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Overweight, obesity, and associated factors in 14-18-year-old adolescents of Shiraz, Iran

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A B S T R A C T

Objective: This paper examines the prevalence and correlates of overweight and obesity among 14-18-year-old adolescents of Shiraz, Iran.

Methods: Using multistage random sampling, we recruited 289 male and 249 female adolescents. Daily physical activity, calorie intake, and other important information were obtained using 24-hour recall of physical activities (on two days), a semi-quantitative food frequency questionnaire, and a self-administered questionnaire. Height, weight, and BMI z-scores were measured based on standard protocols.

Results: Prevalence of overweight and obesity was 18% and 6.7%, respectively. Prevalence of overweight including obesity was negatively associated with socioeconomic status of school area ($\chi^2 = 6.6$, $p = 0.037$), father's total years of schooling (13.5% vs. 41.4% and 45.1%), supplement consumption ($\chi^2 = 6.0$, $p = 0.015$), and the energy density of foods ($\chi^2 = 10.3$, $p = 0.006$), but was positively associated with dietary restriction ($\chi^2 = 7.9$, $p = 0.005$), family history of obesity ($\chi^2 = 14.8$, $p = 0.000$), sleep duration ($\chi^2 = 14.1$, $p = 0.042$), and body satisfaction ($\chi^2 = 13.1$, $p = 0.001$). Socioeconomic status of school area (OR = 1.9, 95% CI: 1.1-3.2), supplement consumption (OR = 0.2, 95% CI: 0.1-0.8), dietary restriction (OR = 3.0, 95% CI: 1.5-5.8), family history of obesity (OR = 1.9, 95% CI: 1.2-2.9), body satisfaction (OR = 1.9, 95% CI: 1.1-3.4), the energy density of foods (OR = 0.5, 95% CI: 0.2-0.9), and sleep duration (OR = 1.7, 95% CI: 1.1-2.6) contributed significantly to overweight after controlling for other variables.

Conclusions: Overweight/obesity is prevalent among Iranian adolescents. Encouraging adolescents, especially those with a positive family history of obesity, to follow a more favorable lifestyle may markedly protect them against the onset of obesity and its psychosocial and physical consequences.

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Introduction

As in many other countries, childhood obesity has been a fast-growing health problem in Iran

during recent decades [1-4]. According to the findings of the World Health Organization (WHO) Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases (MONICA) project, Iran was one of the seven countries having the highest prevalence of childhood obesity in 1988 [5]. This high prevalence doubled between 1993 and 1999 [5] and continuously increased [6]. Findings of the fifth national survey of CASPIAN, conducted in 2015, revealed that 20.8% of Iranian students were overweight or obese and that 21.1% had central obesity, indicating the importance of childhood obesity as a public health problem in Iran [7].

Obesity in childhood and adolescence not only may lead to life-threatening chronic diseases [8, 9] and negative psychosocial consequences [10, 11], but also often tracks into adulthood and results in an increased incidence of subsequent metabolic disorders, cardiovascular diseases, and even certain cancers [6, 12]. It is believed that environmental factors, as well as the interaction of genetic and environmental factors, underlie the increasing trend of childhood obesity [12, 13]. Personal control over diet and physical activity choices can usually address overweight and obesity [14].

However, it has also been illustrated that some socioeconomic and demographic characteristics such as age, sex, race, educational level, place of residence, and socioeconomic status of the family contribute to obesity by influencing physical activity and nutritional choices at the individual level [15, 16]. According to the existing data from developed countries, a negative association exists between socioeconomic status (SES) and body weight. This is not, however, the case in developing countries [17].

Because of the increasing prevalence of overweight and obesity among adolescents, continued monitoring of the socioeconomic patterning of weight as well as inspecting for lifestyle-related correlates is important. Because of the lack of sufficient data about environmental correlates of overweight and obesity in adolescents in Iran, the main aim of the current study was to determine the factors associated with overweight and obesity in 14–18-year-old male and female adolescents of Shiraz, southern Iran. It is hoped that the results of this study may improve the current knowledge of the problem and develop strategies to target vulnerable groups.

Methods

This cross-sectional study was carried out in Shiraz, southern Iran. A total of 538 high school students (289 males and 249 females) aged 14-18 years were recruited using a multistage random sampling procedure.

Anthropometric measures

Body weight and height were measured using a portable floor scale and a non-stretch tape fixed to the wall with subjects wearing light clothing and no shoes. The scale was zero-calibrated before the measurement and was repeated after five measurements. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm. All measurements were done by the same trained staff to minimize the measurement bias. Then, the body mass index (BMI) was calculated for each participant using Quetelet's equation:

BMI = (weight in kg)/height in meter squared

The z-score values for BMI-for-age charts developed by the WHO [18] were used to assess the participant's weight status. According to the WHO growth reference [18], overweight and obesity were defined as $+1\ SD \leq BMI < +2\ SD$ and $BMI \geq +2\ SD$ of age/sex-specific BMI z-scores, respectively.

Explanatory variables

Respondents were administered a self-report questionnaire asking sociodemographic and personal variables. Personal variables included dietary supplement consumption, dietary restriction, and family history of obesity, body satisfaction, and sleep duration. Respondents were required to complete physical activity logs for two days, including one weekday and one weekend. The time spent on each specific activity was multiplied by its MET value using the Compendium of Energy Expenditures for Youth [19] to determine the physical activity level and energy expenditure of the participants.

Daily calorie intake was calculated using a semiquantitative food frequency questionnaire (FFQ). This FFQ was developed by Tehran Lipid and Glucose Study (TLGS), and its reliability and relative validity were evaluated against 24-hour dietary recall and biomarkers of plasma and urine in Tehran [20]. The FFQ included food items typically eaten by adolescents, including four main food groups, popular snacks, and beverages. In addition, the energy density of foods for each subject was calculated by dividing the total daily

Table 1. Distribution of male and female participants by sociodemographic variables (n = 538)

Socioeconomic factor	Male	Female	Total	Test value	P value
Sex, n (%)	289 (53.8)	249 (46.2)	538 (100)	-	-
Age, mean ± SD, y	16.38 ± 0.92	16.29 ± 0.98	16.34 ± 0.95	t = 1.17	0.24
Father's total years of schooling, mean ± SD, y	11.01 ± 4.37	9.93 ± 3.56	10.51 ± 4.04	t = 3.16	**0.002**
Mother's total years of schooling, mean ± SD, y	9.79 ± 4.16	8.98 ± 3.38	9.42 ± 3.84	t = 2.49	**0.013**
Father's job, n (%)					
Employee[a]	77 (26.6)	50 (20.1)	127 (23.6)	$\chi^2 = 5.49$	0.064
Self-employed[b]	110 (38.1)	118 (47.4)	228 (42.4)		
Other	102 (35.3)	81 (32.5)	183 (34)		
Total	289 (100)	249 (100)	538 (100)		
Mother's job, n (%)					
Employee[a]	32 (11.1)	11 (4.4)	43 (8)	$\chi^2 = 17.23$	**< 0.001**
Housewife	240 (83.0)	235 (94.4)	475 (88.3)		
Other	17 (5.9)	3 (1.2)	20 (3.7)		
Total	289 (100)	249 (100)	538 (100)		
Monthly income of the household, million Rials[†]	5.83 ± 2.08	5.19 ± 1.76	5.53 ± 1.97	t = 3.86	**< 0.001**
Monthly income per capita, million Rials[†]	1.19 ± 0.53	1.00 ± 0.44	1.10 ± 0.50	t = 4.47	**< 0.001**
School location, n (%)					
High	110 (38.1)	45 (18.1)	155 (28.8)	$\chi^2 = 31.04$	**< 0.001**
Middle	42 (14.5)	68 (27.7)	111 (20.6)		
Low	137 (47.4)	135 (54.4)	272 (50.6)		
Total	289 (100)	249 (100)	538 (100)		
Supplement consumption, n (%)	274 (94.8)	224 (90.0)	498 (92.6)	3.89	**0.048**
No	15 (5.2)	25 (10.0)	40 (7.4)		
Yes	289 (100)	249 (100)	538 (100)		
Total					
Dietary restriction, n (%)					
No	269 (93.1)	219 (88.0)	488 (90.7)	3.59	**0.041**
Yes	20 (6.9)	30 (12.0)	50 (9.3)		
Total	289 (100)	249 (100)	538 (100)		
Family history of obesity or diabetes mellitus in close relatives, n (%)				0.8	0.7
None	163 (56.4)	131 (52.6)	294 (54.6)		
Obesity or diabetes	112 (38.8)	104 (41.8)	216 (40.2)		
Obesity and diabetes	14 (4.8)	14 (5.6)	28 (5.2)		
Total	289 (100)	249 (100)	538 (100)		
Body satisfaction				13.7	**0.017**
Yes, completely	87 (30.2)	71 (28.5)	158 (29.4)		
Yes, with some changes in some parts	155 (53.6)	125 (50.2)	280 (52.1)		
I usually don't think about my shape	17 (5.9)	5 (2.0)	22 (4.1)		
Yes, except for some parts	14 (4.8)	25 (10.1)	39 (7.2)		
No, I am not satisfied	16 (5.5)	23 (9.2)	39 (7.2)		
Total	289 (100)	249 (100)	538 (100)		
Moderate to vigorous physical activity[*]		30 (12.2)		49.84	**0.001**
≥ 1 h/d	125 (43.2)	219 (78.8)	155 (28.8)		
< 1 h/d	164 (56.8)	249 (100)	383 (71.2)		
Total	289 (100)		538 (100)		
Screen time[**]				5.75	**0.017**
> 2 h/d	119 (41.18)	85 (34.10)	204 (37.9)		
≤ 2 h/d	170 (58.82)	164 (65.90)	334 (62.1)		
Total	289 (100)	249 (100)	538 (100)		

[†]At the time of data collection 10 thousand Rials was equivalent to 1 USD. [a] Employed by public or private section, with insurance coverage. [b] Independent jobs like shopkeepers and taxi drivers.

energy intake (kcal) by total weight of daily consumed foods and beverages (g).

Statistical analyses

Data were analyzed using SPSS version 20 (SPSS Inc. Chicago IL, United States, 2011). Independent-samples t tests and one-way ANOVA were applied to examine the relationships between weight and

sociodemographic characteristics. Differences in the prevalence rates of overweight and obesity between boys and girls were tested by the chi-square test. Linear regression was used to examine the predictive power of the independent variables for BMI, while logistic regression was used to estimate the simultaneous effect of several determinants on a categorical outcome. All regression analyses were controlled for sex. Significance level was set at $\alpha = 0.05$, and all tests were 2-sided.

Results

The study included 538 adolescents aged 14-18 years. The number of males and females was 289 (53.8%) and 249 (46.2%), respectively, with a male:female ratio of 1.16. The average age was 16.38 for males and 16.29 for females, with no statistically significant difference.

Other sociodemographic characteristics of the respondents are presented in Table 1. The mean number of years of schooling was 10.5 ± 4.0 years and 9.4 ± 3.8 years for the fathers and mothers of the subjects, respectively, with significantly longer paternal and maternal years of schooling among male subjects ($t = 3.2$, $p = 0.002$ and $t = 2.5$, $p = 0.013$, respectively). The majority of respondents' fathers were self-employed, while housewife mothers were predominant. The proportion of working mothers was significantly higher in male subjects than in female subjects ($\chi 2 = 17.23$, $p < 0.001$).

The mean household monthly income was IRR5.54 ± 1.97 million. The household income for male subjects was significantly higher as compared to their female counterparts ($t = 3.9$, $p < 0.001$). A similar trend was observed for household monthly income per capita. The proportions of males (females) who studied at high-, middle-, and low-SES schools were 38.1% (18.1%), 14.5% (27.7%), and 47.4% (54.4%), respectively. The differences between males and females were statistically significant ($\chi 2 = 31.0$, $p < 0.001$).

A total of 38.8% of males and 41.8% of females reported the presence of obesity or diabetes in their close relatives. About 5% of males and 6% of females had close relatives with both obesity and diabetes.

The majority of the respondents (53.6% of males and 50.2% of females) were not entirely satisfied with their body shape, believing that their body needed some changes in some parts. Generally, males were more satisfied with their body shape as compared with females (30.2% vs

Table 2. Associations between selected variables and weight status of the respondents

Selected variables	Non-overweight (n=405) n (%)	Overweight (n=133) n (%)	χ^2	P value
Sex			0.03	0.87
Male	216 (74.7	73 (25.2)		
Female	189 (75.9)	60 (24.2)		
Father's total years of schooling			7.7	**0.024**
≤8 years	127 (31.4)	55 (41.4)		
9-12 years	184 (45.4)	60 (45.1)		
≥13 years	94 (23.2)	18 (13.5)		
SES of school			6.7	**0.037**
High	128 (31.6)	27 (20.3)		
Middle	78 (19.3)	33 (24.8)		
Low	199 (49.1)	73 (54.9)		
Supplement consumption			5.9	**0.015**
No	368 (90.9)	130 (97.7)		
Yes	37 (9.1)	3 (2.3)		
Dietary restriction			7.9	**0.005**
No	376 (92.8)	112 (84.2)		
Yes	29 (7.2)	21 (15.8)		
Familial history of obesity			14.8	**< 0.001**
No	241 (59.5)	53 (39.8)		
Yes	164 (40.5)	80 (60.2)		
Body shape satisfaction			13.1	**0.001**
Satisfied	344 (84.9)	94 (70.7)		
Don't think about it	15 (3.7)	7 (5.3)		
Dissatisfied	46 (11.4)	32 (24.1)		
Meeting guidelines of moderate to vigorous physical activity (≥1 h/d)			0.02	0.89
Yes	65 (16)	20 (15)		
No	340 (84.0)	113 (85.0)		
Meeting guidelines of screen time (≤2 h/day)			0.4	0.55
Yes	238 (60.1)	82 (63.6)		
No	158 (39.9)	47 (36.4)		
Sleep duration			4.1	**0.042**
Within acceptable range (8-10 h)	269 (67.9)	75 (58.1)		
Out of acceptable range	127 (32.1)	54 (41.9)		
Total calorie intake			4.0	**0.045**
≤ RDA	140 (35.4)	59 (45.7)		
> RDA	256 (64.6)	70 (54.3)		
Energy density of solid foods			10.3	**0.006**
1st tertile	117 (34.6)	58 (45.0)		
2nd tertile	137 (34.6)	37 (28.7)		
3rd tertile	142 (35.9)	34 (26.4)		

Table 3. Results of logistic regression performed to predict the likelihood of OWOB among subjects

Predictors	B	S.E.	Wald	df	P value	Odds ratio	95% CI	
							Lower	Upper
Sex	-0.2	0.3	0.7	1	0.402	0.8	0.5	1.3
Father's total years of schooling	-0.02	0.03	0.4	1	0.517	1.0	0.9	1.0
SES of school location (1)	0.6	0.3	4.9	1	**0.027**	1.9	1.1	3.2
Supplement consumption (1)	-1.5	0.6	5.4	1	**0.020**	0.2	0.1	0.8
Dietary restriction (1)	1.1	0.3	10.5	1	**0.001**	3.0	1.5	5.8
Family history of obesity (1)	0.6	0.2	7.8	1	**0.005**	1.8	1.2	2.9
Body satisfaction (Reference)			6.1	2	**0.047**			
Body satisfaction (1)	0.5	0.5	1.1	1	0.306	1.7	0.6	4.6
Body satisfaction (2)	0.7	0.3	5.5	1	**0.019**	2.0	1.1	3.4
Meeting guidelines of MVPA (1)	0.2	0.3	0.3	1	0.583	1.2	0.6	2.2
Sleep duration (1)	0.5	0.2	5.1	1	**0.023**	1.7	1.1	2.6
Total calorie intake (1)	-0.4	0.2	2.4	1	0.120	0.7	0.4	1.1
Energy density of solid foods	-0.7	0.3	4.5	1	**0.033**	0.5	0.2	1.0

(1) Variables entered: school location (2) Supplement, diet, familial history of obesity, body satisfaction, meeting guidelines of MVPA, meeting guidelines of screen time, sleep duration, total calorie intake, father's total years of schooling, the energy density of solid foods, and finally sex entered at the next step.
MVPA: moderate to vigorous physical activity

28.5%, $\chi^2 = 13.7$, $p = 0.017$). A significantly higher number of male respondents met the guidelines of moderate- to vigorous-intensity physical activity ($\chi^2 = 49.8$, $p < 0.001$), while the number of females meeting the screen time guidelines was significantly higher compared with males ($\chi^2 = 5.8$, $p = 0.017$).

Associations between OWOB and independent factors have been provided in Table 2.

Socioeconomic status of school location had a significant association with BMI, with the mean BMI being lowest in subjects attending high-SES high schools [$F(2,267) = 3.88$, $p = 0.02$, data not shown]. Moreover, the prevalence of OWOB was significantly lower among subjects who attended high-SES schools ($\chi^2 = 6.59$, $p < 0.05$). There existed also an inverse significant relationship between OWOB status ($\chi^2 = 7.46$, $p < 0.05$) and the father's total years of schooling. In addition, a smaller number of OWOB subjects consumed dietary supplements ($\chi^2 = 5.9$, $p = 0.015$), but a greater number had a dietary restriction ($\chi^2 = 7.9$, $p = 0.005$), compared to their non-OWOB counterparts. Positive strong associations were also observed between OWOB and family history of obesity ($\chi^2 = 14.8$, $p < 0.001$) and body dissatisfaction ($\chi^2 = 13.1$, $p = 0.001$).

Although neither physical activity level (meeting guidelines of moderate to vigorous physical activity) nor screen time was significantly associated with weight status, there was a significant positive correlation between sleep duration and weight status ($\chi^2 = 4.1$, $p = 0.042$). It is interesting to note that OWOB subjects were significantly less likely to exceed RDA of daily total calorie intake ($\chi^2 = 4.0$, $p = 0.045$) and consume highly energy-dense foods ($\chi^2 = 10.3$, $p = 0.006$). A quick look at Table 2 shows that the SES of school, supplement consumption, dietary restriction, familial history of obesity, body satisfaction, the energy density of solid foods, and sleep duration significantly contributed to the model.

The strongest predictor of OWOB was dietary restriction (odds ratio [OR] = 3.0, 95% CI: 1.5-5.8) followed by body satisfaction (OR = 1.9, 95% CI: 1.1-3.4), school SES (OR = 1.9, 95% CI: 1.1-3.2), family history of obesity/diabetes (OR = 2.0, 95% CI: 1.2-2.9), and sleep duration (OR = 1.7, 95% CI: 1.1-2.6). This indicates that subjects with dietary restrictions were 3 times, those who dissatisfied with their body shape 2 times, those who studied in low-SES high schools and had a family history of obesity around 2 times, and those with disturbed sleep 1.7 times more likely to be OWOB, after controlling for other factors in the model. The odds ratio of supplement consumption (OR = 0.2, 95% CI: 0.1-0.8) and energy density of solid foods (OR = 0.5, 95% CI: 0.2-1.0) were less than 1, indicating that for every additional unit of energy density of solid foods respondents were 0.48 times less likely to be OWOB and those respondents who consumed supplements were 4.35 (1/0.23) times less likely to be overweight (Table 3).

Discussion

The prevalence of overweight and obesity in

our respondents was 18% and 6.7%, respectively. These findings agree with some earlier observations in Iran [1, 3, 21], but are different from findings of studies conducted in Sistan and Baluchistan province in southeastern Iran [22, 23]. This may be explained by the fact that provinces in southeastern Iran are yet struggling with undernutrition, and although increasing trends in overweight/obesity have been documented in these areas [21], the prevalence of overweight and obesity is still lower than other parts. Our prevalence findings appear to be more favorable in comparison to the United States [24], Asian Pacific countries [25], and Arab states of the Persian Gulf [26]; however, it exceeds the prevalence rates reported for some European countries such as Belgium and Norway [24].

Moreover, our study showed that boys had a higher risk of obesity than girls. This sex difference was concordant with the results of similar studies in the United States [27], Kuwait [26], and China [28]. There was, however, no sex differences in the prevalence of overweight, which is consistent with the findings of Maddah and colleges [22] but consistent with that of Kühnis et al [29]. The discrepancy in results may be explained by genetic, socioeconomic, and racial factors that have been reported as correlates of overweight and obesity [30].

The results of this study indicated that, of all sociodemographic variables studied, father's total years of schooling and the SES of school location contributed significantly to OWOB. Parent's education and school location both are indicators of the SES of adolescents [31], and both had a negative contribution to OWOB in this study. These results are consistent with those of some studies [15, 32, 33, 5, 34, 35, 36, 37] but not others [28, 38, 25, 39]. This rather contradictory finding has been well explained by McLaren in his comprehensive review on the relations between socioeconomic status and obesity in countries with high, middle, and low Human Development Index (HDI) [17]. He found that in high-HDI countries, the majority of associations were negative, namely, body weight increased with decreasing SES, especially for education and occupation. However, the associations tended to be positive in medium- to low-HDI countries. According to the latest statistics, Iran is ranked as a high-HDI country [40].

On the other hand, other factors such as the family history of obesity, dietary restriction, body satisfaction, and supplement consumption were associated with overweight/obesity. Respondents with a positive self-reported family history of obesity were more likely to be OWOB. This finding is in agreement with the findings of Andegiorgish et al [28], who found that OWOB in Chinese children and adolescents was significantly associated with parental obesity and the mother's history of gestational diabetes. Similar findings were documented in Iranian children [38] and adults [3].

Obese respondents in our study were more likely to follow restricted diets. This tendency was consistent with our other finding that OWOB subjects were less satisfied with their body shape than their normal-weight counterparts. These findings further support previous studies [41] that showed elevations in body weight could predict increases in body dissatisfaction. Subsequently, this weight-related body dissatisfaction may impair the emotional well-being of overweight and obese adolescents [42]. As a consequence, poor dietary practices have been reported to be one of the most important contributors to overweight and obesity.

In the present study, overweight and obese respondents were less likely to consume supplements than their normal-weight counterparts. This may suggest that normal-weight subjects tend to take greater care of their health than subjects with OWOB do.

There was an inverse association between OWOB and the mean score for physical activity. Moreover, the mean hours allocated to moderate- to vigorous-intensity physical activity was lower in OWOB and the proportion of time spent on sedentary activities was higher in obese respondents. Decreased physical activity scores in respondents with elevated body weight in this study supports earlier findings regarding the inverse relationship between physical activity level and weight status [43, 44]. This is also in line with the findings of a comprehensive systematic review in which physical activity levels were lower in overweight compared to normal-weight youth in most of the 34 included countries [45]. The greater mean time spent on sedentary activities among obese subjects is also consistent with findings of the previous studies in which a positive association was found between sedentary behavior and weight status [46, 47].

Unexpectedly, the positive association between obesity and daily time allocated to moderate to vigorous activities was significant only in males but not in females. This finding differs from those of previous studies and also with our further findings about the association of

moderate to vigorous physical activity with overweight and OWOB. This may be attributed to the limitations of the implications of BMI. It has been accepted that BMI can be misleading in revealing the individual's body fat as it depends on the net weight and height but fails to differentiate between fat mass and fat-free mass including muscle and bone mass [48]. In our study, male respondents who met the guidelines of > 1 h/d of moderate to vigorous physical activity had higher BMI, while females who met the guideline had significantly lower BMI values than those who did not. The higher BMI in males may be associated with increased lean body mass due to bodybuilding exercises, which is relatively common among Iranian male youths, while females mainly tend to participate in aerobic activities, which do not result in building a vast lean body mass.

Conclusion

In conclusion, overweight and obesity are prevalent among Iranian adolescents. Adolescents from lower socioeconomic status are more likely to have elevated BMI. Moreover, family history of obesity and sleep duration are important factors associated with OWOB. On the other hand, OWOB subjects have higher body image dissatisfaction, which may be associated with behaviors such as dietary restriction, which in turn may affect both their psychosocial and physical health. Preventive measures for adolescents should be formulated accordingly.

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Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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