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Changes in Height and Body Weight Within a Time Period of 35 Years in Males of the Same Age

Cambios en la Altura y el Peso Corporal en un Período de 35 Años en Hombres de la Misma Edad

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SUMMARY: Height and body weight measurements are among the most important anthropometric variables when assessing a population's growth, development and body composition. This study aimed to evaluate the height and body weight variability of male entities aged 17-18 years within 35 years. This goal was realized by comparing the height and body weight of the population of the same gender and age in three different time studies. The descriptive statistical parameters and T-test for independent groups show systematic and significant differences in measured variables between three measurements in different timelines. Both in body height and body weight, from measurement to measurement, significant systematic and statistically significant differences ($p<0.01$) have been identified (1985: BH= 172.8cm, BW= 61.7kg; 2004: BH=176.8 cm, BW=66.9 kg; 2019: BH=178.5 cm, BW=72 kg). The results of this study prove that the change in the socio-economic status of a population over a period time of 35 years can significantly affect the growth and development of children/adolescents.

KEY WORDS: Height; Bodyweight; Adolescents; Anthropometric; Socio-economic status.

INTRODUCTION

Human height and body weight are the most studied quantitative anthropometric variables in Human Anthropology that are differently determined by internal and external factors. Results of some previous studies have shown that even though human bodily growth is above 90 % controlled by genetic factor, if external factors (socioeconomic status, physical activities, health nutrition) act in the sensible and intensive phase of bodily growth, its effect may be significant (Rexhepi, 2009, 2022). According to Silventoinen *et al*. (2000), environmental factors appear to have more influence on women's body height than on men, compared with genetic factors. Body height is more influenced by genetic factors than body weight and less by external factors (McEvoy & Vischer, 2009; Lai & Mayer, 2016). The main findings in the work of Hatton (2014) show that the average height of men in Europe within a century (1870-1980) has increased by 11 cm. Although, according to Hatton (2014), between the two world wars, there was stagnation in growth, the improvement of the health condition, education and the improvement of the socio-economic situation of the population are the most influential factors in the general physical growth.

Body weight is a three-dimensional anthropometric variable influenced by the interaction of internal/genetic factors (approximately 40-70 %) and exogenous/ environmental (McPherson, 2007). Compared to stature, body weight is more influenced by external factors (bio-psycho-socio-economic factors, climate and seasonal, physical activities, certain diseases, environmental factors, and nutritional factors). The studies show that in the different timelines, the exogenous factors significantly may impact both these variables (McEvoy & Vischer, 2009; Fagaras *et al*., 2015). Although age is one of the factors with the most significant changeable impact on almost all anthropological dimensions (Susanne, 1974), also, proper nutrition has a considerable effect on anthropometric dimensions (Rexhepi & Brestovci, 2020). According to Story & Stang (2005), the biological, psychosocial, and cognitive changes that begin during puberty and continue throughout adolescence directly affect nutritional status and nutrient needs and significantly increase their requirements for energy, protein, and micronutrients. Pérusse *et al*. (1988), state that the genetic factor 20 % influences food choice, while the external factor influences 80 % (people's culture, environment,

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socioeconomic status, eating habits). Morgenstern *et al*. (2009), highlighted the relationship between socioeconomic status and being overweight (body mass index - BMI). According to these authors, the lower the socioeconomic status of a population, the higher the BMI value of that population will be; respectively, with the increase of the socioeconomic status, the BMI value will be able to decrease. Based on the results of this paper, the television in the bedroom and the time spent in front of the TV screen have a significant impact on the cause of obesity, in contrast to video games and watching movies that have not shown any significant impact (Morgenstern *et al*., 2009).

Undoubtedly, healthy nutrition (adequate intake of micro and macronutrients) plays an essential and undeniable role in determining the normal growth and development of children and adults. On the contrary, malnutrition (in terms of quantity, quality and feeding time) slows the growth and development of children and young people (Rexhepi, 2022). There are 50 essential nutrients required for normal growth, development, and maintenance of the body; nutritional deficiency of these nutrients may cause growth and development failure (Guthrie & Picciano, 1995).

According to Lifshitz (2009), accurate body weight and stature charts are necessary to detect nutritional growth retardation (NGR). At the same time, proper nutrition and changing bad nutrition habits increase the growth and development of children/adolescents who suffer from NGR (Lifshitz, 2009). Cesani *et al*. (2013), found that malnutrition is more common among children in rural areas than in urban areas. According to this study, those children who practice consuming diets with excessive amounts of Carbs and lipids but deficient in protein are expected to be malnourished (becoming overweight or obese combined with the muscular deficit). Also, based on the results of this research, the authors highlight the necessity of improving the socio-economic-environmental conditions of rural children to protect their health and quality of life (Cesani *et al*., 2013).

Werner Bo, in his book Growth in Sweden, described the human somatic growth in entities of different ages in different time periods. The research found a growth rate, both in height and body weight, for those born in 1981 compared to those born in 1973 for both boys and girls (Werner, 2007).

The present study aims to evaluate the changeability of the body height and body weight variables during a 35 years period of time. The hypothesis on which this research was based was that there are significant differences in the measured variables of body height and body weight between measurements taken at different time periods. This hypothesis will be tested through descriptive statistical parameters, descriptive analysis and t-test.

MATERIAL AND METHOD

Research design: This study is a part of the project "Morphological characteristics of the Kosovo Albanian population", and it was carried out by the Institute of Sports Anthropology in Pristina, Kosovo. By its nature, this research may be considered as an observational and cross-sectional descriptive study.

Site of study and sampling: To investigate body height and body weight changes over different time periods, these two variables were measured in 4461 male entities aged 17-18 years from Pristina. The measured entities were chosen randomly, always respecting the rule that their psycho-physical condition was in the normal range; the measurements were done in three different periods of time:

- In 1985, Hysen Rakovica, within the Faculty of Sports Sciences at the University of Pristina, has measured 241 entities;

- The two other measurements were done in the Institute of Sports Anthropology (2004 measured 3825 entities; 2019 measured 394 entities).

Measuring tools and data collection: The following morphometric variables were measured in accordance with the International Biological Program (IBP):

- Body Height (BH) - indicates the distance from the foot surface to the apex of the head, with the subject's body position in a standard raised posture, without shoes and with the head position in the Frankfort horizontal plane. The stature was measured with a classical anthropometer (expressed in mm);

- Body Weight (BW) - measured with a digital weighing scale (expressed in kg);

Data analysis: The statistical analyses were performed with the IBM SPSS Statistics software package version 20 and Excel-programme. The obtained data were analysed through descriptive analysis and t-test.

Ethical considerations. This study fully complied with the guidelines of the Declaration of the World Medical Association of Helsinki (JAMA. 1997;277:925-926) and received approval from the Institute of Sports Anthropology Ethics Committee.

RESULTS AND DISCUSSION

Aiming for a more straightforward and accurate analysis, we analyzed the results separately for body weight and height. Descriptive statistical findings for body weight in all three measurements are presented in Table I. These results indicate the significant systematic differences in the three done measurements. These results confirm similar systematic differences from measurement to measurement, with similar progressive increases.

Table I. Descriptive statistical parameters of Body Weight (BW)

Year of measurements:	Mean	Min	Max	Std.Dev.
1985	61.73	42.40	82.50	61.10
2004	66.87	45.00	122.50	8.11
2019	72.02	47.30	117.3	11.30

The difference between the first measurement (the year 1985, BW=61.73 kg) and the second measurement (the year 2004, BW=66.87 kg) is 5.14 kg, while the difference between the second measurement (the year 2004) and the third measurement (the year 2019, BW =72.02 kg) is 5.15 kg. This numerical similarity in the difference in body mass growth between the first and second measurements and the second and third measurements, is also similar to the approximate similarity in the time difference between the measurements made (2004-1985=19 years; 2019-2004=15 years). For 34 years of the time difference between the first measurement (1985) and the third measurement (2019), the difference in the body weight of male entities aged 17-18 from Pristina/Kosovo is 10.29 kg (Tables I and II, Fig. 1).

Table II. t-test (BW).

Variables:	1984/2004	1984/2019	2004/2019
Difference in BW (kg)	5.14	10.29	5.15
t-test	12.54	14.91	8.88
p	< 0.01	< 0.01	< 0.01
df	4065	634	4217

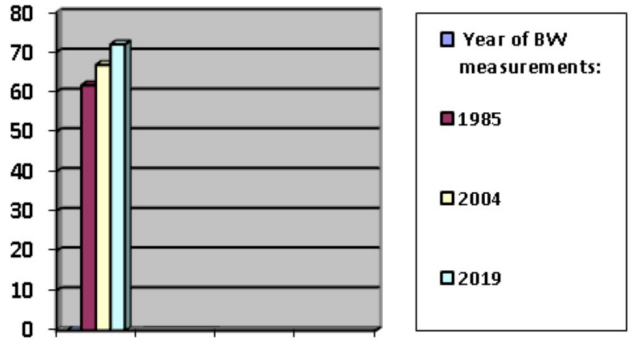

Fig. 1. Body Weight - BW (kg) during three measurements.

Table II shows the statistical validity of the systematic differences in body weight between three measurements carried out in different periods of time. In all three measurements, the differences in body weight are statistically significant with high t-test values and probability $p<0.01$.

Similarly, in body weight and body height, significant systematic differences were realized between the three measurements (Table III). Compared with the body weight, the body height (BH) shows different changeability from measurement to measurement.

Table III. Descriptive statistical parameters of Body Height (BH).

Year of measurements:	Mean	Min	Max	Std.Dev.
1985	1727.83	1589.00	1885.00	59.77
2004	1767.62	1541.00	2046.00	63.34
2019	1784.50	1612.00	2033.00	65.79

The difference between the first measurement (the year 1985, BH=1727.83mm) and the second measurement (the year 2004, BH=1767.62mm) is 39.79mm, while the difference between the second measurement (the year 2004) and the third measurement (the year 2019, BH =1784.50mm) is 16.88mm. The time difference of 35 years, together with the influence of external socio-economic factors, has caused that between the first measurement (1985) and the third measurement (2019), the difference in body height is 56.67 mm (Table IV, Fig. 2). The most significant differences in body height between the first and second measurements (39.79mm) compared to the second and third measurements (16.88mm) can be explained by the radical change in the socio-economic condition of the population after the liberation of the people of Kosovo in 1999, as well as the great support and help of the international factor in the post-war period (2000-2004). Although genetic factors greatly influence body height (BH), a problematic socio-economic situation for a long time can suppress the average growth and development of children and young people. With the improvement of this factor, the compensatory (pronounced) growth of the measured population has come into expression.

Since comparability is essential for epidemiological monitoring, we will compare our results with the Swedish researcher Werner Bo, who, in his book "Growth in Sweden", has analyzed the changes in population growth in different periods. Between our research and Werner's research (Werner, 2007), there are some common characteristics (Table V)

Table IV. t-test (BH)

Variables:	1984/2004	1984/2019	2004/2019
Difference in BH (mm)	39.79	56.67	16.88
t-test	9.9	11.18	8.09
p	<0.01	<0.01	<0.01
df	4065	634	4217

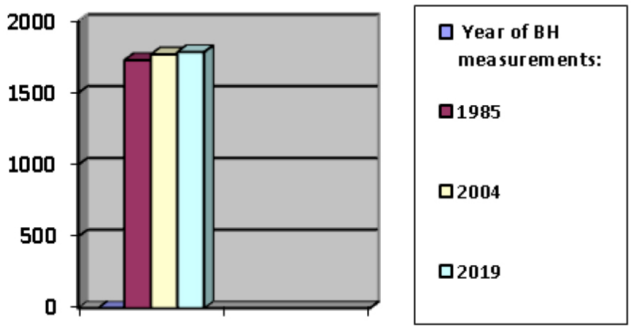

Fig. 2. Body Height - BH (mm) during three measurements.

*The similar time difference in measurements: in our measurements, it is 34 years (the time of measurements 1985-2019), while in Werner's measurements, it is 36 years (the time of measurements 1916-1952);

*Sex and age of the measured entities (in our study, males aged 17-18 yo; in Werner's work, males aged 19-20 yo);

*Between the two time periods when the measurements were made, the two populations were subjected to war (the Kosovar population in 1998-1999 and the Swedish population during the Second World War);

* Based on the age of the entities, the obtained results are quite similar: in our measurements, the difference in growth is 56.67 mm, while Werner, in his book "Growth in Sweden", described the difference in body growth as 41 mm. The difference in the growth of 15 mm between our measurements and the Swedish measurements can hypothetically be explained by the difference in the age of the entities. The Kosovar entities (17-18 years old) have just come out of the phase of rapid physical growth, in contrast to the Swedish entities (19-20 years old), which have just entered the stable phase of slow physical growth.

Let's compare the significant differences (t-test) between the morphometric measurements of weight and body height in the three measures taken in different periods. It can be noticed that the most significant values of the t-test are realized in the body weight (1984/2004=12.54; 1984/2019=14.91; 2004/2019=8.88) variable compared to body height (1984/2004=9.9; 1984/2019=11.18; 2004/2019=8.09) (Tables II and IV). This can be justified because body weight is a three-dimensional variable with a more significant influence of the external factor, compared to body height (a one-dimensional variable) is more influenced by the genetic factor.

Our hypothesis that there are significant differences in the measured variables of body height and body weight between measurements taken at different time periods is confirmed.

CONCLUSION

The explanation of lower values of the height and body weight of the sample of the entities measured in 1985 compared to other measurements may be explained based on the socio-economic condition of Kosovo in this period of time. In 1985, when the first measurements were done, Kosovo was one of the eight constituent parts of the former Yugoslavia and the most economically underdeveloped region, with the largest number of unemployed in the former Yugoslavia. Meanwhile, the results of the second measurement made in 2004, which shows significantly greater values of body height and weight than the measurements of 1985 but smaller compared with the measurements done in 2019, can be attributed to the rapid improvement of the socio-economic condition of the Kosovars after the war. In 1999, after the humanitarian intervention of NATO forces, Kosovo was liberated, and investments from Western countries and the diaspora have made Kosovo rapidly progress in terms of socioeconomics. Meanwhile, the improvement of anthropometric data (stature and body weight) in the third measurement made in 2019 can also be attributed to the continuous development of the socio-economic condition of Kosovo.

Practical application. The obtained results can be used and applied in anthropological contexts.

Table V. Comparisons of differences in body growth between Kosovar and Swedish measurements.

	Kosovo research	Sweden research
Time difference in measurements	2019-1985=34 yo	1952-1916=36 yo
Sex and age of the measured entities	Males, 17-18 yo	Males, 19-20 yo
Between the two measurements, populations have experienced war	War period in ex-Yugoslavia 1998-1999	Second World War
Difference in growth	1784.50-1727.83=56.67mm	1758-1717=41mm

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RESUMEN: Las medidas de altura y peso corporal se encuentran entre las variables antropométricas más importantes a la hora de evaluar el crecimiento, el desarrollo y la composición corporal de una población. Este estudio tuvo como objetivo evaluar la variabilidad de la altura y el peso corporal de entidades masculinas de 17 a 18 años dentro de 35 años. Este objetivo se logró comparando la altura y el peso corporal de la población del mismo sexo y edad en tres estudios temporales diferentes. Los parámetros estadísticos descriptivos y la prueba T para grupos independientes muestran diferencias sistemáticas y significativas en las variables medidas entre tres mediciones en diferentes líneas de tiempo. Tanto en la altura como en el peso corporal, de medición en medición, se han identificado diferencias significativas sistemáticas y estadísticamente significativas ($p<0,01$) (1985: BH= 172,8 cm, BW= 61,7 kg; 2004: BH=176,8 cm, BW=66,9 kg; 2019: BH=178,5 cm, BW=72 kg). Los resultados de este estudio demuestran que el cambio en el estatus socioeconómico de una población durante un período de 35 años puede afectar significativamente el crecimiento y desarrollo de niños/adolescentes.

PALABRAS CLAVE: Altura; Peso corporal; Adolescentes; Antropométrico; Estatus socioeconómico.

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