Research in Physical Education, Sport and Health
2015, Vol. 4, No. 1, pp.111-115
ISSN(Print):1857-8152; ISSN(Online):1857-8160

THE COMPARISON OF ANTHROPOMETRIC CHARACTERISTICS IN BOYS MEASURED IN THE PERIOD BETWEEN 2012 AND 2014

UDC:572.087.1-053.6
(Original scientific paper)

Nikola Stojanović[1], Milorad Jerkan[2], Darko Stojanović[1], Miloš Nikolić[3] & Dragan Perić[4]
[1]The Faculty of Sport and Physical Education, Nis
[2]Health Center, Nis
[3]Medical Faculty, Nis
[4]Sport Center "Čair", Nis

Abstract

The researches that have been conducted so far show that longitudinal and transversal dimensions of human skeleton are greatly influenced by genes in comparison to volume and body weight (Djuraskovic, 2009; Malacko, 2001). The low level of physical activity together with the increased level of calorie intake leads to increased body weight. The growing number of obese people from birth to the old age is more and more present in the world and in Serbia as well (Malina, 2004; Zdravkovic et al., 2009). The aim of this research was to determine the differences in absolute and relative values of longitudinal, transversal dimensions of skeleton, body weight and BMI in pupils measured in the period between 2012 and 2014. The results have shown that the average height in 2012 was 135.94±5.72 cm and in 2014 is 146.4±5.78 cm. The remaining longitudinal and transversal dimensions have increased in accordance with the body weight. BMI has increased as well, it was 18.66±2.95 kg/VTm^2 in 2012 and 20.63±3.65 kg/VTm^2 in 2014. This indicates that the pupils that were classified as normal-weight children in 2012 have become overweight and obese by the year 2014. The differences in the absolute values were established for all the variables which are the result of normal growth and development. There were no statistically significant differences in relative values.

Key words: *anthropometric characteristics, absolute and relative value.*

Introduction

Tracking of growth and development during the school period has to be systematic and continual in order to objectively evaluate the regularity of the developing period. The growth of body measures is slower in preadolescent than adolescent period. The periods of growth and development are often intertwined, primarily due to the fact that chronological and biological age do not match, and that they are under the influence of endogenic factors (genetics, endocrine glands). Childhood is usually divided into two phases, including early and middle childhood. The two phases start at the age of 5 or 6 and continue to 10 or 11 years of age. Middle childhood is arbitrary because it precedes adolescent period which may be different from childhood. The end of adolescence is under great influence of external factors (social factors) and internal (the growth period) factors which is the reason why it is very hard to determine when the adolescence starts (Malina, 2003).

A great number of studies has detected the shift in biological maturity towards younger age in comparison to previous generations (Mišigoj-Duraković, 2008), thus in girls it is shifted to the age of 10 or 11 and in boys 11-13. It is considered that biological maturity influences the physical characteristics of children. Children may feel superior/inferior to their peers of the same chronological age because they are more or less mature (Beunen & Malina 2008, Malina 2004, Jansens et al., 2002). There is evidence of rapid rise in height, and probably other measurements as well, during the middle childhood period but not in all children. Inter-individual differences in the period of growth contribute to great variability of morphological measurements in children (Malina & Bouchard, 1991). Therefore, one unique system for the evaluation of maturity may not be enough for a detailed description of growth and development in the middle childhood period, because children of the same age are different according to the level of biological maturity or in other words maturity status (Coelho e Silva et al, 2004). Maturity status of a

child is going to influence the growth and development measures and the differences between the contrastive groups of children are the result of great differences in the degree of maturity (Baxter-Jones & Sherar, 2007).The easiest and most frequent way of tracking growth is the establishment of height and body weight at different ages. Most of the studies which dealt with this issue were interested in tracking the absolute measures of morphological status, and very few were interested in tracking the relative measures.

Thus, the aim of this research is to establish the increase in absolute and relative morphologic measures of the same group of boys at the age of 8 and 10 during a two-year period, as well as their comparison which will help us get the needed information about the developmental trend of absolute measures in relation to relative measures.

Material & Methods

The sample comprised 33 boys 8 and 10 years of age, students of Duško Radović School in Niš, measured in 2012 at the age of 8 and then in 2014 at the age of 10, in other words when they were second and fourth-year students respectively. All the boys were healthy at the time.

We measured 11 absolute and relative morphological measures: height expressed in cm (TVIS), body weight expressed in kg (TMAS), body mass index expressed in kg/VTm² (BMI), arm length expressed in cm (DURU), relative arm length expressed in % (DURUR), leg length expressed in cm (DUNO), relative leg length expressed in % (DUNOR), shoulder width expressed in cm (ŠIRA), relative shoulder width expressed in % (ŠIRAR), hip width expressed in cm (ŠIKU), relative hip width expressed in % (ŠIKUR). Absolute values of morphological measures were measured according to the instructions of International Biological Program- IBP (Weiner & Lourie, 1981). Relative values of longitudinal and transversal measures were measured in relation to body height by means of the following formula: $R_{mera}= A_{mera}$ x 100/TV, R_{mera} stands for relative value of the morphological measure being measured, A_{mera} is absolute value of the given morphological measure, TV is the value of body height.

Descriptive statistical analysis was used in order to obtain basic parameters, and establish arithmetic means of morphological measures measured at the age of 8 and 10, minimum and maximum values of absolute and relative measures, standard deviation of arithmetic mean, coefficient of variance, as well as the value of skewness and kurtosis of the distribution curvature. Multivariate/univariate analysis of variance was used in order to establish the increase in morphological measures of boys measured in 2012 and 2014 (one-way MANOVA/ANOVA). Statistical package 7.0 for Windows was used for data analysis.

Results

Table 1 and 2 show descriptive statistical parameters of boys measured in 2012 and 2014, at the age of 8 and 10. Based on the value of skewness (Skew.) and kurtosis (Kurt.) of the distribution curvature we may conclude that the results of all morphological measures are normally distributed, which is a precondition for the use of multivariate and univariate method for establishing the increase in morphological measures of boys measured at the age of 8 and 10, in 2012 and 2014.

Table 1. Descriptive statistical parameters of boys 8 years of age measured in 2012

	N	Mean	Min.	Max.	Std.Dev.	Coef.Var.	Skew.	Kurt.
TVIS	33	135.94	121.80	147.50	5.72	4.21	-.16	.41
TMAS	33	34.70	24.00	55.00	7.10	20.47	.67	.69
BMI	33	18.66	14.76	26.30	2.95	15.80	.72	-.15
DURU	33	56.82	52.60	62.20	2.37	4.17	.49	-.43
DURUR	33	41.82	39.22	44.28	1.11	2.65	.25	.34
DUNO	33	75.15	68.00	83.00	3.85	5.13	.47	-.46
DUNOR	33	55.29	50.49	58.37	1.70	3.07	-.38	.95
ŠIRA	33	31.61	27.70	35.20	1.57	4.95	-.24	.73
ŠIRAR	33	23.27	20.37	25.21	1.06	4.57	-.67	.57
ŠIKU	33	23.88	21.00	28.20	1.64	6.85	.47	.44
ŠIKUR	33	17.55	16.10	19.50	.87	4.97	.41	-.61

Legend: **N**- Number of boys; **Mean** – arithmetic mean; **Min.** – minimum result; **Max.** – Maximum result; **Std.Dev.** Standard deviation of arithmetic mean; **Coef.Var.** – Coefficient of variance; **Skew.** – skewness of the distribution curvature of the results; **Kurt.** – Kurtosis of the distribution curvature of the results

If we analyze the average values in Table 1, we can see that the body height of boys 8 years of age measured in 1012 is 135.94 cm, body weight is 34.70 kg, and BMI 18.66 kg/BHm². The remaining absolute values of longitudinal and transversal body dimensions are in accordance with the body height of boys at that age. Relative values were analyzed as well, the results show that the values are also in accordance with the body height.

The results of the boys 10 years of age measured in 2014 (Table 2) show that the average body height is 145.2cm, the average body weight is 44.44 cm, and BMI 20.63. These values are within the range of average values normal for that age (Gerver & DE bruin 1996). The remaining absolute values of longitudinal and transversal body dimensions are in accordance with the body height normal for that age, and the results of relative values, which are in accordance with the body height normal for that age, indicate that there has not been any change in relation to body height.

Table 2. Descriptive statistical parameters of boys 10 years of age measured in 2014

	N	Mean	Min.	Max.	Std.Dev.	Coef.Var.	Skew.	Kurt.
TVIS	33	146.47	135.60	165.00	5.78	3.94	0.95	2.04
TMAS	33	44.44	28.00	63.00	9.09	20.47	0.38	-0.47
BMI	33	20.63	14.55	28.19	3.65	17.68	0.53	-0.61
DURU	33	61.21	56.60	67.70	2.53	4.13	0.06	0.38
DURUR	33	41.79	40.13	43.34	0.95	2.27	-0.11	-1.05
DUNO	33	81.35	73.50	92.00	4.17	5.13	0.56	0.11
DUNOR	33	55.52	52.81	58.08	1.32	2.38	-0.04	-0.59
ŠIRA	33	33.62	30.00	37.20	1.86	5.53	-0.05	-0.54
ŠIRAR	33	22.97	20.45	26.01	1.26	5.49	0.10	0.15
ŠIKU	33	28.90	23.00	34.00	2.57	8.90	-0.11	-0.20
ŠIKUR	33	19.73	16.58	22.90	1.55	7.83	0.20	-0.56

After the evaluation of arithmetic means of all morphological measures in boys at the age of 8 and 10, measured in 2012 and 2014 respectively, we calculated the increase of the mentioned measures on multivariate level by means of multivariate analysis of variance (Table 3). After the analysis of the received results, for the given sample, we established statistically significant difference of centroids of the measurement conducted in 2012 and the one conducted in 2014 (Q= .000).

Table 3. Multivariate variance analysis of the increase in morphological measures of boys

Wilks Lambda	F	Effect - df	Error - df	Q
.330	9.96	11	54	**.000***

Wilks lambda– coefficient value of Wilk's test for the equality of centroids; **F**– coefficient value of the F-test for testing the significance of the difference; **Effect df, Error df**– degrees of freedom; **Q**– coefficient of the significance of the difference of centroids; ***-** statistically significant level of difference between the measured centriods

Table 4. Univariate variance analysis of the increase in morphological measures of boys

Varijabla	Mean 2012	Mean 2014	Priraštaj	F (1; 64)	P
TVIS	135.94	146.47	10.53	55.43	**.000***
TMAS	34.70	44.44	9.74	23.52	**.000***
BMI	18.66	20.63	1.97	5.85	.018
DURU	56.82	61.21	4.39	52.91	**.000***
DURUR	41.82	41.79	-.03	.01	.930
DUNO	75.15	81.35	6.2	39.31	**.000***
DUNOR	55.29	55.52	.23	.41	.525
ŠIRA	31.61	33.62	2.01	22.62	**.000***
ŠIRAR	23.27	22.97	-.3	1.09	.301
ŠIKU	23.88	28.90	5.02	89.54	**.000***
ŠIKUR	17.55	19.73	2.18	49.61	**.000***

Legend: **Mean diff. BOYS** – arithmetic mean of increases of measures in boys; **Mean diff. GIRLS** - arithmetic mean of increases of measures in girls; **F** - value of the coefficient of the F-test for testing the significance of the difference; **df 1, df 2** – degrees of freedom; **p** – coefficient of the significance of the difference of arithmetic means; ***-** statistically significant level of difference between the arithmetic mean.

Since the value of the coefficient of the significance of the difference of group centroids is quiet higher than the limit values (Q= .000) at the multivariate level, it would be advisable to check, at the univariate level, the greatest increase in the morphological measures.

By analyzing Table 4, that shows the results of the variance analysis at the univariate level, we may conclude that there is statistically significant increase in all absolute morphological measures, while significant increase is detected only in relative hip width (RHW) as far as relative measures are concerned. The results of the boys at the age of 8 measured in 2012 (Table 1) show that the average height was 135.94 cm, and in 2014 it is 146.47 cm (Table 2). We may conclude that the boys have grown 10.53 cm within the given period. The increase in body weight is 9.74 kg. Body mass index was 18.66 kg/BH m² in 2012, and in 2014 it is 20.63 kg BH m². During these periods, the boys can be classified as overweight according to the criteria (Cole et al., 2000). It is interesting to stress the fact that the absolute hip width has significantly increased in comparison to shoulder width, and that the increase of the relative shoulder width is negative, while there has been a significant increase in the relative hip width. This may be explained by the greater increase in body weight and body mass index, or in other words the obesity of ten-year old boys.

Discussion

The research conducted on the same target group of boys, at an early school age, at the age of 8 and 10, or the second and fourth-year students, indicates that the height and analysed longitudinal and transversal body dimensions are in the range of a normal growth and development for the analysed developmental period (Gerver & DE bruin, 1996; Mišigoj-Đuraković, 2008). Body mass index average values indicate that the boys belong to the group of overweight children in the second grade, and fourth grade as well. The increase in body weight is the result of the decreased level of physical activity, and obesity is an issue in the modern society. Low level of physical activity together with the excessive calorie intake lead to the increased level of body weight. One of the reasons of obesity is the fact that spontaneous physical activity of preschool children is decreased by 50 % in school children (Maksimović & Matić, 2009). The number of obese people, starting from birth and continuing to the old age, keeps increasing in the world and Serbia as well (Malina, 2004; Zdravković et al., 2009).

The average increase in height and body weight of the analyzed sample is greater compared to the majority of previous studies in this anthropological area. Those studies have shown that the aging is continuously followed by the increase of body height, 5-8 cm in average, as well as the body mass up to about 2-3 kg annually (Popović, 2008). The relative values of arm and leg length in boys indicate that the extremities are normally developed. The average values of shoulder and hip width of the same group of boys at the age of 8 and 10 indicate that shoulders and hips are normally developed (Đurašković, 2009).

The increased body weight and body mass index in this research are the result of the increased levels of body fat, obesity, and not the increased muscle mass. Since we cannot influence genetic factors, it is important to control environmental factors that influence body weight and height and circular and transversal measures ratio. The influence of environmental factors is great during the middle childhood (preadolescence) and we may influence those factors in order to prevent excessive calorie consumption at the expense of the acceleration of growth, where instead of greater height we have greater body weight (Gligorijević, 2008).

Baneful influence of the external environment comes from inadequate family eating habits and extra school snacks. Changed eating habits, as well as fast food that contains great percentage of fat and meat, have a negative impact on children and their weight. These eating habits are common today because parents work long hours and children are left to eat outdoors in fast food restaurants. That is why it is important to promote healthy lifestyle and thus control the problem of obesity.

Conclusion

According to the results of this research conducted on the group of boys 8 years of age measured in 2012 and the same group of boys at the age of 10 in 2014, it may be concluded that the increase in height is 1.53 cm. Body weight has increased by 9.74 kg, and the average arm and leg length are in accordance with the average height of boys at the age of 8 and 10. The same may be said for hip and shoulder width. It is evident that the increase of absolute longitudinal and transversal measures in boys within the two-year period is statistically significant, while the increase in relative measures is only relevant for the hip width and it is statistically significant for the given period. The relative values of upper and lower

extremities are in accordance with the height, and the relative shoulder and hip width are normal for that age. The average values of body mass index indicate that body weight increases with age thus increasing levels of body fat, and not the muscle mass.

References:

Baxter-Jones, A.D. & Sherar, L.B. (2007). Growth and maturation. In: Armstrong, N., Spurway, N., MacLaren, D. & Sharp, N.C.C., editors. *Paediatric Exercise Physiology*. Edinburgh: Churchill Livingstone, pp. 1-26.

Beunen, G. & Malina, R.M. (2008). Growth and Biologic Maturation: Relevance to Athletic Performance. In: Hebestreit, H. & Bar-Or, O., editors. *The Young Athlete*. Blackwell Publishing Ltd, pp. 3-17.

Coelho e Silva, M., Figueiredo, M., Sobral, F. & Malina, R.M. (2004). Profile of youth soccer players: age-related variation and stability. In: Coelho e Silva, M. & Malina, R.M., editors. *Children and Youth in Organized Sports*. Reitoria: Imprensa da Universidade de Coimbra, pp. 189-199.

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: 1240-1243.

Đurašković R.(2009). *Sportska medicina*. Niš: M KOPS Centar.

Gerver, M.J.W. & DE Bruin, R. (1996). *Pedijatric Morphometrics*. Utreht, The Netherlands: Wetenschappelijke uitgeverij Bunge.

Gligorijević S. (2008). Antropometrijski parametri kao pokazatelji akceleracije rasta i prediktori gojaznosti preadolescenata. *Acta Medica Medianae.*47:15-19.

Janssens, M., Van Renterghem, B. & Vrijens, J. (2002). Anthropometric characteristics of 11-12 year old Flemish soccer players. *Science and Football IV (World Congress of Science and Football 4)*. Sydney: Routledge: Taylor & Francis (Psychology Press).

Maksimović, N. i Matić, R. (2009). Relacije rezidencijalnog, društvenog i ekonomskog statusa roditelja i antropometrijskih karakteristika njihove dece. *Glasnik Antropološkog društva Srbije*, vol. 44, str. 497-504.

Malina, R.M. (2003). Growth and maturity status of young soccer players. In: Reilly, T. & Williams, A.M., editors. *Science and Soccer*: Routledge-Psychology Press, pp. 287-306.

Malina, R.M. (2004). Growth and maturation: basic principles and effects of training. In: Coelho e Silva, M. & Malina, R.M., editors. *Children and Youth in Organized Sports*. Reitoria: Imprensa da Universidade de Coimbra, pp. 137- 162.

Malina, R.M. & Bouchard, C. (1991). *Growth, Maturation, and Physical Activity*. 2nd ed: Human Kinetics Europe, Limited. 501 p.

Mišigoj-Duraković M. (2008). *Kinantropologija*. Zagreb: Zelina.

Popović, B. (2008). Trend razvoja antropometrijskih karakteristika dece uzrasta 4-11 godina. *Glasnik Antropološkog društva Srbije*, vol. 43, str. 455-465.

Weiner, J.S. & Lourie, J.A. (1981). *Practical Human Biology*. New York: Academic Press.

Zdravković, D., Banićević, M. i Petrović, O. (2009). *Novi standardi rasta i uhranjenosti dece i adolescenata - priručnik za pedijatre i saradnike u primarnoj zdravstvenoj zaštiti*. Beograd: Udruženje pedijatara Srbije.

Corresponding author:
Stojanović Nikola, PhD student
The Faculty of Sport and Physical Education,
Nis, Serbia
E-mail: nikola987_nish@hotmail.com