Research Papers

Assessing Prevalence of Overweight and Obesity Through Self-Reports of Height and Weight by High School Students in Taipei, Taiwan

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ABSTRACT: *This study compared consistency of age- and gender-specific self-reported height and weight and calculated body mass index among a sample of high school students in Taipei County, Taiwan to reference values for Taiwanese school-aged youth obtained through national studies. Taipei high school students provided self-reports of height and weight that were similar to national reference values. Use of self-reported height and weight in this sample appeared warranted and may reliably be used to calculate aggregate indices of body mass, overweight, and obesity. This study compared prevalence of overweight and obesity in the current sample with other adolescent populations using international criteria (International TaskForce on Obesity). Using these criteria, 17.6% of boys and 9.4% of girls met the definition of overweight and 3.7% of boys and 1.6% of girls met the definition of obesity. While use of self-reported height and weight appears justified in this sample, researchers should not assume self-report measures will always be accurate. Researchers considering use of self-reported height and weight should compare their results to normative reference values when possible to increase confidence in using self-report measures of height and weight.* (J Sch Health. 2004;74(10):401-407)

Body weight represents a major issue, not only in the United States and other Western nations, but in other areas of the world, including Asia. Overweight and obesity are widespread and growing problems globally.[1] Prevalence of overweight and obesity increased substantially the past few decades, and indications suggest the trend will continue.[2] In Taiwan, the availability of a high-fat and high-energy diet has steadily increased for the general population,[3,4] and lifestyles also have become more sedentary and physically inactive.[5] Prevalence of obesity is increasing among adults and children.[6,7] Thus, in Taiwan, overweight and obesity and the associated medical, psychosocial, and economic consequences are important public health issues.[7]

School health education can help address the escalating rates of child and adolescent overweight and obesity.[8,9] Consequently, school health educators are interested in accurately assessing students' body weight to determine needs and evaluate health education interventions designed to promote healthy body weight. These efforts frequently rely on survey research techniques that use self-report measures from school-aged youth,[10] so validity of self-reporting poses concern for researchers. Self-reports are used extensively in the literature as in the US Youth Risk Behavior Survey,[11] but concerns about the accuracy remain.[12,13]

This study (1) compared consistency of age- and gender-specific self-reported height and weight and calculated body mass index (BMI) among a selected sample of high school students in Taipei County, Taiwan, to reference values for Taiwanese school-aged youth obtained through national studies, and (2) determined prevalence of overweight and obesity, based on self-reports of height and weight, among Taipei high school students using a new international reference of overweight and obesity.

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METHODS

Sample Selection

The population consisted of students in grades 10-12 enrolled at senior high schools and vocational high schools in the Taipei, Taiwan, area (Taipei City and Taipei County) during the 1999 academic year. The student population in Taipei City was 134,164, while the student population in Taipei County was 69,204.

Twenty-one schools were selected randomly (14 in Taipei City and seven in Taipei County) from a total of 114 senior and vocational schools in the Taipei area. Within each selected school, one class in each grade (10th, 11th, and 12th grade) was selected randomly for the sample. This process yielded 63 classes consisting of 2,820 students. From this number, survey instruments were collected from 2,665 students. Surveys from 155 students were not obtained due to absence or from failure to participate.

Mean age for participating students was 16.72 (SD = 1.06). Ages ranged from 15 to 21, with 98% between 15 and 18. The sample was fairly evenly distributed in 10th (34.9%, n = 912), 11th (33.0%, n = 864), and 12th (32.1%, n = 839) grades. The sample included 1,564 males and 1,026 females. Twenty-five subjects did not report their gender, and were excluded from the analysis.

Height and Weight Data

As part of a general survey of health attitudes and practices conducted in 1999, subjects reported their height in centimeters and their weight in kilograms. The question-

naire was translated from English to Chinese by two faculty members from the Department of Health Education, National Taiwan Normal University. The survey was administered by these faculty members. When surveys were given to students, they were instructed not to put their names on the forms, that their participation was voluntary, and to answer questions honestly and accurately. Students also were informed that if they had questions or difficulty understanding questions to raise their hands for assistance. Coding and data entry were performed in Taiwan by the faculty members.

Data Analysis

Gender-specific mean and median weight-for-height was calculated for each two-centimeter height increment which included at least 20 subjects. BMI (weight in kg/height in meters^2) also was calculated from self-reported height and weight.[14] Age- and gender-specific BMI was calculated for each age 15 through 18. BMI also was calculated for boys and girls across all ages in the sample, and a *t*-test tested for differences between boys and girls.

International cutoff points for BMI for overweight and obesity by gender and age determined the overall proportion of boys and girls in the two classifications.[15] The two cutoff points were established by pooling data from six countries to develop centile curves which pass through a BMI of 25 kg/mg^2 (overweight) and 30 kg/m^2 (obesity) at age 18. Because they are linked to adult cutoffs for over-

Table 1
Mean Weight-for-Height (kg) in the Current Sample and in a National Reference Survey[a] Where Height and Weight Were Measured

	Boys		Girls	
Height (cm)	Current Sample M (SD)	Reference Sample[a] M (SD)	Current Sample M (SD)	Reference Sample[a] M (SD)
150 - 151.9	------	------	44.0 (4.4) n = 40	45.6 (7.7) n = 2,095
152 - 153.9	------	------	46.7 (6.0) n = 78	47.6(7.9) n = 2,820
154 - 155.9	------	------	48.7 (6.6) n = 109	49.1(8.0) n = 3,455
156 - 157.9	------	------	50.4 (7.2) n = 102	50.7 (8.5) n = 3,798
158 - 159.9	------	------	51.3 (7.4) n = 162	51.8 (8.6) n = 3,834
160 - 161.9	56.0 (10.1) n = 44	54.1 (10.5) n = 1,623	53.0 (7.0) n = 116	53.3 (8.9) n = 3,762
162 - 163.9	56.4 (8.3) n = 64	56.4 (10.7) n = 1,909	54.9 (8.2) n = 118	54.6 (9.2) n = 2,920
164 - 165.9	57.7 (9.1) n = 123	57.6 (10.3) n = 2,227	58.2 (9.7) n = 52	56.0 (9.8) n = 2,022
166 - 167.9	60.2 (9.2) n = 126	59.9 (11.3) n = 2,525	57.0 (7.5) n = 46	57.2 (9.9) n = 1,223
168 - 169.9	60.6 (10.5) n = 179	61.6 (11.2) n = 2,656	60.5 (8.7) n = 29	58.9 (10.4) n = 711
170 - 171.9	63.0 (10.0) n = 234	63.5 (11.3) n = 2,788	------	------
172 - 173.9	62.7 (9.5) n = 202	65.1 (12.2) n = 2,438	------	------
174 - 175.9	67.0 (12.2) n = 189	67.4 (12.7) n = 1,973	------	------
176 - 177.9	67.3 (11.5) n = 126	68.2 (12.5) n = 1,426	------	------
178 - 179.9	69.1 (11.5) n = 95	69.4 (12.1) n = 961	------	------
180 - 181.9	72.1 (12.9) n = 74	72.3 (13.5) n = 599	------	------
182 - 183.9	72.7 (11.6) n = 36	73.0 (13.5) n = 352	------	------
184 - 185.9	76.0 (11.9) n = 21	76.3 (14.5) n = 156	------	------

[a] 2002 national study of 86,967 school children and adolescents (aged 6.5 to 18.5 years)[7].

weight and obesity, they represented indicators of risk for adverse health outcomes. The Childhood Obesity Working Group of the International TaskForce on Obesity (IOTF) proposes these BMI cutoffs as a new international reference of overweight and obesity for children and adolescents aged 2-18 years when comparing prevalence across countries.[16]

Determining international cutoffs was accomplished by pooling large, nationally representative cross-sectional growth studies from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States. These cutoffs were less arbitrary and more internationally based than previous definitions of child and adolescent overweight and obesity. The new cutoffs points helped provide internationally comparable prevalence rates of overweight and obesity in children and adolescents. Analyses were performed with SAS Version 8.02.

Reference Values

Reference values for weight-for height comparisons in this study came from a 2002 national study of 86,967 children and adolescents (aged 6.5 to 18.5 years) obtained from a random sampling of elementary, secondary high schools, and senior high and vocational schools in Taiwan.[17] Body

Table 2
Median Weight-for-Height (kg) in the Current Sample and in a National Reference Survey[a] Where Height and Weight Were Measured

	Boys		Girls	
Height (cm)	Current Sample *Median*	Reference Sample[a] *Median*	Current Sample *Median*	Reference Sample[a] *Median*
150 - 151.9	------	------	43.0 n = 40	44.5 n = 2,095
152 - 153.9	------	------	46.0 n = 78	46.0 n = 2,820
154 - 155.9	------	------	47.5 n = 109	47.6 n = 3,455
156 - 157.9	------	------	49.75 n = 102	49.0 n = 3,798
158 - 159.9	------	------	50.0 n = 162	50.0 n = 3,834
160 - 161.9	52.5 n = 44	51.5 n = 1,623	50.0 n = 116	51.5 n = 3,762
162 - 163.9	55.5 n = 64	54.1 n = 1,909	52.0 n = 118	53.0 n = 2,920
164 - 165.9	56.0 n = 123	55.3 n = 2,227	54.0 n = 52	54.0 n = 2,022
166 - 167.9	58.75 n = 126	57.4 n = 2,525	56.0 n = 46	55.1 n = 1,223
168 - 169.9	60.0 n = 179	61.0 n = 2,656	55.0 n = 29	56.6 n = 711
170 - 171.9	60.0 n = 234	61.0 n = 2,788	------	------
172 - 173.9	61.0 n = 202	62.5 n = 2,438	------	------
174 - 175.9	64.0 n = 189	64.0 n = 1,973	------	------
176 - 177.9	65.0 n = 126	65.4 n = 1,426	------	------
178 - 179.9	68.0 n = 95	69.4 n = 961	------	------
180 - 181.9	70.0 n = 74	70.0 n = 599	------	------
182 - 183.9	70.0 n = 36	69.9 n = 352	------	------
184 - 185.9	72.0 n = 21	73.5 n = 156	------	------

[a] 2002 national study of 86,967 school children and adolescents (aged 6.5 to 18.5 years)[17].

height and weight of all school-aged children were measured in a standardized way using a portable metal stadiometer and a digital or balance beam scale. Weight-for-height (kg) for boys and girls were reported as median, mean, and standard deviation. Reference values for BMI (based on measured height and weight) used for comparison in this study came from the 1997 national Physical Fitness Survey which included data from 42,031 school-aged youth obtained from a systematic random sampling of Taiwanese schools.[18] Mean BMI was reported for age-specific group by gender. A literature review also located recent studies of adolescent populations which applied the International TaskForce on Obesity international cutoffs for overweight and obesity, and these studies provided international reference values for comparisons.

RESULTS

Tables 1 and 2 contain mean and median weight-for-height values in the current sample (based on self-reported height and weight) and in the national reference survey (based on measured height and weight). The mean BMI for boys was 21.7 (SD = 5.0) and 20.4 (SD = 3.5) for girls. The difference between boys and girls was significant (t = 7.10, df = 2579, $p < .001$). Table 3 contains mean age- and gender-specific BMI in the current samples and in the national reference survey.

A higher percent of boys (17.6%) than girls (9.4%) were overweight according to the international cutoff for overweight (χ^2 = 34.15, df = 1, $p < .001$). A higher percent of boys (3.7%) than girls (1.6%) also were classified as obese (χ^2 = 10.01, df = 1, $p < .01$).

DISCUSSION

Comparisons with Reference Values

Weight-for-height values in Taipei County high school students were similar to reports in the national reference study. Mean weight-for-height values differed across all two-centimeter height increments between the two samples by an average of only 0.74 kg for boys and 0.73 kg for girls. Of the 13, two-centimeter height increments for boys, 10 of the means between the two samples were within one kilogram. Of the 10, two-centimeter height increments for girls, eight of the means were within one kilogram. Likewise, median weight-for-height values differed across all two-centimeter height increments between the two samples by an average of only 0.87 kg for boys and 0.74 kg for girls.

Age- and gender-specific BMI of Taipei County high school students also were similar to reports in the national study, with the exception of 15-year-old boys in which there was a substantial difference (21.75 kg/m^2 vs. 20.63 kg/m^2). There was close similarity for boys of other ages and for girls of all ages. The average difference in BMI across all age groups of girls between the two samples was only 0.10 kg/m^2. For boys the average difference was higher (0.53 kg/m^2), due primarily to a substantial difference found between 15-year-olds and the reference sample.

Similarity between Taipei County students and the reference sample provides evidence for validity of self-reported height and weight. In general, close consistency existed between the mean and median weight-for-height and BMI values between the samples. This fact increases confidence in using self-reported height and weight in survey research, and increases confidence in using these measures as a proxy measure for measured height and weight.

Findings showing similarity between self-reported height and weight and corresponding BMI were consistent with other studies showing high validity for older children and adolescents.[19-21] Goodman, Hinden, and Khandelwal[22] found a high correlation among adolescents (r = .92) between BMI calculated from self-reported and measured height and weight. In this study 96% of students were classified correctly as to obesity status when BMI was calculated from self-reported height and weight. Girls were no more likely than boys to be misclassified as obese using

Table 3
Age- and Gender-Specific Body Mass Index (BMI) in the Current Sample and in a National Reference Survey[a] Where Height and Weight Were Measured

	Boys		Girls	
Age	Current Sample *M (SD)*	Reference Sample *M (SD)*	Current Sample *M (SD)*	Reference Sample *M (SD)*
15	21.75 (4.37) n = 144	20.63 (3.08) n = 955	20.15 (3.28) n = 154	20.18 (2.66) n = 942
16	21.45 (3.88) n = 434	21.28 (3.03) n = 540	20.41 (3.93) n = 367	20.45 (2.45) n = 577
17	21.78 (7.05) n = 505	21.19 (2.62) n = 519	20.61 (3.21) n = 312	20.35 (2.30) n = 521
18	21.67 (3.17) n = 410	21.90 (2.70) n = 414	20.38 (2.75) n = 182	20.30 (2.40) n = 299

[a] 1997 national Physical Fitness Survey.[18]

BMI from self-reported height and weight. Thus, the authors concluded that studies can use self-reported height and weight to understand adolescent obesity and its correlates. A study of Swedish adolescents found high correlation (0.88-0.98) between self-reported estimations and objective measures of height and weight among 12-, 15-, and 18-year-old adolescents, but lower correlations among nine year olds.[23]

Not all studies found self-reported height and weight accurately reported by adolescents. A study of US high school students found self-reported height, weight, and BMI calculated from these values highly reliable on two questionnaires completed two weeks apart, but different from measured height, weight, and BMIs calculated from measured values.[10] In this study, on average students overreported height by 2.7 inches and underreported weight by 3.5 pounds. Resulting BMI values averaged 2.6 kg/m^2 lower when based on self-reported versus measured values, producing lower percentages of students classified as overweight or at risk for overweight when based on self-reported rather than measured values. The study also found female students were more likely than male students to underreport weight. Because self-reported height and weight differ from measured height and weight in some adolescent populations, researchers should compare reported values with reference values when possible.

Prevalence Data

The International TaskForce on Obesity's BMI cutoff points were used to assess prevalence of overweight and obesity because these cutoff points are less arbitrary and more internationally based than previous definitions of child and adolescent overweight and obesity. The new IOTF-BMI gender-and age-specific cutoff points proved useful in providing internationally comparable prevalence rates.[16] Using these cutoffs, higher percentages of boys than girls were overweight and obese: 17.6% of boys and 9.4% of girls met the definition of overweight, and 3.7% of boys and 1.6% of girls met the definition of obesity.

Recent studies used IOTF-BMI cutoffs because they provide a consistent international reference for comparisons

Table 4
Gender-Specific Estimates of Adolescent Overweight and Obesity from Studies Using the International Obesity Task Force - Body Mass Index (IOTF-BMI) Cutoffs

Country and Age of Respondents	Boys %	Girls %	Data Collection
Greece [25]			
Overweight (11 - 16)	21.7%	9.1%	1997 - 1998 nationally representative sample;
Obesity (11 - 16)	2.5%	1.2%	Self-reported height and weight.
Sweden [23]			
Overweight (12)	12.3%	6.8%	1997; Self-reported height and weight.
Obesity (12)	7.9%	5.1%	
Overweight (15)	11.6%	5.5%	
Obesity (15)	8.9%	4.2%	
Overweight (18)	11.4%	4.8%	
Obesity (18)	7.3%	3.9%	
Australia [27]			
Overweight (12 - 15)	20.0%	14.5%	1995; National Nutrition Survey;
Obesity (12 - 15)	6.1%	4.4%	Measured height and weight.
Overweight (16 - 18)	18.9%	14.7%	
Obesity (16 - 18)	6.8%	6.0%	
France [26]			
Overweight (12)	19.2%	19.5%	2001; Survey in Eastern France;
Obesity (12)	5.6%	4.9%	Measured height and weight.
Mexico [28]			
Overweight (10 - 17)	15.4% - 18.8%	18.4% - 22.3%	2000; Mexican National Health Survey;
Obesity (10 - 17)	6.1% - 9.0%	5.9% - 8.2%	Measured height and weight.
Brazil [29]			
Overweight (10 - 14)	15.0%	18.0%	1999; Probabilistic sample of schoolchildren
Obesity (10 - 14)	4.5%	4.4%	in Rio de Janeiro; Measured height and weight.
India [30]			
Overweight (10 - 16)	23.1%	27.7%	2000; One affluent school in Delhi;
Obesity (10 - 16)	8.3%	5.5%	Measured height and weight.
Phillippines [31]			
Overweight	6.5%	1.6%	1999; Cross-section of school in three regions;
Obesity	5.7%	1.8%	Self-reported height and weight.

across countries and monitoring the global obesity epidemic. Wang, Monteiro, and Popkin[24] assessed prevalence of overweight using IOTF-BMI references among nationally representative samples of adolescents (10-18 years) in four countries at two data points: China (4.5% in 1974, 6.2% in 1997), Brazil (3.7% in 1974, 12.6% in 1997), Russia (11.5% in 1992, 8.5% in 1998), and the United States (16.8% in 1971-1974, 27.3% in 1988-1994). They did not report gender-specific IOTF-BMI overweight prevalence for these adolescents.

Studies from Greece,[25] Sweden,[23] France,[26] Australia,[27] Mexico,[28] Brazil,[29] India,[30] and the Philippines,[31] do provide gender-specific IOTF-BMI estimates of overweight prevalence allowing comparison with our results (Table 4). In these studies, IOTF-BMI overweight prevalence ranged from 6.5%-23.1% for boys and 1.6%-27.7% for girls, while obesity prevalence ranged from 2.5%-23.1% for boys and 1.6%-27.7% for girls. Taiwanese boys in Taipei County had a higher prevalence of overweight than boys in Sweden, Brazil, and the Philippines, but lower than boys in Greece, Australia, France, and India. However, the India study was restricted to one affluent school and not representative of youth of lower socioeconomic status. Prevalence of overweight in Taiwanese boys was similar to boys in Mexico.

Taiwanese girls had a lower prevalence of overweight than girls in Australia, France, Mexico, Brazil, and India. Prevalence of overweight in Taiwanese girls was similar to that of girls in Greece, and only higher than girls from the Philippines. Yet, in terms of obesity, Taiwanese girls had a comparably low rate of obesity (1.6%) similar to girls in the Philippines (1.8%) and Greece (1.2%) which was substantially lower than girls in the other countries.

Taiwanese boys also had a comparably low rate of obesity (3.7%), and this rate was only higher than rates reported in the Greece study. In some instances Taiwanese adolescents had a higher prevalence of overweight than their counterparts (eg, Swedish boys and girls, Mexican boys, Brazilian boys). However, in these instances, prevalence of obesity was lower than that of the counterpart. For example, prevalence of overweight in Taiwanese boys was 17.6% and in Mexican boys was 15.4%-18.8%, while prevalence of obesity in Taiwanese boys was 3.7% compared to 6.1%-9.0% in Mexican boys.

Taiwanese researchers use the term "obesity" to reflect what researchers elsewhere call overweight or overweight plus obesity. Thus, when comparing these calculations, "obesity" is used broadly to reflect overweight, which also includes obesity. Huang et al[17] reported a prevalence of obesity of 16.3%-19.3% in Taiwanese boys and 15.0%-18.4% in Taiwanese girls using the definition for "obesity" of having a weight-for-height greater than 120% of median weight-for-height. The range for boys was similar to the 17.6% of boys in this sample that met the criterion of overweight based on IOTF-BMI. However, it is much higher than the IOTF-BMI of 9.4% for girls.

Huang[18] advocated against using IOTF-BMI classifications for Taiwanese youth because the international data did not include BMIs of Taiwanese children. The argument is valid for determining overweight and obesity within Taiwan, and every country should establish its own norm of BMI because BMI differs in several countries. Research is pointing to a need for lower BMI cutoffs for defining obesity among Taiwanese adults because Taiwanese appear to respond more severely in terms of disease (hypertension, hyperuricemia, and diabetes) to the same degree of BMI elevation compared to US Whites or Blacks.[32] Furthermore, studies have shown that given the same level of BMI, Chinese and other Asian groups have a higher percentage of body fat than do Whites.[33] However, in this study and others making comparisons across countries and populations of adolescents, the IOTF-BMI overweight and obesity classifications are helpful.

In addition to IOTF-BMI cutoffs, this study also determined the percent of Taipei County students classified as overweight, obese, and underweight using criteria frequently used in studies of US children and adolescents. This was done by using gender- and age-specific cut-points for BMI, based on data from recently revised growth charts (for youth aged two to 20) produced by the Centers for Disease Control and Prevention.[34] As recommended by Kuczmarski et al,[34] the 85th percentile was taken as the cutoff point for overweight and the 95th for obesity. The 5th percentile was taken as the cutoff point for underweight. Using these cutoffs, 21.9% of boys and 7.0% of girls met the definition of overweight, and 5.1% of boys and 1.6% met the definition of obesity. In addition, 9.4% of boys and 12.0% of girls were classified as underweight. The CDC-BMI cutoffs allowed comparison of prevalence estimates obtained by Lowry et al[35] based on 1999 US Youth Risk Behavior Survey (YRBS) results which showed higher percentages of US boys (28.3% overweight, 13.7% obese) and girls (21.4% overweight, 7.7% obese) classified as overweight and obese. However, lower percentages of US boys (2.4%) and girls (2.2%) were classified as underweight. BMI in the US study, like this study, was obtained from self-reported height and weight.

CONCLUSION

Taipei high school students provided fairly accurate self-reports of their height and weight when compared to national reference values. Consequently, use of self-reported height and weight in this sample appeared warranted and may be used reliably to calculate aggregate indices of overweight and obesity. This approach compared prevalence of overweight and obesity in the current sample with other adolescent populations using international criteria. While use of self-reported height and weight appears justified in this sample of adolescents, researchers should not assume self-report measures will always be accurate. Some studies found adolescent reports of height and weight to be inaccurate. Therefore, researchers considering use of self-reporting of height and weight should compare their results to normative reference values when possible. Also, overweight youth frequently underreport their weight.

This study provided evidence that overweight and obesity among Taipei high school students represent a significant health problem. Although current prevalence rates of overweight and obesity appear below levels in the United States and Europe, indications suggest that overweight/obesity is increasing among Taiwan youth.[7] School health educators can help in solving the global obesity epidemic. ■

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Statement of Purpose

The ***Journal of School Health***, an official publication of the American School Health Association, publishes material related to health promotion in school settings. ***Journal*** readership includes administrators, educators, nurses, physicians, dentists, dental hygienists, psychologists, counselors, social workers, nutritionists, dietitians, and other health professionals. These individuals work cooperatively with parents and the community to achieve the common goal of providing children and adolescents with the programs, services, and environment necessary to promote health and improve learning.

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