ANTROPOMETRIC CHARACTERISTICS OF FEMALE STUDENTS OF FIRST AND SECOND YEAR OF HIGH SCHOOL AND THEIR RELATIONS

Bruno Čukulin

High School Vrbovec, Vrbovec, Croatia

Original scientific paper

Abstract

Anthropometric characteristics are part of anthropological features of students. Periodic verification of anthropometric characteristics that are usually applied in educational practice (ATV – body height, ATT – body weight, AOP – forearm girth, ANN – subcutaneous fat on upper arm), can provide us with a glimpse of their quality. The aim of this research is to compare the results of the anthropometric characteristics of female students of first and second year of high school, and their classification into specific classes depending on the criteria required for a specific anthropometric characteristic. Anthropological level of student status is shown through anthropometric characteristics, functional and motor skills, and is used to help teachers to prepare program suitable to the needs of individual students and the transformation of the anthropological dimension of their status. Balance of anthropometric characteristics will certainly be affected by regular physical activity and proper nutrition of students, and thus will have a positive impact on their health.

Key words: *anthropometric characteristics, anthropological status, physical activity, transformation, health*

Introduction

Morphological anthropometry is a method that includes measuring human body and analyzing and studying obtained results (Mišigoj-Duraković et al. 1995). Morphological anthropometry is applied in many areas, but its application is very important for us in educational practice, in teaching of physical education with aim to objectively evaluate general development of the body and the interaction between anthropometric characteristics and functional and motor skills. Anthropometric characteristics are part of the anthropological features defined as characteristic responsible for dynamic of growth and development and specific material of morphological features such as bone growth in length and width, muscle mass and subcutaneous adipose tissue (Findak 2001). In school practices within the teaching of physical education are periodically conducted evaluations of anthropological characteristics. As we monitor and check the functional and motor skills throughout the school year via initial, transitive and final checking, we also evaluate and verify anthropometric characteristics using four variables: ATV – body height, ATT – body weight, AOP – forearm girth and ANN – subcutaneous fat on upper arm. Evaluation results help us to determine whether task for each student development was achieved and whether there has been a positive transformational change in their anthropological status. Examinees are still in the phase of puberty when occur most changes and this phase is characterized by rather intense physical development (Malina, 1994). Program activities can not affect body height, but they are important to calculate desirable body weight. Girth of bone, muscle ratio and subcutaneous adipose tissue should be balanced, it is desirable that the muscle mass is as high as possible, and the ballast weight as low as possible.

Healthy eating and regular physical activity will certainly affect the balanced relations of anthropometric characteristics, and thus prevent the overall health status. In order to increase aerobic endurance as significant indicator of the overall health of students, it is crucial to plan and implement the program and kinesiology activities which will operate on the reduction of subcutaneous adipose tissue, as well as implement those activities that will simultaneously raise all students motor skills to a higher level (Hakkinen, 1993).

Problem and aim

The aim of this study is to compare certain individual anthropometric characteristics (ATV – body height, ATT – body weight, AOP – forearm girth) of first and second grade high school female students and classify them into specific classes according to the criteria laid down for certain anthropometric characteristic. It enables us to determine the anthropological status of each student and with proper selection of kinesiology operators to affect the transformation processes of individual dimensions of anthropological status.

Methods

The sample of examinees

The examinees are 64 female students, 43 first grade and 21 second grade female high school students between 14 and 16 years of age. All examinees are high school students in "Vrbovec High School" attending different professional orientations (economists, retailers, chefs, waiters, butchers) and this study also included 15 female second grade students of general orientation. All female students referred in this study are medically fit for the attendance of P.E. classes.

Pattern variables

Variable sample is a set of three tests to assess the level of anthropometric features that are used in elementary and secondary schools (ATV – body height, ATT – body weight and AOP – forearm girth) (ANN – subcutaneous fat on upper arm was not taken into account due to lack of measurement instrument). We have taken into account the two measurements. The first sample was measured at the beginning of the school year 2011/2012., second sample at the end of the school year 2011/2012. and have taken into account the initial and final checking of the examinees (Overview of physical and health education of the school year 2011/2012.). Testing was conducted in accordance with the measurement requirements prescribed in Applied Kinesiology in Education (Norms) (Findak, Metikoš, Mraković, Neljak, 1996).

Methods of data processing

Standard statistical procedures were used to calculate the basic descriptive parameters of variables: the arithmetic mean (Mean), minimum (Min) and maximum value (Max), standard deviation (Std. Dev.), evaluation of the results according to the proposed standards (Norms) which are presented in table in descriptive manner as poor, below average, average, above average and excellent and t-test for dependent patterns. Data analysis was performed using the statistical package Statistica for Windows 5.0.

Results

Table 1 Descriptive statistical parameters of first grade female students and t-test (N=43)

ATV–Var	Mean	Std. Dev.	Min	Max	t	p
ATV–Var1	163,10	6,26	144	174	-7.28	,0000
ATV–Var4	164,56	6,61	145	180		

(ATV–Var – variable of body height, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max − maximum, t-test, p − level of relevance)

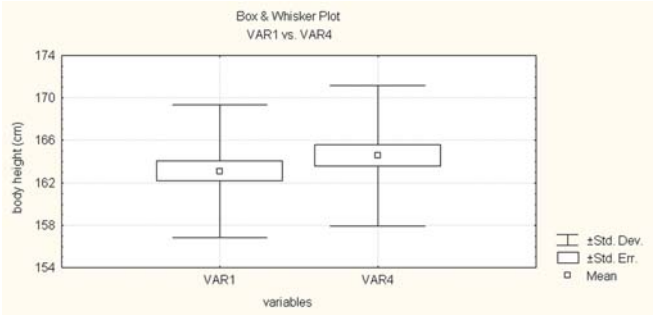

Figure 1 Presentation of results of arithmetic means of ATV tests of females of first grade

Table 2 Descriptive statistical values and t-test for dependent patterns for first grade females (N=43)

ATT–Var	Mean	Std. Dev.	Min	Max	t	P
ATT–Var2	58,60	9,73	39	82	-4,31	,0001
ATT–Var5	60,21	9,96	39	84		

(ATV–Var – variable of body weight, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max − maximum, t-test, p − level of relevance)

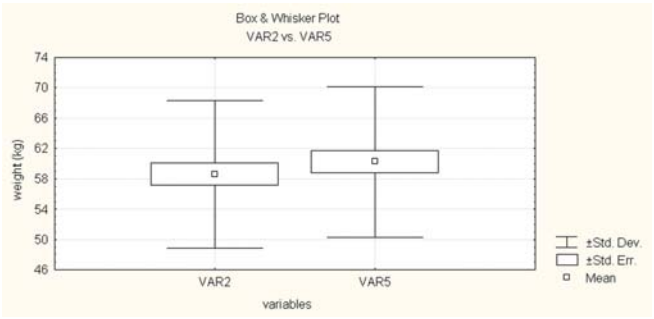

Figure 2 Presentation of results of means of ATT tests of first grade female students

Table 3 Orientation values of body weight in relation to body height of first grade females

Mean of ATV Mean ATT results of first grade female students	Norms (Findak et al., 1996).
163,10 (ATV) 58,605 (ATT) (Inicial state)	Below AVG
164,56 (ATV) 60,21 (ATT) (Final state)	Below AVG

Table 4 Descriptive statistical values of first grade female students and t-test (N=43)

AOP–Var	Mean	Std. Dev.	Min	Max	t	p
AOP–Var3	24,35	2,16	19	28		
AOP–Var6	24,78	2,04	21	29	-3,35	,0017

(AOP–Var – variable of forearm girth, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max − maximum, t-test, p − level of relevance)

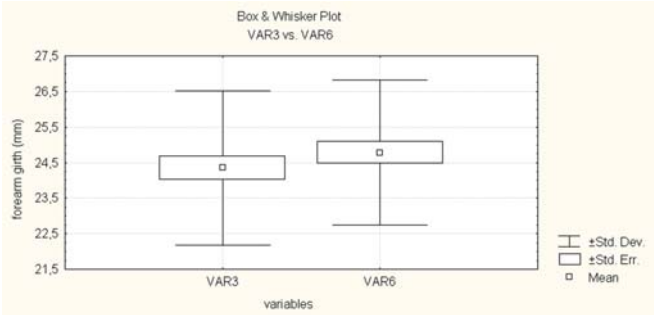

Figure 3 Presentation of results of means of AOP tests of first grade female students

Table 5 Orientation values of forearm girth for first grade female students

Mean of AOP results of first grade female students	Norms (Findak et al., 1996).
24,35 (Inicial state)	Excellent
24,78 (Final state)	Excellent

Table 6 Descriptive statistical values of second grade female students and t-test (N=21)

ATV–Var	Mean	Std. Dev.	Min	Max	t	p
ATV–Var7	167,93	5,26	160,0	178	-1,78	,0896
ATV–Var10	168,10	5,21	160,5	178		

(ATV–Var – variable of body height, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max − maximum, t-test, p − level of relevance)

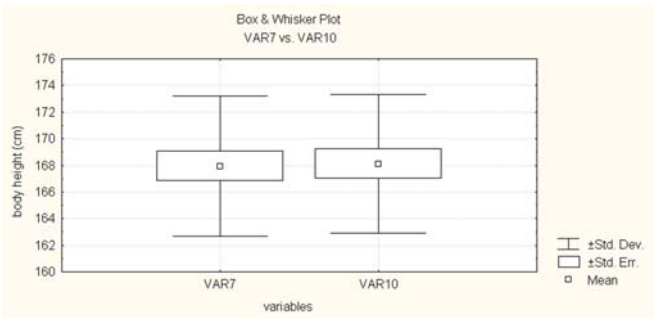

Figure 4 Presentation of results of means of ATV tests of second grade female students

Table 7 Descriptive statistical values of second grade female students and t-test for dependent patterns (N=21)

ATT–Var	Mean	Std. Dev.	Min	Max	t	p
ATT–Var8	60,98	12,03	48	102	-1,76	,0940
ATT–Var11	62,57	14,65	51	119		

(ATT–Var – variable of body weight, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max – maximum, t-test, p – level of relevance)

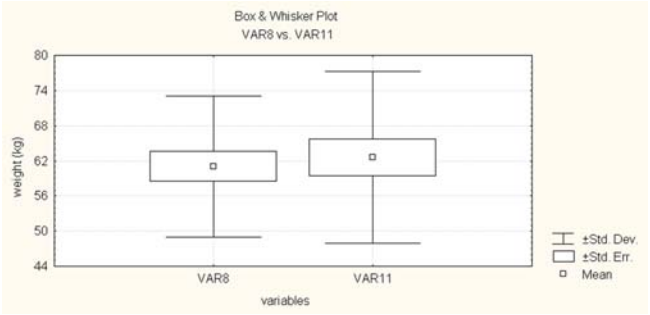

Figure 5 Presentation of results of means of ATT tests of second grade female students

Table 8 Orientation values of body weight in relation to body height for second grade females

Mean of ATV and ATT results of second grade female students	Norm (Findak et al., 1996).
167,93 (ATV) 60,98 (ATT) (Inicial state)	Above AVG
168,10 (ATV) 62,57 (ATT) (Final state)	AVG

Table 9 Descriptive statistical values of second grade students and t-test (N=21)

AOP–Var	Mean	Std. Dev.	Min	Max	t	p
AOP–Var9	23,95	1,69	21,5	28		
AOP–Var12	23,95	1,88	22,0	30	,00	1,00

(AOP–Var – variable of forearm girth, Valid N – number of examinees, Mean – mean, Std. Dev. – standard deviation, Min – minimum, Max – maximum, t-test, p – level of relevance)

Table 10 Orientation values of forearm girth for second grade female students

Mean of AOP results of second grade female students	Norm (Findak et al., 1996).
23,95 (Inicial state)	Excellent
23,95 (Final state)	Excellent

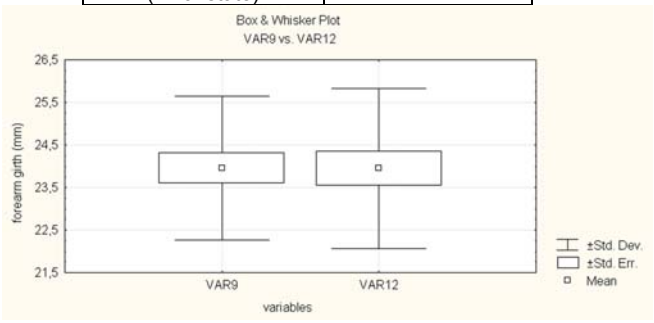

Figure 6 Presentation of results of means of AOP tests of second grade female students

Discussion

Processed statistical data show the arithmetic mean of first and second grade female students in the variables of body height (ATV), body weight (ATT) and the forearm girth (AOP). With the arithmetic mean of a single variable, the table shows the number of students participating in the study, standard deviation, minimum and maximum score, t-test for dependent patterns and p-level of significance whose outcome depends on whether we reject or accept the null hypothesis (Ho). With t-test for dependent patterns (Table 1.) of body height variable (ATV) we have determined that there is a statistically significant difference between the results of the first grade female students in two time points at a significance level of 0.05 ($p < 0.05$) and was accepted first hypothesis H1 that statistically differs groups significantly (Petz, 1985). The results showed that the variables in body weight (ATT) and forearm girth (AOP) of first grade female students statistically differ significantly in the two time points (Table 2. and Table 4.). Norms stating the guiding values of weight in relation to height of the body, the first grade female students recorded below average results in the initial and final measurements (Table 3.) (Findak, Metikoš, Mraković, Neljak, 1996). The female students have obtained excellent results in variables forearm girth (AOP) for initial and final measuring (Table 5.) (Findak, Metikoš, Mraković, Neljak, 1996). Results were also presented in Box & Whisker Plot graph that compares each variable in the initial and final measuring with three parameters: a small box showing the arithmetic mean, rectangle shows the standard error of arithmetic mean, and the horizontal lines show the standard deviation of the results (Graph 1., Graph 2., Graph 3., Graph 4., Graph 5., Graph 6.). The results of the second grade female students show that there is no statistically significant difference between the initial and final measurements of the variables of body height (ATV), body weight (ATT) and forearm girth (AOP) ($p < 0.05$) (Table 6., Table 7. and Table 9.). According to norms stating the guiding values of weight in relation to height of the body, the second grade female students have recorded in the initial measurement above average results, and the average final measurement results (Table 8.) (Findak, Metikoš, Mraković, Neljak, 1996).

Standard values of forearm girth (AOP) for the second grade female students show excellent results in both time points of measurement (Table 10.) (Findak, Metikoš, Mraković, Neljak, 1996). Numerous studies have shown that parents lifestyle, habits, diet and obesity are closely associated with the habits and obesity of children. Therefore children with both obese parents have 80% probability of developing obesity during life, while the risk of obesity in the case when only one parent is obese falls to 40% (Sothern M.S., 2004). and (Safer and associates, 2001). Research shows that parental physical inactivity strongly predicts child's inactivity.

Conclusion

Based on the results of this research, it was presented that there are differences in their interrelationships among anthropometric characteristics of first and second grade female students. The results showed that the initial state of all anthropometric variables (ATV, ATT and AOP) surveyed among first grade female students show statistically significantly different from the final state, while the second grade female students in the aforementioned variables, there was no statistically significant difference between the initial and final states at the level of significance of 0.05 ($p < 0.05$) (Petz, 1985). Norms stating the guiding values of weight in relation to height of the body, the first grade female students were in the initial and final measurements recorded below average results (Table 3.), while the second grade female students in the initial measurement recorded above average, and in the final measuring average results (Table 8.) (Findak, Metikoš, Mraković, Neljak, 1996). The variables of forearm girth (AOP) female students of first and second grade students have recorded for initial and final measuring excellent results (Table 5. and Table 10.) (Findak, Metikoš, Mraković, Neljak, 1996). From the results it is evident that there is a gap in the variables of body height (ATV) and body weight (ATT) with respect to the variable of the forearm girth (AOP) at the first graders, but this gap is reduced in the second grade students results. Females in the first grade have increased body weight in relation to height of the body and an excellent result in a variable forearm girth. It refers to the fact that first grade students are developed and have elevated ratio of subcutaneous adipose tissue in relation to muscle mass. The problem of child obesity is more and more present in Croatia, primarily due to a lack of physical activity and improper diet. Troiano and Flegal (1998). and Sallis and Owen (1999). emphasize the great importance of physical activity in preventing obesity, increasing the level of child health, increase bone density, strengthening their confidence, preventing from osteoporosis and stress. In the second grade students these proportions are lower resulting in relative height and body weight ratio they achieve above average and average results and excellent results in a variable forearm girth. We assume that the reasons which led to these results are maturation of second graders and entering the II phase of rapid growth and development (Findak 2001)., increasing awareness of the benefits of physical activity, increased interest and concern for physical appearance, the increasing demands of physical education program in second grade compared to first grade. Physical exercise has no significant impact on the growth and maturation, but active students that were involved in some kind of sport activity generally have a higher aerobic endurance, as well as higher levels of functional-motor skills (especially muscular endurance and running speed).

Whitaker and associates (1997). emphasize that students with high Body Mass Indeks (BMI) are more likely to be obese in later life, while Nawalyah and Bong (2004). point out that the BMI is greatly affected by the socioeconomic status of students. Obese children are mostly from middle income families, which have tendency to have a negative attitude toward physical activity. Physical activity has a full preventive impact on health if carried out continuously throughout their lives, so it is one of the main tasks of teaching physical education in school to create in students the habit of physical activity, exercise and sport (Mišigoj-Duraković et al. 1999).

References

Findak, V. (2001). *Metodika tjelesne i zdravstvene culture* [Methodics of physical education. In Croatian.]. Zagreb: Školska knjiga.

Findak, V., Metikoš, D., Mraković, M., & Neljak, B. (1996). *Primijenjena kineziologija u školstvu (Norme)* [Applied kinesiology in schools (Norms). In Croatian.]. Zagreb: Hrvatski pedagoško–književni zbor.

Hakkinen, K. (1993). Changes in physical fitness profile in female volleyball players during the competitive season. *Journal of Sports Medicine & Physical Fitness, 33*(3), 223-232.

Malina, R.M. (1994). Physical growth and biological maturation of young athletes. *Exerc Sport Sci Rev, 22*, 389-433.

Mišigoj-Duraković, M., et al. (1999). *Tjelesno vježbanje i zdravlje* [Physical exercise and health. In Croatian.]. Fakultet za fizičku kulturu, Zagreb

Mišigoj-Duraković, M., et al. (1995). *Morfološka antropometrija u športu* [Morphological antropometry in sport. In Croatian.]. Zagreb: Fakultet za fizičku kulturu.

Nawalyah, A.G., & Bong, H.L. (2004). Food intake and physical activity patterns of obese children in primary schools in Kuching, Sarawak, Malaysia. *Asia Pac Journal of Clinical Nutrition. 13*, 146.

Petz, B. (1985). *Osnovne statističke metode za nematematičare* [Basic statistical methods for unmathematicians. In Croatian.]. Zagreb: Sveučilišna naklada Liber.
Safer, D.L., Agras, W.S., Bryson, S., & Hammer, L.D. (2001). Early body mass index and other anthropometric relationships between parents and children. *International Journal of Obesity Relat Metab Disord, 25*(10), 1532-1536.
Sallis, L., & Owen, N. (1999). *Behavioral medicine and health psychology 3*. Thousand Oaks, CA: Sage Publications. Phyisical activity and behavioral medicine.
Sothern, M.S. (2004). Obesity prevention in children: Physical activity and nutrition. Nutrition*, 20*(7-8), 704-708.
Troiano, R.P., & Flegal, K.M. (1998). Overweight children and adolescents: Description, epidemiology and demopgraphics. *Pediatrics. 101,* 497-504.
Whitaker, R.C., Wright, J.A., Pepe, M.S., Seidel, K.D., & Dietz, W.H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *N Eng J Med, 337*, 869-873.

ANTROPOMETRIJSKE ZNAČAJKE UČENICA PRVIH I DRUGIH RAZREDA SREDNJE ŠKOLE I NJIHOVI ODNOSI

Sažetak

Antropometrijske značajke sastavni su dio antropoloških obilježja učenika. Periodičnim provjeravanjima antropometrijskih značajki koje se primijenjuju u školskoj praksi (ATV – tjelesna visina, ATT – tjelesna težina, AOP – opseg podlaktice, ANN – potkožni nabor nadlaktice) možemo dobiti uvid u njihovu kvalitetu. Cilj ovog istraživanja jest usporedba rezultata antropometrijskih značajki učenica prvih i drugih razreda srednje škole te njihovo svrstavanje u određene rangirne razrede u odnosu na kriterije propisane za određenu antropometrijsku značajku. Rezultati antropometrijskih značajki, funkcionalnih i motoričkih sposobnosti prikazuju razinu učenikovog antropološkog statusa te pomoću njega nastavnici izrađuju program prilagođen potrebama učenika i transformaciji pojedinih dimenzija njihovog antropološkog statusa. Na uravotežene odnose antropometrijskih značajki zasigurno će utjecati redovita tjelesna aktivnost i pravilna prehrana, a time će se i pozitivno djelovati na zdravlje učenika.

Ključne riječi: *antropometrijske značajke, antropološki status, tjelesna aktivnost, transformacija, zdravlje*

Received: September 14, 2014
Accepted: May 10, 2015
Correspondence to:
Bruno Čukulin, BSc
High School Vrbovec
10340 Vrbovec, 7. svibnja 2, Croatia
Phone: +385 91 8950 689
E-mail: brunocukulin@gmail.com