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Socio-demographic Factors Associated with Body Mass Index of Female Adolescent Students in Semnan City, Iran

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ABSTRACT

Malnutrition among adolescents is not only an important health problem but also an economic development problem in Iran and other developing countries. The home environment is found to be related to the development of malnutrition in children. Information on this relationship is important to identify the target risk groups for nutritional intervention. The objective of this study was to determine the association between socio-demographics with BMI status in high school adolescent girls in Semnan. In a cross- sectional study, using two-stage random sampling, 256 girl students aged 14-18 years were randomly selected from eight Semnan high schools. Weight and height were measured and BMI was calculated. Weight status was determined based on the CDC 2000 reference for BMI-for-age. Data on socio-demographic factors like age, age at menarche, family size, parental education, parental job and economic status was collected through a questionnaire. Age at menarche and mother's literacy had significant association with weight status (P =0.031, P =0.001 respectively). Logistic regression analyses showed mother's literacy and age at menarche were strong predictors for overweight but not for under weight. Increasing maternal nutritional knowledge is necessary to initiate changes in nutritional conduct. In addition, a longitudinal study of adolescent nutrition and its associated factors is suggested.

INTRODUCTION

Nutritional status during adolescence plays an important role in the human lifecycle (Stang, 2008). Healthy eating habits formed during childhood can persist into adulthood and prevent or delay premature onset of a number of chronic diseases. Global economic development and urbanisation has resulted in great changes in weight status among adolescents worldwide (Hardus *et al*., 2003). A decreasing trend in the prevalence of under-nutrition has been identified in developing countries. On the other hand, an increasing shift towards higher rates of overweight and obesity among adolescents has been reported in developed and developing countries (Lob-Corzilius, 2007).

Socio-economic status (SES) has been found to be related to weight status (Shi *et*

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al., 2005). However, the strength of the association varies between countries. In developed countries, low SES may be associated with overweight/obesity, whereas in developing countries the opposite situation could also be the case (Jackson *et al*., 2002).

Evidence suggests that under-nutrition still exists as a public health problem in Iran; particularly among young children. The National Food Consumption Survey conducted in 2001-2003 showed that the prevalence of thinness, pre-obesity and obesity among boys aged 15 to 19 years old was 27.6%, 5.1% and 3.6% respectively. The related figures for girls were 10.5%, 9.7% and 3.9% respectively (Mohammadpour *et al*., 2006). Prevalence of overweight in high school students increased to 11.2% in 2004 (Kelishadi *et al.*, 2007). As a result, new cases of children with metabolic syndrome may appear which in turn is likely to create an enormous economic and public health burden for Iran in the near future (Kelishadi *et al*., 2007).

Iran is a country with great diversity in socio-demographic and cultural factors in different provinces. Few studies have investigated the relationship between socio-demographic factors and health and nutrition in Iran, particularly in Semnan (Abdollahi *et al*., 2005; Kelishadi *et al*., 2007). Information on this relationship is important to identify a set of contributors to weight status in adolescent girls, which could be applied in designing nutrition intervention programmes. Semnan is located in the centre of Iran. Non-communicable diseases such as hypertension, diabetes and heart disease have been considered as major health problems in Semnan (Naghavi, 2003). The northern half of the city is richer than the southern half of the city.

The objective of this cross-sectional study is to determine the association between BMI status and socio-demographic factors like age, age at menarche, family size, parental education, parental job and economic status in female adolescent students in Semnan city in Iran.

METHODOLOGY

Pilot study and sampling

A pilot study was performed on a sample of 40 students (10 students of the four age groups each) who were similar to the study population. Height and weight were measured and BMI was calculated. The weight standard deviation of the students was higher than their height and BMI.

Using the following formula, 64 students from four educational grades of high school were determined.

$$N = \frac{t^2 s^2}{d^2} = \frac{(1/96)^2 \times (2/04)^2}{(0/5)^2} = 64$$

Based on a pilot study, a sample of 256 students was selected. Semnan city was divided into four areas (North, South, West and East) according to socio-economic status. Two schools were selected randomly from each of the four different areas. Using a two-stage random sampling method, 256 girl students aged 14-18 years old from 8 high schools were selected. Only students from puberty age (14-18 years) were included. Those few students who for some reasons were younger or older than this defined age group were excluded and new students were added to the sample. Data collection took two months (April and May 2004). Questionnaires were pre-tested and modified according to the study objectives.

Measurement of height and weight

Height and weight were measured according to WHO protocol (WHO, 1995). Height was measured to the nearest 0.1 cm using a tape fixed to a wall. Using a Buerrer scale, weight was measured to the nearest 0.5 kg. Students wore light indoor clothes and weight was measured without shoes. The scale was calibrated before the

examination. All of the measurements were performed by two trained health workers. One took the measurements and the other recorded the readings. To minimise variations in anthropometric measurements, all measurements were obtained by the same experienced staff members.

Body Mass Index (BMI) was calculated as weight in kilogram divided by height in meter square. Underweight was defined as having a BMI lower than 5th percentile of age- and sex-specific BMI (Center for Disease Control and Prevention(CDC) 2000); normal weight was defined as BMI between 5th and 85th percentiles; at risk for overweight and overweight were defined as BMI between 85th and 95th and greater than 95th percentile, respectively (Kuczmarski *et al.*, 2000

Household socio-demographics and economic characteristics

Birth date was recorded. Age was calculated by decreasing birth date from the survey date. The onset of menarche was assessed by questions indicating whether and when they have had their first period.

Two categories were defined for family size: 3 to 4 and 5 to 10 persons. No family with less than three persons was found. The educational level of fathers was classified into two groups: illiterate / completed primary school and completed high school / academic degree. The educational level of mothers was defined as illiterate and educated. The fathers' occupation was categorised as retired / labourer and employee (government) / self-employed. The mothers were classified as housewives and others.

As in previous studies, household economic status score was recorded based on household assets (Shi *et al.*, 2005). Score of ownership of home as well as having video CD player, colour television set, computer, refrigerator, personal land, mobile phone, washing machine, automobile and personal house were added together. Each item was given a value of 1. The internal consistency of the household economic score was good (Cronbach's α=0.7). Subsequently, three categories were constructed from the economic status score: (1) Low was considered as 6 or less; (2) High was considered as having a score of 7 to 9. The correlation coefficient between household economic status and educational level of father was 0.30 (P< 0.001).

Data analysis

Epi-info 2002 (CDC, Atlanta, Georgia) was used to calculate BMI percentiles. All other statistical analyses were completed using SPSS11.5 (SPSS Inc., Chicago, IL). The chi-square test was used to assess the association between categorical variables. Coefficient correlation was used to observe the presence of any correlation between quantitative variables and BMI for age percentiles. Statistical significance was achieved when the p value was less than 0.05.

RESULTS

Sample characteristics and measurements

256 mature girl students aged 14-18 years old participated in this study. The prevalence of underweight, at risk for and overweight was 5.9%, 11.7% and 4.7% respectively (Table I). Underweight was slightly higher (9.4%) among 17.5-18.5 years old students. The highest percentage of obesity (6.3%) was in the 16.5-17.4 age groups, but these differences were not significant (Table 1).

Household socio-demographics and economic characteristics

Based on chi-square test, there was a significant association between age of menarche and weight status (p=0.031, Table 2). There was also a negative association

Table 1. Weight status of Iranian adolescent girls by age group

Age (years)	*BMI status*									
	Underweight		*Normal*		*At risk for overweight*		*Overweight*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
14.5-15.4[a]	4	6.3	55	85.9	3	4.7	2	3.1	64	100
15.5-16.4	2	3.1	49	76.6	10	15.6	3	4.7	64	100
16.5-17.4	3	4.7	50	78.1	7	10.9	4	6.3	64	100
17.5-18.5	6	9.4	45	70.3	10	15.6	3	4.7	64	100
Total	15	5.9	199	77.7	30	11.7	12	4.7	256	100

[a] Categorisation according to the high school educational grade

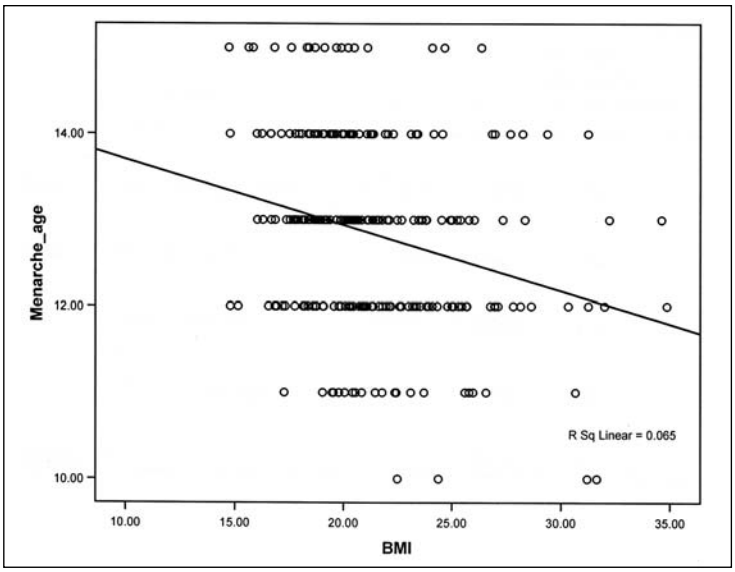

Figure 1. Correlation between BMI and age at menarche in the subjects

between age at menarche and BMI percentile ($p< 0.0001$, r = -0.2, Figure 1).

There were more large families of 5-10 persons (65.6%) than small families. The mean ± SD of family size was 5.1 ± 1.2 persons. No association between family size and BMI status was found ($p>0.05$). No family with less than three persons was found.

There was a significant association between mothers' educational level and BMI status of children ($p=0.001$, Table 2), where a higher percentage of underweight (12.5%), at risk for overweight (25%) and overweight (10%) girls were in the group with illiterate mothers. However, in contrast, mothers of 88.7% of normal weight students had completed high school (Table 2).

There was no association between parents' job and BMI status of the children (Table 2). Most of the mothers were housewives (66.6%). Table 2 shows the socio-economic characteristics of the students. The mean ± SD of score of household economic status was 6.4 ± 1.2 scores. No association between household

Table 2. Weight status of subjects by socio-demographic factors

Variables		*BMI status*										
		Underweight		*Normal*		*At risk for overweight*		*Overweight*		*Total*		*P value*
		n=15		*n=199*		*n=30*		*n=12*				
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	
Age at menarche (years)	10-12	6	5	66	70.3	12	16.8	4	7.9	88	100	0.031[a]
	13-15	9	6.5	133	82.6	18	8.4	8	2.6	168	100	
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100	
Family size (persons)	3-4	6	6.8	66	75	12	13.6	4	4.5	88	100	NS[c]
	5-10	9	5.4	133	79.2	18	10.7	8	4.8	168	100	
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100	
Father's education	Illiterate / primary school	11	8.7	93	73.8	16	12.7	6	4.8	126	100	NS
	Completed High School / Academic Degree	4	3.1	104	81.3	14	10.9	6	4.7	128	100	
Total		15	5.9	197[d]	77.6	30	11.8	12	4.7	254	100	
Mother's education	Illiterate	5	12.5	21	52.5	10	25	4	10	40	100	
	Educated	10	4.7	177	82.3	20	9.3	8	3.7	215	100	0.001[b]
Total		15	5.9	198[e]	77.6	30	11.8	12	4.7	255	100	
Father's job	Retired / labourer	0	0	23	79.3	5	17.2	1	3.4	29	100	
	Employee (Government) / Self-employed	15	6.7	174	77.3	25	11.1	11	4.9	225	100	NS
Total		15	5.9	197[d]	77.6	30	11.8	12	4.7	254	100	
Mother's job	Housewife	13	7.6	134	78.8	16	9.4	7	4.1	170	100	
	Employee	2	2.4	64	75.3	14	16.5	5	5.9	85	100	NS
Total		15	5.9	198[e]	77.6	30	11.8	12	4.7	255	100	
Household ES	Low	7	6	90	77.6	14	12.1	5	4.3	116	100	
	High	8	5.7	109	77.9	16	11.4	7	5	140	100	NS
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100	

[a] Significant *P*-value using chi-square test
[b] Significant *P*-value using Fisher test
[c] Non-significant
[d] Decline in sample value because of father's death
[e] Decline in sample value because of mother's death

Table 3. Results of logistic regression analyses

Dependent variable	*Independent variable*	*OR*	*95%CI*	*P*
At risk for overweight/ overweight	Age at menarche	2.7	1.3-5.6	0.006[a]
	Family size	1.2	0.6-2.6	0.49
	Father's education	0.8	0.4-1.9	0.77
	Mother's education	4.2	1.7-9.9	0.001[b]
	Father's job	0.9	0.3-2.9	0.94
	Mother's job	0.5	0.2-1	0.07
	Household ES	1.1	0.5-2.5	0.66

[a] Significantly associated with overweight
[b] Significantly associated with overweight

economic status and BMI status was found (Table 2).

To identify the factors that had the strongest influence on manifestation of malnutrition, logistic regression analyses were undertaken. Literacy of mother and age at menarche were strong predictors for being at risk of overweight and overweight but not for underweight (Table 3).

DISCUSSION

The main objective of the present study was to explore the association between socio-demographic factors and BMI status.

Evidence showed that overweight may result in earlier onset of puberty in girls (Herman-Giddens, 2007). A suggested mechanism is that adiposity may trigger estrogen production; leading to an earlier onset of menarche (McDowell *et al.*, 2007). The findings of the present study may confirm this phenomenon, since we found the same association between age at menarche and overweight among girls as reported by other studies (Bratberg *et al.*, 2007; Kahl *et al.*, 2007).

No association was found between family size and weight status. A negative association may exist between family size and weight status as in larger families there are less health and nutritional resources (Dowda *et al.*, 2001). However, to ascertain any factual relation, confounding factors should be taken into account.

Many studies have shown that educational achievement of parents, both fathers and mothers, is associated with their children's nutritional status (Wang, 2001; De Vito *et al.*, 1999). The educational attainment of parents could lead to higher income and may imply a higher availability of food and household resources (Giuoglino & Carneiro, 2004). On the other hand, it might be positively associated with higher nutritional awareness as well as better caring of children (Crockett & Sims, 1995). In the present study, however, we found only the mother's educational level to be associated positively with the adolescent's BMI. It could be explained by the assumption that mothers' education is one of the income determinants in families. Furthermore, in the studied population, mothers are responsible for shopping and cooking, therefore the educational level of mothers may affect the purchased food items and method of cooking.

The importance of education, especially maternal education, as a risk factor for childhood obesity, was shown by a higher occurrence of overweight and obesity in students whose mothers had a lower educational level (Al-Saeed *et al.*, 2007). We did not find any association between parents' occupation and BMI status, similar to the findings reported by another study (Lamerz *et al.*, 2005). However, the fact that there was no significant difference between

fathers' occupations in the studied groups should be taken into consideration. Moreover the majority of the mothers were housewives.

The most commonly used measures of social class in epidemiologic studies are occupation, education, and income (Liberatos *et al*., 1988). However, it is reported that with regard to self-administered questionnaires, a large percentage of adolescents are unable to provide a substantive response regarding their father's occupation (Currie *et al.,* 1997).

Under these circumstances, the World Health Organisation (WHO) Health Behaviour in School-aged Children Survey adopted a family affluence scale as an additional indicator of socio-economic status (SES) (Stene *et al*., 1999). The same approach has also been used in developing countries (Jackson *et al*., 2002). Such indicators are culture specific, and therefore must be adapted based on local knowledge. Because it was difficult to get information about household income, we decided to create an index of household SES based on household possessions. This SES index is culture-specific and was developed especially for Semnan city and their economic level. Association with household economic status may be explained in two ways: first, that household possessions may be related positively to income and high intake of food; second, that the families with a high household economic status had more activity saving devices such as televisions, computers, video CD players and automobiles which may reflect physical inactivity.

In this study, no association was found between economic status and anthropometric figures. Since there is no valid questionnaire for assessing socio-economic status in Iran, the finding was compared to other societies undergoing rapid economic growth and epidemiologic transition and similar results were found (Stene *et al.,* 1999).

There are limitations to this study. These include (i) small sample size, (ii) the multilevel cluster sampling technique, which limits the possibility of drawing conclusions for Semnan province, and (iii) the non-existence of valid questionnaires for assessing socio-economic status.

CONCLUSIONS

More research is needed to investigate the possible ways of how SES and parents' educational level affects nutritional status and what could be the entry point for nutrition intervention aimed at improving the BMI status of children and adolescents. In addition, a longitudinal study of adolescent nutrition and its associated factors is needed in this area. As part of its responsibility to tackle the obesity epidemic, there is a need for the government to improve mothers' educational level as a matter of importance.

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