

Association of Perceived Weight Status *versus* Body Mass Index on Adherence to Weight-modifying plan Among Iranian Children and Adolescents: The CASPIAN-IV Study

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Objective: To identify risk-groups adhering to weight-changing plans for body dissatisfaction in a National sample of Iranian students.

Design: Cross-sectional.

Setting: Primary, Middle and high-schools.

Participants: 13486 students (mean age, 12.5 y).

Main outcome measures: Demographic and anthropometric characteristics were collected via valid instruments. Body image and adherence to weight-changing diets were assessed by using validated questionnaires.

Results: 46.5% students were satisfied with their weight and 12.5% declared that they had attempts for weight control, this

was significantly higher among adolescent girls (13.8%, $P=0.0005$). Participants who perceived themselves as overweight and obese, were more likely (OR= 5.32) to follow weight-reduction diets than their peers with normal-weight perception. Actual overweight-BMI and obese-BMI individuals had greater odds for being on a diet (1.3 and 1.47, respectively) compared to their normal-BMI counterparts.

Conclusion: Promoting strategies to improve body image concerns and prevent adverse outcomes of chronic dieting among adolescents are necessary.

Keywords: Body image, weight perception, body dissatisfaction, adolescents, weight reduction diet.

Body image refers to a multi-component concept including different aspects of perceptions, cognitions and feelings, as well as behavioral practices related to individual's own body [1]. Self-esteem and psycho-social development of individuals are affected by body image as a part of one's personality [2]. Previous research has indicated that teenagers are the vulnerable target group for development of body dissatisfaction due to the considerable physical and psychological changes [3]. Overweight and obese adolescents tend to be less satisfied with their body weight compared to under- and normal-weight counterparts [4]. This is more prevalent among adolescent girls, who are at greater risk of body dissatisfaction due to the exposure of extreme slimness and media images [5].

Perceived weight and body image disturbance contribute to weight-control practices. Unhealthy weight-control behaviors such as following restricted diets, binge-

eating, provoking vomiting, and changing physical activity levels are considered as an approach to achieve more favorable body shape and satisfaction [6]. Although fatness is accepted as a part of cultural norms reflecting a greater degree of health, affluence and fertility among females than males [7], recent research has indicated higher desire of extremely-thin body shape in young females [8].

Although few studies have assessed the prevalence of body-dissatisfaction and related weight-control behaviors in the pediatric age group, limited data are available from developing countries [9]. This study was conducted to determine the association of perceived weight *versus* actual body weight on adherence to weight modifying plan among a representative sample of Iranian children and adolescents.

METHODS

A cross-sectional school-based survey was conducted in

2011-2012 among a Nationally representative sample of Iranian children and adolescents. Data from the fourth part of Childhood Adolescence Surveillance and Prevention of Adult Non-communicable disease (CASPIAN) were used for the current study.

The CASPIAN-IV survey was conducted on a stratified multi-stage probability sample of Iranian children and adolescents from urban and rural area of 30 provinces. The study protocol has been published previously [10]. In total, 13486 students participated in this study. The present study was approved by the ethical committees of relevant national organizations. Parental consent form and verbal assent showing willingness of child were obtained for participation in this study.

Socio-demographic characteristics and physical examination including height, weight, and waist-circumference were collected using standard protocols [10] by trained healthcare professionals. Body mass index (BMI) was then calculated by division of weight in kilograms to height in squared meters. Interview-based questionnaires used for this project showed a relatively high reliability (Pearson correlation coefficient of the test-retest phase was 0.94), and face and content validity (score >0.75) [11,12] before administration in the current study. The questionnaires were designed based on the Global School-based Health Survey (GSHS) proposed by World Health Organization (WHO), including questions about health risk behaviors, communication with friends, dietary intakes and food behaviors, other life-style factors and so on. Modification of some items was applied according to Iranian socio-culture amileu status. Previous experience of being on a diet to modify weight status was asked by a question added to the main body of the questionnaire. All interviews were done in a calm and friendly atmosphere [12].

We measured body satisfaction using the question "What do you think regarding your body size?"; with a five-point likert scale answers including 'much too thin', 'a bit too thin', 'about the right size', 'a bit too fat', 'much too fat'. For the analysis, the variable was dichotomized into underweight (a bit too thin and much too thin), overweight (a bit too fat and much too fat) *versus* normal weight perception. Any previous attempts to change body weight and following weight-modifying diets were assessed with a four-scale question consisting "No; My weight is normal, yes; I need to lose weight, yes; I need to gain weight, yes".

Socio-demographic characteristics of study participants were classified as a combination of parental educational level and occupation, having own computer and car, housing type (rented *vs.* personal) using principal component analysis (PCA).

Overweight (BMI between 85th and 95th percentiles for age and sex) and obesity (BMI greater than 95th percentile) were defined according to the WHO reference curves [13]. Abdominal adiposity was determined by the ratio of waist-to-height more than 0.5 [14].

Statistical analysis: All analysis was performed using STATA package. The odds of adherence to weight-reduction plan were determined using multivariate logistic regression models according to BMI and perceived weight, controlling for potential covariates such as age, gender, physical activity, obesity, socio-economic status, and screen time activities in different models. In Model I, as a crude model, the association between BMI (perceived weight) and adherence to weight-reduction plan was assessed. Model II was adjusted for potential covariates. Normal-weight was considered as the reference category. *P* value less than 0.05 was considered as the significant.

RESULTS

We enrolled 13486 school students with the mean age of 12.47 years (95% CI: 12.40, 12.54) (49.2% girls, 75.6% urban). More than 90% of students were from the public schools. Mean (95% CI) BMI and waist circumference were 18.8 (18.74, 18.95) kg/m² and 67.1 (66.77, 67.42) cm, respectively.

Overall, 9.5 and 12% of participants were classified as overweight and obese, respectively. In total, 46.5% of students were satisfied with their weight, showing significant gender differences (49% *vs.* 44.11% in boys and girls, respectively, *P*<0.001). Among study participants, 12.5% of students declared that they were on a diet to lose weight, this figure was significantly higher among adolescent girls compare to boys (13.81% *vs.* 11.2%, *P*=0.0005). The demographic, anthropometric characteristics and following weight-reduction plans of study participants are presented in **Table I**.

Fig. 1 demonstrates association between BMI and perceived weight status. Overall, 53.5% of healthy-weight

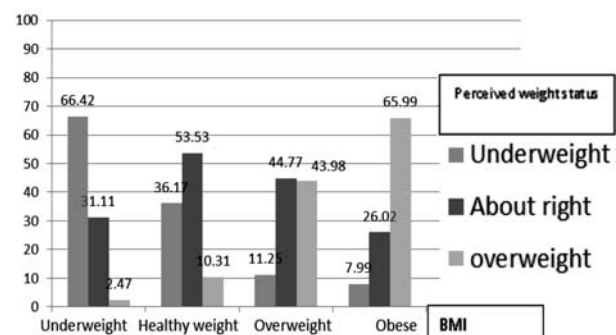


FIG. 1 Association between BMI and perceived weight status among Iranian students.

TABLE I ANTHROPOMETRIC AND DEMOGRAPHIC CHARACTERISTICS OF SUBJECTS ACCORDING TO SEX: THE CASPIAN-IV STUDY

	Boys	Girls	Total	P value
Age (y) ¹	12.4 (12.18,12.54)	12.6 (12.40,12.79)	12.5 (12.40,12.54)	0.20
BMI (Kg/m ²) ¹	18.7 (18.56, 18.91)	18.9 (18.78, 19.13)	18.8 (18.74, 18.95)	0.1
WC (cm) ¹	67.9 (67.31, 68.47)	66.3 (65.79, 66.76)	67.1 (66.77, 67.42)	<0.001
<i>Screen time activity</i> ²				
≤2 h/day	5799 (87.73)	6021 (93.06)	11820 (90.37)	<0.001
>2h/day	811 (12.27)	449 (6.94)	1260 (9.63)	
<i>Physical activity</i>				
<2 times/week	1945 (28.75)	2608 (39.61)	4553 (34.11)	
2-4 times/week	2410 (35.62)	2500 (37.97)	4910 (36.78)	<0.001
>4 times/week	2410 (35.62)	1476 (22.42)	3886 (29.11)	
<i>Socio-economic status (SES)</i> ²				
Poor	2082 (33.18)	2065 (33.77)	4147 (33.47)	
Moderate	2050 (32.67)	2050 (33.52)	4100 (33.09)	0.571
Good	2143 (34.15)	2000 (32.71)	4143 (33.44)	
<i>BMI (kg/m²)</i>				
Underweight	881 (13.03)	740 (11.28)	1621 (12.17)	
About right	4333 (64.11)	4497 (68.52)	8830 (66.28)	<0.001
Overweight	627 (9.28)	660 (10.06)	1287 (9.66)	
Obese	918 (13.58)	666 (10.15)	1584 (11.89)	
<i>Perceived weight status</i>				
Underweight	2335 (34.24)	2261 (34.19)	4596 (34.21)	
About right	3342 (49.00)	2917 (44.11)	6259 (46.59)	<0.001
Overweight	1143 (16.76)	1435 (21.70)	2578 (19.19)	
<i>BMI-Perceived weight status</i>				
Healthy weight-underweight	308 (4.57)	195 (2.98)	503 (3.79)	
Healthy weight-about right	2401 (35.65)	2310 (35.33)	4711 (35.49)	
Healthy weight-overweight	598 (8.88)	385 (5.89)	983 (7.41)	
Underweight-underweight	543 (8.06)	531 (8.12)	1074 (8.09)	<0.001
Underweight-about right	1606 (23.85)	1577 (24.12)	3183 (23.98)	
Underweight-overweight	153 (2.27)	117 (1.79)	270 (2.03)	
Overweight-underweight	26 (0.39)	14 (0.21)	40 (0.30)	
Overweight-about right	311 (4.62)	596 (9.11)	907 (6.83)	
Overweight-overweight	789 (11.71)	814 (12.45)	1603 (12.08)	

HTN; Hypertension, DM; Diabetes mellitus, BMI; body mass index, WC; waist circumference, WHtR; waist-to-height ratio, SES; Socio-economic status; ¹Continuous variable are as mean (95%CI); ²SES categories based on PCA, consisted of parental educational level and occupation, having own computer and car, and housing type (rented vs. personal).

adolescents perceived their weight accurately as about right; this figure was higher among obese-BMI students (66%) who correctly perceived themselves as overweight and 66.4% of underweight adolescents who estimated their weight perception accurately as underweight.

Table II compares the body image, actual body mass index and abdominal obesity according to adherence to weight changing plan. By measured BMI, the prevalence

of subjects adhering to a weight-reduction plan was 14.3% and 23.1%, among overweight and obese individuals, respectively, with significant differences between actual body mass index categories ($P<0.001$).

Thirty-three percent of abdominally obese adolescents were on a weight reduction diet. However, adolescents who perceived themselves as underweight (33.0%) or overweight (44.7%), were more likely to

follow weight reduction plans compared to their about-right (22.3%) weight perception peers.

When we combined actual BMI and perceived weight status, the highest rate (30.0%) of following weight reduction diets was observed among overweight and obese adolescents who had correctly perceived themselves as overweight subjects. This figure was 14.4% in those students who were actually overweight or obese, but perceived their weight as about right subjects. Fifteen percent of students who tried diets to change their weight were healthy-weight teens, who perceived themselves as about right and 22% of students who tried diets to change their weight were underweight students with about right weight perception. Congruent BMI-

perceived weight revealed that 54.2% of students had tried dietary practices to control their weight.

Prevalence of adherence to weight changing plan by perceived weight status, BMI and gender is shown in **Table III**. Those adolescents who perceived their weight as overweight and were actually overweight-BMI (30.3%) or obese-BMI (31.5%) had higher frequencies of adherence to weight reduction diets. The above results were also found among girls; the higher rates of being on weight reduction plans was documented in 36.4% of overweight-perception and overweight-BMI and 33% of overweight body image categories who were actually obese by measured BMI. Similar patterns were reported among boys.

TABLE II COMPARISON OF BODY IMAGE, ACTUAL BODY MASS INDEX AND ABDOMINAL OBESITY ACCORDING TO ADHERENCE TO A WEIGHT CHANGING PLAN: THE CASPIAN-IV STUDY ADHERENCE TO WEIGHT CHANGING PLAN BASED ON A SPECIAL DIET

Variables	No	Yes	P-value
BMI (Kg/m ²) ¹	18.54 (18.44, 18.64)	20.96 (20.65, 21.26)	<0.001
WC (cm) ¹	66.31 (65.98, 66.63)	72.63 (71.82, 73.44)	<0.001
<i>BMI</i> ²			
Underweight	1433 (12.34)	182 (10.95)	<0.001
Normal weight	7944 (68.42)	859 (51.68)	
Overweight	1042 (8.97)	237 (14.26)	
Obese	1192 (10.27)	384 (23.10)	
<i>Abdominal obesity</i> ²			
Yes	1984 (17.03)	555 (33.27)	<0.001
No	9666 (82.97)	1113 (66.73)	
<i>Perceived weight status</i> ²			
Underweight	4036 (34.36)	554 (33.04)	<0.001
About right	5882 (50.07)	374 (22.30)	
Overweight	1829 (15.57)	479 (44.66)	
<i>BMI-Perceived weight status</i> ²			
Healthy weight-underweight	476 (4.10)	26 (1.56)	<0.001
Healthy weight-about right	4459 (38.43)	250 (15.04)	
Healthy weight-overweight	886 (7.64)	97 (5.84)	
Underweight-underweight	920 (7.93)	152 (9.15)	
Underweight-about right	2811 (24.23)	369 (22.20)	
Underweight-overweight	244 (2.10)	25 (1.50)	
Overweight/obese-underweight	36 (0.31)	4 (0.24)	
Overweight/obese -about right	667 (5.75)	240 (14.44)	
Overweight/obese - overweight	1104 (9.51)	499 (30.02)	
<i>Congruent BMI-Perceived weight status</i> ²			
Yes	6483 (55.87)	901 (54.21)	0.232
No	5120 (44.13)	761 (45.79)	

¹Continuous variable are as mean (95% CI); ²Categorical variables are as numbers (N) and percentages.

TABLE III ADHERENCE TO WEIGHT-CHANGING PLAN ACCORDING TO PERCEIVED WEIGHT-STATUS, BMI AND GENDER

Perceived weight status	BMI					Total	P-value
	Underweight	Normal weight	Overweight	Obese			
Boys	Underweight	542 (12.36)	1604 (11.97)	78 (8.9)	74 (9.4)	2298 (11.87)	0.759
	About right	307 (4.5)	2400 (5.2)	325 (9.2)	273 (9.8)	3305 (5.99)	0.001
	Overweight	26 (7.6)	311 (20.5)	222 (21.17)	567 (30.33)	1126 (25.31)	0.001
Girls	Underweight	530 (16.03)	1576 (11.23)	65 (9.2)	52 (9.6)	2223 (12.28)	0.024
	About right	195 (6.1)	2309 (5.3)	248 (9.2)	137 (12.41)	2889 (6.051)	0.001
	Overweight	14 (14.28)	596 (29.53)	341 (36.36)	473 (32.98)	1424 (32.16)	0.077
Total	Underweight	1072 (14.17)	3180 (11.60)	143 (9.09)	126 (9.5)	4521 (12.07)	0.07
	About right	502 (5.17)	4709 (5.3)	573 (9.2)	410 (10.7)	6194 (6.02)	<0.001
	Overweight	40 (10.0)	907 (26.46)	563 (30.3)	1040 (31.53)	2550 (29.13)	0.004

Adjusted logistic regression models (**Table IV**) showed that the odds ratios (ORs) of adherence to weight-reduction plan was significantly higher for both overweight and obese BMI, and underweight and overweight/obesity perception, in comparison to their normal weight BMI or normal weight perceptions. Except for underweight BMI, ORs were slightly attenuated by adjusting potential confounders (model II: BMI, model II: perceived weight). Additionally adjusted BMI models for perceived weight and body image models for BMI indicated independent associations of BMI and weight perception on adherence to weight reduction plans. Participants who perceived themselves as overweight and obese, were more likely (OR= 5.32) to follow weight reduction diets than their peers with normal-weight perception. Actual overweight-BMI and obese-BMI individuals had greater odds for being on a diet (1.3 and 1.47, respectively) compared to their counterparts with normal BMI.

DISCUSSION

In the present study, the association between weight-perception and measured-BMI on weight-control practices of Iranian adolescents were examined. We found that overweight and obese individuals had greater odds for being on a diet. Participants who perceived themselves as overweight or obese, were more likely to follow weight-modifying plans than their peers with normal-weight perception.

The frequency of overweight perception was higher among girls than boys, which is consistent with previous reports [9,15,16]. In the present study, girls were more likely to follow weight-modifying plans than boys. Disordered eating pattern such as skipping meals and yo-yo dieting have been mentioned as restricted weight-control behaviors among adolescents who attempt to

achieve their desired body image [17]. In our study, more than half of healthy-weight subjects reported to be on a diet. Body image concerns; however, are not always limited to overweight or obese girls. According to Herzog, *et al.* [18], not only overweight women display a high degree of body dissatisfaction, but also it is a characteristic in females of all bodyweight categories. Therefore, it appears that adherence to weight-loss plans is a prevalent dieting strategy irrespective of actual weight status [17].

In the current study, both actual overweight and obese individual adolescents were more likely to follow weight loss behaviors compared to their normal-BMI peers. It might partly be explained by social stigmatization and pressure to be thin as presented by Western ideal of a slim body and cultural ideals of thinness [17]. Involvement in weight-control behaviors was higher among adolescents who had overweight-obese perceived weight in comparison to normal weight perception counterparts. In line with previous reports, being dissatisfied with body weight and shape might lead to weight loss dieting and eating disorders [19]. A notable strength of the present study is that it explores body weight dissatisfaction and consequently weight-control practices in a large nationally representative sample. However, there are several limitations that must be addressed. First, cross-sectional studies are not able to imply cause and effect associations. Second, we assessed body image distortion with a single item in the questionnaire. It is suggested to use more depth measures of body shape and weight concerns and estimate different aspects of body image concerns such as dissatisfaction with specific parts of body and physical appearance (*e.g.*, fat or muscularity). Third, we estimated actual weight status by measured BMI. Thus, misclassification of individuals according to BMI categories might occur, as an example highly

TABLE IV ODDS RATIOS (95% CI) FOR MEASURED BMI AND PERCEIVED WEIGHT STATUS: THE CASPIAN-IV STUDY

		Adherence to weight changing plan based on a special diet (yes/no)		
		OR	95% CI	P-value ²
<i>BMI¹</i>				
Model I ³	Underweight	1.17	0.98, 1.39	0.072
	Normal	1	---	---
	Overweight	2.10	1.79, 2.46	<0.001
	Obesity	2.97	2.58, 3.43	<0.001
Model II ⁴	Underweight	1.28	1.06, 1.54	0.008
	Normal	1	---	---
	Overweight	1.97	1.67, 2.32	<0.001
	Obesity	2.98	2.55, 3.48	<0.001
Model III ⁵	Underweight	1.16	0.96, 1.41	0.110
	Normal	1	---	---
	Overweight	1.30	1.08, 1.57	0.006
	Obesity	1.47	1.21, 1.77	<0.001
<i>Perceived weight</i>				
Model I ³	Underweight	2.15	1.85, 2.51	<0.001
	Normal	1	---	---
	Overweight and obesity	6.44	5.57, 7.44	<0.001
Model II ⁴	Underweight	2.47	2.12, 2.89	<0.001
	Normal	1	---	---
	Overweight and obesity	6.22	5.34, 7.25	<0.001
Model III ⁶	Underweight	2.48	2.12, 2.90	<0.001
	Normal	1	---	---
	Overweight and obesity	5.32	4.46, 6.35	<0.001

¹Overweight: BMI:85th-95th; obesity: BMI>95th; ²P-values are resulted from logistic regression; ³Without adjusted (crude models); ⁴Adjusted for age, sex, socio-economic status, screen time, family history of obesity, physical activity; ⁵Additionally adjusted for perceived weight status; ⁶Additionally adjusted for BMI.

muscular subjects could be classified in overweight or obese BMI centiles due to the muscle mass rather than body fat [20].

Our findings are of practical and clinical importance for health care providers to evaluate and prevent risk for disordered weight control practices. Higher levels of body satisfaction have been found to exert protective effects against restrictive weight control practices [21]. Studies have also indicated that modification of body dissatisfaction was successful through school-based intervention programs [22]. The findings emphasize on necessity of promoting gender-specific strategies to improve body image concerns and prevent adverse health consequences of chronic dieting among adolescents.

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WHAT IS ALREADY KNOWN?

- Overweight and obese adolescents tend to be less satisfied with their body weight compared to under- and normal-weight counterparts.

WHAT THIS STUDY ADDS?

- Participants, who perceived themselves as overweight/obese, were more likely to follow weight-reduction diets than their peers with normal-weight perception. Overweight and Obese individuals had greater odds for being on a diet compared to their normal-BMI counterparts.

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