DIFFERENCES IN OBJECTIVELY AND SUBJECTIVELY MEASURED WEIGHT AND HEIGHT IN SLOVAK ADOLESCENTS

Nora Halmova – Janka Kanasova – Jaroslava Kopcakova

Abstract

The goal of our contribution is the issue of differences in objectively and subjectively measured weight (and consequently Body Mass Index /BMI/) and height in Slovak adolescents. The data obtained are a part of international study Health Behaviour in School Aged Children (HBSC) performed in Slovakia in 2017/2018. Our representative sample consisted of 782 adolescents of the fifth to ninth grades of elementary schools in Slovakia in the target group of 11 to 15 years old. We also obtained objective somatic indicators by measuring and subjective indicators were obtained using 2 item questions of the HBSC questionnaire. The results obtained point to the fact, that adolescents tend to add height and decrease weight (boys on average 0.9 kg and girls 0.6 kg) by self-reported question. However, statistically significant difference was observed in weight difference among boys girls and in total. Overweight boys tend to take almost 3 kilograms of their weight. Moreover, obese boys tend to take 5.14 kilograms and obese girls 2.40 kilograms of their weight. The results of survey show that adolescents self-assessing their height and weight tend to increase their height and decrease their weight, which is more pronounced in boys than in girls.

Key words

Weight , height, adolescents, self-reported measures, objective measures

Introduction

Obesity is one of the biggest problems of the 21st century. It was ranked among 10 biggest risks for the world population for the year 2019 by the World Health Organization. The incidence of obesity and relate complications is rising and that is the reason that a lot of scientific studies are dealing with this widespread problem. The number of obese people in Slovakia is somewhere in the middle related to other European countries (Inchley et al., 2017). Every sixth citizen of Slovakia is considered obese nowadays (ec.europa.eu). In 2016, our country was one of the countries with the highest rate of obesity in Europe, we ranked seventh. In the world ranking, Slovakia was in 33rd place. The problem of obesity mainly affects children. Overweight children are more likely to have problems at school, to miss classes, they are unlikely to complete college education. They tend to be less satisfied as well and they are up to three times more likely to be bullied, which can be the reason of lower performance at school (OESD). Overweight or obese teens who underestimate their weight status are less motivated to

change their health for the better (Maximova et al., 2008). Improper subjective assessment of body weight can result in health problems, adversely affect the quality of life and proper functioning of adolescents in society. Some studies have shown that boys and girls who considered themselves " too fat " or wished to be slimmer decreesed their weight to greater extent (related to the objective measurement) than those who were satisfied with their weight. Dissatisfaction with weight, however, is connected with the effort to lose weight (Blake et al., 2013; Millstein et al., 2008). Validation studies comparing self-assessment and direct measurements of height and weight suggest that both adults and adolescents lower their weight and BMI (Niedhammer, Bonenfant, Goldberg & Leclerc, 2000; Spencer, Appleby, Davey & Key, 2002; Zhou, Dibley, Cheng, Ouyang & Yan, 2010; Wang, Patterson & Hills, 2002; Enes et al.,2009; Elgar, Roberts, Tudor-Smith & Moore 2005; Elgar & Stewart, 2008) while height values are often over-reported (Brener, Mcmanus, Galuska, Lowry & Wechsler, 2003; Himes, Hannan, Wall & Neumark-Sztainer, 2005). It is also generally documented that the lower weight reported by respondents is mostly in women, (Elgar & Stewart, 2008; Brener et al., 2003; Brettschneider, Rosario & Ellert, 2011) elderly people (Elgar & Stewart, 2008; Kuczmarski, Kuczmarski & Najjar, 2001) and overweight adolescents (Niedhammer et al,. 2000; Elgar & Stewart, 2008; Himes et al., 2005; Elgar et al., 2005).

The effect of age on the validity of self-assessment of reported height and weight during adolescence is unclear, as studies often report findings for one age group (Elgar et al., 2005; Jansen, van de Looij-Jansen, Ferreira, de Wilde, & Brug, 2006; Morrissey, Whetstone, Cummings & Owen, 2006) or too wide range age group (Himes et al., 2005). There is a considerable evidence that subjectively determined and self- reported BMI data show differences compared to objectively obtained ones - measured BMI values, especially related to adults.

Previous studies on this topic have found that there is a tendency to decrease objective BMI in self – reported BMI and the estimations of prevalence of owerweight and obesity are therefore too low (Sherry, Jefferds & Grummer-Strawn, 2007)

The aim of the study presented is to show the differences in measured and self- reported weight and height values and subsequently Body Mass Index in Slovak adolescents.

The study was approved by the Ethics Committee of the University of Constantine the Philosopher in Nitra and approved under the number (UKF-2020/1355-1:191013).

Methods
Sample and procedure
We used data from the Health Behaviour in School-aged Children (HBSC) study conducted in 2018 in Slovakia. Two-stage sampling was used to obtain a representative sample. In the first step, 140 larger and smaller elementary schools located in rural as well as in urban areas from all regions of Slovakia were asked to participate. These were randomly selected from a list of all

eligible schools in Slovakia obtained from the Slovak Institute of Information and Prognosis for Education. School response rate (RR) was 77.9%. In a second step, data were collected from 8405 adolescents from grades 5 to 9 of primary schools in Slovakia in the target group of 11 to 15 years (mean age 13.43; 50.9% boys). For the purpose of this study based on objective measures were conducted about 10% randomly selected schools from the total HBSC study sample. We obtained data from 888 adolescents from the fifth to ninth grades of 12 elementary schools in Slovakia in the target group of 11 to 15 years old (mean age 12.97; SD 1.20; 56.0 % boys). From study sample of 888 adolescents we excluded 106 respondents because of missing values in self-reported items (height or weight). Our final study sample consisted of 782 adolescents (mean age = 13.5, 55.8% boys).

Measures
Anthropometric data
We measured *Body height* by the Anthropometer A226 (TRYSTOM Co., Ltd.). During the measurement we proceeded according to the methodology of measuring the height dimensions as follows (Kopecky, Krejchovsky & Shvarc, 2013): before the measurement, school-aged children took an active upright position and maintained it throughout the measurement. Position of the head was standardized by asking the respondent to stand straight, without shoes and with the heels together. School-aged children stood with their backs to the perpendicular wall (without the batten on the floor), with their heels and toes together. The walls touched the heels, butt and shoulder blades with the head oriented in the so-called Frankfurt Horizontal.

We measured *Body weight* (kg) and *Fat Percentage* (%) by Bioimpedance Body Composition Analysis (BIA) with an InBody 230 (Biospace Co., Ltd.). The analysis was carried out according to the manufacturer's instructions (InBody 230 User's Manual). School-children were instructed prior to measurement that were dressed up in t-shirt and trousers or skirt. The starting weight was set to -0.5 kg, considering that we did not weigh schoolchildren in underwear. Boys and girls with a proportion of body fat over 25% and 30% respectively, were considered to be overweight or obese (Sweeting, 2007; Costa-Urrutia, Vizuet-Gamez, & Ramirez-Alcantara, 2019).

Self-reported data
We measured *body weight* with the single item question from HBSC questionnaire: "How much do you weigh with no clothes on?" in kg (Inchley, Currie, Young, Samdal, Torsheim, Augustson , Mathison, Aleman-Diaz, Molcho, Weber & Barnekow, 2016).

Body height was obtained with the single item question from HBSC questionnaire: "How tall are you with no clothes on?" in cm (Inchley et al., 2016)

Body Mass Index was calculated from the respondent's answers for this HBSC questions. The responses to this question were used as a continuous variable. WHO standards (WHO, 2017) were used for BMI z-score calculations.

Statistical analyses

First, we described the sample using descriptive statistics. The analysis of measured and self-reported values of height or weight (and BMI calculated from them) is based on the difference between measured and self-reported values, i.e. positive/negative values indicates that adolescents reported smaller/higher than the true value. Since the normality of the distribution of the differences in height, weight and BMI is rejected, differences between the measured and self-reported anthropometric parameters were assessed by Wilcoxon signed rank test.Finally, overweight and obesity statuses were determined by body fat percentage – in each gender and age category 85th and 95th percentile were the thresholds for treating overweight and obesity, respectively, i.e. we assign each adolescent into one of the three categories – normal weight (85% of adolescents), overweight (10% of adolescents) and obesity (5% of adolescents) (WHO Multicentre Growth Reference Study Group, 2006). For comparing the difference of measured and self-reported anthropometric parameters in these categories the Kruskal-Wallis test was used followed by post hoc Mann-Whitney test with Bonferroni correction. All analyses were conducted with SPSS v21 (IBM, Armonk, NY, USA).

Results

The background characteristics of the sample are presented in Table 1, overall and by gender.

Table 1 Descriptive statistics for age, body mass index measured, body mass index self-reported total and separately for boys and girls

	Total (n=782)	Boys (n=436)	Girls (n=346)
Age: Mean (SD)	13.50 (1.28)	13.46 (1.31)	13.35 (1.29)
BMI measured: Mean (SD)	20.13 (3.91)	20.14 (4.06)	20.09 (3.71)
BMI self-reported: Mean (SD)	19.49 (3.30)	19.59 (3.41)	19.35 (3.14)

Note: SD - standard deviation, BMI - Body Mass Index

Next, Table 2 shows the averages of the measured and self-reported anthropometric parameters. The difference between measured and self-reported was determined by Wilcoxon signed rank test. All differences between self-reported weight, height and BMI and measured weight, height and BMI are highly significant. Adolescents tend to add height and decrease weight (boys on average 0.9 kg and girls 0.6 kg) by self-reported question. As a result of that, the reported BMI is on average 0.4 kg /m2 lower than measured BMI.

Table 3 presents means and standard deviations of anthropometric parameters differences (measured minus self-reported) in weight categories according to body fat percentage. The height difference was not statistically significant across the weight categories among boys, girls and in total. However,

statistically significant difference was observed in weight difference among boys, girls and in total. Overweight boys and girls tend to take almost 3 kilograms of their weight. Moreover, obese boys tend to take 5,14 kilograms and obese girls 2,40 kilograms of their weight. As a consequence, statistical significant difference was observed also in BMI difference.

Table 2 The averages of anthropometric parameters of measured weight, height and BMI, self-reported weight, height and BMI and their difference

	Measured (SD)	Self-reported (SD)	Difference (SD)	Sig.
boys (n=436)				
Weight [kg]	51,13 (10,30)	50,19 (9,88)	0,94 (2,36)	p<0,01
Height [m]	1,60 (0,08)	1,61 (0,08)	-0,005 (0,03)	p<0,001
BMI [kg/m2]	19,84 (3,35)	19,35 (3,14)	0,49 (1,16)	p<0,001
girls (n=346)				
Weight [kg]	54,40 (14,29)	53,81 (13,55)	0,59 (3,84)	p<0,001
Height [cm]	1,64 (0,12)	1,65 (0,12)	-0,007 (0,04)	p<0,001
BMI [kg/m2]	19,97 (3,75)	19,60 (3,42)	0,37 (1,61)	p<0,001
Total (n=782)				
Weight [kg]	52,95 (12,78)	52,21 (12,19)	0,74 (3,27)	p<0,001
Height [cm]	1,62 (0,10)	1,63 (0,11)	-0,006 (0,03)	p<0,001
BMI [kg/m2]	19,91 (3,58)	19,49 (3,30)	0,42 (1,43)	p<0,001

Table 3 Means and standard deviations of anthropometric parameters differences (measured minus self-reported) in weight categories according to body fat percentage

	Normal weight Mean (SD)	Overweight Mean (SD)	Obesity Mean (SD)	Sig.[a]
boys (n=436)				
Weight [kg]	0,13 (3,21)	2,70 (4,71)	5,14 (7,55)	p<0,001
Height [m]	-0,006 (0,04)	-0,009 (0,03)	-0,016 (0,05)	ns
BMI [kg/m2]	0,17 (1,31)	1,32 (1,89)	2,32 (3,53)	p<0,001
girls (n=346)				
Weight [kg]	0,67 (2,05)	2,85 (3,44)	2,40 (3,24)	p<0,001
Height [cm]	-0,004 (0,03)	-0,011 (0,03)	-0,016 (0,05)	ns
BMI [kg/m2]	0,35 (1,04)	1,39 (1,46)	1,41 (1,43)	p<0,001
Total (n=782)				
Weight [kg]	0,37 (2,77)	2,76 (4,18)	3,93 (6,12)	p<0,001
Height [cm]	-0,005(0,03)	0,010 (0,03)	-0,16 (0,05)	ns
BMI [kg/m2]	0,25 (1,20)	1,35 (1,71)	1,92 (2,81)	p<0,001

[a]Kruskal-Wallis test significance; ns- not significa

Discussion

The aim of the study presented is to show the differences in measured and self- reported weight and height values and subsequently Body Mass Index in

Slovak adolescents. The number of researches comparing measured and self-reported height and weight is increasing, e.g. there was a similar study of adolescents in Finland. On average self-reported height and weight were slightly higher than objectively measured on the place (Sarkkola, Rounge, Simola-Ström, Kraemer, Roos & Weiderpass, 2016). These results do not correlate with our findings, our adolescents, when self-reporting, tend to report smaller weight. Similar results as we found were achieved, for example,in a research in Canada where 4615 adolescents and adults from all over Canada were interviewed and then their objective indicators were measured. Self-reported values were highly correlating with body measurements, but on average the height reported was 0,88 cm higher than the measured height, the weight reported was 2,33 kg lower than the actual measured weight. Most respondents in the survey reported lower weight and excessive height.

We agree with the statement that self-reported weight and height indicators are much easier to be obtained but they should not be used as a tool to monitor obesity and overweight (Elgar & Stewart, 2008). It was shown by the studies in Australia that the self-reported weight was statistically significantly lower than the measured values for both sexes. They did not find any differences in the reporting of weight between boys and girls, which does not correlate our results. Similarly to our results, statistically significant differences were found in these individuals between objective weight and weight reported by overweight or obese adolescents compared to normal or underweight adolescents. The comparison of self- reported weight and height was in agreement with those measured objectively in 69% of boys and 70% of girls. The percentage of misclassification of overweight or obesity using the data reported in this study was 31% of boys and 30% of girls (Wang et al., 2002). We agree with the results of other authors who claim that men underestimated their weight to a greater extent than women as well (Bodenlos, Rosal, Blake, Lemay & Elfenbein, 2010; Park, 2011; Eichen, Conner, Daly & Fauber, 2012). We can only agree with (Gorber, Tremblay, Moher & Gorber, 2007) who examined the relationship between objective and subjective weighting based on a systematic review of 65 studies and argue that the subjective method of reporting actual weight and values obtained differ from objectively measured height and weight, this method is not a sufficiently objective indicator and there were shown some intersexual differences as well.

Conclusion

The results of our survey as a part of HBSC study in Slovakia in the years 2017/2018 (Madarasova-Geckova et al., 2019) show that adolescents self-assessing their height and weight tend to increase their height and decrease their weight, which is more pronounced in boys than in girls. At this age, this difference is statistically significant at p< 001 in self- assessment of weight, where obese boys lowered up to 2,74 kg more than girls. These self-reported subjective data should be treated with caution, as they may significantly affect the assessment of the prevalence of obesity and overweight of children and adults, which may have an impact on further research in this area and

a negative impact on the health of the current population. There is a need to focus more on determining the real somatic parametres, especially weight, and thus contibute to the accurate updating of data on the current adolescent population and subseequently ensure their healthy development, which preesupposees a full quality life of individuals who form a healthy society.

Implication
Based on our results, we propose some recommendations for future research and practice. Our results confirm the fact that there are some differences between self-reported and measured weight, height and subsequently BMI. If we rely on self- reported weight, height and BMI data in adolescents,it may result in bias and misidentification of underweight, normal weight, overweight and obesity of adolescents. Despite being a quick, inexpensive and easy-to-implement measure to identify adolescent overweight and obesity, there are several reasons for their careful use.
The self-reported weight and height data are subjective and using them real weight and height can be undersestimated, values may be skewed and it may also affect adolescents´ beliefs about their body composition It is strongly recommended for pediatricians, trainers, Physical Education teachers to combine weight and height measurements with other measurements such as body fat percentage, waist and hip circumference ratio, fat mass index, etc. Last but not least, it is important to take into account the maturation.

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Nora Halmová *Corresponding autor*
Constantine the Philosopher University
Faculty of Education, Department of Physical Education and Sports
Dražovská 4, 949 01 Nitra
Slovakia
halmova@ukf.sk

Janka Kanásová
Department of Physical Education and Sports
Faculty of Education
Constantine the Philosopher University
Dražovská 4, 949 01 Nitra
Slovakia
jkanasova@ukf.sk

Jaroslava Kopčáková
Department of Health Psychology and Research Methodology
Medical Faculty
UPJ Safarik University in Kosice
Tr. SNP 1, 040 01 Kosice
Slovakia

Palacky University Olomouc
Olomouc University Social Health Institute
771 11 Olomouc
Czech Republic
jaroslava.kopcakova@upjs.sk