



# The validity of parental-reported body height and weight: a comparison with objective measurements of 7-8-year-old Czech children

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**ABSTRACT:** The values of body weight and height can be recorded in various ways. Self-reports and parental-report methods are amongst the most typical ways to collect data. These methods have advantages, but also limits. Anthropometric measures are recommended to improve measurement precision. The aim of this study was to investigate whether the parental-reported body weight and height of 7-8-year-old Czech children corresponded with the measured body weight and height. Data concerning children's body weight and body height were collected via parental informed consent and anthropometric measurements. The research sample consisted of 388 children from 7 to 8 years-old (boys,  $n = 176$ ; girls,  $n = 162$ ). Only children with parental informed consent were included. Correlations between parental-reported and measured data were analysed with the Pearson correlation coefficient to examine the strength of linear dependence between the two methods. The differences between parental-reported and measured data were tested using the Wilcoxon signed-rank test. P-values below  $\alpha = 0.05$  were considered statistically significant. Parents manifested a tendency to underestimate body weight and especially the body height of their children. This trend was seen in boys and girls in both age groups. Out of the 388 children with parent-reported height, parents under-reported their child's height by 1 cm or more in 37.1% of the children, 39.6% of the parents reported a height within 0.99 cm of the measured height, and 23.3% of parents over-reported their child's height by 1 cm or more. The same number of children had parent-reported weights, parents under-reported their child's weight by 1 kg and more in 25.2% of the children, 57.7% of the parents reported a weight within 0.99 kg of the measured weight, and 17.1% of the parents over-reported their child's weight by 1 kg or more. The Pearson correlation coefficient between the measured and parental-reported height and weight revealed a statistically significant strong positive linear relationship in both genders ( $r_{\text{height}} = 0.912$ ,  $r_{\text{weight}} = 0.943$ ; all  $p < 0.001$ ). The differences between the measured and parental-reported height and weight were not significantly different (all  $p < 0.05$ ). The high agreement and correlation between measured and parental-reported body height and weight suggest that parental-report methods can be an appropriate alternative to objective measurement and can be used as a valid tool to classify body height and weight for large population studies of Czech children in school-based research when anthropometric measures are not available.

**KEY WORDS:** subjective, objective, anthropometry, body size, children

## Introduction

The rise in overweight and obesity is globally evident in all age groups (Nasreddine et al. 2012; Ng et al. 2014; Ogden et al. 2012; Vignerova et al. 2007; World Health Organisation 2016). The Czech Republic is not an exception in this respect. This is evidenced by studies based on objective methods of data collection (anthropometric measurements), which use the national growth standards (Vignerova et al. 2006), according to which the number of overweight children increased 5-fold from the 1990s to 2010 (Marinov and Pastucha 2012; Vignerova et al. 2006), and self-reported weight and height studies, which use WHO BMI standards 5-19 years (Sigmundova et al. 2013; Sigmund et al. 2015). Overlooked overweight can grow into obesity, the most common metabolic disorder that is a risk factor for many non-communicable diseases at any age (Apovian 2016). In addition, paediatric obesity is often transmitted to adulthood with severe health consequences (World Health Organisation 2016). The aim of experts is to stop or even reduce the increasing prevalence of overweight and obesity in children. The occurrence of this phenomenon should therefore be constantly monitored.

The assessment of the somatic state of the paediatric and adolescent population, based on an assessment and comparison of body weight and body height, or derived Body Mass Index (BMI), is a subject of interest in a number of scientific studies. Both national and international growth standards are used to assess growth (Christesen et al. 2016; Kulaga et al. 2011, 2013; Nilsen et al. 2016; Rosario et al. 2010; Vignerova et al. 2006). The data in these scientific studies are commonly obtained in various ways. Ob-

jective (anthropometric) methods are difficult to apply in population studies, thus subjective methods of self-reporting or parental reporting on their children are used in a number of studies.

Self-report methods are one of the most common ways of collecting data on body height and weight. Self-reports have the advantages of practicality and low costs, they are quick and easy to administer and are a good method for sampling large numbers of individuals. The self-report method is used across almost all ages (Brettschneider et al. 2011; Lee et al. 2013; Niedzwiedzka et al. 2015), self-report is used with adults and adolescents, parental reports are used more often with children (Connor and Gugenheim 2011). However, this method also has numerous limits (Singleton, Straits, and Miller Straits 1993).

A number of studies have shown that adults and adolescents do not always state accurate values of the detected parameters in self-reports. There is a tendency to underestimate body weight especially in higher weight individuals, and overestimate body height, especially in individuals with lesser growth (Kuczmarski et al. 2001; Flood et al. 1999; Nawaz et al. 2001; Jansen et al. 2006; Spencer et al. 2001). The studies based on parental reports also point to discrepancies between clinical data on body weight and body height with data obtained through the parental report (Boutelle et al. 2004). Concurrently, there are studies presenting conclusions in which the body weight and height assessment, according to the parental report, corresponds with the anthropometric assessment. (Evans and He 2007; Chaimovitz et al. 2008).

Parental perceptions of children's weight status play an important role in long-term children's medical status from

the view of overweight and obesity. It influences the choice of preventive steps, such as healthy nutrition and appropriate physical activity for gaining and/or maintaining an ideal body weight (Hackie and Bowles 2007; Chiang et al. 2009; Magarey et al. 2003; Neumark-Sztainer et al. 2008).

Due to the limitations associated with self-report or parental-report methods, direct or anthropometry measures have been recommended to improve measurement precision. Measured height and weight are the gold standard for surveillance. Although these types of measurements provide benefits, they often have high costs and require high personal and time demands. Parent-reported data is an attractive alternative (Gorber et al. 2007).

The growth trends of the Czech child population are similar to the growth trends of other European countries. However, certain European countries, including the Czech Republic, have some specificities that are taken into account in national growth standards (Vignerová et al. 2006). The results of this research may be reflected in a simpler organization of future national research.

The aim of this study was to investigate whether parental-reported body weight and height of 7-8-year-old Czech children corresponded with anthropometry measured body weight and height.

## Subjects and Methods

The research was conducted from 2015 to 2016 at 8 selected primary schools in 5 regions in the Czech Republic. The elementary schools were selected on the basis of headmaster's and parent's willingness to cooperate to the research. The research sample consisted of 388 children from 7 to 8 years-old (boys,  $n = 176$ ; girls,  $n = 162$ ). Boys and girls were

divided into subgroups w. r. t. chronological age: 7-year-old (7.0–7.99 years), 8-year-old (8.00–8.99 years). All children of the class year were approached for the research.

Data concerning children's body weight and body height were collected via subjective methods (parental report as a part of informed consent) and concurrently via objective methods (anthropometric measurements). Parental-reports took place before the anthropometry measurements. The date of the anthropometry measurement and the date of the received parental informed consent differed less than 1 month. Body height to the nearest 0.1 cm was measured with an anthropometer (type P-375, Trystom, Czech Republic) and body weight with light clothing without shoes to the nearest 0.5 kg was measured through InBody 720, the calibration of which was checked regularly. The same experienced researchers performed all the measurements. To adjust for the weight of the clothing that was worn during the anthropometry measurement, 0.5 kg was subtracted from the measured body weight. We did not subtract 0.5 kg from the parental reported body weight, because when a child is weighed by a medical doctor or a nurse, for instance as part of a regular medical check, the child is usually weighed wearing only its underwear. The measurements were carried out at the primary schools in the morning under standard conditions while maintaining a high level of hygiene conditions. Data obtained from device InBody 720 were processed with the Lookin Body 3.0 program.

## Statistical analysis

Statistical analysis was performed using SPSS v. 22 (IBM Corporation, New York, United States). Correlations between pa-

rental-reported and measured data were analysed with the Pearson correlation coefficient to examine the strength of linear dependence between the two methods. The differences between parental-reported and measured data were tested using the Wilcoxon signed-rank test. The differences between the measured and reported values were calculated by subtracting the measured data from the reported data within an individual. Therefore, positive values reflect an over report.  $p$ -values below  $\alpha = 0.05$  were considered statistically significant.

### Ethics

The project was approved by the Ethics Committee of the Faculty of Physical Cul-

ture, Palacký University Olomouc, under no. 20/2014. Only children with written parental informed consent were included.

### Results

There were 338 children with parental reports and anthropometric measurements. Out of those, 176 were boys (52%) and 162 were girls (48%).

Table 1 shows mean values and standard deviations of measured and reported body weight and height separately for boys and girls. Also, mean differences between measured and reported data are shown.

The differences between measured and parental-reported height and weight were not significantly different (all  $p < 0.05$ ).

Table 1. A comparison of measured and reported body weight and body height by the gender and age of Czech children

Gender/Age Number of subjects	Measured value Mean $\pm$ SD	Reported value Mean $\pm$ SD	Difference Mean $\pm$ SD <sup>1</sup>
Total sample n=338			
Body weight (kg)	28.46 $\pm$ 5.75	28.29 $\pm$ 5.49	-0.17 $\pm$ 1.91
Body height (cm)	130.87 $\pm$ 6.23	130.57 $\pm$ 6.49	-0.30 $\pm$ 2.67
Girls n=162			
Body weight (kg)	27.94 $\pm$ 5.04	27.89 $\pm$ 5.02	-0.0512 $\pm$ 2.12
Body height (cm)	130.23 $\pm$ 6.31	129.60 $\pm$ 6.45	-0.6302 $\pm$ 2.72
Girls 7-year-old n=78			
Body weight (kg)	26.77 $\pm$ 4.97	26.67 $\pm$ 4.85	-0.1013 $\pm$ 1.67
Body height (cm)	127.70 $\pm$ 5.63	127.23 $\pm$ 5.78	-0.4731 $\pm$ 2.15
Girls 8-year-old n=84			
Body weight (kg)	29.02 $\pm$ 4.89	29.01 $\pm$ 4.94	-0.0048 $\pm$ 2.47
Body height (cm)	132.57 $\pm$ 6.02	131.80 $\pm$ 6.29	-0.7762 $\pm$ 3.16
Boys n=176			
Body weight (kg)	28.95 $\pm$ 6.31	28.67 $\pm$ 5.89	-0.2841 $\pm$ 1.69
Body height (cm)	131.46 $\pm$ 6.11	131.46 $\pm$ 6.41	0.0085 $\pm$ 2.60
Boys 7-year-old n=82			
Body weight (kg)	26.47 $\pm$ 4.91	26.15 $\pm$ 4.34	-0.3159 $\pm$ 1.55
Body height (cm)	128.06 $\pm$ 5.31	127.97 $\pm$ 5.47	-0.0890 $\pm$ 2.20
Boys 8-year-old n=94			
Body weight (kg)	31.11 $\pm$ 6.62	30.85 $\pm$ 6.20	-0.2564 $\pm$ 1.81
Body height (cm)	134.42 $\pm$ 5.16	134.51 $\pm$ 5.58	0.0936 $\pm$ 2.91

<sup>1</sup>The difference was calculated by subtracting the report value from the measured value per subject. Note that negative values reflect underestimation of parental reporting.

The Pearson correlation coefficients between the measured and the parental-reported height and weight revealed a statistically significant positive linear relationship in both genders (Table 2,  $r_{\text{height}} = 0.912$ ,  $r_{\text{weight}} = 0.943$ ; all  $p < 0.001$ ).

### Accuracy of parental-reported height and weight

Out of the 338 children with parental-reported height, parents under-reported their child's height by 1 cm or more in 37.1% (125) of the children, 39.6% (134) of the parents reported a height within 0.99 cm of the measured height, and 23.3% (79) of the parents over-reported their child's height by 1 cm or more. A detailed assessment of height overestimation revealed that out of the total 23.3% (79) parents, 10.9% (37) over-estimated by 1 cm, 5.6% (19) by 2 cm, 2.4% (8) by 3 cm, and 4.5% (15) by 4 cm or more (4.0-16.0 cm). A maximum overestimation by 16 cm was recorded in only one case. An overestimation by 8 cm, 7 cm, and 6 cm were noted in two cases each, and an overestimation by 5

cm in one case. A detailed assessment of height underestimation revealed that out of the total 37.1% (125) parents, 19.2% (65) underestimated by 1 cm, 8.9% (30) by 2 cm, 3.6% (12) by 3 cm, and 5.4% (18) by 4 cm or more (4.0-15.0 cm), a maximum underestimation by 15 cm was also recorded in only one case, similarly to an underestimation by 9 kg and 6 kg. An underestimation by 5 kg was recorded in three cases, by 7 kg in four cases, and by 10 kg in two cases.

The same number of children had parental-reported weights, parents under-reported their child's weight by 1 kg and more in 25.2% (85) of the children, 57.7% (195) of the parents reported a weight within 0.99 kg of the measured weight, and 17.1% (58) of the parents over-reported their child's weight by 1 kg or more. A detailed assessment of the body weight overestimation revealed that out of the total 17.1% (58) parents, 10.7% (36) overestimated by 1 kg, 3% (10) by 2 kg, 0.9% (3) by 3 kg, and 2.7% (9) by 4 kg or more (4.0-15.0 kg). A maximum overestimation by 15 kg was recorded in one case. An overestimation by 5 kg and 6 kg was noted twice in both the

Table 2. The Pearson correlation coefficients of parental-reported and measured body heights and weights by age and gender

Gender/Age Number of subjects	Pearson correlation coefficient (r)	
	Body weight (kg)	Body height (cm)
Total sample n=338	0.943*	0.912*
Girls n=162	0.911*	0.910*
Girls 7-year-old n=78	0.962*	0.911*
Girls 8-year-old n=78	0.874*	0.869*
Boys n=176	0.964*	0.915*
Boys 7-year-old n=82	0.951*	0.917*
Boys 8-year-old n=94	0.942*	0.930*

\* $p$ -value < 0.001

cases. A detailed assessment of the body weight underestimation revealed that out of the 25.2% (85) parents, 14.8% (50) underestimated by 1 kg, 4.7% (16) by 2 kg, 3.3% (11) by 3 kg, and 2.4% (8) by 4 kg and more (4.0-7.0 kg). Parents underestimated the weight of their child by 5 kg in three cases and by 6 kg and 7 kg respectively in one case each.

An accurate parental-report was a report whose differences in respect to the anthropometric measures ranged between -0.99 and 0.99 cm in height and between -0.99 kg and 0.99 kg in weight. Parents tended to underestimate the weight and particularly the height of their children. This trend was apparent in boys and girls in both the age groups. The percentage of parental underestimation, a good estimation and overestimation in body weight and body height by age and gender is presented in Figures 1 and 2.

## Discussion

Our study examines whether parental-reported body height and weight of 7-8 year-old Czech children corresponds with measured body height and weight.

Parental-reported height and weight can vary with the child's age and gender. Our study has found that the parents of girls recorded the accurate weight in nearly 60% of cases, while the parents of boys in almost 56% cases. Parents tended to underestimate the measurements of their sons. The tendency to overestimate was comparable in both the boys and girls. In the assessment of height the opposite was the case, as underestimation was noted more in the parents of girls by approximately 10%. The parents of boys were more successful in accurate estimates of weight. The tendency to overestimate was 6% higher in the parents of boys compared with parents of girls.

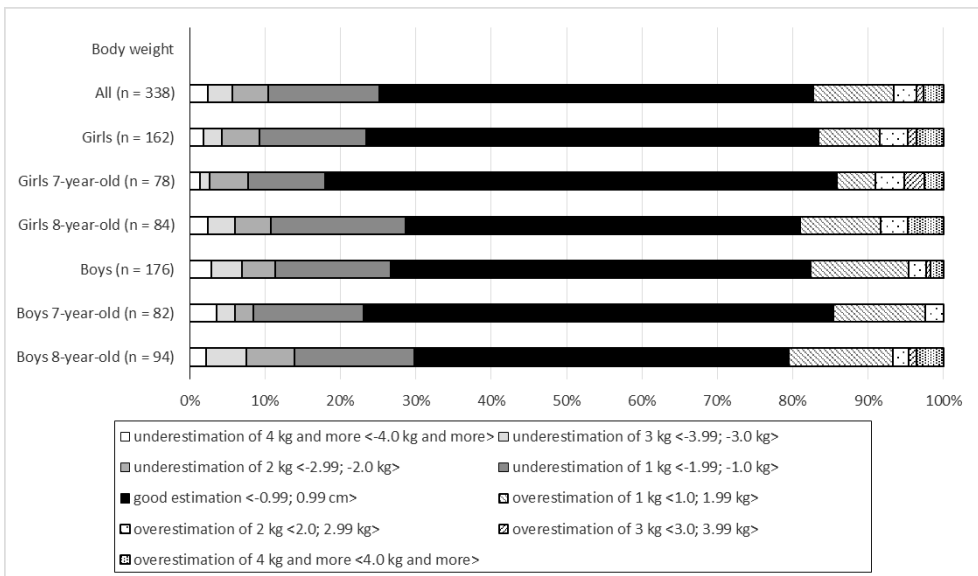


Figure 1. Percentage of parental underestimation, good estimation and overestimation in body weight by age and gender

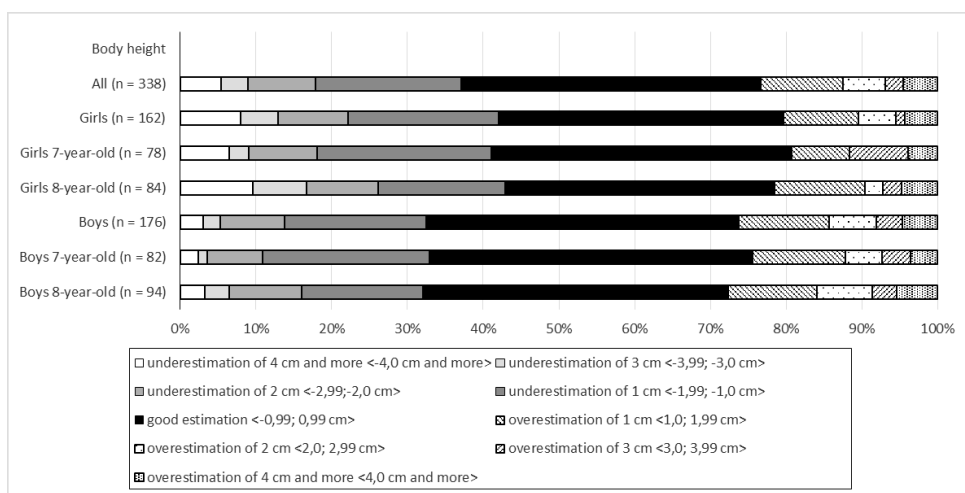


Figure 2. Percentage of parental underestimation, good estimation and overestimation in body height by age and gender

Evaluation of the accuracy of parent-reporting of weight and height in boys and girls, within the individual age groups, revealed that in both genders, the reporting of weight and height was more accurate in the case of seven-year-old children. This accuracy of parent-reports may be affected by the general health screenings held when a child reaches the age of 7. The screening includes weight and height, BMI, and assessment of the child based on growth charts in order to identify malnutrition, overweight, and obesity. The parents of seven-year-olds can thus have better information about the child's weight and height (Czech Republic 2012). Compared with 7-year-old children, parents of 8-year-old children tend to overestimate, and in particular, underestimate weight. In terms of height, the differences in overestimation and underestimation of 7-year-olds and 8-year-olds are comparable.

In general, parental reports tend to underestimate rather than overestimate the actual body height and weight.

The inaccuracy of parental-reported height and weight has been identified previously in studies performed in several different countries among the general population of children. In general, these are parents who overestimate their child's height, as reported in studies conducted in Japan (Sekine et al. 2001) and Europe (Garcia-Marcos et al. 2006; Huybrechts et al. 2006), but there are also parents who underestimate height as a study reported from the United States (Akinbami and Ogden 2009). Height errors vary by the child's gender, with a larger effect among boys, as a Canadian study found (Dubois and Girard 2007). Connor and Gugenheim (2011) also observed the effect of the child's sex, with parents tending to overestimating their son's height and underestimating their daughter's height. We did not observe the effect of the child's sex so clearly in this study because parents tended to underestimating children's height rather than overestimating in both sexes. The United States study found that height errors varied

with age (Akinbami and Ogden 2009). Connor and Gugenheim (2011) found that the variability of height error was smaller in older children, but the mean height error was unaffected by the child's age. We found that parents of 7-year-old children have more accurate parental-report of body height and weight than parents of 8-year-old children.

There are apparent discrepancies among the studies. These can be impacted by different study designs. Certain reports (Dubois and Girad 2007; Garcia-Marcos et al. 2006; Huybrechts et al. 2006; Sekine et al. 2001) including ours, have compared the reported and measured data that were collected from the same subjects, although there is a study from the United States (Akinbami and Ogden 2009) which compared the population estimates computed from reported and measured data in different subjects.

In contrast to height, a number of parents underestimate their child's weight (Akinbami and Ogden 2009; Huybrechts et al. 2006), although a Canadian study found consistent overestimation of weight (Dubois and Girad 2007). The study also reported a greater overestimation in boys (Dubois and Girad 2007), whereas Connor and Gugenheim (2011) found an underestimation in both genders, but a larger underestimation of weight in girls. We observed an underestimation in both genders in our study, but a larger underestimation of weight in boys.

The high agreement and correlation between measured and parental-reported body height and weight suggest that parental-report methods can be used as a valid tool to classify body height and weight for large population studies of Czech children in school-based research when anthropometric measures are unavailable.

## Limitations of the study

The main limitation of the study is the fact that the data are obtained on the basis of parental report, where we cannot recognize, if the informed consent was filled out by mother or father.

## Conclusions

Parental reports are an appropriate tool for determination of body height and weight in studies with a large research sample among early school age children.

This study did not find significant differences between parental reported and measured body height and body weight in Czech children. Parental reports tend to underestimate rather than overestimate the actual body height and weight.

A number of studies monitor the prevalence of overweight and obesity on the basis of BMI values. In light of the conclusions of the present study, further research should be conducted into whether Czech children can be reliably classified into BMI categories based on parental reports.

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### Authors' contributions

All authors credited for having contributed equally to this research paper.

### Conflict of interest

The authors declare that they have no conflicts of interest to this work.

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