Aperito Online Publishing

Obesity and Control

Open Access

Received: Oct 24, 2014
Accepted: Dec 31, 2014
Published: Jan 03, 2015

http://dx.doi.org/10.14437/OCOA-1-103 Research Monica Hunsberger, Obes Control Open Access 2015, 1:1

Measured Anthropometrics are Needed in Rural Areas: An Important Role for School Nurses

Monica Hunsberger, RD, MPH, PhD[1*], Jamie Smith, RN, BSN, MPH[2], Beth Ann Beamer, RN, BSN[3], Jean O'Malley, MPH[4] and Paul McGinnis MPA[5]

[1]University of Gothenburg, Public Health Epidemiology and Community Medicine, Box 454, SE 405 30 Gothenburg, Sweden

[2]Jefferson County School District 509-J, 445 SE Buff Street, Madras, OR 97741, USA

[3]St. Charles Health System, Health Promotion Coordinator, 470 NE A St. Madras, OR 97741, USA

[4]Oregon Clinical & Translational Research Institute, Oregon Health & Science University, Portland, OR 97239, USA

[5]Eastern Oregon Coordinated Care Organization, Integration Director, 309 E 2nd Street, The Dalles, OR 97058, USA

Abstract

In a sample of 8th and 11th grade children at one rural school located in Oregon, USA we demonstrate that measured anthropometric values are needed for accurate surveillance of body mass index (BMI). Gender and grade adjusted quantile regression analysis showed the median self-reported BMI (calculated from reported height and weight) was 1.39 ± 0.43 kg/m^2 lower than that of measured anthropometric data, $p<0.001$, and the 75th percentile was 1.90 ± 0.77 kg/m^2 lower in self-reported data, $p<0.05$). The bias in self-reported data increases as BMI increases, underestimating rural population obesity prevalence among youth. School nurses are poised to systematically and longitudinally assess students that may not have regular access to health care.

Keywords: Rural health; School nursing; Obesity; Quality improvement; Children

***Corresponding Author:** Monica Hunsberger, University of Gothenburg, Public Health Epidemiology, Box 454, SE 405 30 Gothenburg, Sweden, Tel: +46(0) 31 786 6499, Fax 031-7781704; E-mail: monica.hunsberger@gu.se

Introduction

Morbidity associated with childhood overweight and obesity is well established [1] and hence accurate assessment of the prevalence is important for community planning purposes. Rural communities often face challenges in obtaining accurate health measures due to problems related to population sparseness and limited economic and technical resources. For these reasons, rural communities often rely on secondary community health assessment data, which in the case of anthropometric data, are often based on self-reported heights and weights collected by state agencies [2-5]. These secondary data sources are subject to reporting bias on the part of the respondents.

The use of secondary data sources is convenient, however; the accuracy of community specific data from secondary data sources may underestimate the true prevalence of conditions such as obesity [6]. Oregon was recently identified as the only state in the nation to have a decrease in childhood obesity in a study that relied on parental reporting of child height and weight during a telephone survey [6]. These findings are surprising in light of our surveillance in rural schools.

The height and weight measurements necessary for unbiased assessments of body mass index (BMI) calculated by kg/m^2 can be measured in rural communities. Accurate measurement of BMI requires only a calibrated scale, a stadiometer and people trained to use them. Standardized measures provide an accurate estimate of the extent of the obesity problem that is not subject to the reporting bias found in self-reported weight and height measurements.

In the rural Jefferson County School District 509-J (JCSD) over 47% of the children in the community were identified as overweight or obese by measured anthropometrics [7]. For over a decade the JCSD has collected height and weight measures on school children in grades K-5. At the urging of the Mt. View Community-based Participatory Research Partnership (MV-CBPRP), a community based partnership, the school nurse expanded surveillance efforts to include 6th, 8th, and 11th graders using The Centers for Disease Control and Prevention standardized protocol beginning in the 2008/2009 school year [8]. At the same time, 8th and 11th grade students completed the Oregon Healthy Teens survey (OHT), an instrument that collects data on self-reported height and weight [9]. The aim of this study is to assess differences between BMI calculated from measured anthropometrics and BMI calculated from self-reported height and weight.

Methods

Subjects

The subjects include JCSD 8th and 11th graders who participated in anthropometric data collection (height and weight) during the fall 2008/2009 and students who participated in the OHT survey. Both data collections addressed the same group of students. Height and weight was collected at Jefferson County Middle School (JCMS) on 9/16/08 and at Madras High School (MHS) on 9/18/08; no effort was made to capture absent students on later dates. In the 8th grade, 209/221 students participated in measurement and in the 11th grade 194/235; a participation rate at JCMS and MHS of 95% and 83% respectively. The response rate to the OHT survey was 76.2% in 8th graders and 71.4% in 11th graders. Data from the two sources were not matched due to the confidentiality agreement of OHT survey [9].

Instruments

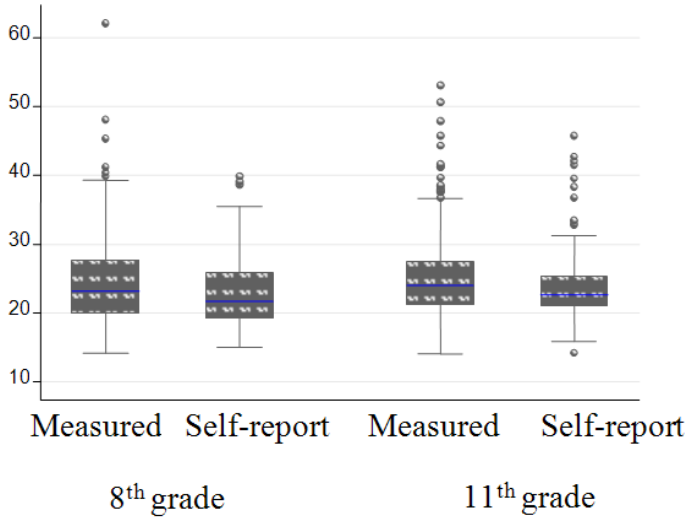
OHT is a Youth Risk Behavioral survey and is similar to the National Youth Risk Behavioral Surveillance Survey (YRBSS). OHT is a comprehensive health survey that is school-based, anonymous and voluntary, covering risk behaviors and other factors that influence the health and well-being of Oregon's children and adolescents [9]. Surveys are administered annually to approximately one-third of Oregon's 8th and 11th graders. Each year, using a random selection of districts within counties and schools within districts, students are surveyed. In addition, schools can opt in and pay to be part of OHT if they wish to access the data for planning or assessment purposes. Oregon uses an "active notification" with a "passive permission/ passive consent" model for parents. From reported OHT height and weight values, BMI was calculated using the following formula: $BMI = weight\ (kg)/[height\ (m)^2]$ and plotted on age and gender specific CDC growth charts. If height, weight, age or sex was missing, BMI values were set to missing because the calculation of BMI is age and sex specific for youth. Values characterized as biologically implausible or "Out of Range" were set using the age and gender specific guidelines established by the Centers for Disease Control and Prevention (CDC) [9]. For both male and female children the cut-off was set at 55 kg/m^2 [9]. In 2008/2009, approximately 6% of surveys were eliminated due to combinations of "dubious" answers and another 2% were eliminated because the student did not fill out the grade or gender information (Figure 1).

District Measurement

JCSD used CDC protocol for weighing and measuring youth [8]. Height was measured by stadiometer and weight was measured by calibrated Tanita scale with only light weight clothing. Items such as shoes and over clothes, i.e. sweatshirts, were removed for weighing. Measured data were entered into Nurse's Aide School Health Software version 3.2, a

comprehensive school health program that calculates age and gender specific BMI.

Figure 1: BMI calculated from measured versus self-reported



Data Analysis

Differences between measured and self-reported values BMI categories were assessed by Pearson's chi-square. These categories were based on the age and gender specific CDC BMI percentiles.

Quantile regression was used to examine differences in the median, 25th and 75th percentiles of BMI (kg/m^2). The quantile regressions included gender and grade as covariates [10]. Interactions between gender and data source (measured or self-report) were tested for but were not statistically significant. All analyses were completed using Stata 9.0 Intercooled (Stata Corporation, Austin, Texas).

Results

The study population is described in Table 1. The self-reported weights or heights of four 8th graders were considered "Out of Range" in the secondary data set (OHT). Quantile regression (Table 2), adjusted for grade and gender, indicated that the median and 75th percentiles of the BMIs computed from self-reported heights and weights were significantly lower than those obtained from measured (-1.39 ± 0.43 kg/m^2 and -1.90 ± 0.77 kg/m^2 for median and 75th percentile, respectively). The estimates of the 25th percentile of BMI did not differ significantly by source of reporting (Table 2).

Table 1: Population characteristics by data source

Data Source	**Self-report** [a]	**Measured** [b]
N (total)	234	403
Males, n (%)	125 (53.4%)	222 (55.0%)
Grade		
8th	209 (65.5%)	110 (34.5%)
11th	194 (61.0%)	124 (39.0%)
BMI median (kg/m^2)	22.3	23.3
BMI mean (kg/m^2)	23.6	25.0
BMI Category		
Not at Risk, n (%)	158 (67.5%)	203 (50.4%)
Overweight, n (%)	39 (16.7%)	90 (22.3%)
Obese, n (%)	37 (15.8%)	110 (27.3%)
Excluded due to missing data, n	29	0
Excluded as out of range, n	4	0

[a] Self-reported height and weight on Oregon Healthy Teens survey; [b] Measured height and weight taken by school nurse

Table 2: Quantile regression of BMI by reporting source

Quantile	**25%**	**50%**	**75%**
Measured BMI of Female 8th Graders	19.5 ± 0.37	23.1 ± 0.40	27.7 ±
Effect of self-report	-0.51 ± 0.31	-1.39 ± 0.43*	-1.90 ± 0.77*
Effect of male gender	+0.60 ± 0.33	-0.10 ± 0.47	+0.02 ± 0.62
Effect of 11th grade	+1.5 ± 0.37*	+1.00 ± 0.32*	-0.30 ± 0.58

Source: (0) measured by school nurse or (1) self-report on Oregon Healthy Teens

Gender: male (0) and female (1)

Grade: 8th (0) or 11th grade (1)

*Significance p <.05

Discussion and Conclusion

Self-reported height and weight significantly underestimate BMI values. Our findings add to the existing literature, reinforcing the observation that self-reported values is unreliable [11-14]. The bias in self-reported data increased as BMI increased, magnifying the impact on estimates of obesity prevalence. In particular, children at or above the median were more likely to under report their weight. Our findings are consistent with those of a study that examined only 8th graders and found students who were at risk for overweight and those who were already overweight were more likely to underestimate their weight than students who were normal weight [15].

The secondary data set used in this analysis considered self-reported weights and heights that resulted in a BMI greater than 55 to be out of range. Our results indicate that there were children with verified measurements that resulted in a BMI greater than 55, suggesting that the CDC cut-off was too low for this population. This may contribute to the apparent bias in self-reported data, however if the "Out of Range" children are reclassified as obese the percentage of obese children by self-report is only 17.2%, (compared to 27.3% by measured data), and the chi square is still highly significant (15.88, 2 d.f., $p<0.001$).

School nurses are uniquely positioned to play an important role in meeting recommendations for BMI surveillance and in reducing childhood obesity. The *Let's Move, American's Move to Raise a Healthier Generation of Kids*, campaign calls for Healthy Eating, Physical Activity and Action [16]. Specifically, *Let's Move* has a recommendation to "educate doctors and nurses across the country about obesity, ensure they regularly monitor children's BMI, provide counseling for healthy eating early on, and, for the first time ever, will even write a prescription for parents laying out the simple things they can do to increase healthy eating and active play" [16]. School nurses interact with the nations' youth on a regular to daily basis and are in an ideal position to provide systematic monitoring.

JCSD is unique in their efforts. Few schools in Oregon collect height and weight for calculation of BMI. In a survey of 75 Oregon school districts conducted by the Oregon Department of Human Services, JCSD was one of just eight school districts to calculate BMI percentiles [17]. Some states, including Arkansas and Pennsylvania, mandate schools to notify parents of their child's BMI (i.e. Arkansas Center for Health Improvement, Act 1220, 2003; Pennsylvania Growth Screening Program, 2004). These programs have been met with opposition from both parents and school staff and have raised concern about the resources needed to devote to such efforts [18-20]. Other research suggests that parents are likely to support BMI screening programs if they are engaged and involved in the development of the program [18, 21]. As a myriad of approaches to obesity prevention and intervention are developed and tested there is a need for appropriate surveillance measures to assess changes that are not only meaningful to researchers but also to the communities served [22]. School nurses are poised to systematically and longitudinally assess students that may not have regular access to health care.

Strengths and Limitations

First, only one school district from the state was analyzed. This strengthens the comparison of the population estimates by data source, but it limits the generalizability of the results. Second, our analysis is limited to 8th and 11th grade students. Finally, it was not possible to match cases due to the protected identity of the students participating in OHT. However, this study's strength lies in the use of quantile regression to estimate the effect of data source for children in different parts of the BMI distribution and the clear illustration of discrepancy by reporting source in children who are overweight. Additionally, we demonstrate the important role that school nurses can play in assessing BMI in rural schools.

In conclusion, rural school districts can collect accurate prevalence measures for assessment and evaluation of childhood overweight and obesity by utilizing an important resource; rural school nurses. Their smaller student enrollment simply makes it more feasible. In one study, school policies were seen as the biggest barrier to having BMI screening in schools [23], a barrier that can be overcome when parents and the school district work together.

Acknowledgments: We thank all members of the Mountain View Community Health Improvement & Research Partnership who made this work possible.

Funding source: This research was supported by the Northwest Health Foundation and the Oregon Clinical and Translational Research Institute (OCTRI) grant number UL1 RR024140 from NCRR/NCATS, a component of the National Institutes of Health (NIH), and NIH Roadmap for Medical Research.

References

1. North Carolina Department of Health and Human Services, Division of Public Health, State Center for Health Statistics, Sources of data for community profiles, January 2007.
2. Washington State Department of Health http://assessnow.info/data_sources (accessed February 20, 2012).
3. Oregon Office of Rural Health, Oregon Health & Science University, Rural community profiles http://www.ohsu.edu/xd/outreach/oregon-rural-health/data/publications/index.cfm#CP_JUMP_1541264 (accessed February 20, 2012).
4. New York State Department of Health, Information for a healthy New York http://www.health.state.ny.us/statistics/chac/usefulcha/findings.htm (accessed February 20, 2012).
5. Dietz W. Health consequences of obesity in youth: childhood predictors of adult disease. Pediatrics 1998; 101: 518.
6. Bethell C, Simpson L, Stumbo S, Carle A, Gombojav N. National, state and local disparities in childhood obesity. Health Affairs. 2010; 29 (3):347-356.
7. McGinnis P, Hunsberger M, Davis M, et al. Transitioning from CHIP to CHIRP blending community health development with community-based participatory research. Fam Community Health. 2010; 33(3):228-237.
8. Nihiser A, Lee S, Wechsler H, et al. Body mass index measurement in schools. Journal of School Health 2007; 77 (10): 651-671.
9. Oregon Health Division. Health Promotion and Chronic Disease Prevention Program. Summary of BMI data collection in school districts. 2009. http://public.health.oregon.gov/BirthDeathCertificates/Surveys/OregonHealthyTeens/Pages/index.aspx#2013oht
10. Beyerlein A, Toschke AM, von Kries R. Risk factors for childhood overweight: shift of the mean body mass index and shift of the upper percentiles: results from a cross-sectional study. International Journal of Obesity 2010; 34: 642–648. doi:10.1038/ijo.2009.301.
11. Strauss RS. Comparison of measured and self-reported weight and height in a cross sectional sample of young adolescents. Int J Obes Relat Metab Disord.1999;23(8):904-908.
12. Brener N, McManus T, Galuska D, Lowry R, Wechsler H. Reliability and validity of self-reported height and weight among high school students. Journal of Adolescent Health. 2003; 32(4):281-287
13. Lin D. Actual measurements of body weight and height are essential: most self-reported weights and heights are unreliable. Nutrition Today [serial online]. 2007 November, 42(6), 263-266.
14. Kurth BM & Ellert U. Estimated and Measured BMI and Self-Perceived Body Image of Adolescents in Germany: Part 1 - General Implications for Correcting Prevalence Estimations of Overweight and Obesity. Obesity Facts. 2010:3(3);181-190.
15. Kubik M, Story M, Rieland G. Developing school-based BMI screening and parent notification programs: findings from focus groups with

elementary school students. Health Education and Behavior. 2007; 34(4):622-633.

16. Let's Move. http://www.letsmove.gov/ Accessed April 10, 2012.
17. Byrd S. Dealing with controversy: the lessons of implementing BMI screening. NASA Newsletter (Englewood, CO) 2003. 18 (1):18.
18. Dishongh K. State anti-fat crusade peeves parents, others. Report cards to include kid's body mass index. Arkansas Democrat-Gazetter, August 2003.
19. Holzman P. Pennsylvania wants schools to battle obesity. Intelligence Journal, December 10, 2003.
20. Plotnikoff R, Lighfoot P, Barrett L, et al. A framework for addressing the global obesity epidemic locally: the Child Health Ecological Surveillance System (CHESS). Preventing Chronic Disease. 2008; 5(3). http://www.cdc.gov/pcd/issues/2008/jul/07_0007.htm. Accessed [Feb 20, 2012].
21. Sherry B, Jefferds M, Grummer-Strawn L. Accuracy of adolescent self-report of height and weight in assessing overweight status. Arch Pediatric Adolesec Med. 2007; 161(12):1154-1161.
22. Morrissey SL, Whetstone LM, Cummings DM, Owen LJ. Comparison of self-reported and measured height and weight in eighth-grade students. *J Sch Health.* 2006;76(10):512-5.
23. Stalter A, Chaudry R, Polivka B. Facilitating factors and barriers to BMI screenings in schools. Journal of School Nursing. 2010; 26: 320.