Values of the body mass index of adolescents from Romania reported
to the number for hours of physical education practiced

Badicu G. ABCDE

Department of Physical Education and Special Motility, Faculty of Physical Education and Mountain Sports,
University Transilvania of Brașov, Romania

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Abstract

Purpose: The objective of this research is to show the values of the body mass index (BMI) of adolescents in Romania,
Brasov county, reported to the number hours of physical education practiced.

Material: The experiment was conducted between October 2016 - January 2017 in four high schools in Brasov county:
Andrei Şaguna High School, Andrei Mureșanu High School, Unirea High School and Sports High School. This
research was conducted on 470 pupils, of whom 224 are boys and 246 are girls, aged between 14 and 18. All
the subjects (n=470) had their BMI calculated, depending on gender/grade/age and high school.

Results: The results of the ANOVA One-Way analysis have shown a significant statistical difference between the four
high schools in terms of BMI average level (F=36.493; p<0.001), in both boys and girls (F=33.100; p<0.001).
Furthermore, also in terms of age, there are significant statistical differences between boys (F=6.085; p<0.001)
and girls (F=3.920; p=0.004). The results of the Tukey test presented significant differences between the four
high schools, as far as subjects’ gender is concerned as well.

Conclusions: The study has shown that the values of the BMI are higher in pupils from Andrei Şaguna, Andrei Mureșanu,
Unirea high schools and lower in pupils from the Sports High School, both in boys and in girls.

Keywords: adolescents, body mass index, pupils, high school.

Introduction

Problem of children and teenagers’ physical training
optimization is relevant for the last decades [1].

As we all know, sport has a major impact in our lives
because it is an activity that affects our lifestyle, health as
well as each individual’s personality.

The practice of different sports activities not only
helps us cope with the weight loss challenge, but also
with daily stress, which became one of the most negative
factors impacting our health, along with fatigue.

It is a known fact that practicing sports on a regular
basis helps us lead a happier, more quiet, productive and
stress-free life.

According to the Eurobarometer Survey carried out
in 2013 [2], on the relation between sports and European
countries and population, 60% of Romanians never
practice, close to the European average of 59%.

Currently, in Romania, 3 out of 10 children and
adolescents are overweight and 8% are obese. Romania
is on the third place in Europe as far as child obesity is
concerned, and the growing numbers of obese children
make us expect to disastrous numbers in the upcoming
years [3].

In an era of obesity, where children spend hours in a
row in front of the computer, is required to take of some
elementary measures which concern healthy development
of preschools and school children, which become
increasingly more sedentary.

The fact that physical education is no longer a
priority in schools is not a novelty. In most of school’s
concentration is done on standardized tests and materials,
by minimizing the importance of physical education on
children’s health.

In Romanian schools, the food pupils eat consists
mainly in croissants, biscuits, waffles or sandwiches
soaked with sauces or unhealthy alternatives found in
stores near the schools [4].

The consequences of obesity in children and adults
are, amongst others, the inability of integrating into the
community, the school and work environment, moving
from one place to another or depression and suicide.

In this continuous struggle to control weight and
maintain a good health, we should focus mostly on the
type and quantity of the food and drinks we consume. In
this matter, too little attention was paid to the amount of
energy it takes to practice. It has been proven that 70% of
the population in the western countries is not sufficiently
active in order to have an optimal health and weight [5].

According to the findings of scientists, 75% of health
issues are caused by inappropriate nutrition, unhealthy
lifestyle and weight gain [5].

As far as the body mass index (BMI) is concerned,
we mention that there are a number of researches that
analyzed its values, both in teenagers, adults and in other
categories of people [6-9].

A study conducted by Craig et al. [10], which examined
BMI in pupils from Seventh Day Adventist schools in
Australia, has shown low rates of overweight and obesity,
but also higher rates of underweight, compared to the
national standards. Statistical analyses of the study have
proven that a lower BMI was associated with age, gender,
regular breakfasts, a low consumption of soft drinks and
regular practice. Also, pupils reported a frequent and high
consumption of fruit, vegetables and cereals, compared to the Australian national standards.

Another study conducted by Cuceu et al. [11], demonstrates the role and effects of physical exercises, more precisely aerobics, on the BMI in first year female students at the North University Center of Baia Mare. The results of the study present significant differences of the BMI values between the experimental and the control groups. The aerobics has a more positive effect on the BMI in female students from the experimental group, compared to the students in the control group, who did not also practice aerobics, as part of their physical education classes.

The purpose of this research is to show the values of the BMI in teenagers in Romania, reported to the number for hours of physical education practiced.

The hypothesis of this research is based on the assumption that practicing on a regular basis affects in a positive manner the BMI of teenagers from urban areas.

Material and methods

Participants: This research was conducted on 470 pupils, of whom 224 are boys and 246 are girls, aged between 14 and 18.

The subjects of this research were ninth, tenth, eleventh and twelfth grade pupils.

The pupils were distributed depending on gender and grade as follows: 121 ninth grade pupils (60 male, 61 female), 115 tenth grade pupils (52 male, 63 female), 118 eleventh grade pupils (58 male, 60 female), 116 twelfth grade pupils (54 male, 62 female).

The distribution for Andrei Saguna High School are: for ninth grade: 32 pupils (20 male, 12 female); tenth grade: 30 pupils (14 male, 16 female); eleventh grade: 29 pupils (12 male, 17 female); twelfth grade: 30 pupils (15 male, 15 female). For Andrei Mureşanu High School: ninth grade: 31 pupils (10 male, 21 female); tenth grade: 30 pupils (10 male, 20 female); eleventh grade: 32 pupils (15 male, 17 female); twelfth grade: 33 pupils (13 male, 20 female). For Unirea High School: ninth grade: 32 pupils (12 male, 20 female); tenth grade: 30 pupils (10 male, 20 female); eleventh grade: 31 pupils (15 male, 16 female); twelfth grade: 29 pupils (10 male, 19 female). The Sports High School: ninth grade: 26 pupils (18 male, 8 female); tenth grade: 25 pupils (18 male, 7 female); eleventh grade: 26 pupils (16 male, 10 female); twelfth grade: 24 pupils (16 male, 8 female).

Organization of the research: The experiment was conducted between October 2016 – January 2017, in four schools in Brasov County: Andrei Şaguna High School, Andrei Mureşanu High School, Unirea High School and Sports High School.

We mention that one single class from each grade was chosen for this experiment, respectively, from ninth to twelfth.

In the first phase of this experiment, we assessed the subjects’ height and weight by the researcher. Based on the obtained results, we calculated the BMI [12], for each subject, depending on gender/grade/age and high school. The values of the BMI (kg/m²) were: less than 18.5 – underweight; 18.5 - 24.9 – normal; 25.0 - 29.9 – overweight; greater than 30.0 – obese.

Statistical analyses: Statistical analyses were conducted by SPSS (IBM SPSS Statistics Version 20). In order to determine if there are significant differences in terms of BMI levels in boys and girls, between the different high schools participating in this study and depending on age, we used the ANOVA One-Way analysis. For the verification and comparison of significant differences between values pairs we applied the post-hoc Tukey test.

Results

Table 1 describes the characteristics of the study sample. The average and the standard deviation were calculated both for boys and girls, as far as the BMI (kg/m²) is concerned, in each school, depending on age and the number of participants in the study.

Gender based analysis of the body mass index, depending on school type and age category

The results of the ANOVA One-Way analysis have shown that there is a significant difference, statistically speaking, between the four high schools, as far as average level of BMI is concerned (F=36.493; p<0.001).

In order to verify between which of the four high schools the differences are significant, we applied the post-hoc Tukey (see Table 2). The results that were achieved highlighted significant statistical differences between the average level of BMI in boys from the Sports High School (m=21.99±1.44), compared to the other high schools: “Andrei Şaguna” (m=23.90±1.72), “Andrei Mureşanu” (m=24.62±1.70) and “Unirea” National College (m=24.51±1.39).

Also, the results of the ANOVA One-Way analysis have shown that there is a significant statistical difference between the four high schools participating in this study, as far as the level of BMI in girls is concerned. (F=33.100; p<0.001).

Female pupils from the Sports High School have an average body mass index of 21.03, whereas female pupils from the other high schools have a BMI average of over 23.7.

The results of the intergroup Tukey test (see Table 3) are significant (p<0.001) for the comparison of the BMI level in girls from the Sports High School (m=21.03±1.78), with the BMI level in girls from the other high schools: “Andrei Şaguna” (m=24.07±2.08), “Andrei Mureşanu” (m=23.74±1.50) and “Unirea” High School (m=24.40±1.42).

The results of the ANOVA One-Way analysis have shown that there is a significant statistical difference between different age categories in terms of average level of BMI (F=6.085; p<0.001).

Results of the Tukey test (see Table 4) have highlighted significant statistical differences between BMI of 14 year-old boys (m=22.50±1.78) on the one hand, and the BMI of 17 year-old boys, respectively 18 year-old boys (m=24.17±1.48), on the other hand. Also, we have noticed significant differences between the BMI values on 15
Table 1. Descriptive statistics of the participants

| Variables                      | Male Mean ± SD | Female Mean ± SD |
|--------------------------------|----------------|-----------------|
| N                              | 224            | 246             |
| BMI (kg/m²)                    | 23.60 ± 1.91   | 23.66 ± 1.98    |
| BMI depending on school:       |                |                 |
| Andrei Şaguna National College | 23.90 ± 1.72   | 24.07 ± 2.08    |
| Andrei Mureşanu High School    | 24.62 ± 1.70   | 23.74 ± 1.50    |
| Unirea National College        | 24.51 ± 1.39   | 24.40 ± 1.42    |
| Sports High School             | 21.99 ± 1.44   | 21.03 ± 1.78    |
| BMI depending on age:          |                |                 |
| Andrei Şaguna National College |                |                 |
| 14 years old                   | 22.53 ± 1.84 (n=20) | 22.91 ± 1.06 (n=12) |
| 15 years old                   | 22.42 ± 1.43 (n=2) | 25.82 ± 0.55 (n=2) |
| 16 years old                   | 24.0 ± 1.87 (n=12) | 23.95 ± 1.21 (n=16) |
| 17 years old                   | 24.98 ± 1.07 (n=27) | 24.48 ± 0.93 (n=30) |
| Andrei Mureşanu High School    |                |                 |
| 14 years old                   | 22.29 ± 1.70 (n=3) | 22.3 ± 1.28 (n=19) |
| 15 years old                   | 25.65 ± 3.47 (n=7) | 23.95 ± 0.21 (n=2) |
| 16 years old                   | 23.91 ± 0.63 (n=10) | 24.07 ± 0.37 (n=20) |
| 17 years old                   | 24.52 ± 0.94 (n=17) | 24.28 ± 0.69 (n=37) |
| 18 years old                   | 25.40 ± 0.66 (n=11) |                 |
| Unirea National College        |                |                 |
| 15 years old                   | 24.18 ± 2.47 (n=12) | 24.59 ± 2.48 (n=20) |
| 16 years old                   | 24.10 ± 0.79 (n=10) | 23.67 ± 0.67 (n=20) |
| 17 years old                   | 24.58 ± 0.56 (n=15) | 24.43 ± 0.69 (n=21) |
| 18 years old                   | 25.21 ± 0.67 (n=10) | 24.18 ± 0.97 (n=14) |
| Sports High School             |                |                 |
| 15 years old                   | 20.73 ± 0.95 (n=18) | 21.11 ± 3.62 (n=8) |
| 16 years old                   | 22.08 ± 1.16 (n=7) | 20.77 ± 0.44 (n=7) |
| 17 years old                   | 22.25 ± 1.54 (n=25) | 20.94 ± 0.55 (n=10) |
| 18 years old                   | 22.84 ± 0.98 (n=18) | 21.29 ± 0.85 (n=8) |

*. The mean difference is significant at the 0.01 level. BMI = Body mass index.

Table 2. Body mass index in male subjects depending on the school – multiple comparisons∗ with Tukey Hsd

| (I) School                        | (J) School                        | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | Upper Bound |
|-----------------------------------|-----------------------------------|-----------------------|------------|------|-------------------------|-------------|
| "Andrei Şaguna" National College  | "Andrei Mureşanu" High School     | -.71814               | .30361     | .087 | -1.5041                 | .0678       |
| "Unirea" National College         | "Andrei Mureşanu" High School     | -1.60762              | .30541     | .195 | -1.3983                 | .1830       |
| "Andrei Mureşanu" High School     | "Andrei Şaguna" National College  | 1.91393*              | .27750     | .000 | 1.1955                 | 2.6323      |
| "Andrei Mureşanu" High School     | "Unirea" National College         | .71814                | .30361     | .087 | -1.0678                 | 1.5041      |
| "Andrei Mureşanu" High School     | Sports High School                | .11053                | .32291     | .986 | -.7254                 | .9465       |
| "Andrei Şaguna" National College  | Sports High School                | 2.63207*              | .29665     | .000 | 1.8641                 | 3.4000      |
| "Unirea" National College         | "Andrei Şaguna" National College  | .60762                | .30541     | .195 | -1.830                 | 1.3983      |
| "Andrei Mureşanu" High School     | "Andrei Şaguna" National College  | -.11053               | .32291     | .986 | -.9465                 | .7254       |
| "Andrei Mureşanu" High School     | Sports High School                | 2.52155*              | .29849     | .000 | 1.7488                 | 3.2943      |
| Sports High School                | "Andrei Şaguna" National College  | -.91393*              | .27750     | .000 | -2.6323                | -1.1955     |
| "Andrei Mureşanu" High School     | "Unirea" National College         | -2.63207*             | .29665     | .000 | -3.4000                | -1.8641     |
| "Unirea" National College         | "Andrei Şaguna" National College  | -2.52155*             | .29849     | .000 | -3.2943                | -1.7488     |

*. The mean difference is significant at the 0.05 level. a. Gender = Male.
The level of the BMI was also analyzed on girls, between the five age categories. The BMI average levels for the five age categories were in this order: 22.55, 23.76, 23.76, 24.03 and 23.13. The one-way variance analysis (ANOVA) revealed a significant difference between these means $F(4.241)=3.920; p=0.004$. The measurement of the effect made via eta-square index shows a very insignificant effect, too little to be taken into consideration ($\eta=0.06$) (see Table 5).

### Table 3. Body mass index in female subjects depending on the school – multiple comparisons* with Tukey Hsd

| (I) School                              | (J) School                              | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | Upper Bound |
|----------------------------------------|----------------------------------------|-----------------------|------------|------|------------------------------------|-------------|
| “Andrei Şaguna” National College       | “Andrei Mureşanu” High School           | .32845                | .28835     | .666 | -.4175                             | 1.0744      |
| “Unirea” National College              | “Andrei Şaguna” National College       | -.33725               | .29084     | .653 | -1.0896                            | .4152       |
| Sports High School                     | “Unirea” National College              | .303565*              | .36392     | .000 | 2.0942                             | 3.9771      |
| “Andrei Şaguna” National College       | “Andrei Mureşanu” High School           | .32845                | .28835     | .666 | -1.0744                            | .4175       |
| Sports High School                     | “Unirea” National College              | -.66569               | .27156     | .070 | -1.3682                            | .0368       |
| “Unirea” National College              | “Unirea” National College              | -2.70720              | .34870     | .000 | 1.8051                             | 3.6093      |
| Sports High School                     | “Andrei Şaguna” National College       | -3.37289*             | .35077     | .000 | 2.4655                             | 4.2803      |
| “Unirea” National College              | “Andrei Mureşanu” High School           | -2.70720              | .34870     | .000 | -3.6093                            | 1.8051      |
| “Andrei Şaguna” National College       | “Andrei Mureşanu” High School           | -2.70720              | .34870     | .000 | -3.6093                            | 1.8051      |

* The mean difference is significant at the 0.05 level. a. Gender = Female.

### Table 4. Body mass index in male subjects depending on age – multiple comparisons* with Tukey Hsd

| (I) Age | (J) Age | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | Upper Bound |
|---------|---------|-----------------------|------------|------|------------------------------------|-------------|
| 14      | 15      | -.26657               | .48139     | .981 | -.1.5907                           | 1.0576      |
|         | 16      | -1.16078              | .48139     | .116 | -1.0576                           | 1.5907      |
|         | 17      | -1.50686*             | .43091     | .005 | -2.6921                           | .3216       |
|         | 18      | -1.66917*             | .48139     | .006 | -2.9933                           | .3450       |
|         | 14      | .26657                | .48139     | .981 | -1.0576                           | 1.5907      |
|         | 16      | -1.89421              | .41465     | .200 | -2.0348                           | .2463       |
|         | 17      | -1.24029*             | .35480     | .005 | -2.2162                           | .2644       |
|         | 18      | -1.40260*             | .41465     | .008 | -2.5431                           | .2621       |
|         | 14      | 1.16078               | .48139     | .116 | -1.6341                           | 2.4849      |
|         | 15      | .89421                | .41465     | .200 | -2.2463                           | 2.0348      |
|         | 17      | -1.34608              | .35480     | .866 | -1.3220                           | .6298       |
|         | 18      | -1.50839              | .41465     | .736 | -1.6489                           | .6322       |
|         | 14      | 1.50686*              | .35480     | .005 | .3216                             | 2.6921      |
|         | 15      | 1.24029*              | .35480     | .005 | .2644                             | 2.2162      |
|         | 16      | .34608                | .35480     | .866 | -1.6298                           | 1.3220      |
|         | 17      | .16231                | .35480     | .991 | -1.1382                           | .8136       |
|         | 18      | 1.66917*              | .48139     | .006 | .3450                             | 2.9933      |
|         | 15      | 1.40260*              | .41465     | .008 | .2621                             | 2.5431      |
|         | 16      | .50839                | .41465     | .736 | -1.6322                           | 1.6489      |
|         | 17      | .16231                | .35480     | .991 | -1.8136                           | 1.1382      |

* The mean difference is significant at the 0.05 level. a. Gender = Male.

(m=22.77±2.87) and 17 year-old boys (m=24.01±1.61), as well as on 18 year-old boys (m=24.17±1.48).

The level of the BMI was also analyzed on girls, between the five age categories. The BMI average levels for the five age categories were in this order: 22.55, 23.76, 23.76, 24.03 and 23.13. The one-way variance analysis (ANOVA) revealed a significant difference between these means $F(4.241)=3.920; p=0.004$. The measurement of the effect made via eta-square index shows a very insignificant effect, too little to be taken into consideration ($\eta=0.06$) (see Table 5).
The main findings of this study are:

1) there is a high number of overweight pupils from Şaguna, Andrei Mureşanu and Unirea high schools, whereas pupils from the Sports High School, in their vast majority, have a normal weight;

2) there are significant statistical differences between the BMI levels both depending on gender and on age categories, on all the pupils involved in the experiment.

Numerous studies examined the values of the BMI and of obesity in teenagers from different countries in the world. A UNICEF report 2009-2010 studied the health of 11, 13 and 15 year-old children in 29 countries and revealed that the highest percentage of obese children was registered in the USA (nearly 30%) [13].

Siversten et al. [14] showed that there is evidence for a curvilinear relationship between BMI and both sleep duration and insomnia for girls, whereas the relationship was linear for boys. The study shows that compared to the average weekday sleep duration among adolescents in the normal weight range (6 hrs 29 min), both underweight (5 hrs 48 min), overweight (6 hrs 13 min) and obese (5 hrs 57 min) adolescents had shorter sleep duration.

A similar study was conducted by Halvorsen et al. [15], who demonstrates that overweight and obesity are associated with acne in girls aged 18 and 19, but the same association was not observed in boys. The prevalence of overweight was 9.5% in girls and 15.4% in boys. The prevalence of acne was 13.1% in girls and 14.0% in boys. Among those who were overweight or obese (BMI ≥25), the prevalence of acne was 18.5% in girls and 13.6% in boys. In girls, there was an unadjusted OR of 2.1 (95% CI, 1.4-3.3) between acne and overweight, and an adjusted OR of 2.0 (95% CI 1.3-3.2). In boys, no significant associations were found between acne and BMI.

Another study conducted on 199135 adolescents from 36 countries and 72900 children from 17 countries provided information on their height, weight and fast-food consumption. This study shows that there is an association between increasing frequency of fast-food consumption and higher BMI in 6–7-year-old children, but this association was reversed in adolescents. This cross-sectional study provides evidence that among children from many different nations, fast-food consumption may contribute to weight gain. The reverse association observed in adolescents should be interpreted with caution, as the results may be affected by bias, particularly underreporting of fast-food consumption and reverse causation [16].

Adesina et al. [17] highlighted that factors which contributes to the weight problems of adolescents are the high socioeconomic class, higher maternal education, spending > 3 hours a day watching television and frequent ingestion of snacks. Results showed that the prevalence of underweight, overweight, obesity and stunting was 6.4%, 6.3%, 1.8% and 5.4%, respectively. The authors recommend the need for evaluation periodic of adolescents and health education to promote healthy eating habits and regular physical exercise as part of the School Health Programme.

### Table 5. Body mass index in female subjects depending on age – multiple comparisons* with Tukey Hsd

| (I) Age | (J) Age | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval |
|--------|--------|-----------------------|-----------|------|-------------------------|
| 14     | 15     | -1.20711              | .48796    | .100 | -2.5483                 |
|        |        |                      |           |      | .1341                   |
| 15     | 14     | .00383                | .42032    | 1.000| -1.1591                 |
|        |        |                      |           |      | 1.1515                  |
| 16     | 17     | .27252                | .39423    | .958 | -1.3561                 |
|        |        |                      |           |      | .8110                   |
| 17     | 14     | 1.21093*              | .42480    | .038 | .0434                   |
|        |        |                      |           |      | 2.3785                  |
| 15     | 14     | 1.21093*              | .42480    | .038 | .0434                   |
|        |        |                      |           |      | 2.3785                  |
| 16     | 17     | .57681                | .53978    | .822 | -2.0604                 |
|        |        |                      |           |      | .9068                   |
| 17     | 14     | 1.20711               | .48796    | .100 | -1.1591                 |
|        |        |                      |           |      | 1.1515                  |
| 16     | 15     | .00383                | .42032    | 1.000| -1.1515                 |
|        |        |                      |           |      | 1.1515                  |
| 17     | 14     | 1.21093*              | .42480    | .038 | .0434                   |
|        |        |                      |           |      | 2.3785                  |
* The mean difference is significant at the 0.05 level. a. Gender = Female.
Some limitations of the present study have to be mentioned. Our findings are certainly limited by the relatively small sample size and the uncontrolled nature of the study design. The small sample size may decrease the power to detect statistically significant results in general. In addition, the assessment of the body mass index could have led to small inaccuracies which can allow for measurement errors.

The statistical power was further reduced when sexes were analyzed separately. Variations in body weight and height were found to widen along the age in the present study, and this is in line with nationally representative samples. Overall, the results of the present study should be replicated with a more representative sample to confirm the validity of the presented findings.

Conclusions
This study revealed that the values of the BMI are higher in pupils from Andrei Şaguna, Andrei Mureșanu and Unirea high school, this being due mainly to unhealthy nutrition, a sedentary lifestyle and other factors. On the other hand, we noticed on pupils from the Sports High School very good values of BMI, because of the many hours of sports activities included in the educational program of this domain.

For the other theoretical high schools involved in the study, the curriculum includes one hour of physical education per week, insufficient for a good health of teenagers and for fighting obesity.

In conclusion, it is worth mentioning that sports must be a part of each individual’s daily life, because, besides the positive effects that it has on health, it also helps us fight weight gain.

Conflict of interests
The author declares that there is no conflict of interests.

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