Original Article

Fruit and vegetable intake, body mass index and waist circumference among young female students in Isfahan

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ABSTRACT

Background: Obesity is growing rapidly in our country. Nutrition is an important issue of obesity. The aim of this study was to determine the association between fruit and vegetable intake with the waist circumference and the body mass index (BMI) among young female university students. **Materials and Methods:** This cross-sectional study was conducted on 236 healthy female university students aged between 18 and 30 years old, who were selected randomly from the students of Isfahan University of Medical Sciences, Iran. A previously validated semi-quantitative food frequency questionnaire was used to assess the entire dietary component intake. Physical activity was assessed by daily recording of the physical activities. **Findings:** The prevalence of obesity, central adiposity and overweight was 1.7, 0.9 and 8.1%, respectively. The mean value of BMI and the waist circumference was 21.54 kg/m^2 and 70.37 cm, respectively. There was an inverse correlation between the fruit and vegetable intake and body weight (r = -0.1, P = 0.03) as well as BMI (r = -0.1, P = 0.04) and also there was an inverse correlation between the fruit intake and body weight (r = -0.1, P = 0.01) and BMI (r = -0.1, P = 0.01). There was no significant correlation between fruit and vegetable as well as fruit or vegetable separately with the waist circumference. **Conclusion:** There were significant correlations between fruit and also fruit and vegetable and body weight and BMI among female university students. There was no significant correlation between fruit and vegetable as well as fruit or vegetable separately with waist circumference.

Key words: Body mass index, central obesity, fruit and vegetable, waist circumference

INTRODUCTION

Obesity, particularly central obesity, has an increasing trend in Iran which is a developing country. Moreover, waist-to-hip ratio (WHR) among women has increased from 0.84 to 0.88.[1] Central obesity, in itself, is considered as a risk factor for many chronic diseases and also as one of the components of metabolic syndrome. Recent studies have shown that prevalence of metabolic syndrome among adults of Tehran is more than 30% and among adolescents is 10%.[2] Hence, preventive and controlling methods for rising trend of obesity and subsequently reduction of its complications is of importance. Two nutritional and non-nutritional factors are involved in incidence of obesity. For instance, obesity is associated with receiving a low vitamin C.[3] In addition to have high amounts of vitamin C, vegetables and fruits contain many other useful compounds. In a cross-sectional study on female teachers aged 40-60 years, an inverse correlation was observed between fruit and vegetable intake with concentration of C-reactive protein (CRP) and metabolic syndrome.[2] In addition, another study in the U.S. reviewed

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the effect of parental behavioral intervention on children nutritional habits as increased vegetable and fruit intake and decreased fat and sugar intake; and eventually increase consumption of fruit and vegetable compared with decreased consumption of fat and sugar was associated with significant reduction in increased percentage of children weight.[4] In addition, in a cross-sectional study on Mediterranean population, increased vegetable, fruit and fiber intake had an inverse significant correlation with weight gain.[5] In another study, the prevalence of obesity and central obesity was evaluated with traditional and special diet in two groups of Mexican; the results showed that the traditional diet which was rich in fruits and vegetables significantly was not correlated with waist circumference (WC) and BMI.[6] In other studies on 15-19-year-old youths in Jamaica, vegetable and fruit intake had an inverse significant correlation with obesity, WC and WHR.[7,8]

However, the above-mentioned studies conducted either on children and adolescents or on middle-aged people. Considering that adolescents are considered as the future population of our country, and prevalence of obesity-particularly central obesity- in recent years had an increasing trends in this age group especially among women, and also the relationship between foods intake and diseases have been less considered in Iran, this study was done on young females given to replacement of fast foods in diet of this age group.[1]

On the other hands, vegetable and fruits contain many nutritious and non-nutritious compounds and since recent epidemiological studies have emphasized on food groups compared with a nutrient food, therefore our view is on food items and even better, on vegetable and fruit. Thus, in this study, we reviewed the fruit and vegetable intake with BMI, WC and obesity among young females in Isfahan.

MATERIALS AND METHODS

The study population calculated through the following formula: $n = (Z_{1-\alpha/2} + Z_{1-\beta}) \, S^2/d^2$

The number 236 was obtained through this equation. According to previous studies, standard deviation of BMI was 4.6 and d considered 0.68 considering to the required budget and using previous studies. Furthermore, the power of test was considered 80%.

Measurements

This study was done cross-sectionally on 236 female students of Isfahan University of Medical Sciences at age range of 18-30 years. The students were selected through systematic clustered random method; thus, first five schools randomly were selected among all the schools, 2-4 groups randomly were selected from each school among different entrance year students. A certain number of students in each group were selected randomly according to the required number of samples. First, written informed consent was obtained from all of them. Nutritional assessment was done through the

semi-quantitative validated food frequency questionnaire (FFQ).[9,10] FFQ contained 168 items with an appropriate validity according to previous studies about vegetables, fruit, dairy and grains. Physical activity assessment evaluated through daily physical activity record. Weight was measured without shoes with a standard scale with 0.1 kg accuracy. Height was measured with a measuring tape, and WC measured in the slimmest area while individual was at the end of a normal exhalation. The measuring tape was nonelastic and had no pressure on body and its accuracy was 0.1 cm. BMI was calculated by dividing weight (kg) on squared height (m^2). Because measurements done in a position while the samples wore light clothing, they were asked to put out the cloths may change body and waist shape. In order to measure blood pressure, they were asked to rest for 15 minutes and then it was done by a trained expert in sitting position from the right arm using an analog barometer whose cuff size varied depending upon individuals' arm circumference. Systolic blood pressure recorded by hearing the first Koroktoff sound and diastolic blood pressure recorded by loss of voice (fifth phase of Koroktoff). Before measuring the blood pressure, they were asked about consumption of team coffee and physical activity. Other information about age, drug and smoking reviewed through a predesigned questionnaire has been used in other previous studies.

Statistical methods

In order for data analysis, Program Nutritionist 4 was used for assessing food intake and data analysis was done through Software SPSS version 11.5. Data distribution first was used by Kolmogorov-Smirnov, drawing histogram and P-P plot in terms of normal data. In order to evaluate the association between fruit and vegetable intake with BMI and WC, multiple linear regression was used (*Default Method = Enter*) and the effect of confounding factors was adjusted. In order to evaluate the association between fruit and vegetable intake with obesity and central obesity, logistic regression was used and the effect of confounding factors was adjusted. Moreover, correlation test also was used to find the relationship between fruit and vegetable intake with BMI and WC. In order for development of data analysis, fruit and vegetable group once entered into analysis separately and the other time entered together. Obesity, central obesity and overweight were separately evaluated and then for development of data, overweight and obesity were considered as a unit group with those with BMI over 25 km/m^2. *P*-values under 0.05 considered significant.

RESULTS

Mean, SD, minimum and maximum values are separately illustrated in Table 1 for age, weight, height, BMI, systolic and diastolic blood pressure. According to this table, mean weight, BMI and WC were 55.66, 21.54 and 70.37, respectively. The prevalence of overweight, obesity, central obesity and totally BMI over 25 among the female students of Isfahan University of Medical Sciences was 8.1, 1.7, 0.9 and 9.8%, respectively.

Moreover, mean, SD, minimum and maximum values for intake of protein, carbohydrate, energy, fat, vitamin C, folic acid, food fiber intake, fruit and vegetable intake, fruit intake and vegetable intake are shown in Table 2.

Correlation model with control of energy intake was used to find the correlation between fruit and vegetable intake together and separately with BMI, WC, WHR and body weight. According to the reported results in Table 3, there was an inverse significant correlation between total fruit and vegetable intake with weight (r = -0.1; P = 0.03) and BMI (r = -0.1; P = 0.04) as well as fruit intake with weight (r = -0.1; P = 0.01) and BMI (r = -0.1; P = 0.01).

Logistic regression with adjustment of confounding factors effect for energy, whole grains and dairy intake were used in order to find the association between fruit and vegetable intake together and separately with overweight, obesity and central obesity; and according to Table 4, there was no significant correlation between vegetable and fruit intake separately with overweight, total overweight and obesity. The adjusted odds ratio for fruit and vegetable groups was not significant to each other.

DISCUSSION

In the present study which was done on female students of Isfahan University of Medical Sciences, there was an inverse correlation between fruit intake and fruit and vegetable together with weight and BMI; however, there was no significant correlation between fruit and vegetable intake together and separately with WC, obesity, central obesity, overweight, WHR, total overweight and obesity.

According to the studies, mean fruit *and* vegetable intake in women population over 40 years was 228 ± 79 *and* 186 ±

88, respectively.[2] In the present study which was done on young female population between 18 and 30 years, it was 348.91 ± 218.79 and 189.47 ± 102.47 g/day, respectively, so that the results indicated that the study subjects consumed more vegetable and fruit. It seems that low prevalence of obesity, overweight and having weight, normal BMI and WC

Table 1: Characteristics of young female students in Isfahan University of Medical Sciences

	Mean	SD	Minimum	Minimum
Age (year)	20.76	1.57	29	18
Weight (kg)	55.66	7.94	83	40
Height (cm)	1.61	0.05	1.84	1.48
BMI (kg/m²)	21.54	2.87	32.03	14.51
WC (cm)	70.37	5.83	89	52
Systolic blood pressure mmHg	103.67	11.60	130	100
Diastolic blood pressure mmHg	72.96	7.75	100	42

Table 2: Food intake of young female students in Isfahan University of Medical Sciences

	Mean	SD	Minimum	Minimum
Carbohydrates (g/day)	327.25	104.05	904.7	111.6
Protein (g/day)	90.74	31.87	1.223	15.39
Fat (g/day)	73.93	39.69	262.7	15.39
Energy (kcal/day)	2267.16	758.78	3969	202.2
Vitamin C (mcg/d)	159.98	106.74	709.9	30.86
Folic Acid (mcg/d)	310.25	147.45	1553	108.2
Food fiber (g/day)	17.84	11.51	147.4	5.34
Vegetable and Fruit intake (g/day)	538.52	270.76	1506.31	139.49
Vegetable intake (g/day)	189.47	102.45	629.2	3.56
Fruit intake (g/day)	348.91	218.72	1235.50	48.26

Table 3: Correlation coefficient for association of fruit and vegetable intake together and separately with mentioned variables

	Overweight	Obesity	Central adiposity	Obesity and Overweight	Weight	BMI	WHR	WC
Fruit and Vegetable	0.08[1,2] (P = 0.17)	0.04 (P = 0.5)	0.01 (P = 0.8)	0.1 (P = 0.12)	-0.1 (P = 0.03)	-0.1 (P = 0.04)	0.01 (P = .8)	0.1 (P = 0.05)
Vegetable	0.005 (P = 0.9)	-0.0002 (P = 0.9)	0.001 (P = 0.9)	0.005 (P = .9)	-0.001 (P = 0.9)	0.002 (P = 0.9)	0.02 (P = .7)	0.01 (P = 0.8)
Fruit	0.1 (P = 0.1)	0.05 (P = 0.4)	0.01 (P = 0.7)	0.1 (P = 0.07)	-0.1 (P = 0.01)	-0.1 (P = 0.01)	0.02 (P = .6)	0.1 (P = 0.2)

BMI = Body mass index, WHR = Waist to hip ratio, WC = Waist circumference [1]Values indicate correlation coefficient of the two mentioned variables, [2]All the correlation coefficients reported by controlling energy intake

Table 4: Multiple adjusted odds ratio and 95% confidence interval (CI) for subjects with overweight and total overweight and obesity among quarters of vegetable and fruit intake separately

	Quarters of vegetable intake				Quarters of fruit intake			
	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter
Overweight	1[1]	1.1	0.7	2.1[2]	1[1]	0.4	1.3	1[2]
Overweight and obesity	1	1.54	0.7	2[2]	1	0.2	0.7	0.5[2]

[1]Values indicate odds Ratio, [2]P > 0.05

in most of the study subjects was one of the reasons for lack of a significant correlation between fruit and vegetable intake with prevalence of obesity and central adiposity.

In a study on women from Tehran, it was found that prevalence of obesity and central adiposity were 67 and 93% and mean BMI and WC were 25.9 and 85.5%, respectively.[11] While the values in the present study were 1.7 and 0.9% and 21.5 and 70.3 percent, respectively.

Other studies which reviewed the correlation between vegetable and fruit intake with obesity, BMI and WC found an inverse correlation between vegetable and fruit intake with metabolic syndrome, obesity, overweight and WC.[4,5,7,8] The differences of the present study with the mentioned study that shared an access significant correlation, was mean age of the subjects (20.76 years in the present study) compared to other studies (over 40 years), low prevalence of overweight and obesity, difference in race and cross-sectional nature of the study. For instance, in a cross-sectional study on 40-60-year-old-women from Tehran, there was an inverse correlation between vegetable and fruit intake and metabolic syndrome (central adiposity is one of its components). In another study in the U.S. on children, increased vegetable and fruit intake compared with decreased fat and sugar intake had a significant reduction in percentage of overweight of children. Furthermore, in a cross-sectional study on Mediterranean population, increased vegetable, fruit and fiber intake had an inverse significant correlation with weight gain. Moreover, in a prospective study on 89,432 men and women from five countries participated in The European Prospective Investigation into Cancer and Nutrition (EPIC), there was an inverse significant correlation between fruit and vegetable intake with body weight. This study showed that weight would be reduced 14 g per day with 100 g of fruit and vegetable.[12] In a one-blinded intervention on two groups of people with myocardial infarction, the correlation between fruit and vegetable intake was reviewed with weight loss. This study showed that increased intake of vegetable and fruit is correlated with decreased intake of energy, weight loss and WC.[13] In addition, in another intervention in the U.S. on 77 samples with overweight and obesity, there was an inverse correlation between fruit intake with weight and BMI.[14]

Another study on young population of Isfahan showed that in addition to consider intake values of adolescents, considering to their dietary diversity score (DDS) is also important. In this study, it was indicated that dietary diversity score in fruit and vegetable food groups had an inverse correlation with obesity, central obesity, weight and WC. Besides, dietary diversity score generally was inversely correlated with obesity and central adiposity status.[15] According to a study on 10-18-year-old youths in Tehran, it was shown that vegetable and fruit intake in this age group was lower than recommended value and they more consumed unnatural foods instead. Therefore, implementation of such studies on this age group is important in Iran.[16]

Since no study has ever been done on student population, this study was important due to report of obesity prevalence percentage among university students.

One of the strength points of this study was adjustment of potential confounding factors reported in logistic regression model. The potential effects of energy intake, dairy and whole grain intake were adjusted in our analysis. Using Quantitative FFQ showed accurate consumption of each of food items. Moreover, in analysis of data, Software Nutrients 4 was developed which was based on Iranian foods and is considered as one of the other strength points.

In an inverse correlation observed in linear correlation between fruit and vegetable with weight and BMI, the correlation coefficient relatively has been week. However, it should be noted that week correlation coefficient in this population was influenced by lower prevalence of subjects with overweight and obesity.

The limitation of the present study was that it was a cross-sectional study and the data were based on FFQ (memory). Besides, FFQ of vegetable used in cooked foods was not considered. One of the other reasons for a significant correlation between vegetable and fruit intake with prevalence of obesity and central adiposity was probable errors for completion of FFQ. Therefore, implementation of prospective studies seems necessary.

Although there was an inverse significant correlation between fruit and vegetable intake with body weight and BMI among female students of Isfahan University of Medical Sciences; however, there was no significant correlation between fruit and vegetable intake and separately with WC, overweight, obesity and central adiposity. It should be noted that implementation of this study was important in terms of reporting the prevalence of obesity and mean BMI and WC in this age group.

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