

## Age Changes in Height, Weight and Nutritional Condition in Adolescents from Novi Sad

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The height and weight are two most frequently used traits in assessing the development, nutritional and health condition of individuals and populations.

In compliance with International Biological Programme (IBP) and WHO, a transversal anthropological investigation was conducted in high schools of the city of Novi Sad in 2003. The investigation included 403 males and 462 females aged 15-18. The results indicate that males are characterised by significantly greater height and weight in all of the ages, while greater triceps skinfold thickness is recorded in females. A significantly greater body mass index after the age of 15 is recorded in males. The highest percentage of subjects are with normal nutritional condition, a lower number of them are moderately underweight or overweight, while the underweight and overweight subjects are present in the smallest number. A more adequate approach of assessing the nutritional condition includes the combined values of BMI and triceps skinfold thickness.

*Key words:* height, weight, triceps skinfold thickness, body mass index, adolescents, the city of Novi Sad.

### Introduction

Age changes of the height and weight reflect developmental changes during the period of adolescence and also clearly indicate the development of an organism and socio-economic conditions.

The height and weight are used for assessing the growth, physical and health condition of an organism [4, 2, 3, 10, 14, 13, 5]. They are also used for assessing the nutritional condition [11, 9, 12, 1, 8]. A trait is also used for assessing the nutritional condition is the triceps skinfold thickness [6, 1].

The aim of the study is to determine the body status of adolescents of the city of Novi Sad.

### Material and Method

The transversal investigation was conducted in high schools of the city of Novi Sad in 2003, in compliance with the International Biological Programme and WHO. The investigation included 403 males and 462 females aged 15-18. The height and weight

values were the basis for calculating the body mass index (BMI  $\text{kg}/\text{m}^2$ ), as well as the triceps skinfold thickness and BMI percent. The nutritional condition assessment was obtained using BMI percent and the combined percent values of BMI and triceps skinfold thickness according to NHANES I standards [7].

The data were processed using SPSS 10 for Windows while the significance of differences was determined by t-test.

## Results

Table 1 presents the mean and standard deviation values of the height, weight, triceps skinfold thickness and BMI in relation to the sex and age. It can be observed from Table 1 that the mean of male height ranges from 176.4 cm (the age of 15) to 181.7 cm (the age of 18), while in females it ranges from 165.6 cm (the age of 15) to 167.4 cm (the age of 18), with males showing significantly greater height values in all ages ( $p < 0.01$ ).

As for the weight, the means are in the range of 68.9 kg (the age of 15) to 78.8 kg (the age of 18) in males, and of 58.6 kg (the age of 15) to 62.2 kg (the age of 18) in females. Significant differences are observed in all ages, greater values being recorded in males ( $p < 0.01$ ).

The triceps skinfold thickness means range from 12.0 mm to 11.9 mm in males, and from 16.7 mm to 16.4 mm in females (at the age of 15 and 18, respectively). Significantly greater values are recorded in females, in all ages.

The absolute annual increase of all of the traits is greatest between the age of 15 and 16, except for the male height, which shows the greatest increase at the age of 17.

BMI ranges from 22.1  $\text{kg}/\text{m}^2$  (the age of 15) to 23.8  $\text{kg}/\text{m}^2$  (the age of 18) in males, and from 21.3  $\text{kg}/\text{m}^2$  to 22.2  $\text{kg}/\text{m}^2$  in females (at the ages of 15 and 18, respectively). Significantly greater means are observed in males after the age of 15 ( $p < 0.01$ ).

BMI distribution of males and females is given in Fig. 1.

The greatest percent of the subjects fall into the category of normal nutritional condition (P15–P85). Approximately 5.00 % are underweight ( $P < 5$ ), and 10.00 % are moderately overweight (P85–P95).

The nutritional condition based on the combined values of BMI and triceps skinfold thickness is presented in Fig. 2.

Table 1. Mean value ( $\pm$ SD) for body height, body weight, triceps skinfold thickness and BMI according to sex and age

Age	Number	Body height (cm)	Absolute increase (cm)	Body weight (kg)	Absolute increase (kg)	Triceps skinfold thickness (mm)	Absolute increase (cm)	Body mass index ( $\text{kg}/\text{m}^2$ )
Males								
15	89	176.4 $\pm$ 9.0	–	68.9 $\pm$ 13.5	–	12.0 $\pm$ 6.4	–	22.1 $\pm$ 3.7
16	105	179.1 $\pm$ 7.8	2.7	74.7 $\pm$ 13.2	5.8	12.5 $\pm$ 6.5	0.5	23.2 $\pm$ 3.4
17	93	182.2 $\pm$ 7.8	3.1	78.1 $\pm$ 14.2	3.4	11.6 $\pm$ 5.7	-0.9	23.5 $\pm$ 3.7
18	116	181.7 $\pm$ 6.3	-0.5	78.8 $\pm$ 12.1	0.7	11.9 $\pm$ 5.6	0.3	23.8 $\pm$ 3.1
Total	403	180.0 $\pm$ 8.0		75.4 $\pm$ 13.7		12.0 $\pm$ 6.0		23.2 $\pm$ 3.5
Females								
15	110	165.6 $\pm$ 6.0	–	58.6 $\pm$ 8.2	–	16.7 $\pm$ 5.5	–	21.3 $\pm$ 2.8
16	120	167.0 $\pm$ 6.4	1.4	59.8 $\pm$ 7.3	1.2	16.1 $\pm$ 4.5	0.6	21.4 $\pm$ 2.2
17	101	167.3 $\pm$ 6.2	0.3	60.6 $\pm$ 8.8	0.8	16.4 $\pm$ 4.7	0.3	21.6 $\pm$ 2.6
18	131	167.4 $\pm$ 6.6	0.1	62.2 $\pm$ 8.8	1.6	16.4 $\pm$ 5.2	0.0	22.2 $\pm$ 2.8
Total	462	166.9 $\pm$ 6.1		60.3 $\pm$ 8.4		16.4 $\pm$ 5.0		21.6 $\pm$ 2.6

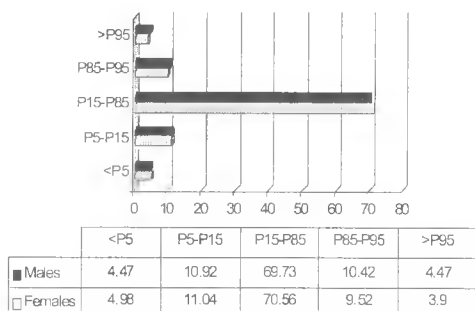


Fig. 1. The nutritional condition according to the percent of Body Mass Index (BMI kg/m<sup>2</sup>)

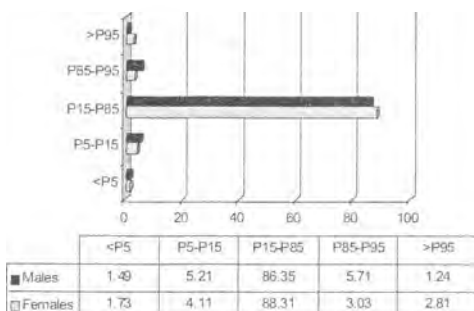


Fig. 2. The nutritional condition according to the combined percent of BMI and triceps skinfold thickness

It can be observed that the percent of males and females that fall into the category of normal nutritional condition is higher than the percent of those that are underweight, moderately underweight, moderately overweight and overweight (Fig. 2).

## Discussion

The average height and weight recorded in high school pupils aged 15-18 in the city of Novi Sad are slightly higher than those recorded in adequate groups in Vojvodina region [4, 2, 3, 10, 14], Slovenia [13], the Czech Republic [5], Cyprus [12], the United Arab Emirates [1] and Turkey [8].

The average Body Mass Index recorded in both sexes is slightly greater than this is the case with the results obtained in Turkey [8], Croatia [11] except for 16-year-old females, and in Cyprus [12] with the exception of 15-year-old females. Except for 17-year-old girls, the females in this study are characterised by lower values than those recorded by Al-Hourani et al. [1].

The nutritional condition according to NHANES I standard indicates that the number of subjects with normal values is smaller than that is the case in the study by Pavlović [9]. In our population there is a greater number of the overweight of both of the sexes, and a smaller number of the underweight males than this is recorded by Onen et al. [8].

The percent of the adolescents with normal nutritional condition is even higher if the triceps skinfold thickness is taken into consideration, apart from BMI values. The degree of nutritional condition obtained by the combined BMI and triceps skinfold thickness is more adequate than the one obtained only by BMI values.

## Conclusion

On the basis of the obtained results, the following conclusion can be drawn:

- Adolescents in the city of Novi Sad are characterised by great height and in most of the cases of normal nutritional condition.
- The average height, weight and triceps skinfold thickness do not significantly vary during the period of adolescence.
- Males are characterised by greater height and weight, while in females greater triceps skinfold thickness is recorded.

• The nutritional condition obtained by the combined values of BMI and triceps skinfold thickness is a more adequate approach.

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