

Patterns of physical activity and dietary habit in relation to weight status in adolescent girls

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ABSTRACT

Healthy eating and physical activity habits formed during childhood can persist into adulthood and prevent or delay premature onset of a number of chronic diseases. The aim of this study was patterns of physical activity and dietary habit in relation to weight status in adolescent girls. In a cross sectional study, using two stage cluster sampling 256 adolescent girls were randomly selected from 8 Semnan secondary schools. Weigh and height were measured and Body Mass Index (BMI) was calculated. In adolescents, anthropometric indices were defined based on the CDC 2000 cut-off points for age and gender-specific BMI. Data of energy and nutrient intake was collected with the 24-hour dietary recall and food record questionnaires. The food frequency questionnaire was used to evaluate daily food consumption. Physical activity was determined using Baecke questionnaire. Data analyzed indicated that daily fat intake ($p=0.003$, $r=+0.18$), energy percent of fat ($p=0.04$, $r=+0.01$) and fast food frequency ($p=0.026$, $r=+0.139$) had significant relationship with BMI percentile. There was a significant relationship between snack frequency and weight status in high school adolescent girls ($p=0.023$). Data analyzed indicated that physical activity had significant relationship with weight status in adolescent girls ($p=0.0001$). The findings suggest that make physical activity enjoyable and improvement food habit among adolescent girls are necessary to induct.

Keywords: Physical Activity; Dietary Habit; Adolescent Girls; Weight Status

INTRODUCTION

There are nearly one billion adolescents in the world accounting for 20-25% of the total population in the developing countries. This particular group of population is likely to increase rapidly in the next 30 years due to population momentum effect [1]. Nutritional status during adolescence plays an important role in human lifecycle [2]. Healthy eating and physical activity habits formed during childhood can persist into adulthood and prevent or delay premature onset of a number of chronic diseases. The global economic development and urbanization has resulted in great changes in the weight status of adolescents worldwide [3]. The prevalence of overweight and obesity has been increasing during the last decades, including in Iran. The National Food Consumption Survey conducted

in 2001-2003 showed that the prevalence of overweight in boys and girls was 6.2%, and 8.7%, respectively [4]. Prevalence of overweight in high school students was 11.2% in 2007 [5]. Decreased physical activity and increased consumption of snacks, such as sweets, sugar-sweetened drinks and fast foods, may have contributed to this trend.

There is evidence of an association between physical activity and dietary behaviors in adolescents. For example, Kremers et al. [6] and Driskell et al. [7] found an association between low fruit and vegetable consumption and low levels of physical activity. Keski-Rahkonen et al [8] and Cohen et al. [9] found that breakfast skipping was associated with infrequent physical activity.

To design appropriate strategy to tackle malnutrition (under nutrition or over nutrition)

among adolescent girls, it is essential to study the health behavior and dietary patterns. Few studies have investigated the relationship between Patterns of physical activity and dietary habit in adolescent girls and health and nutrition in Iran, particularly in Semnan. Considering the fact that improving the health status of adolescent girls, as future mothers, will ensure the health of the future generation, the aim of this study was therefore to investigate Patterns of physical activity and dietary habit in relation to weight status in adolescent girls in Semnan. We hope that the results of this study can be used for designing relevant intervention programs that will address the needs of this age group of the community.

METHODS

Pilot study and sampling

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

Using following formula, 64 students of each four educational grade of high school were determined. Based on the pilot study a sample of 256 students was selected. According to socio-economic status, Semnan city was divided to four areas (north, south, west and east). Two schools were selected randomly from each of the 4 different areas. Using a two-stage random sampling method, 256 girl students aged 14-18 year old from 8 high schools were selected. Only student in puberty age (14-18 years) were included. Those few students who for some reason were younger or older than this defined age group were excluded and new students were exchanged. Data collection took two months (April and May 2004). Questionnaires were pre-tested and modified according to the study objective.

Measures

Height and weight were measured according to WHO protocol [10]. 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 minimize variations in anthropometric measurements, all measurements were obtained by the same experienced staff members. 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 (CDC 2000-Center for Disease Control and Prevention); 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 percentiles, respectively [11]. For the purpose of simplicity, the CDC's between 85th and 95th percentile is referred to as overweight and the greater than 95th percentile is referred to as obesity in this article.

Dietary habit

Data of energy and nutrient intake was collected with the 24-hour dietary recall and food record questionnaires. In the 24-hour dietary recall questionnaire, the participants were asked to recall and report all the nutrients, drinks, and dietary supplements they had in the past 24 hours.

Nutrition models, measuring cups, spoons and other tools were used to estimate the correct amount of consumed food. In the food record questionnaire, the students were asked to report their food consumption on a specific day based on the number of spoons, cups and other common measuring tools.

The advantage of the 24-hour dietary recall questionnaire is that it is completed without any prior notice. Hence, the respondents do not change their food intake. However, because it relies on the individual's memory, the participants may not remember all the foods they have. The food record questionnaire could minimize this error. None of these questionnaires was sufficient enough for determination of the amount of consumed foods; this was the reason why both questionnaires were used to gain more accurate results [12].

The ingredients of the food during the two days were categorized and their values were measured and coded. The data were then analyzed using the locally developed Dorosty Food Processor (DFP) software; this software is based on Iranian food habits and used for the

assessment of macronutrient and micronutrient intakes.

The food frequency questionnaire was used to evaluate daily food consumption. To determine the preliminary reliability and validity of the food frequency questionnaire, the questions were designed through the review of previous published studies, books, magazines and other scientific references related to the research topic in Iran and other countries. Also, the opinions and suggestions of many professors were collected before the final questionnaire was prepared. The food frequency questionnaire includes questions on the number of meals and snacks per day and the frequency of consuming milk, dairy products, fruits, vegetables, red meat, soft drinks, and fast foods per week.

Physical activity

Physical activity was determined using Baecke et al. questionnaire [13, 14]. The questionnaire was validated for reporting physical activity in Holland in 1982 [15]. Previous findings revealed a high correlation with physical activity ($r = 0.69$, $p < 0.01$), therefore; the questionnaire has been considered as a proper instrument in epidemiologic surveys [15].

In grouping the data, the score of physical activity was considered ≤ 2.40 and > 2.40 based on the quarter after merging the first and the second quarter and the third and the fourth one.

Using Baecke's questionnaire, low and high activity levels were defined as physical activity score of ≤ 2.40 and > 2.40 , respectively.

Statistical analyses

Data were collected and stored on a computer database. Epi-info 2002 (Centers for Disease Control and Prevention, Atlanta, Georgia) was used to calculate BMI percentiles. All other statistical analyses were completed using SPSS11.5 (SPSS Inc., Chicago, IL). The Chi-square and Fisher exact test was used to assess the association between categorical variables. ANOVA was used to compare mean of quantitative variables. Coefficient correlation was used to observe if there is any correlation between quantitative variables and BMI for age percentiles. Statistical significance was achieved when the p value was less than 0.05.

RESULTS

Weight status

256 female students aged 14-18 years participated in this study. Table 1 presents the mean of age, weight, height and BMI of the students. Table 2 shows that the prevalence of underweight, overweight and obesity was 5.9%, 11.7% and 4.7%, respectively. Underweight was slightly higher (9.4%) among 17.5-18.5 years old students. The highest percentage of obesity (6.3%) was in 16.5-17.4 age groups, but these differences were not significant.

Dietary pattern

Table 3 shows the mean and standard deviation of the evaluated nutrients by weight status. According to this table, no significant difference was observed among the 4 groups of adolescents. Only a borderline significant difference was observed in the number of snacks per day ($p = 0.05$).

Table1: Subject characteristics according to age and weight status

	Weight Status				
	Underweight n=15	Normal n=199	Overweight n=30	Obese n=12	Total
	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)
Age (year)	16.62 $\pm$ 1.44	16.33 $\pm$ 1.12	16.73 $\pm$ 1.01	16.64 $\pm$ 1.07	16.58 $\pm$ 0.17
Height (m)	158.90 $\pm$ 17.17	159.08 $\pm$ 20.67	157.31 $\pm$ 25.25	159.41 $\pm$ 29.25	158.67 $\pm$ 0.93
Weight (kg)	43.43 $\pm$ 5.59	52.38 $\pm$ 7.23	62.75 $\pm$ 9.92	74.29 $\pm$ 14.9	58.21 $\pm$ 13.31
BMI (kg/m ²)	17.17 $\pm$ 1.9	20.67 $\pm$ 2.43	25.25 $\pm$ 3.16	29.25 $\pm$ 5.6	23.08 $\pm$ 5.27

Table 2: Prevalence of underweight, overweight and obesity by age group in Iranian adolescent girls

Age group(years)	Weight Status									
	Underweight		Normal		Overweight		Obese		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 Categorization according to the educational grade of high school

Table 3: Food intake mean ($\pm$ SD) by weight status in Iranian adolescent girls

Food Factors	Weight Status				
	Underweight n=15	Normal n=199	Overweight n=30	Obese n=12	Total
	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)	Mean($\pm$ SD)
Energy (kcal/d)	1906 $\pm$ 595.54	1962.5 $\pm$ 478.69	2002.3 $\pm$ 478.60	1825.5 $\pm$ 513.31	1957.47 $\pm$ 485.84
Carbohydrate (g/d)	264.83 $\pm$ 94.41	257.33 $\pm$ 72.41	257.4 $\pm$ 56.55	245.69 $\pm$ 59.36	257.23 $\pm$ 71.32
Protein (g/d)	59.41 $\pm$ 18.91	63.01 $\pm$ 19.59	65.3 $\pm$ 20.53	55.13 $\pm$ 22.98	62.70 $\pm$ 19.8
Fat (g/d)	69.83 $\pm$ 23.64	76.47 $\pm$ 24.74	84.49 $\pm$ 35.50	72.86 $\pm$ 31.56	76.85 $\pm$ 26.50
Energy intake of Carbohydrate (%)	55.11 $\pm$ 5.42	52.75 $\pm$ 7.78	51.55 $\pm$ 7.81	54.7 $\pm$ 6.03	62.84 $\pm$ 7.60
Energy intake of Protein (%)	13.04 $\pm$ 1.87	12.9 $\pm$ 2.71	12.95 $\pm$ 2.9	12.03 $\pm$ 3.08	12.88 $\pm$ 2.7
Energy intake of Fat (%)	33.25 $\pm$ 5.48	35.01 $\pm$ 6.82	36.68 $\pm$ 8.97	2.33 $\pm$ 0.65	35.09 $\pm$ 7.05
Meals (times/day)	2.80 $\pm$ 0.41	2.53 $\pm$ 0.64	2.46 $\pm$ 0.62	3.08 $\pm$ 0.9	2.53 $\pm$ 0.63
Snacks (times/day)^a	2.73$\pm$0.70	2.64$\pm$0.73	2.4$\pm$0.72	5.75$\pm$1.42	2.64$\pm$0.74
Fruits & vegetables (times/week)	6.06 $\pm$ 1.62	6.06 $\pm$ 2.17	6.0 $\pm$ 2.19	4.50 $\pm$ 2.43	6.03 $\pm$ 2.11
Red Meat (times/week)	2.8 $\pm$ 1.61	3.84 $\pm$ 2.11	3.73 $\pm$ 2.30	5.83 $\pm$ 1.33	3.80 $\pm$ 2.83
Dairy Products (times/week)	4.93 $\pm$ 1.83	4.9 $\pm$ 2.396	4.33 $\pm$ 2.64	0.9 $\pm$ 1.16	4.88 $\pm$ 2.36
Fast foods (times/week)	0.4 $\pm$ 0.63	0.87 $\pm$ 1.17	0.86 $\pm$ 1.13	1.66 $\pm$ 2.1	0.85 $\pm$ 1.14
Soft Drinks (times/week)	1.93 $\pm$ 1.9	1.87 $\pm$ 1.74	1.83 $\pm$ 1.53	1.66 $\pm$ 2.1	1.86 $\pm$ 1.73

^a Borderline significant P.value (P=0.05)

Table 4 was the basis of grouping between-meal snacks by quarter. Based on the frequency, the first and second quarters were merged together as the third and forth ones. A significant statistical correlation was observed between the number of meals and weight status after the Chi-square test was used ($p=0.023$), as most of the underweight (6.6%) and obese (11%) girls were in the groups with highest number of between-meal snacks per day.

According to Table 4, although most of the overweight (14%) and obese (7%) girls were in the group with 1 or 2 between-meal snacks and

most of the students with a normal weight status (78.8%) belonged to the group with at least 3 main meals per day, no statistically significant correlation was found between the number of meals per day and nutrition status of high school adolescent girls in Semnan ($p>0.05$). Moreover, as Table 4 shows, no significant difference was observed between weight status and the frequency of fruits, vegetables, red meat, and dairy and fizzy beverages consumption per week in Semnan high school girls.

Table 4: Frequency of food intake by weight status of Iranian adolescent girls

	Weight status
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variables		Underweight n=15		Normal n=199		Overweight n=30		Obese n=12		Total	
		n	%	n	%	n	%	n	%	n	%
Fruits & Vegetables (Times/Week)	<7	4	4.6	67	77	10	11.5	6	6.9	87	100
	≥7	11	6.5	132	78.1	20	11.8	6	3.6	169	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100
Red Meat (Times/Week)	<4	11	9.2	91	76.5	14	11.8	3	2.5	119	100
	≥4	4	2.9	108	78.8	16	11.7	9	6.6	137	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	
Dairy products (Times/Week)	<5	6	5.4	89	79.5	14	12.5	3	2.7	112	100
	≥5	9	6.3	110	76.4	16	11.1	9	6.3	144	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	
Fast Foods (Times/Week)	Do not eat	10	8.2	91	74.6	15	12.3	6	4.9	122	100
	≥1	5	3.7	108	80.6	15	11.2	6	4.9	134	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	
Soft Drinks (Times/Week)	<2	8	6.3	97	76.4	15	11.7	7	5.5	127	100
	≥2	7	5.4	102	79.1	15	11.6	5	3.9	129	100
Total		15	5.9	199	77.7	30	11.7	12	14.7	256	
Snacks^a (Times/Day)	<3	6	5	95	79.2	18	15	1	0.8	120	100
	≥3	9	6.6	104	76.5	12	8.8	11	8.1	126	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	
Meals (Times/Day)	1-2	3	3	76	76	14	14	7	7	100	100
	≥3	12	7.7	123	78.8	16	10.3	5	3.2	156	100
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100

^a Significant P.value (P<0.0001)

As presented in Table 5, there was a positive correlation between BMI percentile for age and daily fat intake and the percentage of energy intake from fat ($r=+0.18$, $p=0.003$, $r=+0.01$, $p=0.04$, respectively). Based on the results, with the increase in overweight and obesity in girls, consumption of ready-made meals increased per week; a positive significant correlation was observed between the frequency of ready-made meals consumption per week and the BMI percentile for age ($r=+0.139$, $p=0.026$).

No significant correlation was found between BMI and the daily intake of energy, carbohydrate, protein, and percentage of energy intake from macronutrients (except for fat) (Table 5).

Physical activity

To perform the Chi-square test, the data of the first and second quarters and the third and fourth ones were merged together. As the table 6 shows, in the group with the physical activity score ≤ 2.40 , the lowest percentage (2.9%) belonged to the underweight girls and in the group with physical activity score > 2.40 , the lowest percentage (2%) belonged to the obese girls followed by overweight girls (3.3%). Also, a higher percentage of normal girls (86.6%) belonged to this group.

Physical activity level was significantly lower in overweight (3.3%) and obese (2%) girls ($p=0.0001$).

Table 5: Coefficient correlation between nutritional factors and BMI for age percentage in Iranian adolescent girls

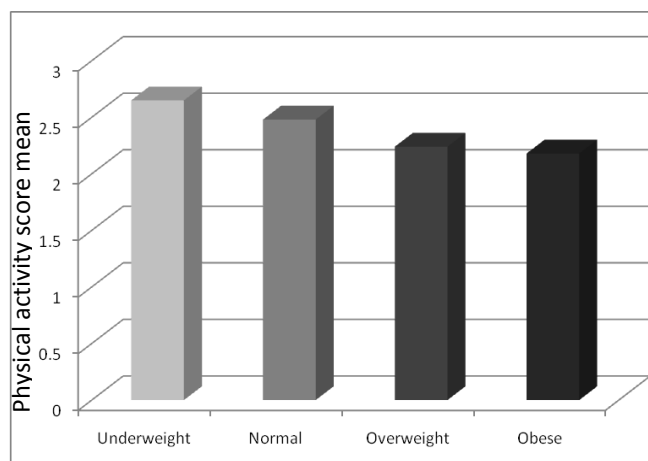
Nutritional Factors	BMI for age percentage	
	r	P.value
Energy (kcal/d)	0.09	NS ^a
Carbohydrate (g/d)	0.07	NS
Protein (g/d)	0.11	NS
Fat (g/d)	0.18	0.003^b
Energy intake of Carbohydrate (%)	0.12	NS
Energy intake of Protein (%)	0.01	NS
Energy intake of fat (%)	0.01	0.04^b
Meals (times/day)	-0.08	NS
Snacks (times/day)	0.06	0.053
Fruits & vegetables (times/week)	0.08	NS
Red Meat (times/week)	0.05	NS
Dairy Products (times/week)	0.07	NS
Fast foods (times/week)	0.13	0.02^b
Soft Drinks (times/week)	-0.05	NS

^a Non significant (P>0.05)

^b Significant and positive correlation

Table 6: Nutritional status of Iranian adolescent girls by physical activity level

categorization variable		Weight Status										P.value
		Underweight n=15		Normal n=199		Overweight n=30		Obese n=12		Total		
		n	%	n	%	n	%	n	%	n	%	
Physical activity	Low(≤ 2.40)	3	2.9	68	64.8	25	23.8	9	8.6	105	100	0.0001
	High(> 2.40)	12	7.9	131	86.8	5	3.3	3	2	151	100	
Total		15	5.9	199	77.7	30	11.7	12	4.7	256	100	

**Figure 1:** Physical activity scores mean by nutritional status

Data analysis on physical activity and nutritional attitude showed (Figure 1) that the difference in mean physical activity score and nutritional attitude between underweight, normal, overweight, and obese (categorized based on BMI for age) high school girls was statistically significant ($p < 0.0001$). The coefficient correlation showed a negative association between physical activity score and BMI percentile ($p < 0.0001$, $r = -0.046$).

DISCUSSION

Dietary pattern

Energy and macronutrient intake

The present study showed a significant association between weight status and daily intake of fat and the percentage of energy intake from fat among adolescent girls in Semnan, which was congruent with the results of the studies on Canadian children and adolescents aged 4-18 years [16] and Malaysian adolescents [17]. A study on 331 Spanish adolescents aged 14-18 years also revealed a significant positive correlation between BMI and the percentage of energy intake from fat [18]. The consumption of fat rich and fried foods and snacks by the

students, which deliver too much energy increases the fat mass of the body, can justify the significant correlation between daily intake of fat and weight status.

This study showed no correlation between weight status and the daily intake of energy, carbohydrates, proteins, and the percentage of energy intake from macronutrients, which is consistent with the results of a study conducted by Crant et al. [19]. However, some studies have reported a correlation between nutritional status and daily intake of energy and macronutrients [18, 20]. A reason for different observed effects is that unlike underweight individuals, overweight and obese people tend to underreport their nutritional intake [16]. It should also be considered that although nutritional intake of overweight subjects may not be different from underweight or normal subjects, physical activity and mobility can affect the weight status. As some studies have reported, overweight or obese subjects are less active than those who are underweight or especially those who have a normal weight [16, 21].

Meals

Weight status can be affected by the imbalance in the distribution of energy in different meals of the day. Based on the previous studies, breaking down one meal into several meals prevents weight and BMI from increasing due to the increased thermogenesis effect of the food [22]. In the present study, no correlation was found between weight status and the number of meals consumed per day by adolescent girls in Semnan. These results are in agreement with the results of a study on Polish children and adolescents [23].

Snacks

Another finding of this study was a significant correlation between weight status and the number of snacks consumed per day in adolescent girls in Semnan, which is in agreement with the results of the studies undertaken in Hong Kong [24]. It is possible that the consumption of ready-made and junk food, which have little nutritional value,

between the main meals results in the loss of appetite due to delivering a burst of energy and a great deal of fat while preventing the body from receiving necessary nutrients. The mentioned factors at this age could result in malnutrition manifested as obesity, underweight or overweight in Semnan adolescent female students.

Fruits & vegetables

In the present study, no correlation was observed between nutritional status and the frequency of fruits and vegetables consumption, which can be due to the similarity of the groups in this regard. A similar result was reported by Field et al. who investigated the correlation between BMI and the consumption of fruits and vegetables among American girls [25]. The correlation between weight status and fruit and vegetable consumption is based on the role of fiber in preventing obesity and overweight. Increasing the volume of food, fibers create a gel like layer in the small intestine wall and inhibit the diffusion of fat molecules to the mucosa layer which results in decreased fat absorption. Literature review suggests that higher fruit and vegetable consumption, which increases the soluble fibers, is an important factor in energy stability and balance which, in turn, prevents obesity [26].

Red meat

Another finding of this study was lack of a significant correlation between weight status and the frequency of red meat consumption per week among adolescent girls in Semnan, which is consistent with the results of the studies on adolescents in Tehran [27] and Isfahan [28]. Based on some studies, high protein diets containing red meat, with lowering blood triglycerides, affectively aid weight control and decrease BMI without any side effects on bone mass [29].

Dairy products

The present study did not reveal any correlation between weight status and the frequency of consuming dairy per week. The underlying reason could be the qualitative evaluation of dairy intake. Questioning the frequency of dairy consumption per week does not give information about the amount which is consumed each time. This finding was in line with the results of a study conducted on high school girls in districts 1 and 19 in Tehran [27]. The relationship between weight status and dairy consumption is based on the role of calcium in the regulation of fat metabolism in adipose cells, triglyceride storage, and weight control. The increase in 1,25

dihydroxycholecalciferol in low calcium diets stimulates the entrance of calcium into the adipose tissue and lipogenesis and inhibits lipolysis which result in the accumulation of fat while the mentioned effects are inhibited by the calcium in dairy products [30].

Fast food

A significant positive correlation was found between BMI percentile and the frequency of fast food consumption per week among adolescent girls in Semnan. This finding was consistent with the results of the studies conducted on adolescents in Boston and Canada [21, 31].

The relationship between weight status and the ready-made food is based on the effect of these foods on the intake of energy and other nutrients. Almost 50% of the energy of the ready-made foods is from fat and they often include high amounts of fat and simple carbohydrates but have little amount of iron, calcium, riboflavin, vitamin A, and folate [32]. The previous studies have shown that the children and adolescents who consume ready-made foods as snacks have higher intake of energy, fat, carbohydrate, and coke but lower intake of vitamins A and C, milk, fruits and vegetables [33, 34].

Soft drinks

The sugar in coke delivers a great amount of energy which results in obesity and overweight. Moreover, the consumption of fruits and vegetable decreases in individuals who consume a lot of coke [35]. In the current study, no relationship was found between weight status and the frequency of drinking coke. Although this finding is in line with the results of a study by Forshee et al., [36] other studies have reported different results [37]. Our study was conducted in March and April when the weather is cool and this could be the reason why no significant correlation was found between coke consumption and weight status.

Physical activity

It has been suggested that obese individuals are in a long-term state of energy imbalance where they have consumed more energy than they need. There has been a continuing debate as to which is most important: eating too much food, or the lack of sufficient activity. Evidence shows that in several countries people eat less than they used to do which might refer to the fact that a decline in physical activity is the key factor in many cases of obesity [38]. There was a negative association between BMI status and physical activity score as suggested by other investigators [39, 40, 41].

CONCLUSION

The findings suggest that make physical activity enjoyable and improvement food habit among adolescent girls are necessary to induct.

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