high correlation of these characteristics with health status such research has recently become more intense, not only in the world (de Onis and Habicht, 1996; de Onis et al., 2007; Cole, 2000) but in Croatia as well (Horvatin – Fučkar, Tkalčić and Vraneković, 2003; Horvat, Mišigoj –Duraković and Prskalo, 2009).

Research on anthropometric characteristics and determining children's growth rate and development has been conducted for many years, Pejčić et al. (1997) and the monitored development rate of children from different areas, Oja and Jürimäe (2002), in 6-7-year-old children, identified a significant increase in body height and a slight increase of BMI for both boys and girls, and body weight only for girls. Horvatin – Fučkar, Tkalčić and Vraneković (2003) determined different and uneven height increase among

boys in their population of primary school age children. Studying the morphological characteristics, Butte et al. (2006) suggest that the growth parameters, including body weight and body height are mainly a heritable trait. Using anthropometric measures and BMI, Zafirova and Todorovska, (2009), established a significant increase in body height and weight between two age groups of 6-and 7-year-old boys and girls. Aberle et al. (2009) determined that 4-year-old children whose measures were taken in 2005 were significantly shorter and lighter than the children measured in 1985. They also suggest that this is a consequence of war in 1991 in that region, which resulted in migrations and lower economic standard and development, but there was no significant difference in anthropometric measures and BMI in children from urban and rural areas in Slavonia. Apart from monitoring the anthropometric characteristics, the studies have also dealt with the impact of environment on the growth and development as well as potential differences in their rate for children who grow up in different demographic areas. Pejčić et al. (1997) determined a faster development rate in the morphological and motor space of urban children in comparison to rural children in Croatia. Based on anthropometric measurements, BMI and physical activity levels, Joens-Matre (2008) determined a more significant increase in body weight for children in rural areas than for children from towns and big cities. Although it is considered that due to changes in body structure during growth and development, and with respect to growth and development among different age and ethnic groups in children, it is not desirable to apply BMI (which is calculated using the formula: weight (in kg) divided by height (in meters) squared). More recent studies have shown a good correlation between BMI and total body fat content (Cole et al., 2007), i.e. adipose tissue in the body, which confirmed the suitability of the BMI application as an indicator of obesity in children and adolescents.

In the analysis of obesity increase and the proposed anthropometric measures, De Onis (2004), indicated that national programmes should include body height and weight measurement in the early detection of children with an increased risk of being overweight and obese, which should be recorded at least once a year. According to James and Lobstein (2009), in order to determine obesity in children it is necessary to use BMI percentiles adjusted to children's age and gender. It is also considered that BMI in children can be used to assess malnutrition (low BMI) or being overweight and obese (high BMI) (de Onis et al., 2007).

From the point of view of kinesiology, the knowledge of a child's anthropological status is essential for quality planning and programming of physical activity and choice of content which should facilitate and be in accordance with growth and development. Namely, the postulates of programming any physical activity process in kinesiology include anthropological features among which are also morphological features (Findak, 1997). Anthropometric characteristics are an important indicator of pupils' growth and development. Since each directed process of physical activity for children and the young is aimed at their development as well, being familiar with this data provides teachers with information crucial for further planning of their work (Findak, 2001).

The aim of this study was to determine the growth rate, nutritional status and the degree of possible differences in anthropometric characteristics between children in urban and rural areas in Slavonia.

Methods

Participants and Variables

The survey was conducted using a transverse random sample that consisted of 801 children (407 male and 394 female pupils) from grades 1 to 4 in several primary schools in Slavonia. The sample was divided into two subsamples, urban and rural, and each was further subdivided according to age and gender. The urban sample consisted of 204 male and 202 female pupils from places with city or town status in Slavonia; the rural sample consisted of 203 male and 192 female students from villages (places that do not have city status).

The sample of variables consisted of anthropometric measures, height (ATV), body weight (ATT) and body mass index (BMI). Body weight was measured using digital scales while height was calculated using an anthropometer according to IBP standard. The BMI was calculated for each pupil, and index value was thereafter converted into BMI percentiles (Cole et al. 2000, 2005) and the average BMI value according to age was calculated (for each class).

The data was collected during 2009 on a sample of 10 schools from urban areas and 10 schools from rural areas within the project Kinesiology education in preschool and primary education. Three experienced Kinesiology teachers from the Faculty of Teacher Education in Osijek were in charge of data collection.

Data Processing Methods

Basic descriptive parameters (mean, standard deviation and percentages) were calculated for each variable. The t-test was used to determine the differences in the observed variables between the subsamples, and a two-factor multivariate analysis of variance (MANOVA) tested the significance of the difference between the two subsamples, especially according to age and gender.

Results and Discussion

The results for body height and body mass in boys from urban and rural areas (Table 1) indicate that in absolute values, both subsamples for boys have similar values, and that their annual increment in body height and body mass is approximately equal.

The urban boys in grades 1 to 4 grew 17.5 cm taller in total, with an average annual growth of 5.3 cm, and the boys from rural areas grew 16.15 cm in height with an average gain of 5.5 cm.

During the same period the boys from urban areas gained a total of 10.45 kg in body mass, with an average annual gain of 3.5 kg, and the body weight of the boys from rural areas increased by 12.5 kg, with an average annual growth of 4.16 kg. Testing the significance of the difference in the observed variables, it was determined that there

were no statistically significant differences between the boys from urban and rural areas neither within certain age groups nor in the values of body height and body weight.

Table 1. *Anthropometric characteristics, descriptive parameters and t-test for the boys from urban and rural areas.*

Grade	Type	n	BH (height)			BW (weight)		
			Mean	Std.dev.	t –test	Mean	Std.dev.	t –test
1	Urban	50	127.2	5.22	0.61	27.4	6.48	0.32
	Rural	51	127.8	6.85		26.3	5.12	
2	Urban	51	134.4	5.11	0.32	30.85	4.93	0.78
	Rural	50	132.4	6.66		31.15	6.05	
3	Urban	52	138.78	6.74	0.16	33.55	7.41	0.97
	Rural	51	137.06	5.56		33.51	7.82	
4	Urban	51	144.74	7.35	0.59	37.85	8.49	0.62
	Rural	51	143.95	7.85		38.78	10.74	

*p = 0. 05

Testing the differences in the overall observed morphological area, no statistically significant difference was observed between the two groups. The results of the multivariate analysis of variance indicated that statistically significant differences can only be observed in the "age" factor (F = 52.9; p = 0.00), which is natural, considering the annual growth in body height and body weight, whereas for the "urban-rural" factor (F = 2.0; p= 0.14) and the interaction of these two factors (F =1.6; p =0.15), there were no statistically significant differences. Thus, we can say that the two groups of pupils from different demographic areas belong to the same population in the observed morphological area.
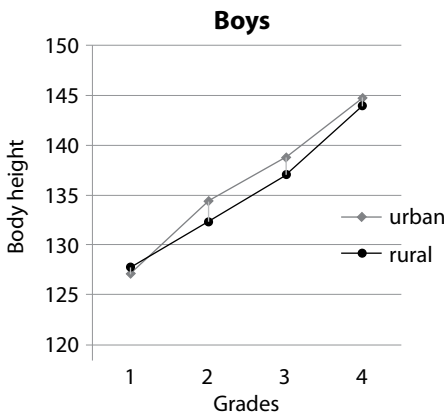

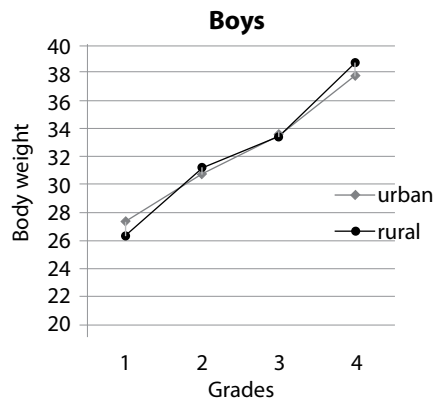
Figure 1. *Body height*

Figure 2. *Body weight*

Figure 1. and 2. Curves of growth in body height and body weight for the boys from grades 1 – 4.

Looking at the curve of growth in body height and body mass, it is evident that the curves in both observed variables for both groups are almost equal. This graphical representation is consistent with the results obtained, which indicates no differences between the pupils. It is obvious that there is a steady trend of increment both for body height and body weight.

Table 2. *Body mass index values for the pupils in urban and rural areas.*

Grade	Mean		t-test	
	Urban	Rural	t-value	p
1	17.10	16.00	2.30	0.02*
2	17.09	17.64	-1.29	0.20
3	17.25	17.69	-0.78	0.44
4	17.94	18.45	-0.82	0.41

*p = 0. 05

Considering body mass index values for the boys, there is a noticeable, steady increase during the first four grades of primary school. It is evident that the boys are around normal values regarding their age and gender. The only statistically significant difference between the two groups of boys in BMI is present merely in the first grade, while in other grades there are no significant differences in obesity. This result can be explained by the conditions imposed by the urban environment and the way of life, which is most evident in the lowest grade, while this difference disappeared later due to the "balanced" way of life during school age, which is reflected in a steady increment of the body mass index.

Similarly, the results for girls indicate approximately equal values in both groups of examinees for the observed variables, body height and weight. In the period from grade 1 – 4, urban girls grew taller for a total of 16.55 cm, with an average annual growth of 5.5 cm. In the same period, rural girls' height increased by 17.9 cm, with an average annual growth of 6 cm.

For the body weight of urban girls there was a notable increase of 10.21 kg, with an average annual gain of 3.40 kg, whereas body weight of rural girls increased by 13.35, kg, with an average annual gain of 4.45 kg.

Although somewhat higher scores were observed in the absolute values for girls in grade 4 from rural areas, the t-test determined that there was no statistically significant difference in the observed variables in any of the time periods.

Differences in body height and weight between girls in urban and rural areas.

Table 3. *Anthropometric characteristics, descriptive parameters and t-test for the girls from urban and rural areas.*

Grade	Type	n	BH (height)			BW (weight)		
			Mean	Std.dev.	t –test	Mean	Std.dev.	t –test
1	Urban	49	125.92	6.32	0.73	24.96	6.08	0.71
	Rural	52	126.34	6.08		24.67	4.07	
2	Urban	50	131.84	7.19	0.52	28.86	7.33	0.25
	Rural	38	130.80	6.23		27.24	5.26	
3	Urban	50	139.11	4.58	0.18	33.14	7.00	0.29
	Rural	51	137.59	6.47		31.77	5.84	
4	Urban	53	142.47	7.70	0.09	35.17	7.42	0.10
	Rural	51	144.33	9.31		38.02	9.73	

*p = 0.05

The results of multivariate analysis of variance indicated that statistically significant differences can only be observed in the "age" factor (F = 53.74; p = 0.00), but for the "urban-rural" factor (F =0.15; p = 0.86) and the interaction of these two factors (F = 1.40; p = 0.21), there were no statistically significant differences.

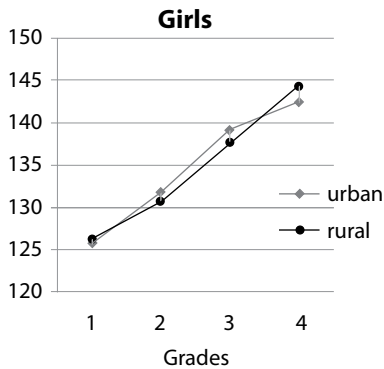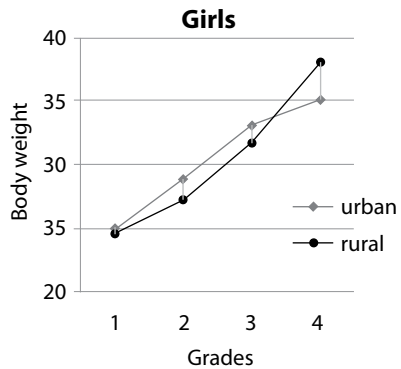**Figure 3.** *Body height*

Figure. 4 *Body weight*

Figure 3. and 4. Curves of growth in body height and body mass for the girls in urban and rural areas.

The curve of growth in body height and body mass was similar for girls in urban and rural areas, the same as for boys. But in this sample there is a linear growth trend discernible until the fourth grade, when there is a faster growth rate for female pupils from rural areas. Although it appears that girls in rural areas develop more intensively during this period, according to the results of difference analysis, it is obvious that this difference was not statistically significant.

Table 4. *Body mass index values for the female pupils in urban and rural areas.*

Grade	Mean		t- test	
	Urban	Rural	t-value	p = 0.05
1	15.70	15.40	0.83	0.41
2	16.44	15.82	1.08	0.28
3	17.06	16.75	0.54	0.59
4	17.18	17.79	-1.06	0.29

BMI scores also show an increase during the first four grades for the girls, both from urban and rural areas, but as with boys, girls are not at risk of becoming obese. It is evident that there was no statistically significant difference in the BMI of girls in urban and rural environments for all age groups.

BMI values converted into percentiles (Cole et al., 2000) for the boys and girls in Slavonia are shown in tables and graphs. Cole et al. (2000) emphasize that BMI values up to 85 percentiles represent a normal condition, 85 to 95 percentiles indicate overweight and values over 95 percentiles indicate obesity. Figures 5 and 6 shows the number of the pupils belonging to certain categories according to BMI percentile values.

Taking into account the entire population of younger school children from the region of Slavonia, the following results were obtained.
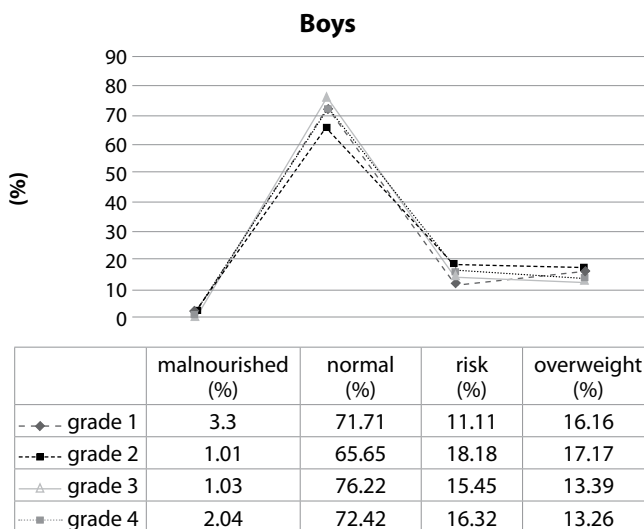

	malnourished (%)	normal (%)	risk (%)	overweight (%)
grade 1	3.3	71.71	11.11	16.16
grade 2	1.01	65.65	18.18	17.17
grade 3	1.03	76.22	15.45	13.39
grade 4	2.04	72.42	16.32	13.26

Figure 5. *Percentage of the boys categorised according to percentiles.*

These results indicate that the largest number of the boys have normal weight, but also that a high percentage of children are at risk or in the overweight category. If we combine these two categories, it is apparent that around 30% of children have potential problems with excessive body weight and there is a noticeable trend of increase with chronological age.
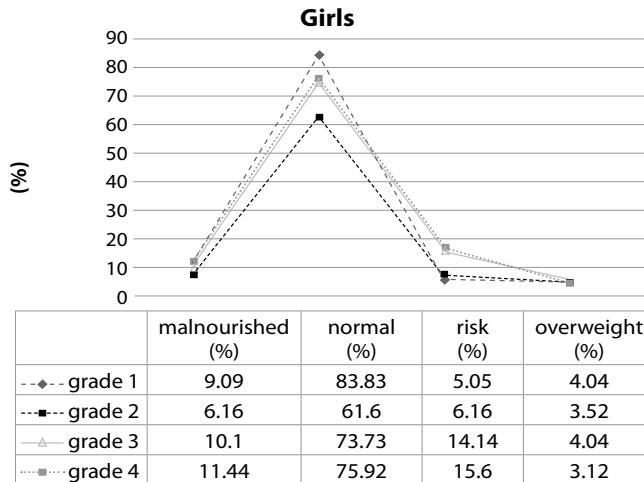
	malnourished (%)	normal (%)	risk (%)	overweight (%)
--◆-- grade 1	9.09	83.83	5.05	4.04
---■--- grade 2	6.16	61.6	6.16	3.52
--△-- grade 3	10.1	73.73	14.14	4.04
·····■····· grade 4	11.44	75.92	15.6	3.12

Figure 6. *Percentage of the girls categorised according to percentiles.*

As is the case with boys, most of the girls at a younger school age are in the category of normal weight. But similarly to boys, there is a noticeable trend of increase in the percentage during growth and development. Also, there are more children at risk of being overweight or the obesity zone. For girls, this percentage, which is around 20%, was most evident in grades 3 and 4. The results presented in percentages indicate that most of the Slavonian children taking part in this research are mainly in the normal range. Still, for both genders, there is a noticeable negative trend and the increase in the number of children in the categories that represent a risk for being overweight or obese, which is especially emphasized in boys, particularly in grade 2. Thus, the percentage of children who are above the 85th percentile is rising, which is in line with the negative trend of increase in BMI during the first four grades of primary school, both for boys and girls.

Differences between Genders in the Observed Anthropometric Area

Studying the growth rate and obesity degree in boys and girls during the first four grades of primary school the following results were obtained.

Table 5. *Anthropometric characteristics, descriptive parameters and t-test for the boys and girls.*

Grade	Type	n	BH (Height)			BW (Weight)		
			Mean	Std.dev.	t –test	Mean	Std.dev.	t –test
1	Boys	101	127.53	6.08	-0.11	27.07	5.44	0.00*
	Girls	101	126.14	6.17		24.81	3.88	
2	Boys	101	133.28	5.96	0.04*	31.00	5.49	0.00*
	Girls	88	131.39	6.77		28.16	6.53	
3	Boys	103	137.94	6.22	0.63	33.53	7.58	0.27
	Girls	101	138.34	5.64		32.45	6.44	
4	Boys	102	144.35	7.58	0.68	38.32	9.65	0.17
	Girls	104	143.88	8.61		36.57	8.71	

*p = 0. 05

The descriptive parameters and analysis of differences in body height and body mass between boys and girls indicate significant differences only in grades 1 and 2, when the boys are more dominant than the girls, whereas in grades 3 and 4 there are no statistically significant differences in anthropometric characteristics.

Although the increase in body height and weight for both groups is average, it is obvious that for the girls, there is a more rapid increase of growth rates between grades 2 and 3 when they grew up to 7 cm and gained 4 kg in body mass. In this period the girls' development is close to the boys' and statistically significant differences disappear.

The results of multivariate analysis of variance indicate a significant difference between the two groups with respect to gender (F = 9.11; p = 0.00) and age (F = 105.36; p = 0.00). However, there are no differences in the interaction of these two factors (F = 0.58; p = 0.75). Also, the discrepancy between the groups according to gender is more significant than according to regional and urban-rural factors, which do not indicate any significant differences between the two samples. Based on the obtained results we can conclude that the observed population differs more according to gender than the geographical environment where they come from.

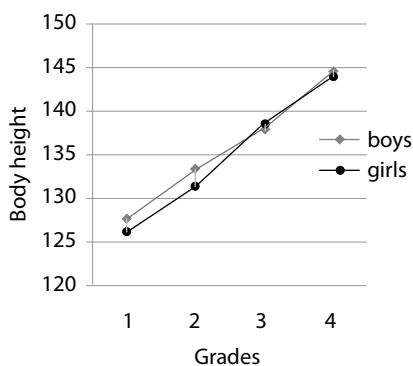Figures 7. and 8. The curves of growth in body height and body mass for the boys and girls.
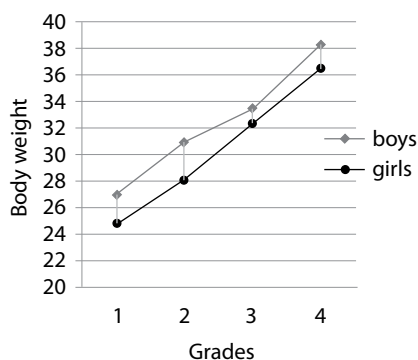

Figure 7. *Body height*

Figure 8. *Body weight*

Table 6. *BMI values and the difference between the boys and girls.*

	Mean		t- test	
Grade	Boys	Girls	t-value	p = 0.05
1	16.54	15.55	-3.26	0.00*
2	17.36	16.17	-3.37	0.00*
3	17.47	16.9	-1.43	0.15
4	18.19	17.48	-1.68	0.09

*p = 0.05

The same as in anthropometric measures, male pupils have a statistically more significant higher BMI in grades 1 and 2, while in grades 3 and 4 differences in BMI were not significant.

This is the result of the girls' rapid increase in body weight that happens in grade 3 and is significantly higher than that of boys. Namely, specific sexual dimorphism on most parameters of growth and development begins to manifest itself significantly during sexual maturation and until puberty girls' and boys' development progresses evenly. Even then there are distinctive features, such as the pelvic bone basis point, which reflects differences already in intrauterine life and in the prepubertal period there are also differences in psychological aspects. The size of the pituitary and its development are indicators of sexual dimorphism (MacMaster et al. 2007). Pubertal momentum of growth starts earlier and ends earlier in girls. The first manifestations of puberty are associated with the beginning of maximum growth rate and menarche appears only at the end of the maximum growth (Tanner, 1986). A rapid increase of BMI could be attributed to sexual dimorphism, which will not be manifested until puberty. These changes in grades 3 and 4 have neutralised the "advantage" in boys' BMI in grades 1 and 2. Furthermore, the research shows that younger school children in the Slavonian region show a significant trend of increase in body height and body weight during the first four grades of primary school. The increment of body height is in line with natural growth and development that occurs at this age when the values of height increase are stable and amount to 5cm per year (according to Mišigoj-Duraković, 2008). Mean results of body height, body weight and BMI are also consistent with the results of previous research in this area: Katić et al., (2009), Horvat, Mišigoj – Duraković and Prskalo (2009), Zafirova and Todorovska (2009). The percentage of children who are at risk of obesity, as well as BMI values, show a steady upward trend, which is not positive. Since obesity has recently become a major public health problem for both adults and children, and BMI can be used to assess malnutrition (low BMI) or being overweight or obese (high BMI) (de Onis, 2007), the obtained BMI values were compared to standards. It is recommended that children who are between 5 and 85 percentile should be considered having normal weight, children between 85-95 percentiles should be considered having an increased risk of obesity, and children who are above 95 percentile should be classified as obese. It is clear that most children in the Slavonian region are in the range of 5-85 percentiles, which is considered normal. However, the observed trend of the increasing BMI and the number of children with a higher BMI from grades 1–4 must be treated with an adequate approach to nutrition and physical activity in order to prevent obesity. De Onis (2007) states that the measures for preventing the incidence of obesity should include: 1) recumbent length for children under 2 years and standing height for adults so that BMI and "height to weigh ratio" can be calculated, 2) dissemination of programmes which include the assessment of body weight from birth to 18 years, 3) interpretation of anthropological measures in relation to the prescribed reference data, 4) early intervention among parents and educators in terms of support and promotion of healthy eating habits and physical activity. Also, the obtained results are similar to the values presented in Horvat, Mišigoj – Duraković

and Prskalo (2009) and Zafirova and Todorovska (2009). Although it was assumed that, according to popular opinion, there would be differences between urban and rural children in anthropometric characteristics, the obtained results showed that there was no difference. The same was confirmed in the study by Aberle et al. (2009) which determined that preschool children in Slavonia from urban and rural areas, in the region around Slavonski Brod, also did not differ in body height and body weight. However, Pejčić et al. (1997) found statistically significant differences in some morphological measures in children from the Goranska and Primorska region, as well as Jens - Matre et al. (2008) who determined more significant increase in body weight among children in rural areas than among children from towns and bigger cities. They also concluded that children from small towns are the most physically active. These results could be explained by the fact that not many places in Slavonia, which have a formal city status, have been completely urbanized and also by a short period of time in which the differences in the developmental stages in these two samples could not be perceived. The differences between boys and girls may be attributed to sexual dimorphism and more rapid development of girls during elementary education. Zafirova and Todorovska (2009) also found a significant increase in body height and weight between the two age groups of 6- and 7-year-old children both for boys and girls, as well as gender differences in anthropometric parameters, where the boys were more dominant, except in the skin fold measures. It is a well-known fact that girls reach puberty and mature earlier than boys, so the differences were only noticeable in the first and second grade. However, because of their more rapid development girls catch up with their peers, and perhaps in higher grades of primary school they even surpass them in the observed anthropometric characteristics. Oja and Jürimäe (2002) established a significant increase in body height both for boys and girls, and body weight only for girls during a two-year development, at the age of 6 and 7. Butte et al. (2006) state that the determinants of human growth, timing and puberty rate, and other measures of bone and sexual maturation are under genetic control.

Conclusion

The results obtained in this research indicate that there are no differences between the male and female pupils from urban and rural areas in Slavonia, but there is a significant increase of overweight children, especially girls, after the second grade. Such results suggest that there is no need for differentiated Physical education programmes in certain areas, but it is necessary to select subject matter and activities which can influence the incidence of obesity in younger school children. A systematic monitoring of children's anthropological features should be an integral part of their growth and development since in this way we can detect early defects in children's growth and development, which can then be treated either preventively by adequate kinesiology programmes from kinesiological aspect or by medical treatments from clinical aspect. Further interest by Kinesiology teaching methodology for research of morphological

characteristics and their concepts is based on the fact that the prescribed Physical education syllabus for primary schools emphasizes, in anthropological component, stimulation of optimal development of pupils' morphological characteristics. Therefore, these characteristics are continuously being fostered and monitored in all aspects of Physical education. When maintaining children's health, their nutrition and regular physical activity should be monitored in order to protect children from harmful consequences imposed by modern life.

References

Aberle, N., Blekić, M., Ivaniš, A. & Pavlović, I. (2009). The Comparison of Anthropometrical Parameters of the Four-Year-Old Children in the Urban and Rural Slavonia, Croatia, 1985 and 2005. *Collegium Antropollogicum, 33* (2), 347-351.

Butte, N.F., Garza, C. & de Onis, M. (2006). Evaluation of the Feasibility of International Growth Standards for School-Aged Children and Adolescents. *The Journal of Nutrition Symposium: A New 21st-Century International Growth Standard for Infants and Young Children* (pp 153 -157). Retrieved from jn.nutrition.org on 15 March 2010.

Cole, T.J., Bellizzi, M.C., Flegal, K.M. & Dietz, W.H. (2000). Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey. *British Medical Journal*, 320, 1240 – 1246.

Cole, T.J., Faith, M.S., Pietrobelli, A. & Heo, M. (2005). What is the best measure of adiposity change in growing children: BMI, BMI %, BMI z-score or BMI centile?. *European Journal of Clinical Nutrition, 59*, 419–425.

Cole, T.J., Flegal, K.M., Nicholls, D. & Jackson, A. (2007). Body mass index cut offs to define thinness in children and adolescents: international survey. *British Medical Journal, 335*, 1-8.

de Onis, M. & Habicht, J-P. (1996). Anthropometric Reference Data for International Use: Recommendations from a World Health Organization Expert Committee. *American Journal of Clinical Nutrition* 64 (4), 650 – 658.

de Onis, M. & Blossner, M. (2003). The World Health Organization Global Database on Child Growth and Malnutrition: Methodology and Applications. *International Journal of Epidemiology*, 32(4), 518 – 526.

de Onis, M. (2004). The use of anthropometry in the prevention of childhood overweight and obesity. *International Journal of Obesity, 28*, 81–85.

de Onis, M., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C. & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization, 85*(9*)*, 660–667.

Findak, V. (2001). *Metodika tjelesne i zdravstvene kulture, priručnik za nastavnike tjelesne i zdravstvene kulture.* Zagreb: Školska knjiga.

Findak, V. (1997). *Programiranje u tjelesnoj i zdravstvenoj kulturi.* Zagreb: Školske novine.

Hansen, S.E., Hasselstrbm, H., Grbnfeldt, V., Froberg, K. & Andersen, L.B. (2005). Cardiovascular disease risk factors in 6–7-year-old Danish children: the Copenhagen School Child Intervention Study. *Preventive Medicine, 40*, 740–746.

Horvat, V., Mišigoj-Duraković, M. & Prskalo, I. (2009). Body Size and Body Composition Change Trends in Preschool Children over a Period of Five Years. *Collegium Antropollogicum, 33* (1), 99–103.

Horvatin-Fučkar, M., Tkalčić, S. & Vraneković, S. (2003). Antropometrijske karakteristike učenika od 1. do 4. razreda osnovne škole. *V. Findak (ur.),Zbornik radova, 12. Ljetna škola kineziologa Republike Hrvatske,* (str 219 – 222). Rovinj, Hrvatska, Fakultet za fizičku kulturu.

Janssen, I., Katzmarzyk, P.T., Boyce, W.F., Vereecken, C., Mulvihll, C., Roberts, C., Currie, C., Pickett, W. Health Behaviour in School- Aged Children Obesity Group. (2005). Comparison of Overweight and Obesity Prevalence in School – Aged Youth from 34 Countries and Their Relationship with Physical Activity and Dietary Patterns. *Obesity Reviews, 6(2), 123 – 132.*

James, W.P.T. & Lobstein, T. (2009). BMI Screening and Surveillance: An International Perspective. *Pediatrics,* 124 (1), 42-49.

Joens-Matre, R.R., Welk,G.J., Calabro, M.A., Russell, D.W., Nicklay, E. & Hensley, L.D. (2008). Rural-Urban Differences in Physical Activity, Physical Fitness, and Overweight Prevalence of Children. *Journal of Rural Health, 24* (1), 1 49-54.

Jones, R.A., Okely, A.D., Gregory, P. & Cliff, D. (2009). Relationship between Weight Status and Child, Parent and Community Characteristics in Preschool Children. *International Journal of Pediatrics Obesity,* 4 (1), 54 – 60.

Katić, R., Pejčić, A. & Viskić- Štalec, N. (2009). The Mechanisms of Morphological-Motor Functioning in Elementary School Female First- to Fourth-Graders. *Collegium Antropollogicum, 28* (1), 261–269.

Launer, L.J. & Harris, T. (1996). Weight, Height and Body Mass Index Distributions in Geographically and Ethnically Diverse Samples of Older Persons. *Age and Aging,* 25 (4), 300 – 306.

MacMaster, F.P., Keshavan, M., Mirza ,Y., Carrey, N., Upadhyaya, A.R., El-Sheikh,R., Buhagiar, C.J., Taormina, P., Boyd, C., Lynch, M., Rose, M., Ivey, J., Moore, G.J. & Rosenberg, D.R. (2007). Development and sexual dimorphism of the pituitary gland. *Life Sciences*, *80 (10)*, 940-944.

Malina, R.N. & Bouchard, C. (1991). *Growth, maturation and physical activity*. Human Kinetics Books, Champaign, IL.

Mišigoj – Duraković, M. (1995). *Morfološka antropometrija u športu*. Fakultet za fizičku kulturu, Zagreb.

Mišigoj-Duraković, M. (2008). *Kinantropologija – biološki aspekti tjelesnog vježbanja*. Kineziološki fakultet Sveučilišta u Zagrebu, Zagreb.

Ogden, L.C., Flegal, K.M., Carrol, M.D. & Johnson, C.L. (2002). Prevalence and Trends in Overweight among US Children and Adolescent 1999 -2000. *The Journal of the American Medical Association,* 288, (14), 1728 – 1732.

Ogden, L.C., Carrol, M.D., Curtin, L.R., McDowell, M.A., Tabak, C.J. & Flegal, K.M. (2006). Prevalence of Overweight and Obesity in the United States, 1999-2004. *The Journal of the American Medical Association*, 295, (13), 1549 – 1555.

Oja, L. & Jürimäe, T. (2002). Changes in anthropometrical characteristics during two years in 6 year old children. *Anthropologischer Anzeiger*, *60* (3), 299-308.

Pejčić, A., Katić, R., Štalec, J. & Viskić-Štalec, N. (1997). Morfološko-motoričke karakteristike dječaka i djevojčica primorskoga i gorskoga kraja. *1. međunarodna znanstvena konferencija Kineziologija-sadašnjost i budućnost* (pp 60 – 62). Dubrovnik, Hrvatska, Fakultet za fizičku kulturu, Sveučilište u Zagrebu.

Reilly, J.J. & Dorosty, R.A. (1999). Epidemic of Obesity in UK Children. *The Lancet*, 354 (9193), 1874 – 1875.

Reilly, J.J. (2007). Childhood Obesity: An Overview. *Children & Society*, 21 (5), 390 – 396.

Tanner, J.M. (1986). Normal Growth and Techniques of Growth Assessment. *Clinics in Endocrinology and Metabolism*, 15 (3), 411 – 451.

WHO Child Growth Standards (2006). Retrieved on 20 February 2012 from http://www. who.int/childgrowth/standards/en/.

Zafirova, B. & Todorovska, L. (2009). Anthropometric parameters of growth and nutritional status in children aged 6 to 7 years in R. Macedonia. *Advances in Medical Sciences*, 54 (2), 289-295.

Zsidegh, P., Photiou, A., Meszaros, Z., Prokai, A., Vajda, I., Sziva, A & Meszaros, J. (2007). Body Mass Index, Relative Body Fat and Physical Performance of Hungarian Roma Boys. *Kinesiology*, 39 (1), 15- 20.

Zvonimir Tomac
Faculty of Teacher Education, University of Josip Juraj Strossmayer in Osijek
Ulica cara Hadrijana b.b.. 31 000 Osijek, Croatia
ztomac@ufos.hr

Mara Šumanović
Faculty of Teacher Education, University of Josip Juraj Strossmayer in Osijek
Ulica cara Hadrijana b.b.. 31 000 Osijek, Croatia
msumanovic@ufos.hr

Ivan Prskalo
Faculty of Teacher Education, University of Zagreb
Savska cesta 77, 10 000 Zagreb, Croatia
ivan.prskalo@ufzg.hr

Morfološka obilježja i pokazatelji pretilosti djece mlađe školske dobi u Slavoniji

Sažetak

Cilj ovog istraživanja bio je utvrditi tempo rasta, stupanj uhranjenosti kao i moguće razlike djece različitih demografskih područja u Slavoniji. Uzorak ispitanika činilo je 801 dijete (407 učenika i 394 učenica) 1. do 4. razreda osnovnih škola u Slavoniji, a uzorak varijabli činile su dvije antropometrijske mjere: tjelesna visina i tjelesna masa te je izračunat indeks tjelesne mase - BMI

Izračunati su osnovni deskriptivni parametri za utvrđivanje razlika u promatranim varijablama. Korišten je i t-test, a dvofaktorskom multivarijatnom analizom varijance (MANOVA) testirala se značajnost razlika između dva subuzorka. Uočeno je kako nema značajne razlike u promatranim antropometrijskim karakteristikama između djece urbanih i ruralnih sredina. Kod oba spola je primjetan ravnomjeran trend prirasta u tjelesnoj visini i tjelesnoj masi. Vrijednosti BMI također pokazuju negativan trend porasta kod oba spola, kao i povećanje broja djece koja se nalaze u zoni rizika od pretilosti, tijekom prva četiri razreda. Značajne razlike primjećene su samo između spolova u 1. i 2. razredu pri čemu su dječaci dominantniji u tjelesnoj visini i tjelesnoj masi.

Sustavno praćenje antropoloških obilježja trebalo bi biti neizostavno tijekom rasta i razvoja djece kako bi se pravovremenim i adekvatnim pristupom preventivno djelovalo na organizam i spriječile negativne posljedice na zdravlje.

Ključne riječi: *antropometrija, BMI, djeca, razvoj, stupanj uhranjenosti*

Uvod

Fenomeni rasta i razvoja i njihove specifičnosti uvjetovani su egzogenim i endogenim čimbenicima. Rast i razvoj djece mogu biti indikatori zdravlja, kao i kvalitete ishrane i života. Isto tako poznato je i da antropometrijske karakteristike variraju u vremenu ovisno, ne samo o endogenim čimbenicima, nego i o etničkim, socio-ekonomskim, i drugim egzogenim faktorima (Zsidegh i sur., 2007; Jones i sur., 2009). Na taj način sve te karakteristike uvjetuju međusobno djelovanje nasljednih i

okolinskih faktora na rast i razvoj. Najčešće, rast i razvoj teku paralelno i međusobno se dopunjuju, no ipak postoje razdoblja u kojima se svaki od njih, neovisno jedan o drugom, usporavaju ili ubrzavaju. Danas se pod pojmom rasta podrazumijevaju kvantitativne anatomske i fiziološke promjene, odnosno morfološko sazrijevanje, dok se pod razvojem podrazumijeva funkcionalno sazrijevanje, ili razvoj psiholoških i motorički sposobnosti. Proučavanjem procesa rasta došlo se da spoznaja kako se on ne odvija linearno, nego tijekom ekstrauterinog razvoja. Ovisno o dobi, čovjek prolazi kroz dvije faze ubrzanog rasta i dvije faze usporenog rasta (prema Mišigoj – Duraković, 2008). Istraživanja su pokazala kako je mlađe školsko doba (6-10 godina) relativno stabilna faza u kojoj nema burnih promjena i velikih odstupanja u rastu između spolova, ali s mogućim individualnim razlikama (Malina i Bouchard, 1991). Tjelesna visina i tjelesna težina variraju u različitim geografskim regijama u svijetu (Launer and Harris, 1996; Janssen i sur., 2005), ali i u različitom demografskom okruženju iste regije (Aberle i sur., 2009). Također, posljednjih su nekoliko desetljeća mnoge studije utvrdile sve veću pojavu prekomjerne tjelesne težine, pa i pretilosti kod djece širom svijeta (Reilly i Dorosty, 1999; Ogden i sur., 2002; Janssen i sur., 2005; Ogden i sur., 2006; Reilly, 2007). S obzirom da antropometrijske karakteristike mogu biti pokazatelj stanja zdravlja i kvalitete prehrane i uhranjenosti populacije (WHO, 1995; de Onis, 2003), područje istraživanja antropometrijskih karakteristika postaje sve rasprostranjenije među istraživačima. Tako je prema preporukama WHO (WHO, 1995; Abrantes i sur., 2002) najrasprostranjeniji indikator za procjenu statusa uhranjenosti BMI (indeks tjelesne mase).

S kineziološkog stajališta, poznavanje antropološkog statusa djeteta nužno je u kvalitetnom planiranju i programiranju tjelesne aktivnosti i izboru sadržaja koji bi trebali biti u skladu i u funkciji rasta i razvoja. Naime, temeljna polazišta u programiranju bilo kojega procesa vježbanja u kineziologiji su antropološka obilježja, među kojima i morfološka (Findak, 1997). Antropometrijske karakteristike bitan su pokazatelj stanja rasta i razvoja učenika. Kako je svaki upravljani proces vježbanja kod djece i mladeži, usmjeren i na njihov razvoj, nastavnicima njihovo poznavanje predstavlja osnovne informacije za planiranje i programiranje rada (Findak, 2001). Istraživanja antropoloških obilježja, posebno antropometrijskih karakteristika, sustavno se provode dugi niz godina, a sve učestalijom pojavnom pretilosti kod djece i visokom povezanošću tih karakteristika sa stanjem zdravlja takva istraživanja u posljednje vrijeme postaju sve intenzivnija, ne samo u svijetu (de Onis i Habicht, 1996; de Onis i sur., 2007; Cole, 2000), nego i na području Republike Hrvatske (Horvat, Mišigoj-Duraković i Prskalo, 2009).

Istraživanja antropometrijskih karakteristika i utvrđivanja tempa rasta i razvoja djece provode se već dugi niz godina. Tako Pejčić i sur. (1997) prate tempo razvoja djece iz različitih područja, Oja i Jurimae, (2002), kod djece starosti 6-7 godina ustanovljuju značajan prirast u tjelesnoj visini i blagi porast vrijednosti BMI kod dječaka i kod djevojčica, a u tjelesnoj masi samo kod djevojčica. Hrvatin i sur. (2003)

na populaciji djece mlađe školske dobi utvrđuju različit i neravnomjeran prirast dječaka u visinu. Proučavajući morfološka obilježja Butte i sur. (2006) navode kako su parametri rasta, uključujući tjelesnu težinu i tjelesnu visinu, uglavnom nasljedna značajka. Zafirova i Todorovska, (2009), koristeći antropometrijske mjere i BMI, su ustanovile značajan porast u tjelesnoj visini i tjelesnoj težini između dvije dobne skupine starosti 6 i 7 godina i kod dječaka i kod djevojčica, Aberle i sur. (2009) utvrđuju kako su djeca mjerena 2005. značajno niža i lakša od djece mjerene 1985., što autori objašnjavaju utjecajem rata u periodu tijekom 1991., posljedičnim migracijama i lošim ekonomskim standardom i razvojem, ali i kako nema značajne razlike u antropometrijskim mjerama i BMI kod djece urbane i ruralne sredine u Slavoniji. Osim praćenja antropometrijskih obilježja istraživanja su se bavila i utvrđivanjem utjecaja okoline na rast i razvoj kao i mogućim razlikama u njegovom tempu kod djece koja odrastaju u različitim demografskim sredinama. Brži tempo razvoja djece urbanog (primorskog) kraja nego djece ruralnog (goranskog) kraja Republike Hrvatske u morfološko motoričkom prostoru utvrđuju Pejčić i sur. (1997). Joens – Matre (2008) na temelju antropometrijskih mjera i BMI te razine tjelesne aktivnosti utvrđuju značajno povećanu tjelesnu masu kod djece ruralnih sredina nego kod djece iz manjih i većih gradova. Iako se smatra da zbog promjena u građi tijela tijekom rasta i razvoja te s obzirom da se rast i razvoj razlikuju među dobnim i etničkim skupinama kod djece, nije poželjno primjenjivati BMI (koji je definiran kao omjer mase i kvadrata visine), novija su istraživanja pokazala dobru korelaciju BMI-a i ukupnog sadržaja tjelesne masti (Cole, 2007), odnosno postotka masnog tkiva u organizmu, čime je potvrđena prikladnost primjena BMI-a kao mjere pretilosti u djece i adolescenata.

De Onis (2004) u analizi povećanja pretilosti i predloženih antropometrijskih mjera ukazuje da bi nacionalni programi trebali uključivati mjere tjelesne visine i tjelesne mase u ranom otkrivanju djece s povećanim rizikom prekomjerne tjelesne težine i pretilosti, koje bi se trebale mjeriti barem jednom godišnje. Prema James i Lobstein (2009) za utvrđivanje pretilosti kod djece potrebno je koristiti BMI percentile koje su prilagođene dobi i spolu djeteta. Također se smatra da BMI kod djece može služiti za procjenu pothranjenosti - niski BMI ili prekomjerne tjelesne težine i pretilosti -visoki BMI (de Onis, 2007).

Cilj ovog rada je utvrditi tempo rasta, stupanj uhranjenosti kao i moguće razlike između djece urbanih i ruralnih sredina u antropometrijskim karakteristikama u Slavoniji.

Metode rada

Uzorak ispitanika i varijabli

U istraživanju, koje je provedeno transverzalnom metodom, slučajni uzorak ispitanika činilo je 801 dijete (407 učenika i 394 učenica) 1. do 4. razreda osnovnih škola u Slavoniji. Uzorak je podijeljen u dva subuzorka, urbani i ruralni, te svaki

sukladno dobi i spolu. Urbani uzorak činila su 204 učenika i 202 učenice iz mjesta koja imaju status grada u Slavoniji, a ruralni uzorak činila su 203 učenika i 192 učenice sa sela (mjesta koja nemaju status grada).

Uzorak varijabli činile su antropometrijske mjere, tjelesna visina ATV i tjelesna masa ATT, te indeks tjelesne mase (BMI). Tjelesna težina mjerena je digitalnom vagom, a tjelesna visina mjerena je antropometrom prema IBP standardu. Za svakog učenika izračunat je BMI, a vrijednost indeksa naknadno je preračunata u BMI centile (Cole i sur. 2000, 2005) te se izračunala prosječna vrijednost BMI po dobi (svakom razredu).

Podatci su prikupljeni tijekom 2009. godine na prigodnom uzorku u 10 škola s urbanih područja i 10 škola s ruralnih područja, u sklopu znanstvenog projekta Kineziološka edukacija u predškolskom odgoju i primarnom obrazovanju. Podatke su prikupljala tri nastavnika kinezioloških kolegija s Učiteljskog fakulteta u Osijeku s višegodišnjim iskustvom u radu s djecom mlađe školske dobi.

Metode obrade podataka

Za svaku varijablu su izračunati osnovni deskriptivni parametri (aritmetička sredina i standardna devijacija i postoci), za utvrđivanje razlika u promatranim varijablama između subuzoraka korišten je T-TEST, a dvofaktorskom multivarijatnom analizom varijance (MANOVA) testirala se značajnost razlika između dva subuzorka, posebno po dobi i spolu.

Rezultati i rasprava

Iz rezultata mjerenja tjelesne visine i tjelesne mase učenika urbanih i ruralnih sredina (Tablica 1) vidljivo je kako u apsolutnim vrijednostima dječaci oba subuzorka imaju slične vrijednosti te kako im je godišnji prirast i u tjelesnoj visini i u tjelesnoj masi približno jednak.

Dječaci iz urbanih područja u razdoblju 1. – 4. razreda ukupno narastu za 17,5 cm u visinu, s prosječnim godišnjim prirastom od 5,3 cm, a dječaci s ruralnog područja narastu za 16,15 cm u visinu s prosječnim prirastom od 5,5 cm.

U istom razdoblju u tjelesnoj masi dječaci s urbanog područja prime ukupno 10,45 kg, s prosječnim godišnjim prirastom od 3,5 kg, a dječacima s ruralnog područja tjelesna masa se poveća za 12,5 kg, s prosječnim godišnjim prirastom od 4,16 kg.

Testiranjem značajnosti razlika u promatranim varijablama uočeno je da nema statistički značajne razlike između dječaka urbanih i ruralnih sredina unutar pojedinih dobnih skupina ni u vrijednostima tjelesne visine niti u vrijednostima tjelesne mase.

Tablica 1.

Testiranjem razlike u cjelokupnom promatranom morfološkom prostoru uočeno je da nema statistički značajne razlike između dvije skupine ispitanika. Rezultati dvofaktorske multivarijatne analize varijance ukazuju da je statistički značajna razlika samo po faktoru „dob" (F = 53,74; p = 0,00), što je i prirodno, s obzirom na godišnji prirast u tjelesnoj visini i tjelesnoj težini, dok po faktoru „urbano-ruralno"

(F =0,15; p = 0,86) i međusobnoj interakciji ta dva faktora (F = 1,40; p = 0,21) nema statistički značajne razlike. Dakle, može se reći da dvije skupine ispitanika iz različitih demografskih sredina pripadaju istoj populaciji u promatranom morfološkom prostoru.

Graf 1. i 2 .

Promatranjem krivulje prirasta u tjelesnoj visini i tjelesnoj masi vidljivo je kako su krivulje u obje promatrane varijable kod obje skupine gotovo jednake. Ovaj grafički prikaz je u skladu s dobivenim rezultatima koji su pokazali da nema razlike između učenika. Vidljivo je kako je ravnomjeran trend razvoja prisutan i u prirastu tjelesne visine i tjelesne mase.

Tablica 2.

Iz vrijednosti indeksa tjelesne mase kod dječaka primjetan je stalni porast tijekom prva četiri razreda osnovne škole, vidljivo je da se dječaci nalaze oko normalnih vrijednosti s obzirom na njihovu dob i spol. Jedina statistički značajna razlika između dvije skupine dječaka u BMI pokazala se samo u prvom razred, dok u ostalim razredima nije uočena značajna razlika u pretilosti. Razlog za ovakav rezultat može biti u uvjetima koje urbana sredina nameće načinu života i što je izraženo u najmlađem razredu, dok se kasnije ta razlika gubi „izjednačenim" načinom života tijekom školovanja, što se vidi u ravnomjernom prirastu indeksa tjelesne mase.

Slično kao i kod učenika, rezultati i kod učenica pokazuju približno jednake vrijednosti u obje skupine ispitanica u promatranim varijablama tjelesne visine i tjelesne mase. U razdoblju od 1. do 4. razreda djevojčice urbane sredine narastu ukupno za 16,55 cm u visinu, s prosječnim godišnjim prirastom od 5,5 cm. U istom razdoblju djevojčice ruralne sredine narastu za 17,9 cm, s prosječnim godišnjim prirastom od 6 cm.

U tjelesnoj masi djevojčica urbanih sredina primjetno je povećanje za 10,21 kg, s prosječnim godišnjim prirastom od 3,40 kg, dok se kod djevojčica ruralnih sredina tjelesna masa poveća za 13,35 kg, s prosječnim godišnjim prirastom od 4,45 kg.

Iako su u apsolutnim vrijednostima u 4. razredu kod djevojčica iz ruralnih sredina uočeni nešto viši rezultati, t-testom se utvrdilo kako ni kod djevojčica nema statistički značajne razlike u promatranim varijablama u niti jednom dobnom razdoblju.

Tablica 3.

Rezultati dvofaktorske multivarijatne analize varijance ukazuju na statistički značajne razlike prema faktoru „dob" (F = 53,74; p = 0,00), ali prema faktoru urbano - ruralno (F =0,15; p = 0,86) U interakciji ta dva faktora (F = 1,40; p = 0,21), nema značajnih razlika.

Graf 3. i 4 .

Kao i kod dječaka, krivulje prirasta u tjelesnoj visini i tjelesnoj masi slične su i kod učenica urbanih i ruralnih područja. Međutim ovdje je linearan trend prirasta primjetan do četvrtog razreda, kada dolazi do naglijeg prirasta kod učenica iz ruralne sredine. Iako se čini da se djevojčice u ruralnim sredinama u tom razdoblju razvijaju intenzivnije, iz rezultata analize je vidljivo da ta razlika nije statistički značajna.

Tablica 4.

Rezultati indeksa tjelesne mase također pokazuju trend povećanja tijekom prva četiri razreda, kod djevojčica, i urbane i ruralne sredine, ali kao i kod dječaka, ni djevojčice nisu u rizičnoj skupini od pretilosti. Vidljivo je da nema statistički značajne razlike u BMI kod djevojčica urbanih i ruralnih sredina u svim dobnim skupinama.

Uzimajući u obzir cjelokupnu populaciju djece mlađe školske dobi s područja Slavonije, dobiveni su sljedeći rezultati.

Vrijednosti BMI preračunate u centile (Cole i sur., 2000) kod slavonskih dječaka i djevojčica su prikazane u tablicama i grafovima. Cole i sur: (2000) naglašavaju kako vrijednost BMI do 85 centila predstavlja normalnu uhranjenost, između 85 i 95 centila predstavlja prekomjernu tjelesnu težinu, a preko 95 cenitla podrazumijeva pretilost. U tablicama 7 i 8 prikazan je broj učenika koji se nalaze u pojedinim kategorijama prema vrijednosti BMI centila.

Graf 5.

Iz rezultata prikazanih u postocima vidljivo je da se najveći broj dječaka nalazi u kategoriji normalno uhranjene djece, međutim također je vidljivo kako se visoki postotak djece nalazi u rizičnoj skupini ili među pretilima. Ukoliko se spoje te dvije kategorije, uočljivo je da se broj djece koji potencijalno imaju problema s prekomjernom tjelesnom težinom kreće oko 30% i uočljiv je trend povećanja s kronološkom dobi.

Graf 6.

Kao i kod dječaka, i najveći dio djevojčica mlađe školske dobi nalazi se u kategoriji normalno uhranjene djece. Međutim, slično kao i kod dječaka, primjetan je trend povećanja postotka s tijekom odrastanja te se povećava broj djece u zoni rizika od prekomjerne težine ili u zoni pretilosti. Kod djevojčica je taj postotak najuočljiviji u 3. i 4. razredu i kreće se oko 20%. Gledajući rezultate izražene u postocima vidljivo je kao se najveći dio djece slavonske populacije uglavnom nalazi u normalnim vrijednostima, međutim kod oba spola je primjetan negativan trend i povećanje broja djece u kategorijama koje predstavljaju rizik od pretilosti ili pretilost, koji je naglašen kod dječaka, osobito u 2. razredu. Dakle, postotak djece koja se nalaze iznad 85 centila u stalnom je porastu, što je i u skladu s negativnim trendom prirasta BMI tijekom prva 4 razreda osnovne škole i kod dječaka i kod djevojčica.

Promatranjem tempa rasta i stupanj pretilosti kod dječaka i djevojčica tijekom prva četiri razreda osnovnoškolskog obrazovanja dobiveni su sljedeći rezultati.

Tablica 5.

Iz deskriptivnih parametara i analiza razlika u tjelesnoj visini i tjelesnoj masi između dječaka i djevojčica vidljivo je kako su značajne razlike prisutne samo u 1. i 2. razredu, kada su dječaci dominantniji u odnosu na djevojčice, dok u 3. i 4. razredu nije uočena statistički značajna razlika u antropometrijskim karakteristikama.

Iako obje skupine također imaju prosječan prirast u tjelesnoj visini i težini, vidljivo je kako se kod djevojčica nagliji skok u prirastu dobiva između drugog i trećeg razreda, pri čemu djevojčice narastu do 7 cm u visinu i prime 4 kg u tjelesnoj masi. U tom trenutku djevojčice u svom razvoju sustižu dječake te nestaju statistički značajne razlike.

Rezultati multivarijatne analize varijance ukazuju na značajno razlikovanje dvije skupine po faktorima spol (F = 9, 11; p = 0, 00) i dob (F = 105, 36; p = 0, 00). Međutim, nema razlike i u interakciji ta dva faktora (F = 0, 58; p = 0, 75). Također je primjetno značajnije razlikovanje skupina po spolu nego po regionalnom faktoru, tj. urbano-ruralnom, pri čemu nema značajnih razlika dva uzorka. Na temelju dobivenih rezultata može se zaključiti kako se promatrana populacija više razlikuje po spolu nego po geografskoj sredini iz koje potječe.

Graf 7. i 8.

Tablica 6.

Jednako kao i u antropometrijskim mjerama, učenici imaju statistički značajnije viši BMI u 1. i 2. razredu dok u 3. i 4. razredu razlika u vrijednostima BMI nije značajna. Rezultat je to naglog prorasta u tjelesnoj masi kod djevojčica koji se događa u trećem razredu i značajno je viši nego kod dječaka. Naime spolni dimorfizam u većini parametara rasta i razvoja počinje se značajnije očitovati tijekom spolnog sazrijevanja, a do puberteta djevojčice i dječaci se razvijaju usporedno. I tada postoje osobitosti, kao što koštana osnova zdjelice pokazuje razlike već u intrauterinom životu, a u predpubertetskom periodu postoje razlike i u psihološkom pogledu. Veličina hipofize i njezin razvoj pokazatelji su spolnog dimorfizma (MacMaster i sur. 2007). Puberalni zamah rasta započinje ranije i ranije završava u djevojaka. Prva manifestacija puberteta spovezana je s početkom maksimalne brzine rasta, a menarhe nastupa tek na kraju maksimalnog prirasta (Tanner, 1986). Nagli prirast BMI indeksa mogao bi se pripisati spolnom dimorfizmu koji će se očitovati tek u pubertetu. Ove promjene u 3. i 4. razredu su neutralizirale „prednost" u BMI učenika 1. i 2. razreda. Nadalje, istraživanje pokazuje da učenici i učenice mlađe školske dobi slavonske regije pokazuju značajan trend prirasta u tjelesnoj visini i tjelesnoj masi tijekom prva četiri razreda osnovne škole. Prirast koji je prisutan u tjelesnoj visini u skladu je s prirodnim rastom i razvojem koji se događa u toj dobi kada su vrijednosti prirasta u visinu stabilni i kreću se oko 5cm godišnje (prema Mišigoj-Duraković, 2008). Aritmetičke sredine rezultata tjelesne visine, tjelesne mase i vrijednosti BMI također su u skladu s rezultatima dosadašnjih istraživanja na ovim područjima: Katić i sur., (2008, 2009), Horvat i

sur. (2009), Zafirova i Todorovska (2009). Postotak djece koja se nalaze u rizičnim skupinama od pretilosti kao i vrijednosti BMI također pokazuju stalan trend porasta, što nije pozitivno. S obzirom na to da je pretilost u posljednje vrijeme postala jedan od najvećih javnih zdravstvenih problema, kako kod odraslih tako i kod djece, a BMI može služiti za procjenu pothranjenosti - niski BMI ili prekomjerne tjelesne težine i pretilosti - visoki BMI (de Onis, 2007), dobivene vrijednosti BMI su uspoređene sa standardima. Preporučeno je djecu koja se nalaze između 5 i 85 percentila smatrati normalno uhranjenom, djecu između 85 – 95 percentila smatrati da imaju povećani rizik od pretilosti, a djecu koja se nalaze iznad 95 percentila smatrati pretilima. Vidljivo je kako se većina djece slavonske regije nalaze u rasponu od 5 do 85 percentila, što se smatra normalnim. Međutim na uočeni trend porasta BMI i broja djece s povećanim BMI u razdoblju od 1. do 4. razreda potrebno je reagirati adekvatnim pristupom u prehrani i tjelesnoj aktivnosti i tako prevenirati prevalenciju pretilosti. Tako de Onis (2007) navodi da bi mjere za sprječavanje pojavnosti pretilosti trebale uključivati: 1) ležeću dužinu za djecu do 2 godine i stojeću visinu za odrasle kako bi se mogao izračunati BMI i „tjelesna težina na tjelesnu visinu" 2) proširivanje programa koji podrazumijevaju procjenu tjelesne težine od rođenja do 18 godine, 3) interpretaciju antropoloških mjera u odnosu na propisane referentne podatke, 4) ranu intervenciju kod roditelja i odgojitelja u smislu podrške i promocije zdravih prehrambenih navika i tjelesne aktivnosti. Također, dobiveni rezultati su slični vrijednostima koje su u svojim istraživanjima dobili Horvat i sur. (2009) i Zafirova (2009). Iako se pretpostavljalo da će se, prema uvriježenom mišljenju, uočiti razlike između djece urbane i ruralne sredine u promatranim antropometrijskim karakteristikama, rezultati su pokazali da razlike nema, a isto se potvrdilo i u istraživanju Aberle i sur. (2009) gdje je utvrđeno da se slavonska djeca predškolske dobi urbane i ruralne sredine, u regiji oko Slavonskog Broda, također ne razlikuju u tjelesnoj visini i tjelesnoj masi. Međutim, Pejčić i sur. (1997) su utvrdili statistički značajne razlike u nekim morfološkim mjerama između djece primorskog i goranskog kraja, kao i Jens – Matre i sur. (2008) koji utvrđuju značajno povećanu tjelesnu masu kod djece ruralnih sredina, nego kod djece iz manjih i većih gradova, ali i da su djeca iz manjih gradova najviše tjelesno aktivna. Ovakvi rezultati bi se mogli objasniti nedovoljnom urbanizacijom mjesta u Slavoniji koja imaju formalni status grada te kratkim vremenskim periodom da bi se mogle uočiti razlike u razvojnim fazama kod ta dva uzorka. Razlike između dječaka i djevojčica mogu se pripisati spolnom dimorfizmu i bržem razvoju djevojčica tijekom osnovnoškolskog obrazovanja. Zafirova i Todorovska (2009) su također utvrdile značajan porast u tjelesnoj visini i tjelesnoj težini između dvije dobne skupine starosti 6 i 7 godina i kod dječaka i kod djevojčica, kao i spolne razlike u antropometrijskim parametrima, u kojima su dječaci dominantniji, osim u kožnim naborima. Poznato je naime kako djevojčice ranije ulaze u pubertet i sazrijevaju, tako da su dobivene razlike samo u prvom i drugom razredu. Međutim, zbog naglijeg razvoja djevojčice sustižu svoje vršnjake, a vjerojatno i u višim razrednima osnovne škole i prestižu u

promatranim antropometrijskim karakteristikama. Oja i Jurimae (2002) tijekom dvije godine razvoja, u 6. i 7. godini, ustanovljuju značajan prirast u tjelesnoj visini i kod dječaka i kod djevojčica, a u tjelesnoj masi samo kod djevojčica. Butte i sur. (2006) nalaze kako su determinante ljudskog rasta, vrijeme i tempo ulaska u pubertet i ostale mjere koštanog i spolnog sazrijevanja pod genetičkom kontrolom.

Zaključak

Dobiveni rezultati u ovom istraživanju ukazuju kako nema razlika između učenika i učenica urbanih i ruralnih područja u Slavoniji, ali je primjetan trend porasta djece s prekomjernom tjelesnom težinom već nakon drugog razreda osnovne škole, osobito kod djevojčica. Ti rezultati upućuju kako nema potrebe za diferenciranim programom Tjelesne i zdravstvene kulture prema području življenja, ali je potrebno izabirati sadržaje kojima je moguće utjecati na sprječavanje pojavnosti pretilosti kod djece mlađe školske dobi. Sustavno praćenje antropoloških obilježja djece i mladih trebalo bi biti neizostavni dio tijekom rasta i razvoja djece, jer se na taj način u ranoj fazi mogu otkriti nedostatci u rastu i razvoju na koje se može utjecati bilo preventivno, adekvatnim kineziološkim programima, s kineziološkog aspekta, ili u smislu liječničke intervencije s kliničkog aspekta. Dodatni interes kineziološke metodike za istraživanjima morfoloških karakteristika i njihovim spoznajama temelji se na činjenici da propisani Nastavni plan i program Tjelesne i zdravstvene kulture u osnovnoj školi posebno naglašava, u antropološkoj sastavnici, poticanje optimalnog razvoja morfoloških obilježja učenika. Stoga se ta obilježja, u svim oblicima rada Tjelesne i zdravstvene kulture, kontinuirano potiču i prate. U očuvanju zdravstvenog statusa djece treba voditi brigu o njihovom načinu ishrane kao i kvalitetnoj i redovitoj kineziološkoj aktivnosti, kako bi se spriječile neželjene posljedice suvremenog načina života na djetetov organizam.