Original Article

Measurements and profiles of body weight misperceptions among Taiwanese teenagers: a national survey

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Children and adolescents tend to lose weight, which may be associated with misperceptions of weight. Previous studies have emphasized establishing correlations between eating disorders and an overestimated perception of body weight, but few studies have focused on an underestimated perception of body weight. The objective of this study was to explore the relationship between misperceptions of body weight and weight-related risk factors, such as eating disorders, inactivity, and unhealthy behaviors, among overweight children who underestimated their body weight. We conducted a cross-sectional, descriptive study between December 1, 2006 and February 15, 2007. A total of 29,313 children and adolescents studying in grades 4-12 were enrolled in this nationwide, cross-sectional survey, and they were asked to complete questionnaires. A multivariate logistic regression using maximum likelihood estimates was used. The prevalence of body weight misperception was 43.2% (26.4% overestimation and 16.8% underestimation). Factors associated with the underestimated perception of weight among overweight children were parental obesity, dietary control for weight loss, breakfast consumption, self-induced vomiting as a weight control strategy, fried food consumption, engaging in vigorous physical activities, and sleeping for >8 hours per day (odds ratios=0.86, 0.42, 0.88, 1.37, 1.13, 1.11, and 1.17, respectively). In conclusion, the early establishment of an accurate perception of body weight may mitigate unhealthy behaviors.

Key Words: children and adolescents, body image, diet, obesity, misperception

INTRODUCTION

Body weight management remains a crucial public health topic for many governments. The prevalence of adolescent obesity is increasing worldwide.[1-4] Adolescent obesity may also be associated with diabetes and other chronic health conditions.[5,6] However, children and adolescents tend to lose body weight through unhealthy solutions, such as purging,[7,8] vomiting,[9] and dietary restraint.[10] These behaviors may be associated with dissatisfaction in body image.[11,12]

The perception of body image has been studied over the past few years.[13-15] A previous study revealed that the prevalence of body weight misperceptions among overweight adolescents in the United States is 44% and 47% among females and males, respectively.[16] Kim and So found that the prevalence of body weight misperception among South Korean adolescents was 49.3% (23.7% overestimation and 25.6% underestimation).[17] Factors associated with self-distortion include gender,[18-20] maternal attitude,[21] psychiatric disorder,[22] body weight,[23] diet,[24] and exercise.[25] According to previous studies, teenagers are affected most by this behavioral phenomenon, and data have shown that this behavioral shift in teenagers is primarily caused by changes in lifestyle and self-esteem [21,26] as they mature into adulthood. Misperceptions of body image can be classified into two categories: overestimation and underestimation. The overestimation of body image is exhibited by those who believe they are heavier than they actually are; underestimation is the exact opposite, wherein people believe they are skinnier than they actually are. Thus far, most studies have focused on the

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Manuscript received 01 January 2015. Initial review completed 19 January 2015. Revision accepted 03 March 2015.
doi: 10.6133/apjcn.2016.25.2.08

overestimation of body image and its correlation with eating disorders[18,27,28] in the age group between early childhood and adolescence. Despite the value provided by studies conducted on body weight overestimation, the underestimation of body weight has been largely ignored. This is a major concern because little is known about the behavioral impact of body weight underestimation and its associations in this age group. More importantly, in recent years, the number of obesity cases has increased and become a global issue.[29] The number of children diagnosed with juvenile diabetes has also increased significantly in proportion with the increase in childhood obesity,[30,31] making research on the underestimation of body weight even more relevant and necessary. The perception of body image could affect eating behavior, weight control, and future weight status. Misperception has been associated with lower life satisfaction and poor self-rated health.[32-34] Hence, an effective weight control program for adolescents should include the perception of body image as well as the body mass index (BMI). Lim and Wang demonstrated that children who misperceive their body weight exhibit poorer health-related outcomes than their peers with accurate perceptions. Boys who underestimated their body weight had higher rates of stress, whereas girls who underestimated their body weight showed higher rates of unhealthy snack intake.[32,35] Remmers found that almost half of parents with overweight adolescents misperceived their children's weight status.[36] Parents greatly influence their children's weight status and health-related behaviors, such as eating breakfast, physical activity, consuming snacks, and watching television.[35-37]

Therefore, the objectives of the present study were to estimate the perceptions of body image among Taiwanese teenagers by comparing their actual BMI values and to examine the associations of BMI values with factors including gender; parental obesity; sleep quality; the consumption of breakfast, fried food, sugar-containing drinks, and night time snacks; and time spent on sedentary and vigorous physical activities.

METHODS

Design

This study involved a cross-sectional, descriptive survey. The corresponding author designed a 3-stage stratified sampling and obtained a representative sample by applying a sample number proportional to the school's student number. The participating schools included 55 elementary schools, 38 junior high schools, 18 senior high schools, and 15 vocational schools located in Northern, Central, Southern, and Eastern Taiwan (Figure 1). Details of the study design have been previously reported elsewhere.[9,38,39]

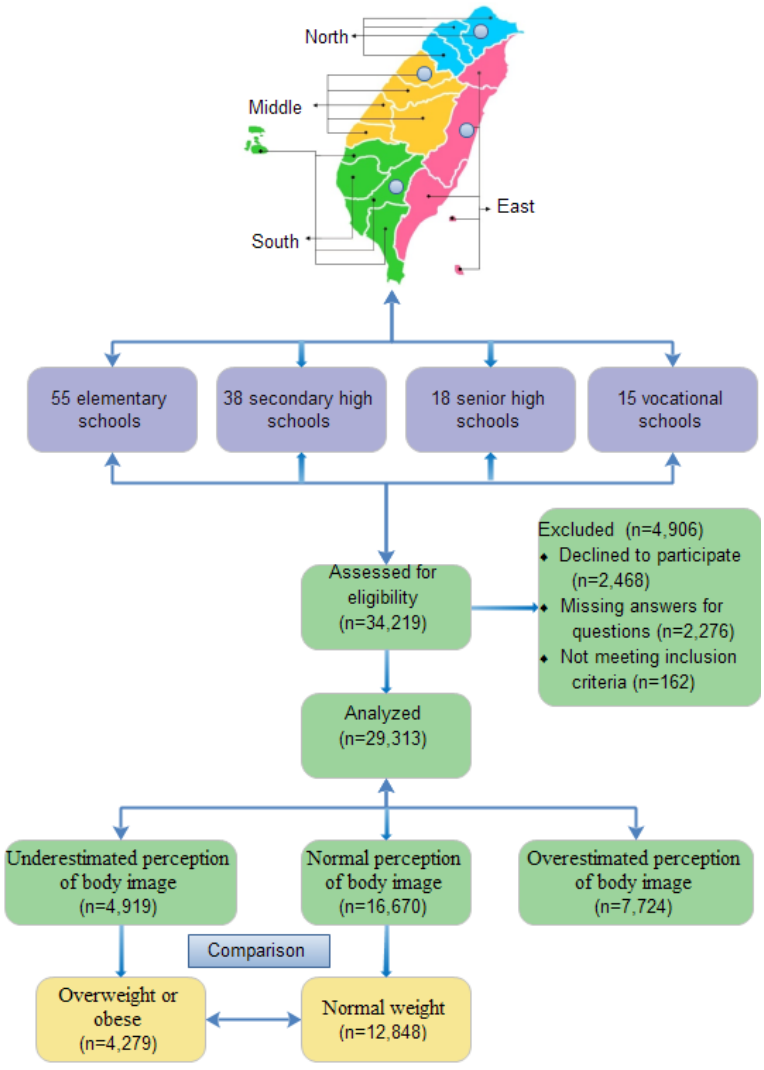

Figure 1. Flow diagram of sampling, data collection, and analysis

Participants

Data obtained from a national survey (Aid Student to Fit) conducted between December 1, 2006 and February 15, 2007 was examined to determine the weight status of Taiwanese students aged 10-18 years. The participating students were given self-administered structured questionnaires. After a half-day training course, teachers at the selected schools ensured that the questionnaires had been completed in a uniform manner. The students were encouraged to ask any questions they had regarding the questionnaires.

Measurements

The International Physical Activity Questionnaire-Youth Show Card Version (IPAQ-Y) was used to assess the durations of moderate and vigorous physical activity during the preceding 7-day period.[39-42] Vigorous physical activity refers to activities that require strong physical efforts and cause a rapid increase in breathing patterns. Moderate physical activity refers to activities that require moderate physical effort and cause a moderate increase in breathing patterns. The IPAQ-Y demonstrated acceptable reliability and validity, with correlations of 0.85 with the physical activity diary log and 0.53 with accelerometer results, respectively.[41-43]

Sedentary behaviors were defined as the time spent watching television; using a computer or playing video games; reading books, newspapers, and magazines; riding in a vehicle; and studying and completing homework. The participants reported the average number of hours per weekday and weekend spent on these activities. This scale was evaluated by experts and had a content validity index of 0.99.[39] The test-retest reliability within a 2-week interval was 0.84, as assessed using the intraclass correlation coefficient (ICC).[39]

The amounts of fluids, fruits, and vegetables were measured using the average portion of each consumed by the participants in the preceding 7-day period. Pictures of food samples were provided to the participants to facilitate accurate answers. For example, 1 portion of a vegetable was measured as approximately a half bowl of cooked vegetables, and a photograph of the vegetable was provided. The participants selected 1 of the following alternatives to denote average vegetable consumption per day: none, <1 portion per day; 1 portion per day; 2 portions per day; or >3 portions per day. The consumption of whole-grain products as a proportion of staple food consumption was confirmed by asking the participants the following question: "What percentage of your staple food consumption is comprised of whole-grain products?" The participants were asked to select from the following alternatives: all, <half, about half, >half, or none. This scale was evaluated by experts and had a content validity index of 0.89. The test-retest reliability over a 2-week interval was 0.89, as assessed using the ICC. Correlations with a 3-day dietary log ranged from 0.74 to 0.77.[39]

The heights and weights of the participants were measured in a standardized manner using a portable metal stadiometer and a digital beam scale by school nurses. The BMIs of the participants were calculated, and obesity, overweight status, and underweight status were defined according to the standards set forth by the Department of Health, Taiwan.

The body images of early teenagers aged 10 to 12 years and adolescents aged 13-18 years (Figure 2) were measured and were classified as underweight (1-2), normal weight (3-4), overweight (5), or obese (6-7). A professional artist constructed various body image figures of both children and adolescents with different weights for females and males. The corresponding author offered pictures of female and male participants aged 10 to 12 and 13 to 18 years with different body weights (underweight, normal weight, overweight, and obese), including an album of anatomically correct drawings. A professional artist combined some characteristics of ages and body weights to represent the bodies of children and adolescents. After 2 rounds of discussion regarding the drafts, pictures of the models, and BMI data, 5 experts in medicine, sports, and the arts accepted the third version. Four adults (a parent, a teacher, a nurse, and a physician) and 6 children and adolescents matched the pictures and figures. The agreement score was 97.2%.

Ethical considerations

The study was approved by the Institutional Review Board of the National Yang-Ming University (960034R)

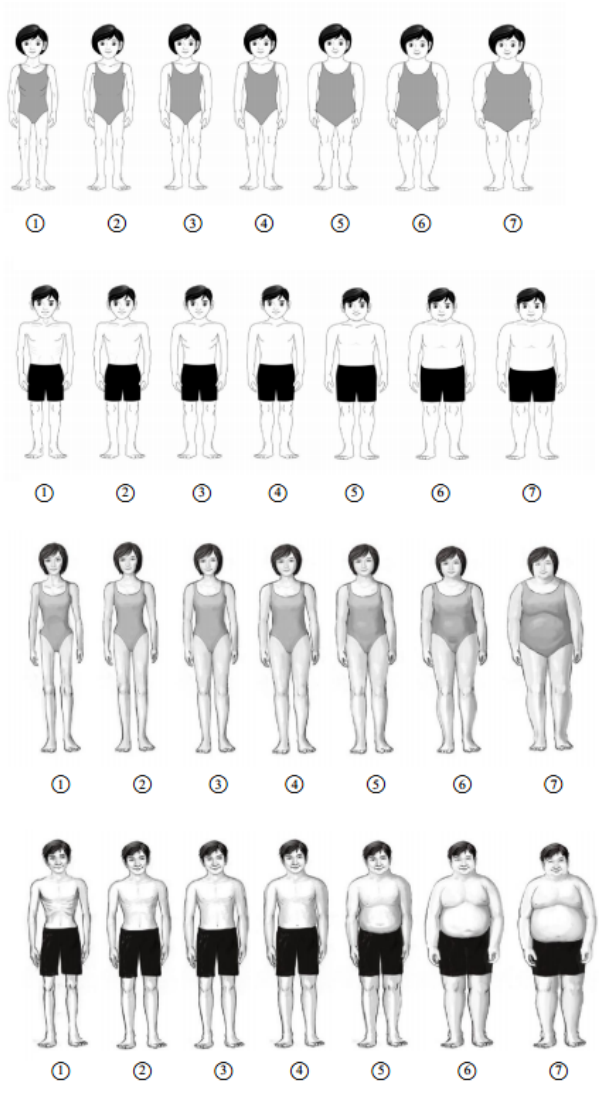

Figure 2. The body shapes of different body weights for females and males in their early teens and adolescents (designed by Yiing Mei Liou and Vanbay Chang)

and the educational authorities in Taiwan (1020045591A). An introductory letter regarding the present study along with a consent form was distributed to the selected students to take home. Only those who returned the consent form signed by a parent and the student were asked to complete the study questionnaires. The students' participation in this study was voluntary, as they could refuse to participate.

Data analysis

Statistical Product and Service Solutions (SPSS) for Windows version 18.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. The distributions and frequencies for each category of variables were examined, and odds ratios (OR) were calculated to determine the relationship between body image and potentially related factors. Overweight and obese adolescents with underestimations of their body weights were designated as the study group and adolescents of normal weight with accurate perceptions of their body weights as the control group. Student's *t* test was used to compare the average durations spent on physical activities, sedentary activities, and sleeping. Relevant factors were identified using a multivariate logistic regression analysis along with maximum likelihood estimates. Initially, all study variables (as described in the Measurements section) were included in the logistic regression model. A *p* value of less than 0.05 was considered statistically significant.

RESULTS

Sample characteristics

A total of 34,219 participants were enrolled in the study. Participants with missing answers (n=2,276) and those who did not meet the inclusion criteria, including age <10 years or >18 years (n=162), were excluded from the study (Figure 1). Based on the BMI classification according to the Health Promotion Administration, Ministry of Health and Welfare, Taiwan, 29,313 participants (14,190 female subjects and 15,123 male subjects) were classified as follows: underweight (23.1%), normal weight (52.1%), overweight (11.3%), or obese (13.4%).[44] The participants were also classified as underweight (3.8%), normal weight (74.2%), overweight (16.1%), or obese (5.9%) based on the BMI classification of the International Obesity Task Force.[45, 46]

The characteristics of the study participants are shown in Table 1. A total of 4,919 (16.8%) participants had an underestimated body image perception, 16,670 (56.8%) had a normal body image perception, and 7,724 (26.4%) had an overestimated body image perception. Male participants showed a higher tendency to underestimate their body weight (10.7% and 22.5% in female and male participants, respectively), whereas female participants tended to overestimate their body weight (29.8% and 23.1% in female and male participants, respectively). After separating the participants according to age group, it was found that adolescents aged 13-15 years tended to underestimate their body weight, and children aged 10 to 12 years tended to overestimate their body weight. After separating the participants according to their body weight classification, the overweight and obese groups showed markedly increased tendencies to underestimate their body weights (52.6% and 63.9% in overweight and obese participants, respectively). The underweight group tended to overestimate their body weight (83.0%).

Factors associated with body image misperception

We analyzed overweight and obese participants with body weight underestimations (study group, n=4,279, 14.6%) and participants with normal weights and accurate perceptions of their body weight (control group, n=12,848, 43.8%) (Table 1). When factors associated with body image perceptions were analyzed (Table 2), parental obesity was significantly higher in the study group than the control group (13.6% vs 15.3%). The rate of self-induced vomiting employed as a weight control strategy was significantly higher in the study group than in the control group (6.7% vs 5.9%, respectively), whereas the ratio of dietary control for weight loss was lower in the study group than in the control group (41.5% vs 60.1%, respectively). When eating behaviors were analyzed, the study group showed higher odds ratios of eating fried food, eating night time snacks, and drinking soft drinks every day than the control group (23.0%, 9.3%, and 17.0% vs

Table 1. The demographic data among participants (n=29,313)

	Underestimated weight	Correctly perceived weight	Overestimated weight
	n (%)	n (%)	n (%)
All	4919 (16.8)	16670 (56.8)	7724 (26.4)
Gender			
Women	1517 (10.7)	8448 (59.5)	4225 (29.8)
Men	3402 (22.5)	8222 (54.4)	3499 (23.1)
Age, year			
10~12	1300 (14.9)	4991 (57.1)	2445 (28.0)
13~15	2213 (18.7)	6630 (55.9)	3009 (25.4)
16~18	1406 (16.1)	5049 (57.9)	2270 (26.0)
BMI classification			
Underweight	0 (0)	1152 (17.0)	5626 (83.0)
Normal weight	640 (4.2)	12848 (84.2)	1765 (11.6)
Overweight	1750 (52.6)	1241 (37.3)	333 (10.1)
Obesity	2529 (63.9)	1429 (36.1)	0 (0)

BMI: body mass index.

Table 2. Factors associated with body image perception among children (n=17,127)

	Study group n=4,279	Control group n=12,848	OR (95% CI)
	n (%)	n (%)	
Paternal obesity (BMI >27)	582 (13.6)	1,966 (15.3)	0.98 (0.97~1.00)
Maternal obesity (BMI >27)	364 (8.5)	1,156 (9.0)	0.99 (0.98~1.01)
Diet control for weight loss	1,776 (41.5)	7,722 (60.1)	0.68 (0.66~0.70)
Self-induced vomiting as weight control strategy	287 (6.7)	758 (5.9)	1.13 (1.05~1.21)
Breakfast (every day)	2,931 (68.5)	9,032 (70.3)	0.94 (0.90~0.99)
5 serving of vegetables and fruits (every day)	436 (10.2)	1,285 (10.0)	1.00 (0.99~1.01)
Fly food (every day)	980 (23.0)	2,557 (19.9)	1.04 (1.02~1.06)
Soft drinks (every day)	727 (17.0)	2,081 (16.2)	1.05 (0.98~1.13)
Night snack (every day)	398 (9.3)	1,002 (7.8)	1.02 (1.01~1.03)
Vigorous physical activity >2 hours/week	1,378 (32.2)	3,700 (28.8)	1.05 (1.03~1.08)
Screen time after classes >2 hours/day	4,185 (97.8)	12,642 (98.4)	1.00 (0.98~1.01)
Sleeping time >8 hours/day	2,161 (50.5)	5,833 (45.4)	1.10 (1.07~1.14)
Sleep quality, good	3,243 (75.8)	9,392 (73.1)	1.11 (1.05~1.18)

OR: odds ratio; CI: confidence interval.

19.9%, 7.8%, and 16.2%; OR=1.04, 1.02, and 1.05, respectively). Furthermore, the study group had a lower ratio of eating breakfast than the control group (68.5% vs 70.3%, respectively; OR=0.94). The study group showed greater proportions of higher quality sleep (75.8%, OR=1.11) than the control group (73.1%), as well as longer sleep durations (mean±SD=7.7±1.2 vs 7.3±1.2 h/day, respectively, $p<0.001$). The study group spent an average of 139 mins per week engaging in vigorous physical activity, whereas the control group spent an average of 128 mins per week ($p=0.009$). The mean duration of using the Internet, playing computer games, and watching television after classes on weekdays in the study and control groups were 169 and 180 mins per day, respectively ($p=0.002$).

Associated factors between the study and control groups were compared using a multivariate logistic analysis. Self-induced vomiting, eating breakfast, and fried food consumption, as well as increased time spent on vigorous physical activity and sleeping for 8 hours per day were significantly higher in the study group than in the control group (OR=1.37, 1.13, 1.11, and 1.17, respectively). By contrast, parental obesity, dietary control for weight loss, and eating breakfast every day were significantly lower in the study group than the control group (OR=0.86, 0.44, and 0.88, respectively) (Figure 3).

Because the male participants in the study group showed an OR of 2.15, the male and female participants were subcategorized to evaluate differences by gender (Figure 3).

Factors associated with female participants were evaluated using a multivariate logistic analysis. The study group engaged in vigorous physical activity for more than 2 hours per day and slept for more than 8 hours per day compared with the control group (OR=1.24 and 1.49, respectively). By contrast, maternal obesity and dietary control for weight loss remained significantly lower in the study group than in the control group (OR=0.71 and 0.38, respectively).

In the male participant subgroup, the associated factors were similar; dietary control for weight loss was significantly lower in the study group than the control group (OR=0.61). However, the male participant subgroup tended to spend less time on vigorous physical activity compared with the control group (165 vs 185 mins /week, respectively; OR=0.84). In the female participant subgroup, the study group tended to spend less time on vigorous physical activities compared with the control group (91.6 vs 80.5 mins/week respectively; OR=1.24). In addition, in the male participant subgroup, parental obesity was decreased in the study group compared with the control group (OR=0.77), and the effect of maternal obesity on the male participants was not significant. By contrast, in the female participant subgroup, maternal obesity was decreased in the study group compared with the control group (OR=0.71), and the effect of parental obesity on the female participants was not significant (Figure 3).

DISCUSSION

The present study determined that overweight children with underestimations of their body weights were likely to eat more because they had a significantly lower dietary control rate for weight loss. They had a 12.5% increase in eating fried food every day, 5.4% increase in eating night time snacks, and 3.9% increase in drinking soft drinks; their frequencies of eating breakfast, vegetables, and fruits were also lower. The present study also determined that overweight children who underestimated their weight were associated with parental obesity and poor sleep quality, and applied unhealthy weight control techniques, such as self-induced vomiting. The early establishment of normal body weight perceptions is necessary to prevent unhealthy behaviors.

Among South Korean adolescents, 33.2% of male participants underestimated their body weights, whereas 29.6% of female participants overestimated their body weights.[17] In the present study, the prevalence of misperception was almost the same as in Kim's study. The present study confirmed that male children tend to underestimate their body weight, and that female children tend to overestimate their body weight. Physical growth and changes in the body occur during adolescence; hence, it becomes crucial for adolescents to establish an ideal body image. However, because of public opinion and mass

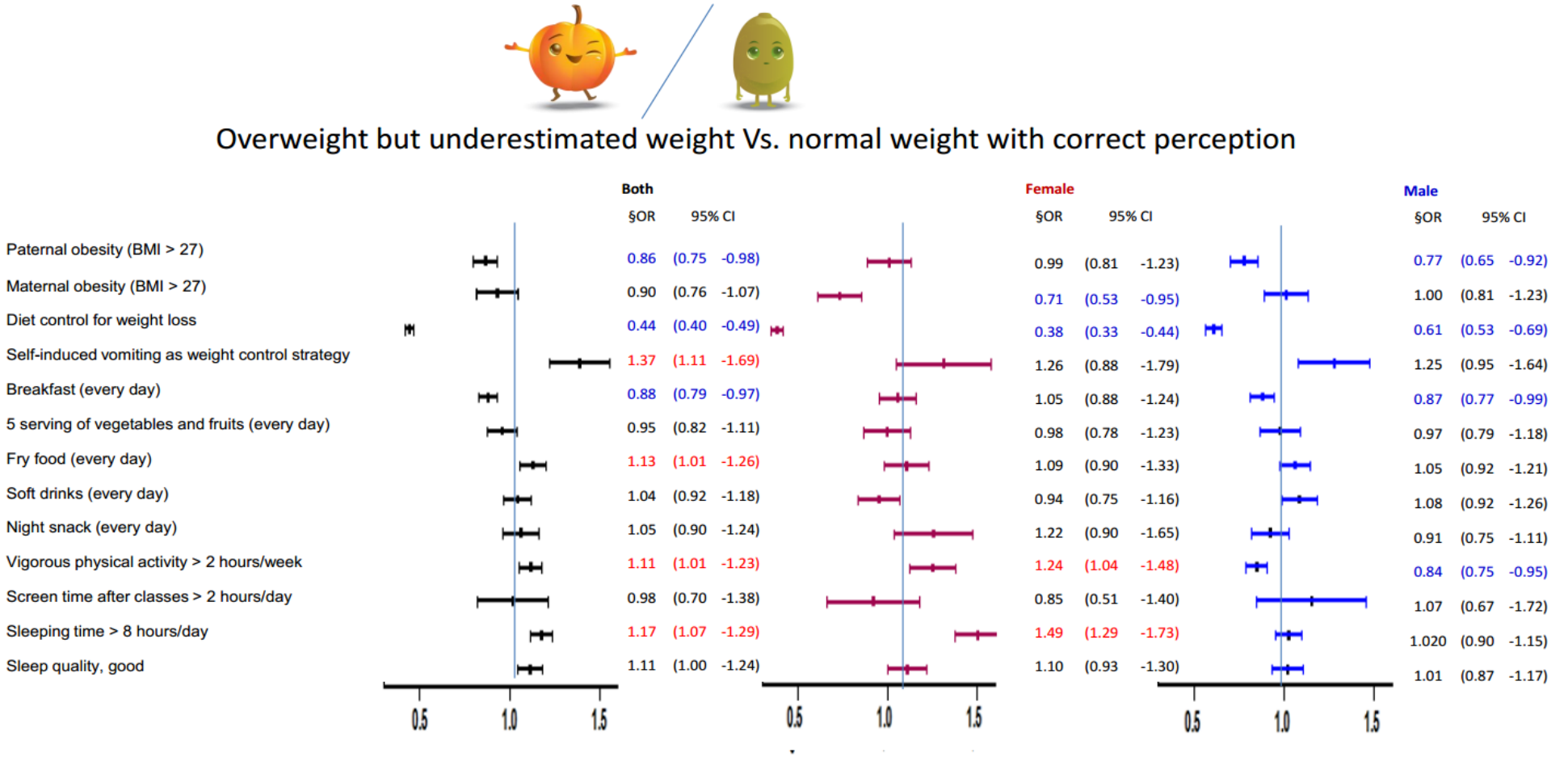

Figure 3. Logistic regression analyses of factors associated with the study group (overweight and obesity with underestimated body weight) compared with the control group (normal weight with normal perception of body weight). §People with normal weight with accurate perception of body weight as a reference.

media, female adolescents prefer a thinner body shape and male adolescents prefer a stronger body shape. Thus, misperceptions and dissatisfaction with one's body weight always lead to abnormal weight management techniques, particularly in growing adolescents.

Previous studies have shown the maternal effect on girls' body images, eating behaviors, and self-esteem.[37,47] In the present study, parental obesity was inversely associated with an underestimation of body weight in their children. This was particularly evident after dividing the groups according to gender. In the study group, male participants had a lower rate of obese fathers than in the control group, whereas female participants in the study group had a lower rate of obese mothers than the control group. Parents are their children's first role models. In the present study, we found that overweight children might have misperceived their parents' body images as their own, and thus were more likely to underestimate their own body weight.

Most previous studies have focused on overestimation of body weight and its correlations with eating disorders.[18,27,28] Few studies have examined the underestimation of body weight and its associations among adolescents. However, the underestimation of body weight is more common in overweight and obese children and adolescents. The present study revealed that overweight and obese children and adolescents both underestimated and were at ease with their body weights. They had less motivation to control their body weight and had better sleep quality. Some studies have also revealed that adolescents with underestimated body weights were less likely to exercise, ate more calories,[33,35] and engaged in more risky health behaviors such as skipping breakfast, playing video games, and not playing on sports teams.[32,48] This category of children had a lower sense of being overweight or obese. They were engaged in unhealthy dietary behaviors, such as eating more fried food and skipping breakfast, and seldom took action to lose weight. However, if they were teased about their weight, they tended to employ extreme but unhealthy methods to control their body weight, such as self-induced vomiting.

Regarding physical activity, in the study group, female participants tended to engage in more vigorous exercise than male participants. This implied a difference in weight management strategies according to gender. Overweight female participants who underestimated their body weights believed that they could be as active as others; therefore, they engaged in more vigorous exercise than their counterparts. Conversely, overweight male participants who underestimated their body weights thought that they were not fat; therefore, they were not concerned about their body shape and engaged less in vigorous activity.

Study limitations

The present nationwide survey examined dietary control and health-related behaviors among overweight and obese children. Nevertheless, the results of this study should be interpreted cautiously. Because the data are cross-sectional, a causal relationship could not be confirmed among the study variables. A longitudinal study is required to establishing causality among the relationships found in this study. Furthermore, the study primarily focused on overweight and obese children who underestimated their body weights and compared them with children of normal weight with accurate perceptions of their body weight. Although the group of overweight and obese children who underestimated their body weight was unique and exhibited similar patterns of dietary control and behavior, we could not clearly identify the effects of body weight status and misperception. Further study is warranted to clarify the relationships between these factors.

Conclusion

The prevalence of body weight misperception was unexpectedly high among Taiwanese children and adolescents. The factors associated with the underestimation of body weight were gender, parental obesity, dietary control for weight loss, sleep quality, and time spent on vigorous physical activity. The early establishment of normal body image perceptions may prevent unhealthy behaviors in children and adolescents, and in turn, may reduce future body weight gain.

AUTHOR DISCLOSURES

The authors declare no conflict of interest. This study was funded by the Department of Physical Education, Ministry of Education, Taiwan, Republic of China.

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Original Article

Measurements and profiles of body weight misperceptions among Taiwanese teenagers: a national survey

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體型的測量方法與台灣青少年錯估體型的評述：國家型調查

兒童青少年會因為錯估體型而去減肥，過去的研究常常強調飲食障礙跟高估自己體型的相關性，但卻很少有研究強調低估體型的危險。本研究的目的是探究錯估體型跟體重相關危險因素的關係，例如低估自己體型的超重兒童的飲食障礙、活動不足等不健康的行為。我們在 2006 年 12 月 1 日到 2007 年 2 月 15 日進行了一個橫斷性、描述性的調查，共有 29,313 位 4 到 12 年級兒童及青少年被邀請參與這個國家型的橫斷面調查，並完成了問卷。用多元邏輯式迴歸最大可能估計分析資料，43.2%的兒童青少年錯估體型（26.4%高估；16.8%低估），超重兒童青少年低估體型的相關因素有父母肥胖、因減肥而節食、吃早餐、因減肥而催吐、吃油炸食物、進行费力的身體活動和睡眠多於八小時（危險比分別是 0.86、 0.42、 0.88、 1.37、 1.13、 1.11 和 1.17）。總之，及早建立正確體型評估可以避免不健康的行為。

關鍵字：兒童青少年、體型意識、飲食、肥胖、錯估