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Running Title:

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WS Lo, SY Ho*, KK Mak, YK Lai, TH Lam for the Hong Kong Student Obesity Surveillance (HKSOS) project

Department of Community Medicine and School of Public Health, The University of Hong Kong, Hong Kong SAR, China

All correspondence: Dr. SY Ho
Department of Community Medicine and School of Public Health
Li Ka Shing Faculty of Medicine
The University of Hong Kong
21 Sassoon Road, Pokfulam,
Hong Kong SAR, China
Tel: (852) 2819 9883
Fax: (852) 2855 9528
Email: syho@hku.hk

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Department of Community Medicine and School of Public Health, The University of Hong Kong, Hong Kong SAR, China

Abstract (249 words)

Purpose To assess the frequency and accuracy of weight comments received from different sources among Chinese adolescents and the relation of weight comments to weight misperception.

Methods In the Hong Kong Student Obesity Surveillance (HKSOS) project 2006-07, 22612 form 1 to 7 students (41.5% boys) completed a questionnaire on obesity. Students were asked if they had received serious "too fat" or "too thin" comments over the past 30 days from family members, peers and professionals, and the accuracy of the comments was assessed against the actual weight status. Weight misperception was defined as discordance between the actual and perceived weight status. Logistic regression was used to calculate adjusted odd ratios (ORs) for weight misperception by weight comments received.

Results One in three students received weight comments, most commonly from mother for both "too fat" and "too thin" comments. Health professional was the most accurate source of weight comments, yet less than half the comments were correct. Receiving incorrect weight comments was significantly associated with weight misperception in all sex–weight status sub-groups, particularly among obese girls. In contrast, student who received correct weight comments were less likely to have weight misperception.

Conclusions Weight comments were commonly received by Chinese adolescents in Hong Kong, yet most of the comments were inaccurate, and such incorrect comments were associated with weight misperception. Family members, peers and professionals should realize the potential adverse effects of their weight comments and adolescents should be taught how to correctly assess their weight status to reduce misperceptions.

Keywords Weight misperception, weight comments, adolescents, Chinese, Hong Kong

Introduction

Weight concerns and body dissatisfaction are common among adolescents (1-3). While most girls want to be thinner, more boys desire to be more muscular (4, 5). Several studies have found that the prevalence of weight teasing on adolescents was high (6-8). Neumark-Sztainer et al reported in a large US study that 25% secondary school students had been teased several times in the past year about their weight (6). Sensitive to weight-related influences, adolescents experience tremendous pressure from weight teasing, contributing to poorer self-esteem and body image, and unhealthy weight-control attempts (diet pills, unhealthy diet behaviors, binge eating etc.) (6-10).

Existing Western studies were implicit whether weight teasing was about being too fat or too thin, but given the high prevalence of obesity and the associated negative image, the former was more likely. Although the effects of teasing over thinness are uncertain, several studies found that adolescents who perceived themselves as too thin were also more likely to have anxiety and depression, compared with adolescents who perceived themselves as having normal weight (11, 12). Such kind of weight teasing would be more relevant in developing countries such as China, where underweight is also common (13).

Few studies had specifically investigated the prevalence and effects of weight teasing by family members such as grandparents and professionals, other than peers and parents (6-8, 10). Other than parents, grandparents in Asian countries also have

great influences on adolescents' eating beliefs and patterns, especially in three-generation households with grandparents being the main caregivers of the children (14). The effect of weight comments by grandparents on adolescent weight perception is unknown. Apart from family and friends, adolescents may also receive weight comments from teachers, social workers and health professionals, but again little is known about their accuracy and effects on adolescent weight perceptions.

Previous studies mainly focused on weight teasing, which included disparaging nicknames and making fun of others' weight and body shape (6-8, 15). To the best of our knowledge, no study has focused on serious weight comments which may include those made out of good intentions and examined whether correct, incorrect or even conflicting (contradicting weight comments) weight comments are independently associated with weight misperception in adolescents.

In the present study we extended the existing research in three ways: First, we studied family members such as parents, siblings and grandparents, as well as teachers, social workers and health professionals, as sources of weight comments and we examined them separately. Second, we examined the accuracy of those weight comments. Third, we investigated the effects of different types (correct, incorrect and conflicting) of weight comments on weight misperception. We hypothesized that adolescents who received incorrect weight comments were more likely to have weight misperception than those who received accurate weight comments.

Methods

Procedures

The present study was part of a large population-based study, the Hong Kong Student Obesity Surveillance (HKSOS) project. Stratified cluster sampling was applied, and the schools were sampled with stratification by school district, source of funding, language of instruction (Chinese/ English), religion background (Christian/Others/None) and single sex/co-education to represent all main stream non-international secondary schools in Hong Kong. Forty-two schools were invited to join this survey. All Form 1 to 7 students (equivalent to Grade 7-12 in US) in selected schools were invited to participate through an informed consent. In 2006-2007, the baseline survey was self-administered during normal school hours under the supervision of trained researchers or teachers. Ethical approval was granted by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. The one-month test-retest reliability of measures used in this study was assessed with 1147 students (31.3% boys; mean age=14.8±1.6) from 3 of the participating schools.

Measures

BMI and actual weight status

Height (cm/inch) and weight (kg/lb) were self-reported by the participants to the nearest integer. The intraclass correlation coefficients (ICC) between the test-retest height and weight data in 1147 subjects were high (0.95 and 0.85, respectively), and the values were comparable to previous research (16). It was also shown in another study that self-reported anthropometric data was highly correlated with measured data in adolescents (17). Using sex-specific Hong Kong local weight-for-height (WFH) cutoffs (18), participants were defined as underweight (<80% median weight-for-height), normal weight (80% - 120% median weight-for-height) and obese

(>120% median weight-for-height). Body mass index (BMI) was calculated by weight (kg) divided by height in squared (m^2).

Prevalence of weight comments received

To assess the prevalence of weight comments received by the students, students were asked whether they had received serious "too fat" comments over the past 30 days from the following sources (yes/no): 1) family members including father, mother, siblings, grandpa, grandma and other relatives; 2) peers including friends and classmates; 3) professionals including teachers, social workers and health professionals; and 4) others including domestic helpers and neighbors. A similar question was asked to assess serious "too thin" comments received over the past 30 days. Agreements between the test and retest responses were high, ranging from 75% to 95%.

Accuracy and types of weight comments

The accuracy of the weight comments was assessed against the actual weight status. Weight comments as "too fat" was treated as "correct" when the individual was defined as obese by the local WFH references (18), and was "incorrect" if the individual had normal weight or was underweight. The same principle applied for weight comments as "too thin". Students who received both "too fat" and "too thin" comments were treated as receiving "conflicting comments", while students who did not receive any weight comments were classified as "no weight comments received", which was the reference group.

Weight perception

A standard perceived weight question asking students to describe their weight status in terms of very thin, thin, normal, fat and very fat (19) was asked. Students were defined as having "weight misperception" if they failed to describe their weight status according to actual weight status. Those who correctly described their weight status according to the local references were classified as "correct perception", which was the reference group.

Data analysis

Potential confounders considered were age (as a continuous variables), place of birth (Hong Kong, or elsewhere), the highest parental education (≤ primary, secondary, or ≥ tertiary), family affluence (relatively poor, medium, or relatively wealthy) and BMI although adjusting for these factors did not change the estimates for the weight perception and psychosocial health problems by more than 5.0% (20) in our sample as a whole or when stratified by sex and weight status.

Missing values on place of birth (0.6%), highest parental education (12.8%) and housing type (1.0%) were imputed using multiple imputation (21). The optimal estimates were obtained based on the imputed database (with the average of 5 imputed values), and they were virtually identical to those obtained using the original database (22), however, the statistical significance was slightly strengthened by the inclusion of the additional cases. Only results from the imputed database are reported here. No imputation was done on the main independent and the outcome variables.

Logistic regression models with robust standard errors accounting for school

clustering effects were used. Potential multicollinearity between independent variables was examined by correlation coefficients (r= 0.007 to 0.44), and none of them were greater than 0.8 (23). The main analyses were stratified by sex as perceived weight status, prevalence and accuracy of weight comments received were both significantly different in boys and girls (ie, effect modification). Statistical analyses were performed using STATA 9.0.

Results

In the present study, 31603 students aged 11 to 18 years were recruited. Of the recruited sample, students were excluded from analyses if they did not provide self-reported height and weight information (N=2319). As the maximum reference values for height of the local WFH cutoffs were 175cm in boys and 165cm in girls, students who exceeded the height limits were also excluded (N=738). Also excluded were those with a BMI smaller than 10 or greater than 50 (24). After excluding questionnaires with incomplete data, 22612 (41.5% boys) were included in the present analysis. Table 1 shows the prevalence rates of underweight and obesity defined by local WFH references were 8.7% (8.6% for boys; 8.7% for girls) and 12.4% (16.1% for boys; 9.7% for girls), respectively. Weight comments were common: 29% of them received weight comments for “too fat” and 26.9% for “too thin” in the past 30 days.

Table 2 summarizes the sources of “too fat” and “too thin” weight comments. Mother was the most frequent source of “too fat” comments for both boys and girls,

followed by siblings and classmates. Generally a higher proportion of girls received "too fat" comments than boys from all the sources except grandfather, although more boys than girls were obese, as defined by local cutoffs. A slightly lower proportion of adolescents received "too thin" comments overall, but mother remained the most common source. The proportion of girls receiving "too thin" comments from their classmates and friends nearly doubled that in boys. The last two columns of Table 2 show that grandparents, teachers, social workers and health professionals gave more "too thin" comments to both boys and girls.

Table 1 Basic characteristics of participants (N=22612)

Characteristics	Boys (N=9375)	Girls (N=13237)	All (N=22612)
Age (years, mean, SD)	14.6 (1.70)	14.7 (1.70)	14.7 (1.70)
Form (%)			
Junior (F1-F3) [a]	61.7	58.2	59.6
Senior (F4-F7) [a]	38.3	41.8	40.4
BMI (kg/m^2 ,mean, SD)	19.5 (3.29)	18.9 (2.73)	19.2 (2.99)
Weight status by local references (%)			
Underweight	8.6	8.7	8.7
Normal	75.3	81.6	79.0
Obese	16.1	9.7	12.4
Parental education level (%)			
Primary or below	12.2	11.9	12.0
Secondary	64.1	67.2	65.9
Tertiary or above	23.7	21.0	22.1
Place of birth (%)			
Hong Kong	73.6	74.6	73.9
Other places [b]	26.4	25.4	26.1
Family affluence (%)			
Relatively poor	38.6	34.9	36.4
Medium	50.3	54.3	52.6
Relatively wealthy	11.1	10.8	10.9
Received weight comments as "too fat" in the past 30 days	22.3	33.8	29.0
Received weight comments as "too thin" in the past 30 days	28.4	25.8	26.9

[a] F1-F3 is equivalent to grade 7 to grade 9; F4-F7 is equivalent to grade 10 to grade 12.

[b] Other places: Mainland China (majority), Macau, Western countries and others.

Table 2 Sources of weight comments reported by boys and girls

	Too fat (%)			Too thin (%)			Ratio (Too fat/Too thin)	
	Boys	Girls	p	Boys	Girls	p	Boys	Girls
Family	14.4	26.1	<0.001	22.2	18.9	<0.001	0.65	1.38
Father	5.3	7.7	<0.001	8.7	7.1	<0.001	0.61	1.08
Mother	9.0	17.0	<0.001	15.1	12.4	<0.001	0.60	1.37
Siblings	4.1	10.6	<0.001	3.9	2.8	<0.001	1.05	3.79
Grandfather	1.0	0.7	0.024	2.0	1.3	<0.001	0.50	0.54
Grandmother	0.6	1.5	<0.001	2.5	2.7	0.45	0.24	0.56
Other relatives	1.2	4.4	<0.001	3.6	4.4	0.009	0.33	1.00
Peers	7.5	13.5	<0.001	6.5	11.4	<0.001	1.15	1.18
Classmates	5.2	8.4	<0.001	4.7	7.8	<0.001	1.11	1.08
Friends	4.2	8.9	<0.001	4.2	7.7	<0.001	1.00	1.16
Professionals	2.1	2.2	0.50	2.8	2.8	0.97	0.75	0.79
Teachers	0.8	1.0	0.07	1.3	1.4	0.63	0.62	0.71
Social workers	0.4	0.4	0.77	0.5	0.6	0.39	0.80	0.67
Health professionals	0.9	0.9	0.89	1.2	1.2	0.87	0.75	0.75
Others [a]	5.5	4.7	0.012	6.5	4.5	<0.001	0.85	1.04

[a] Others include neighbors and domestic helpers.

Figures 1 and 2 show the accuracy of weight comments from different sources when compared with actual weight status among those who received comments. In general, boys received more accurate “too fat” comments than girls from all the sources other than grandfather. The accuracy of “too thin” comments was comparable in both sexes from all the sources except mother and siblings. Health professionals was the most accurate source of both “too fat” and “too thin” comments yet more than half of the comments were incorrect.

Figure 1 Accuracy of weight comment as “too fat” from family, peers and professionals by sex (descending order)
[supplied as separate file: figure 1]

Figure 2 Accuracy of weight comment as “too thin” from family, peers and professionals by sex (descending order”
[supplied as separate file: figure 2]

Table 3 shows different types of weight comments received stratified by sex, weight perception and actual weight status. Around 9.0% boys and 7.5% girls received both "too fat" and "too thin" comments (conflicting weight comments) from different sources. Subjects with weight misperception significantly received more incorrect weight comments than those with correct weight perception in both boys and girls ($p<0.001$).

Table 4 shows the main effects of different types of weight comments and weight misperception. Weight misperception was common in our sample (47% in boys and 56% in girls). Students who received incorrect weight comments were significantly more likely to have weight misperception compared with students who did not receive any weight comments in all sex–weight status sub-groups, but the association was most obvious in obese girls. Normal weight students who received conflicting comments were significantly more likely to have weight misperception (OR=1.73 for boys and 1.93 for girls) than those who did not receive any weight comment. While the association was insignificant in either underweight or obese groups, boys who received conflicting weight comments were more likely to have weight misperception, whereas girls who received conflicting comments were less likely to have weight misperception. In contrast, students who received correct weight comments were significantly less likely to have weight misperception no matter they are boys or girls, nor which weight status they belonged to. All the effects remained even after adjusting for BMI and other SES variables.

Table 3 Distribution of adolescents weight perception stratified by sex, weight status [a] and different types of weight comments received

	Weight comments received			**No weight comments**
	Correct	Incorrect	Conflicting	
Boys (N=9375)				
Correct weight perception (N=4958)	16.9	11.4	8.1	63.5
Underweight	54.6	0	6.9	38.5
Normal weight	-	16.2	8.1	75.7
Obese	51.2	2.0	8.9	37.9
Weight misperception (N=4417)	1.9	35.6	10.0	52.5
Underweight	15.1	3.5	13.8	67.5
Normal weight	-	40.6	9.1	50.3
Obese	8.8	13.9	15.2	62.1
Girls (N=13237)				
Correct weight perception (N=5812)	19.0	19.8	6.5	54.7
Underweight	65.7	1.0	6.7	26.6
Normal weight	-	27.8	6.7	65.5
Obese	62.8	1.0	5.7	30.5
Weight misperception (N=7425)	2.0	47.1	8.3	42.6
Underweight	22.3	15.0	11.1	51.6
Normal weight	-	50.3	8.0	41.6
Obese	17.0	19.3	9.9	53.8

[a] Using the sex-specific local weight-for-height (WFH) cutoffs, our subjects were defined as underweight (<80% median WFH), normal weight (80% - 120% median WFH) and obese (>120% median WFH).

Table 4 Adjusted odds ratio (95% confidence interval) for weight misperception in relation to different types of weight comments received by sex and weight status [a] (N=22612)

	Types of weight comments received	Adjusted [b]	p	Adjusted [c]	p
Boys					
UW	None	1		1	
	Correct	0.16 (0.11-0.22)	<0.001	0.16 (0.11-0.22)	<0.001
	Incorrect [d]	-	-	-	-
	Conflicting	1.19 (0.78-1.80)	0.6	1.25 (0.80-1.94)	0.3
NW	None	1		1	
	Correct	-	-	-	-
	Incorrect	3.76 (3.32-4.25)	<0.001	3.73 (3.28-4.23)	<0.001
	Conflicting	1.71 (1.41-2.06)	<0.001	1.73 (1.43-2.09)	<0.001
OB	None	1		1	
	Correct	0.11 (0.08-0.14)	<0.001	0.11 (0.08-0.15)	<0.001
	Incorrect	4.29 (2.54-7.23)	<0.001	4.75 (2.79-8.09)	<0.001
	Conflicting	1.03 (0.77-1.39)	0.9	1.07 (0.80-1.44)	0.7
Girls					
UW	None	1		1	
	Correct	0.17 (0.14-0.22)	<0.001	0.18 (0.14-0.23)	<0.001
	Incorrect	7.74 (2.85-21.1)	<0.001	6.88 (2.68-17.68)	<0.001
	Conflicting	0.84 (0.55-1.28)	0.5	0.74 (0.45-1.20)	0.2
NW	None	1		1	
	Correct	-	-	-	-
	Incorrect	2.80 (2.59-3.03)	<0.001	2.89 (2.67-3.13)	<0.001
	Conflicting	1.86 (1.62-2.14)	<0.001	1.93 (1.67-2.23)	<0.001
OB	None	1		1	
	Correct	0.16 (0.10-0.24)	<0.001	0.17 (0.11-0.26)	<0.001
	Incorrect	10.39 (4.74-22.8)	<0.001	12.7 (5.24-30.83)	<0.001

Conflicting	0.93 (0.51-1.70)	0.9	0.97 (0.53-1.79)	0.9

[a] Using the sex-specific local weight-for-height (WFH) cutoffs, our subjects were defined as underweight (<80% median WFH), normal weight (80% - 120% median WFH) and obese (>120% median WFH).
UW=Underweight; NW= Normal weight; OB=Obese.
[b] Adjusted for age.
[c] Adjusted for age, highest parental education, family affluence, BMI and school effect.
[d] OR cannot be calculated due to the insufficient number in the group (Underweight boys with weight misperception did not receive any incorrect comments).

Discussion

The most important finding of the present study is that despite the high rates of reported weight comments, less than one fifth of the comments (Figure 1 and 2) were accurate in both adolescent boys and girls. The low accuracy of the weight comments is alarming, as we also found that adolescents who received incorrect weight comments were more likely to have weight misperception than those who received correct weight comments.

Our findings are in line with the previous research that girls received significantly more weight comments as fat from family members and peers than boys (6, 8). While previous research focused mainly on family as a group or on parents only, we also examined the prevalence of weight comments from other family members such as siblings and grandparents. The most common source of "too fat" comments was made by mother, followed by siblings. However, girls received significantly more comments from siblings than boys. It is suggested in the literature that parental comments posed indirect effects on adolescents by increasing the amount of teasing by siblings (7). Although adolescents reported few weight comments by grandparents, it is interesting to note that grandparents gave a lot more "too thin" comments than "too fat" comments (Table 2). It is speculated that as larger body size is seen as a sign of health and wealth in traditional Chinese society and due to their own experience of poverty and hunger, grandparents tended to prefer their grandchild to eat more and weigh more (14).

One exception was noted, however, that a lower proportion of adolescents in our study received weight comments from peers than from their family members, although the reported prevalence of weight comments by family members is comparable with another study (8). As we included not only the negative weight teasing but also weight comments out of good intention, the proportion of weight comments from peers might have become less. As we further analyzed, we found that senior grade students reported a significantly higher proportion of weight comments than their junior counterparts (data not shown) as they were more susceptible to peers interaction (25).

Health professionals, as might be expected, provided the most accurate source of weight comments, although only less than half of the comments were correct. This figure was lower than an US study that 76% of obese adolescents were identified by physicians in clinical visits (26). Moreover, around 60% of physicians could accurately estimate the body size of adolescents between age 12 to 18 years in a recent Canadian study (27). These findings may imply that health professionals in Hong Kong are less trained in assessing weight status for adolescents, especially when anthropometric data is not routinely measured in clinical visits due to short consultation time, lack of space and appropriate equipment (28). No well established observational instrument for defining weight status for children and adolescents is available. Borderline cases may be difficult to be identified as weight and height keep changing in adolescents. This is supported by a study in Australia showing that physicians experienced greater difficulties in defining weight status of a child with a BMI just above or just below the cut-off points of overweight and obesity (28).

Nearly half of our students had weight misperception (Table 3), and this finding is comparable to that of a recent local publication (29). The lack of knowledge about and access to growth charts probably made it difficult for adolescents to evaluate their weight status objectively. Moreover, as adolescents are susceptible to social influences (3, 30, 31), weight comments and opinions from family and peers would be expected to produce effects on weight perception, as suggested by the Tripartite Influence Model (9, 32). However, our study found that the accuracy of weight comments from parents and peers was low. A population-based survey in Hong Kong (33) have shown that one third of adults misperceived their own weight status, while two studies in the UK and US, respectively, observed that only 25%-35% of parents correctly identified their obese adolescent child (17, 34). Although the literature suggested that having obese parents was positively associated with parental report of adolescent obesity (17), whether parental obesity is related to increased frequency of weight comments and accuracy is still unclear.

Using students who did not receive any weight comments during the past 30 days as the reference group (Table 4), we found that in both sexes, students receiving incorrect weight comments were more likely to have weight misperception in all 3

weight groups. Students in normal weight group but receiving conflicting weight comments were also more likely to have weight misperception, while insignificant trends were found in those who were underweight or obese. In contrast, students receiving correct comments were more likely to have accurate weight perception. Results of the present study suggested that weight comments are not always harmful: correct comments out of good intentions have a potential benefit for building correct weight perception among adolescents, which may in turn lead to healthy lifestyles and weight managements. Further studies on this area are warranted.

In the present study, a territory-wide sample was recruited and therefore the sample size was large enough to allow for comparisons between sex and across different weight status groups. Although some participants were excluded due to missing data, our remaining sample was very similar to the corresponding population group in Hong Kong in terms of sex, age, and residential district (all Cohen effect sizes (35) ≤0.2) (data not shown), which showed that subjects included in the analysis were representative to the Hong Kong adolescent population. Moreover, a variety of sources of weight comments was included, hence allowed us to examine the effect of weight comments more in depth. However, several limitations should be taken into account in interpreting the findings. Anthropometric data and the frequency of weight comments received were self-reported. Our test-retest measures, however, revealed that the self-reported height and weight data were highly reliable, and these findings are comparable with other similar studies (17, 36). Although the actual prevalence of weight comments may be lower as adolescents with weight concerns maybe more sensitive to the comments, the test-retest reliability of these self-reported data was high in the present study. Furthermore, the prevalence of receiving weight comments was limited to the past 30 days in order to reduce recall error.

In addition, we are also not able to compare the impact of individual source of weight comments on weight misperception. According to Keery (7), weight teasing from father and elder brothers was associated with higher psychosocial distress than mother and sisters. The effect of teasing or comments is expected to be different on opposite sex. Therefore, future research gathering more information about family composition may enhance our ability to understand the effects of weight comments by sex. The association of receiving incorrect weight comments and weight

misperception with negative psychosocial health problems should be clarified by longitudinal studies.

Our findings suggest that weight comments are common in Chinese adolescents by family members and peers, yet the accuracy of these comments is relatively low. Family members, peers and professionals should realize the potential adverse effects of their weight comments and adolescents should be taught how to correctly assess their weight status to reduce misperceptions. Health professionals should give more advice on adolescents' weight status and implications for tracking the height and weight regularly and using growth charts for children and adolescents are worth discussing.

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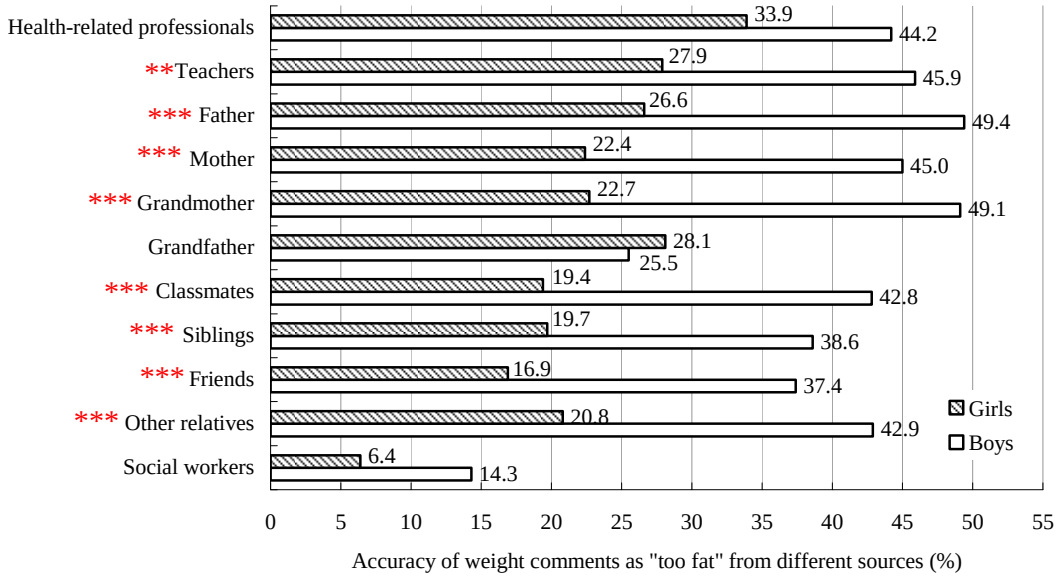
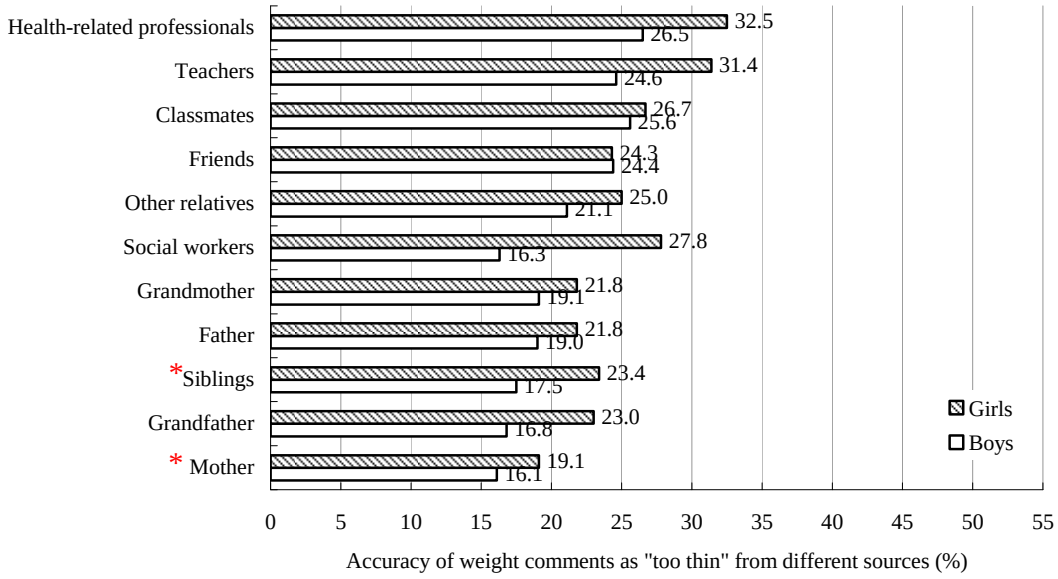
Figure 1 Accuracy of weight comment as “too fat” from family, peers and professionals by sex (descending order)



Key: *p<0.05; **p<0.01; ***p<0.001 between boys and girls

Figure 2 Accuracy of weight comment as “too thin” from family, peers and professionals by sex (descending order)



Key: *p<0.05; **p<0.01; ***p<0.001 between boys and girls