

## ORIGINAL SCIENTIFIC PAPER

# Analysis of Trends in Anthropometric Characteristics of Montenegrin Young Men from Niksic from 1957 to 1969

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## Abstract

The aim of this study is to observe the trend of body height, body weight, and body mass index in Montenegrin young men from Niksic from 1957 to 1969. The sample of respondents in this study numbered a total of 10,738 future soldiers with an average age of  $18.25 \pm 0.78$ , who were tested for military service in the period from 30 June 1957 to 28 December 1969. The average body height of the total sample of future recruits was  $178.58 \pm 6.86$ , the average body weight was  $68.56 \pm 8.66$ , and the average value of body mass index was  $21.48 \pm 2.27$ . The highest body height ( $180.83 \pm 8.13$ ) and body weight ( $73.26 \pm 9.38$ ) was in the group of respondents born in 1958. The highest body mass index ( $22.84 \pm 2.50$ ) was found in the respondents of group born in 1957. The value of the body mass index of all respondents shows that everyone was in the zone of normal weight. The highest body mass index ( $22.84 \pm 2.50$ ) was found in the respondents of group born in 1957. It should be noted that many of these respondents were measured before the age of 18. This means that their growth was not complete. There is a possibility that they on average had a higher body height with the completion of growth and development than this research shows. The results show that all generations of young men from Niksic were at that time of a normal weight. This fact is not surprising because it is known that life was different then than it is now. The results of this study are very important in monitoring the trend of these 3 variables in the Montenegrin population, but they also have some limitations. As mentioned above, the rule for recruiting future soldiers was to be tested before the age of 18, when growth and development were not complete yet, and the results after the completion of the growth and development of the respondents would probably be slightly different from these results.

**Keywords:** *body height, body weight, body mass index, secular trend, Montenegro*

## Introduction

The results of many recent studies show a trend of growth in average body height in adults in countries with economic growth (Milasinovic, Gardasevic, & Bjelica, 2017; Arifi et al., 2017; Masanovic, Bavcevic, & Prskalo, 2019a; Gardasevic, 2019a; Gardasevic, 2019b). Better conditions of life and a better lifestyle have a positive impact on increasing the average body height of the population. The same is the case with adults

in Montenegro (Popovic, 2017). Many researchers around the world are determining and analysing body height of adults for more than 2 centuries (NCD Risk Factor Collaboration, 2016). The researches, carried out by European anthropologists a century ago, have proved the assumption that the tallest people are living in the Dinarides (Pineau et al., 2005), among whom are the Montenegrins, and among first their body height was recognized by Robert Ehrlich at the beginning of



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the 20<sup>th</sup> century (Coon, 1975). Considering that Montenegro was a part of a great state of Yugoslavia until 2006, there is not much preserved data on the body height of Montenegrins. Only since the independence of Montenegro, the number of studies on the body height of Montenegrins has increased and all of them confirm that Montenegrins are one of the highest nations in the world (Bjelica et al., 2012; Milasinovic, Popovic, Matic, Gardasevic, & Bjelica, 2016). This study should contribute to the small amount of data in recent decades on the average height of men in Montenegro.

Body mass index represents the ratio of body weight to body height. It is a parameter that provides information on 4 levels of nutrition, and 3 of these 4 levels of body mass index can show a health risks throughout life (NCD Risk Factor Collaboration, 2017). Underweight, overweight, or obesity are categories of body mass index which can show a health risk. Deficiency or excess of adipose tissue have detrimental consequences for human metabolism (Masanovic, Bavcevic, & Prskalo, 2019b). In children, underweight gives a higher risk for infectious diseases, in youth underweight can also endanger reproductive ability (Han, Mulla, Beiene, Liao, & McDonald, 2010, Masanovic, Milosevic, & Corluca, 2018; Masanovic, Corluca, & Milosevic, 2018). Overweight and obesity can cause a variety of cardiovascular and chronic diseases (Singh, Mulder, Twisk, Van Mechelen, & Chinapav, 2008).

Searching index databases, the authors of this study did not find enough researches on trends in body mass index of the population in Montenegro. Considering the very specific body height and appearance of Montenegrins, it was very interesting to observe the trend of body height, body weight, and body mass index in this population in previous decades. The data the authors used for this study will help eliminate the problem of deficiency of these kind of data for the entire male population in Niksic from 1957 to 1969. Niksic is the second largest city in Montenegro (Figure 1). In these 13 consecutive

years, in the second half of the last century, trend of variables of body height, body weight and body mass in the male population will be presented.

## Methods

All young men from the city of Niksic, the second largest town in Montenegro, during the 13 consecutive years of the last century were included in the sample of this research. Respondents were measured during mandatory medical examinations that served to test their preparedness for military service. Usually, the testing of young men was done before the age of 18, and military service was served after the end of high school, at the age of 19. However, there was a rule that military service could be postponed until the age of 27, if there were some very important reasons, such as further education, etc. Therefore, some of the recruits whose results were included in this study, had medical examinations after the age of 18, which increased the average age of each generation and the complete sample in this study.

The sample of respondents in this study numbered a total of 10,738 future soldiers with an average age of  $18.25 \pm 0.78$ , who were tested for military service in the period from 30 June 1957 to 28 December 1969. Testing was conducted with 13 age generations. The complete sample of respondents was divided into 13 groups, in order to check the trend of body height, body weight and body mass index in all young men in this city in the mentioned 13 years. The first group numbered 31 respondents born in 1957 with an average age of  $23.53 \pm 1.31$ , the second group numbered 42 respondents born in 1958 ( $22.86 \pm 1.82$ ), the third group numbered 44 respondents born in 1959 ( $21.75 \pm 1.66$ ), the fourth group numbered 109 respondents born in 1960 ( $20.29 \pm 1.46$ ), the fifth group numbered 1,153 respondents born in 1961 ( $18.43 \pm 0.63$ ), the sixth group numbered 1,349 respondents born in 1962 ( $17.96 \pm 0.64$ ), the seventh group numbered 1,420 respondents born in 1963 ( $18.31 \pm 0.40$ ), the eighth group had 533 respondents born in 1964 ( $17.88 \pm 0.53$ ), the ninth group had 1,291 respondents born in 1965 ( $17.91 \pm 0.71$ ), the tenth group had 1,444 respondents born in 1966 ( $18.30 \pm 0.36$ ), the eleventh group numbered 1,286 respondents born in 1967 ( $18.23 \pm 0.60$ ), the twelfth group numbered 1,118 respondents born in 1968 ( $18.34 \pm 0.29$ ), and the thirteenth group numbered 918 respondents born in 1969 ( $18.05 \pm 0.20$ ).

During the testing in the medical clinic, all subjects were in the underwear. Anthropometric measurements were performed according to the guidelines International Biological Program (IBP). Of all the variables measured by the subjects, body height and body weight were taken for the purposes of this study. An anthropometer was used to estimate body height, and a medical scale with moving weights with a stadiometer was used to estimate body weight. Body mass index is calculated as the ratio of body weight in kg and body height in  $m^2$ .

The analysis was performed by using the Statistical Package for Social Sciences (SPSS) version 20.0. Means and standard deviations (SD) were obtained for all anthropometric variables. Analysis of nutrition status was done based on body mass index (World Health Organization, 2010).

## Results

Descriptive data of all respondents, members of 13 age groups, are shown in Table 1. Analysis of the average body



FIGURE 1. Niksic, the second largest city in Montenegro

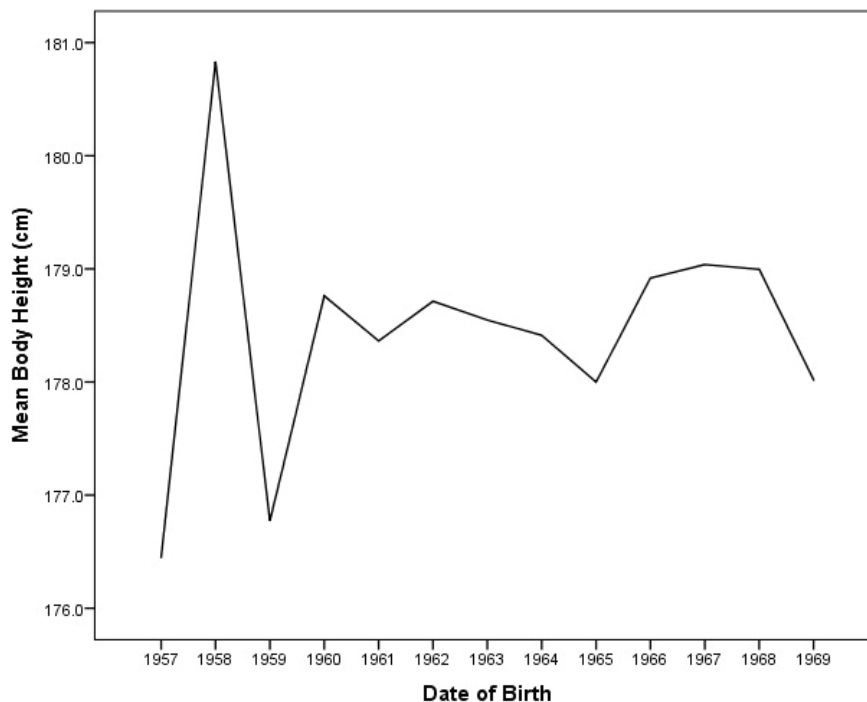
height, body weight and body mass index of young men is shown in Table 1. The average body height of the total sample of 10738 future recruits was  $178.58 \pm 6.86$ . The highest body height ( $180.83 \pm 8.13$ ) was in the group of respondents born in 1958, and the lowest body height ( $176.45 \pm 7.61$ ) was in the respondents born in 1957. In the total number of respondents, the average body weight was  $68.56 \pm 8.66$ . Respondents born in 1958 had the highest body weight ( $73.26 \pm 9.38$ ), and respon-

dents born in 1964 had the lowest body weight ( $67.31 \pm 8.79$ ). In the total number of respondents, the average value of body mass index was  $21.48 \pm 2.27$ . This value of the body mass index shows that everyone was in the zone of normal weight. The highest body mass index ( $22.84 \pm 2.50$ ) was found in the respondents of group born in 1957, and the lowest body mass index ( $21.12 \pm 2.29$ ) was found in the respondents of group born in 1964.

**Table 1.** Descriptive data for a complete sample of young male from Niksic

| Year of Birth    | Mean $\pm$ SD    |                   |                  |                                      |
|------------------|------------------|-------------------|------------------|--------------------------------------|
|                  | Age              | Body Height (cm)  | Body Weight (kg) | Body Mass Index (kg/m <sup>2</sup> ) |
| 1957 (N=31)      | 23.53 $\pm$ 1.31 | 176.45 $\pm$ 7.61 | 71.06 $\pm$ 8.25 | 22.84 $\pm$ 2.50                     |
| 1958 (N=42)      | 22.86 $\pm$ 1.82 | 180.83 $\pm$ 8.13 | 73.26 $\pm$ 9.38 | 22.40 $\pm$ 2.48                     |
| 1959 (N=44)      | 21.75 $\pm$ 1.66 | 176.77 $\pm$ 7.73 | 68.14 $\pm$ 9.74 | 21.79 $\pm$ 2.85                     |
| 1960 (N=109)     | 20.29 $\pm$ 1.46 | 178.76 $\pm$ 7.04 | 69.10 $\pm$ 8.52 | 21.60 $\pm$ 2.12                     |
| 1961 (N=1,153)   | 18.43 $\pm$ 0.63 | 178.36 $\pm$ 6.68 | 68.25 $\pm$ 8.44 | 21.42 $\pm$ 2.11                     |
| 1962 (N=1,349)   | 17.96 $\pm$ 0.64 | 178.71 $\pm$ 6.90 | 68.66 $\pm$ 8.36 | 21.47 $\pm$ 2.04                     |
| 1963 (N=1,420)   | 18.31 $\pm$ 0.40 | 178.55 $\pm$ 6.57 | 67.73 $\pm$ 8.65 | 21.22 $\pm$ 2.25                     |
| 1964 (N=533)     | 17.88 $\pm$ 0.53 | 178.41 $\pm$ 6.88 | 67.31 $\pm$ 8.79 | 21.12 $\pm$ 2.29                     |
| 1965 (N=1,291)   | 17.91 $\pm$ 0.71 | 178.00 $\pm$ 6.60 | 68.57 $\pm$ 8.89 | 21.62 $\pm$ 2.33                     |
| 1966 (N=1,444)   | 18.30 $\pm$ 0.36 | 178.92 $\pm$ 7.00 | 68.90 $\pm$ 8.63 | 21.50 $\pm$ 2.25                     |
| 1967 (N=1,286)   | 18.23 $\pm$ 0.60 | 179.04 $\pm$ 6.86 | 68.54 $\pm$ 8.21 | 21.38 $\pm$ 2.24                     |
| 1968 (N=1,118)   | 18.34 $\pm$ 0.29 | 179.00 $\pm$ 6.88 | 70.18 $\pm$ 8.83 | 21.89 $\pm$ 2.33                     |
| 1969 (N=918)     | 18.05 $\pm$ 0.20 | 178.02 $\pm$ 7.24 | 67.97 $\pm$ 9.07 | 21.44 $\pm$ 2.55                     |
| Total (N=10,738) | 18.25 $\pm$ 0.78 | 178.58 $\pm$ 6.86 | 68.56 $\pm$ 8.66 | 21.48 $\pm$ 2.27                     |

The trend of average body height in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 2.



**FIGURE 2.** The trend of average body height from 1957 to 1969 of young men of Niksic

The trend of average body weight in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 3.

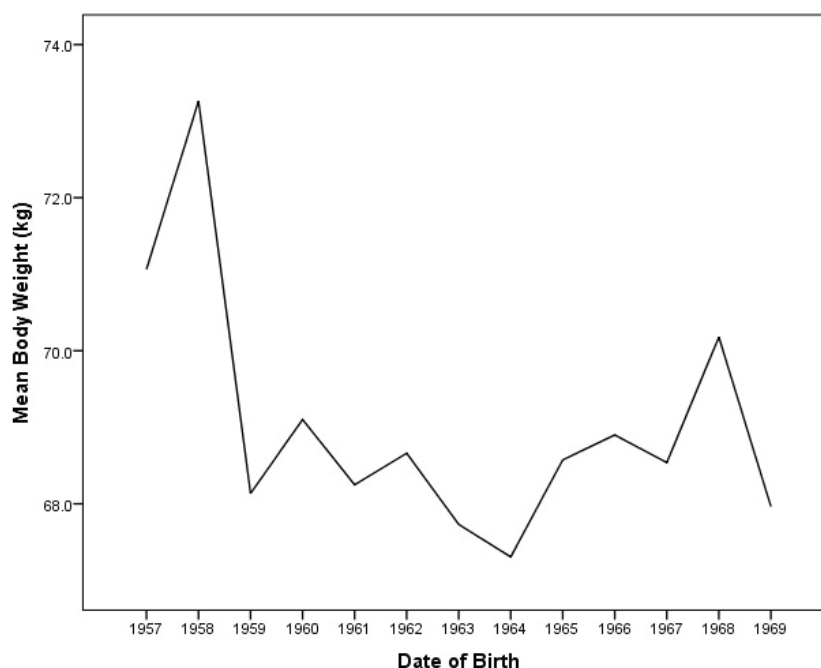


FIGURE 3. The trend of average body weight from 1957 to 1969 of young men of Niksic

In relation to the limit values of the categories of nutrition (underweight, normal weight, overweight and obesity) prescribed by the World Health Organization, it can be seen from Table 1 that all respondents here belonged to the category of

normal weight. The limit values for normal weight are values of body mass index from 18.5 to 24.9. The trend of the average body mass index in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 4.

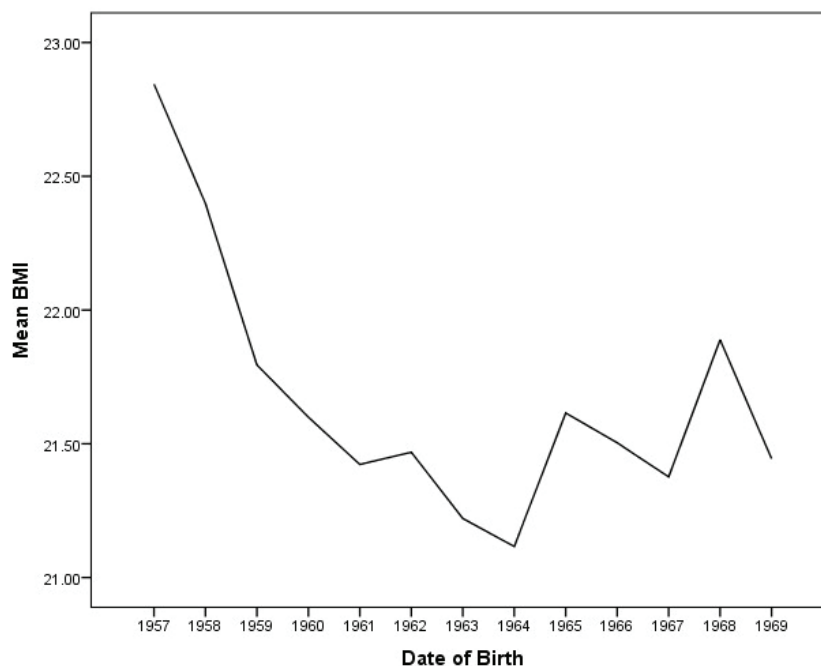


FIGURE 4. The trend of average body mass index (BMI) from 1957 to 1969 of young men of Niksic

## Discussion

The aim of this study is to contribute to the increase in the number of studies that have followed the change in body height in Montenegrins in the last century. According to research by Robert Ehrlich at the beginning of the last century, the average body height of Montenegrins was 177 cm (Coon, 1975). Our research showed that, sixty years later, the inhabitants of Niksic, the second largest city in Montenegro, were tall on average  $178.58 \pm 6.86$ . This is evidence of the secular

trend and increase in average body height in the population of Montenegro by 1.58 cm. It should be noted that many of these respondents were measured before the age of 18. This means that their growth was not complete. There is a possibility that they on average had a higher body height with the completion of growth and development than this research shows. Montenegrin researcher Popovic (2017) found that Montenegrins are one of the tallest nations in Europe with an average body height of 183.36 cm. He based his results on

a survey of the average body height of young men from 13 Montenegrin municipalities, and based on his results, this positive secular trend of average body height can be seen. In our study, it can be seen that young men born in 1957 had the lowest body height, and those born only a year later had the highest body height in the total sample of respondents. The reason for this difference in just one year certainly lies in the fact that even the smallest number of respondents in this study were from these two groups of respondents (31 respondents born in 1957 and 42 respondents born in 1958). If these two groups had a larger number of respondents, their body height ratio would probably be different.

According NCD Risk Factor Collaboration (2017) in the previous 40 years, in 189 countries, an average body height, body weight, body mass index (more than 0.05 kg/m<sup>2</sup> for every 10 years) are increased for children and adolescents. Obesity increased for 6.9% the percentage of underweight decreased.

The results of this study do not show a trend of increase or decrease in the variables body weight and body mass index. The reason for this is the fact that 13 years is not a long period to discuss it. The results show that all generations of young men from Niksic were at that time of normal weight. This fact is not surprising because it is known that life was different then than it is now. Sedentary lifestyle was less represented, virtual life was not led through social networks, much greater physical activity was represented among young people and a much healthier diet than today. These are some of the reasons for today's increase in body mass index among young people. If we analyse the body weight and body mass index in this study, it is noticeable that these are the highest values in the first two age groups, born in 1957 and 1958. But again, the reason, as with the average body height, should be found in

the fact that these two age groups had the lowest number of respondents. Montenegrin researchers Gardasevic et al. (2015) found that in Montenegrins of age of 17 the average body mass index was 24.9 kg/m<sup>2</sup>, and in Montenegrins of age of 18 the average body mass index was 22.8 kg/m<sup>2</sup>. If these values are compared with the values from this study, it is clear that the secular trend among Montenegrin youth is noticeable in this variable as well.

The results of this study are very important in monitoring the trend of these 3 variables in the Montenegrin population, but they also have some limitations. As mentioned above, the rule for recruiting future soldiers was to be tested before age of 18, when growth and development were not complete yet. It can be stated with certainty that they did not reach their final growth then. Table 1 shows that the average age of the complete sample was 18.25±0.78. The reason for this average age of the total sample of respondents, which was slightly higher than 18 years, are those respondents who were tested after the age of 18. It has already been mentioned that military service could be postponed until the age of 27 of respondent, and thus the recruitment was moved a few years later. Probably half a century ago, when this measurement was made, the average values of body height in the subjects would be even higher if the measurement was realized when the growth and development of all subjects were completed. And surely the difference would be bigger between the results of Robert Ehrich and these results and there would be a bigger secular trend. Based on this, it can be concluded that the data from this study are not completely reliable. However, these results make a major contribution to the small amount of trend data in these three variables over the past century, from the research of Robert Ehrich, to the last years when research on this topic has intensified.

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#### Conflict of interest

The authors declare that there are no conflicts of interest.

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