

Dietary Patterns of Young Females and Their Association With Waist Circumference as a Health Index in Northwest of Iran, 2007

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Background: Despite the higher prevalence of overweight and obesity among young people in western countries, the 50th and 95th percentile ranks for waist circumference in the Iranian young Females are higher than those of the western ones.

Objectives: Identifying major dietary patterns in Iranian young females, which associate with central obesity, can probably explain the difference between Iranian young females' pattern and those of their western peers regarding obesity.

Patients and Methods: In the current cross-sectional study, a total of 257 young females aged 11 - 15 years old from Talaat Intelligent Guidance School, Tabriz, Iran (2007) were selected for the study using non-probability simple sampling method. Then, usual dietary intakes of all subjects were evaluated by a food frequency questionnaire and anthropometric measurements such as weight, height, waist circumference, and Body Mass Index (BMI) using the standard protocols. Data were analyzed by inferential statistics (One-way ANOVA, Tukey test for Post-Hoc Analysis, Chi-square test, age-adjusted means, analysis of covariance with Bonferroni correction, correlation and partial correlation) by SPSS software.

Results: In the current study, six major dietary patterns were extracted using factor analysis method. Before and after controlling the age, subjects in the upper tertile of the Iranian Central Obesity Making Dietary Pattern (rich in cruciferous vegetables, green leafy vegetables, soft drinks, tomatoes, other vegetables and vegetable oils) had larger waist circumference in comparison with the ones in the lower tertile (before controlling for age: 64.2 ± 9 vs. 61.6 ± 7 $P = 0.03$; after: 64.5 ± 0.8 vs. 61.5 ± 0.8 , $P = 0.009$). However in lacto vegetarian dietary pattern (rich in legumes, potato, other vegetables, dough, high-fat dairy products and margarine), individuals in the upper tertile had significantly lower weight, waist circumference and body mass index (BMI) in comparison with the ones in the lower tertile (weight: 44.9 ± 9.3 vs. 51.4 ± 10.6 , $P < 0.01$; WC: 59.9 ± 8 vs. 64 ± 7.9 , $P < 0.01$; BMI: 18.6 ± 3.1 vs. 20.6 ± 3.5 , $P < 0.01$).

Conclusions: The current study findings suggest that the Iranian Central Obesity Making Dietary Pattern is directly associated with waist circumference (marker of central obesity), while lacto vegetarian dietary pattern is reversely associated with weight, waist circumference and BMI. Special obesity pattern in Iranian young females can be justified by Iranian Central Obesity Making Dietary Pattern[†].

Keywords: Adolescent; Diet; Anthropometry; Iran

1. Background

Adolescence is an important period in human life, and nutrition plays the main role in this period. Health problems such obesity could be reduced if healthy nutritional recommendations were practiced in adolescence and continued in adulthood (1). Previous studies regarding adolescent's diet have focused on consumption of nutrients or individual foods. However the use of dietary pattern analysis is necessary to identify the whole diet effects on health outcomes; since this multivariate approach could resolve concerns about potentially antagonistic and interactive effects among nutrients and foods (2). Most previous studies on adult dietary patterns indicated that dietary patterns including fresh fruits and vegetables, legumes, milk, and milk products were associated with lower general and central obesity (3-5). Conversely, dietary patterns containing high fats, oils, sweets, refined

meats and red meats were associated with obesity (6, 7). To date, few investigations have focused on dietary patterns in adolescents (8). The existing literature highlights that western dietary pattern is associated with greater odds for the overweight and obesity. While the Basic Food dietary pattern rich in standard milk, other milks, breakfast cereal, and white bread had significant negative associations with obesity markers (9-13).

Studies conducted in the US showed that prevalence of high Body Mass Index (BMI) in young female aged 12 - 19 years was 32.6% (14). In the developing countries the highest prevalence of adolescent overweight was found in Middle East and Eastern Europe. In Iran, from 1993 to 1999, the prevalence of overweight among adolescents doubled and reached 8.3% (15). High prevalence of overweight and obesity in adolescents of western countries

can be related to western dietary pattern. Despite the higher prevalence of overweight and obesity among adolescents in the western countries, the 50th and 95th percentile curves for Waist Circumference (WC) in the Iranian young females are higher than those of the western ones (16). Differences in body fat distribution between young females in the western countries and Iran could be due to genetic or environmental factors such as diet. Identifying major dietary patterns related to central obesity in the Iranian young females can probably explain this different pattern of obesity.

2. Objectives

We aimed to identify major dietary patterns related to central obesity in the Iranian young females to explain different pattern of obesity among them.

3. Patients and Methods

In the current cross-sectional study, a total of 257 young females aged 11 - 15 years old from Talaat Intelligent Guidance School, Tabriz, Iran (2007) were enrolled in the study using non-probability simple sampling method. Students of this school were representative of all districts of Tabriz. Inclusion criterion for the study was studying in this school, and exclusion criterion was having any chronic disease or special diet in the year prior to the study. Thirteen participants were excluded due to disease or special diets in the year prior to the study and 244 students remained for statistical analysis. Data gathering was performed by a nutritionist after approving the project by the Ethical Committee of the School of Nutrition and Health, Tabriz University of Medical Sciences (approval code: 4.5.8487, approval date: 16 February 2007), and obtaining informed written consent from participants. In the consent form, subjects received information regarding the study, confidentiality of their responses and that the participation was not obligatory. Subjects reported their usual dietary intakes during the previous year via validated 162-item semi quantitative Food Frequency Questionnaire (FFQ) (17). Daily intake of foods was then computed.

Subjects' weight was measured via the Tefal digital scale made in France (with an accuracy of 100 grams). For concise weight measurement, it was necessary to educate clients regarding factors or conditions influencing their weight at the measuring time. The factors included excessive amount of clothing (i.e. overcoats, coats, shoes, etc.) and body movement. Hence it was recommended that weight measurer consider factors or the above mentioned conditions.

Students' height was measured using a tape measure with an accuracy of half a centimeter. The students were asked to take off their shoes and press their legs and heels together touching the wall and stand not to move during measurement. To eliminate the hair thickness, the in-

vestigator measured height, by pressing a large triangle lightly on the sagittal plane of the head.

BMI was calculated using the following formula: $BMI = (\text{Weight per kg}) / (\text{Height per meter})^2$

Waist Circumference was measured (to the nearest 0.1 cm) midway between the lowest ribs and the iliac crest without pressure to the body surface by the light clothing using a tape measure.

Overweight and obesity were determined in accordance with the criteria developed through the US center for health statistics in collaboration with the US Chronic Disease Center (CDC) for prevention and health promotion: subjects with BMI > 85th but ≤ 95th percentiles were considered overweight and those with BMI > 95th percentile were considered obese. Also overweight and obesity were determined in accordance with the criteria developed through 2000 International Obesity Task Force (IOTF): subjects with BMI ≥ BMI-for-age cut-point derived from BMI-age curves passed BMI of 25 at age 18 were considered overweight and those with BMI ≥ BMI-for-age cut points derived from BMI-age curves passed BMI of 30 at age 18 were considered obese.

Detailed information regarding identifying dietary patterns is given elsewhere (18). Briefly, after categorizing 162 food items into 40 food groups, factor analysis with varimax rotation was used to identify dietary patterns. Dietary patterns with Eigen value > 1.5 were considered as major dietary patterns. The dietary pattern score was computed for each dietary pattern by summing intake of food groups weighted by their factor loadings (19). Each subject received a factor score for each identified dietary pattern. Subjects were categorized based on the tertiles of dietary pattern scores. One-way ANOVA and Tukey test for Post-Hoc analysis were used to compare general characteristics across tertiles. The ANOVA assumptions were checked before analysis: assumption of Independent Observations was imperative due to different individuals in the compared groups. Normality of variables, and variances equality were confirmed by Kolmogorov-Smirnov and Levene's tests, respectively. Chi-square test was used where appropriate. Also, age-adjusted means for anthropometric measures across tertiles were determined, and analysis of covariance with Bonferroni correction was used to compare the means. Correlation between major dietary pattern scores and anthropometric measurements was determined by Pearson correlation coefficient. Partial correlation was used to control the effect of age. SPSS software (version 13; SPSS, Chicago, IL, USA) was used for all the statistical analyses.

4. Results

According to factor analysis results, there were six major dietary patterns among the subjects. These dietary patterns explained 39.4% of the total variances. Adequacy of sample size for factor analysis was confirmed

by Kaiser-Mayer-Olkin (KMO) index (KMO = 0.770, $P = 0.000$). Detailed information regarding these six dietary patterns and factor loading matrix is given elsewhere (18). Briefly, these dietary patterns included: a) Western Dietary Pattern (WDP) explained 16.6% of variances and was characterized by high consumption of pizza, organ meats, fruit juices, sweets, desserts, high fat dairy, poultry, processed meats, fruits, and refined grains; b) Sweet Junk Foods Dietary Pattern (SJFDP) predicted 5.6% of variances and belonged to adolescents who mostly consumed foods such as dried fruits, jams and honey, sugars and tea; c) Lacto Vegetarian Dietary Pattern (LVDP) explained 4.7% of variances and implied the pattern with high intake of legumes, potato, other vegetables, dough, high-fat dairy products, and margarine; d) Salty Junk Foods Dietary Pattern (SJFDP) predicted 4.4% of variances and showed pattern rich in carrots, puffs, potato chips, popcorn, and crackers; e) Iranian Central Obesity Making Dietary Pattern (ICOMDP) explained 4% of variances and was restricted to subjects who consumed foods like cruciferous vegetables, green leafy vegetables, soft drinks, tomatoes, other vegetables, and vegetable oils; and f) Iranian traditional dietary pattern (ITDP) predicted 3.8% of variances and was characterized by high intake of hydrogenated fats, garlic, broth, tea, poultry and red meats.

Characteristics of subjects and their dietary intakes by tertiles of pattern scores are outlined in Tables 1 - 3. Adolescents placed in the upper tertile of WDP were younger and more likely to be in high economic status compared with those in the lowest tertile. Individuals located in the top tertile of LVDP and ICOMDP were younger, too. The heights of the subjects in the upper tertile of LVDP and ITDP were shorter compared with those of the ones in the lowest tertile. Higher intake of energy and protein, and lower intake of carbohydrate were observed among those placed in top tertile of WDP. In contrast, subjects in the top tertile of the SJFDP consumed more carbohydrate and those in the top tertile of the LVDP consumed less calorie. Lower intake of protein and higher intake of fat were observed among the subjects in top tertile of ICOMDP.

Means and age adjusted means of anthropometric measures across tertiles of dietary pattern scores are presented in Table 4. Subjects of the top tertile of ICOMDP had higher WC compared with the ones in the lowest tertile ($P = 0.03$). Adjustment of age increased the positive associations between this dietary pattern and WC ($P = 0.009$), and also weight ($P = 0.04$). Compared with subjects of the lowest tertile, those in the upper tertile of LVDP had significantly lower weight, WC, and BMI either before or after controlling for age ($P < 0.01$). Results did not show any significant association between other dietary patterns and anthropometric measurements ($P > 0.05$).

Correlation coefficient between dietary pattern scores and anthropometric measurements before and after con-

trolling for age is outlined in Table 5. ICOMDP had marginally direct correlation with WC before controlling for age ($P = 0.06$). This dietary pattern had significantly direct correlation with weight ($P = 0.04$) and WC ($P = 0.03$) and marginally direct correlation with BMI ($P = 0.05$) after controlling for age. Results showed an inverse correlation between LVDP scores and all of the anthropometric measurements, and between Iranian traditional dietary pattern scores and only weight either before or after controlling for age.

Table 1. Characteristics of Study Subjects^a

Parameter	Mean \pm SD	Frequency, %
Age, y		
11	13.21 \pm 0.97	3 (1.2)
12		65 (25.3)
13		90 (35)
14		74 (28.8)
15		25 (9.7)
Weight, kg	48.7 \pm 10.4	
Height, cm	156.7 \pm 6.7	
WC, cm	62.3 \pm 7.9	
BMI, kg/m²	19.7 \pm 3.4	
Weight categorization according to CDC		
Weight \leq 85th percentile	-	212 (82.5)
85th < weight \leq 95th percentile		34 (13.2)
Weight > 95th percentile		11 (4.3)
Weight categorization according to IOTF		
Normal weight	-	212 (82.5)
Overweight		40 (15.6)
Obese		5 (1.9)
Family economic status		
High	-	61 (23.7)
Medium		103 (40.1)
Low		93 (36.2)

^a Abbreviations: BMI, Body Mass Index; CDC, the US center for health statistics in collaboration with the US center for chronic disease prevention and health promotion; IOTF, international obesity task force; and WC, waist circumference.

Table 2. Characteristics and Dietary Intake of Study Participants by Tertiles of Pattern 1, 2 and 3 Scores^a

Parameter	Tertiles of WDP Score			P Value ^b	Tertiles of SJFDP Score			P Value ^b	Tertiles of LVDP Score			P Value ^b
	1 ^c	2	3 ^d		1 ^c	2	3 ^d		1 ^c	2	3 ^d	
Sample size	81	81	82		81	81	82		81	81	82	
Age, y ^e	13.5 ± 0.1	13.2 ± 0.1	13 ± 0.1	0.004 ^f	13.2 ± 0.1	13.3 ± 0.1	13.1 ± 0.1	0.2	13.5 ± 0.1	13.3 ± 0.1	12.9 ± 0.1	0.000 ^g
Ht, cm	157 ± 0.7	157 ± 0.7	157 ± 0.7	0.95	156 ± 0.8	157 ± 0.7	157 ± 0.7	0.4	157 ± 0.7	157 ± 0.6	155 ± 0.8	0.02 ^h
High economic status, %	18.6	24.4	28.2	0.02	23.2	25.6	22.3	0.2	20.1	25.6	24.7	0.1
Low economic status, %	43	30.1	26.9	0.02	42.9	33.7	32.9	0.2	44.2	36	28.2	0.1
Overweight by CDC, %	16.3	10.5	12.9	0.4	13.9	17.4	8.1	0.3	13.9	11.6	14.1	0.3
Overweight by IOTF, %	18.6	15.1	12.9	0.3	15.1	22.1	9.4	0.3	17.4	15.1	14.1	0.9
Obesity by CDC, %	4.6	5.8	2.3	0.4	2.3	5.8	4.7	0.3	5.8	4.6	2.3	0.3
Obese by IOTF, %	2.3	1.2	2.3	0.3	1.2	1.2	3.5	0.3	2.3	1.2	2.3	0.9
OAO by CDC, %	20.9	16.3	15.2	0.3	16.2	23.2	12.8	0.3	19.7	16.2	16.4	0.3
OAO by IOTF, %	20.9	16.3	15.2	0.3	16.3	23.2	13.2	0.3	19.7	16.3	16.4	0.9
Calories intake (Kcal/d)	2447 ± 88	2512 ± 83	2591 ± 55	0.04	2490 ± 105	2613 ± 110	2445 ± 90	0.2	2661 ± 97	2476 ± 83	2411 ± 69	0.04
Carbohydrate, % of total energy	59.9 ± 1	59.1 ± 1.2	58.3 ± 1.2	0.04	57.5 ± 1	59.3 ± 1.2	60.5 ± 1	0.04	59.1 ± 1	58.5 ± 1.1	59.6 ± 1	0.8
Protein, % of total energy	11.8 ± 0.5	12.4 ± 0.4	13 ± 0.5	0.007	13.6 ± 0.3	11.7 ± 4.0	12 ± 0.4	0.4	12.4 ± 0.5	12.9 ± 0.3	12 ± 0.3	0.7
Fat, % of total energy	28.3 ± 0.8	28.5 ± 0.7	28.7 ± 0.8	0.09	28.9 ± 0.6	29.6 ± 0.6	27.5 ± 0.6	0.3	28.5	28.6	28.4	0.7

^a Abbreviations: LVDP, Lacto Vegetarian Dietary Pattern; SJFDP, Sweet Junk Foods Dietary Pattern; and WDP, Western Dietary Pattern.

^b From ANOVA for quantitative variables and chi-square for qualitative variables.

^c Lowest tertile.

^d Highest tertile.

^e Data are presented as mean ± Standard Errors.

^f Significant difference between tertiles 1 and 3 by Tukey post-Hoc analysis (P = 0.003).

^g Significant difference between tertiles 1 and 3 by Tukey post-Hoc analysis (P = 0.003).

^h Significant difference between tertiles 1 and 3 by Tukey post-Hoc analysis (P = 0.008).

Table 3. Characteristics and Dietary Intake of Study Participants by Tertiles of Pattern 3, 4 and 6 Scores^a

Parameter	Tertiles of SJFDP Score			P Value ^b	Tertiles of ICOMDP Score			P Value ^b	Tertiles of ITDP Score			P Value ^b
	1 ^c	2	3 ^d		1 ^c	2	3 ^d		1 ^c	2	3 ^d	
Sample size	81	81	82		81	81	82		81	81	82	
Age, y ^e	13.4 ± 0.1	13.2 ± 0.1	13.1 ± 0.1	0.1	13.4 ± 0.1	13.3 ± 0.1	12.9 ± 0.1	0.001 ^f	13.2 ± 0.1	13.2 ± 0.1	13.2 ± 0.1	0.9
Ht	157 ± 0.8	157 ± 0.6	156 ± 0.8	0.3	157 ± 0.8	158 ± 0.6	155 ± 0.7	0.057	157 ± 0.7	157 ± 0.6	155 ± 0.8	0.02 ^g
High economic status, %	23.2	20.9	27.1	0.3	20.9	29.1	21.2	0.3	30.2	16.6	22.3	0.5
Low economic status, %	45.3	25.6	37.6	0.3	41.9	36	30.6	0.3	33.7	41.9	32.9	0.5
Overweight by CDC, %	18.6	9.3	11.8	0.6	15.1	10.5	14.1	0.6	16.3	15.1	8.2	0.2
Overweight by IOTF, %	19.8	12.8	14.1	0.4	16.3	13.9	16.5	0.7	19.8	15.1	11.6	0.1
Obesity by CDC, %	3.5	4.6	4.7	0.6	2.3	5.8	4.7	0.6	5.8	2.3	4.6	0.2
Obese by IOTF, %	2.3	1.2	2.3	0.4	1.2	2.3	2.3	0.7	2.3	2.3	1.2	0.1
OAO by CDC, %	22.1	13.9	16.5	0.6	17.4	16.3	18.8	0.6	22.1	17.4	12.8	0.2
OAO by IOTF, %	22.1	14	16.4	0.4	17.5	16.2	18.8	0.7	22.1	17.4	12.8	0.1
Calories intake (Kcal/d)	2512 ± 58	2499 ± 33	2537 ± 28	0.4	2586 ± 110	2397 ± 110	2565 ± 76	0.4	2573 ± 116	2519 ± 85	2465 ± 116	0.1
Carbohydrate, % of total energy	59 ± 1	58.7 ± 1	59.6 ± 1.2	0.5	59.6 ± 1	58.4 ± 1	59.3 ± 1.1	0.3	58.9	59.2	59.2	0.4
Protein, % of total energy	12.7 ± 0.4	13.2 ± 0.5	11.4 ± 0.4	0.4	14.9 ± 0.3	12.1 ± 0.4	10.3 ± 0.3	0.007	12.7 ± 0.4	12.6 ± 0.4	12 ± 0.3	0.7
Fat, % of total energy	28.3 ± 0.7	28.1 ± 0.6	29 ± 0.6	0.4	25.5 ± 0.9	29.5 ± 0.9	30.4 ± 0.8	0.006	28.4	28.2	28.8	0.7

^a Abbreviations: ITDP, Iranian Traditional Dietary Pattern; ICOMDP, Iranian Central Obesity Making Dietary Pattern; and SJFDP, Salty Junk Foods Dietary Pattern.

^b From ANOVA for quantitative variables and chi-square for qualitative variables.

^c Lowest tertile.

^d Highest tertile.

^e Data are presented as Means ± Standard Errors.

^f Significant difference between tertiles 1 and 3 by Tukey post-Hoc analysis (P = 0.001).

^g Significant difference between tertiles 1 and 3 by Tukey post-Hoc analysis (P = 0.009).

Table 4. Means and Age Adjusted Means of Anthropometric Measures Across Tertiles of Dietary Pattern Scores ^a

Tertiles	Crude Values ^b			Age-Adjusted Values ^c		
	Weight, kg	WC, cm	BMI, kg/m ²	Weight, kg	WC, cm	BMI, kg/m ²
Tertiles of 1st DP score						
1	49.3 ± 10.5	62.3 ± 7.5	20.0 ± 3.7	48.8 ± 1.1	62.2 ± 0.8	19.9 ± 0.3
2	48.4 ± 10.8	61.9 ± 8.4	19.4 ± 3.3	48.2 ± 1.1	61.9 ± 0.8	19.3 ± 0.3
3	48.8 ± 10.0	62.5 ± 7.8	19.8 ± 3.1	49.5 ± 1.1	62.7 ± 0.8	19.9 ± 0.3
P value for trend	0.73	0.87	0.69	0.73	0.79	0.43
Tertiles of 2nd DP score						
1	48.8 ± 11.6	62.5 ± 8.8	19.9 ± 3.6	49.4 ± 1.1	62.7 ± 0.8	20.0 ± 0.3
2	50.1 ± 10.3	62.7 ± 7.1	20.0 ± 3.2	49.4 ± 1.1	62.5 ± 0.8	19.9 ± 0.3
3	47.6 ± 9.1	61.6 ± 7.7	19.3 ± 3.2	47.7 ± 1.1	61.6 ± 0.8	19.3 ± 0.3
P value for trend	0.44	0.44	0.22	0.44	0.64	0.32
Tertiles of 3rd DP score						
1	51.4 ± 10.6	64.0 ± 7.9	20.6 ± 3.5	51.2 ± 1.0	63.9 ± 0.8	20.5 ± 0.3
2	50.1 ± 10.2	62.9 ± 7.2	20.0 ± 3.2	49.9 ± 1.0	62.9 ± 0.8	20.0 ± 0.3
3	44.9 ± 9.3	59.9 ± 8.0	18.6 ± 3.1	45.4 ± 1.1	60.0 ± 0.8	18.7 ± 0.3
P value for trend	< 0.01	< 0.01	< 0.01	0.001	0.005	0.001
Tertiles of 4th DP score						
1	49.7 ± 10.3	63.0 ± 8.7	20.0 ± 3.2	49.5 ± 1.1	62.9 ± 0.8	20.0 ± 0.3
2	48.5 ± 11.5	62.4 ± 8.0	19.6 ± 3.6	48.8 ± 1.1	62.5 ± 0.8	19.7 ± 0.3
3	48.3 ± 9.3	61.5 ± 6.9	19.6 ± 3.2	48.2 ± 1.1	61.4 ± 0.8	19.6 ± 0.3
P value for trend	0.37	0.22	0.46	0.70	0.47	0.75
Tertiles of 5th DP score						
1	47.7 ± 10.3	61.6 ± 7.0	19.4 ± 3.3	47.6 ± 1.1	61.5 ± 0.8	19.4 ± 0.3
2	48.4 ± 10.0	61.0 ± 7.2	19.5 ± 3.2	47.8 ± 1.1	60.8 ± 0.8	19.3 ± 0.3
3	50.4 ± 10.8	64.2 ± 9.0	20.3 ± 3.6	51.1 ± 1.1	64.5 ± 0.8	20.4 ± 0.3
P value for trend	0.10	0.03	0.11	0.04	0.009	0.07
Tertiles of 6th DP score						
1	49.7 ± 10.0	62.4 ± 7.7	20.0 ± 3.4	49.7 ± 1.1	62.4 ± 0.8	20.0 ± 0.3
2	49.6 ± 11.2	62.8 ± 8.0	19.9 ± 3.5	49.7 ± 1.1	62.8 ± 0.8	20.0 ± 0.3
3	47.2 ± 9.8	61.6 ± 8.0	19.3 ± 3.2	47.1 ± 1.1	61.6 ± 0.8	19.3 ± 0.3
P value for trend	0.11	0.49	0.19	0.17	0.58	0.32

^a Abbreviations: WC, Waist Circumference; BMI, Body Mass Index; and DP, Dietary Pattern.

^b Crude values are presented as Means ± Standard Deviations.

^c Age-adjusted values are presented as Means ± Standard Errors.

Table 5. Correlation Coefficient Between Dietary Pattern Scores and Anthropometric Measurements Before and After Controlling for Age ^a

Scores Type	Crude						Age-Adjusted					
	Weight		WC		BMI		Weight		WC		BMI	
	r	p	r	p	r	p	r	p	r	p	r	p
1st DP score	0.01	0.78	0.03	0.63	0.03	0.59	0.07	0.21	0.05	0.42	0.07	0.26
2nd DP score	-0.02	0.67	-0.01	0.82	-0.04	0.48	-0.03	0.63	-0.01	0.81	-0.04	0.46
3rd DP score	-0.24	< 0.001	-0.20	0.001	-0.23	< 0.001	-0.22	< 0.001	-0.19	0.002	-0.22	< 0.001
4th DP score	-0.001	0.88	-0.04	0.45	0.007	0.91	-0.001	0.98	-0.04	0.47	0.01	0.85
5th DP score	0.08	0.19	0.11	0.06	0.09	0.12	0.12	0.04	0.13	0.03	0.12	0.05
6th DP score	-0.14	0.02	-0.08	0.17	-0.10	0.08	-0.13	0.03	-0.08	0.19	-0.10	0.10

^a Abbreviations: WC, Waist Circumference; BMI, Body Mass Index; and DP, Dietary Pattern.

5. Discussion

In the current study six major dietary patterns were identified among the Iranian young females: WDP, SJFDP, LVDP, SJFDP, ICOMDP and ITDP. Subjects in the top tertile of ICOMDP score had higher WC compared with the ones in the lowest tertile. This dietary pattern which tends to increase central obesity was an exclusive dietary pattern among the subjects. This pattern had higher loads for vegetables, soft drinks, and vegetable oils. This combination of foods recalls Iranian special meals which vegetables such as zucchini, eggplant, tomato, spinach and local green leafy vegetables are fried with ample amount of oil and consumed with carbonated soft drinks. Also, vegetables such as leek, parsley, coriander, fenugreek, celery, green beans and beans are fried with vegetable oils when used in cooking some popular meals such as ghormeh-sabzi, khoresh-t-e-karafs, loobia-polo and baghala-polo. This dietary pattern provided high calories by fats and carbohydrates and very low calories by protein. In consistent with this finding, many previous studies attributed the important role of high protein and low fat diets in reducing central obesity (20-23). Also, this dietary pattern highly loaded with foods containing high amount of goitrogens such as cabbages and turnip. Goitrogens can increase obesity via reducing metabolic rate and basal metabolism. This special dietary pattern probably causes a special obesity pattern, central obesity against general obesity. Few studies focused on dietary patterns among adolescents. The existing literature indicated that following dietary patterns were associated with greater odds for overweight and obesity: 1) Western dietary pattern loading highly with takeaway foods, confectionary, red meat, refined grains, processed meats, fried potato, crisps and soft drinks (9, 10, 13). 2) Health threatening foods dietary pattern containing high sweets, chocolate confectionery, potato crisps, hot chips/fries, artificially-sweetened soft drinks, and sugar-sweetened soft-drinks (11). 3) Modern diet pattern loading highly with white bread, dairy products, sugars, added fats and fruits and decreasing consumption of oils, grains, legumes and vegetables (12). Regarding the special pattern of Iranian adolescents' obesity in comparison with those of the other countries, different obesity-making dietary patterns in this study are not wonderful.

In the current study, subjects of the upper tertile of LVDP had significantly lower weight, WC, and BMI compared with those of the ones in the lowest tertile. In previous studies dietary patterns which had significant negative associations with general and central obesity in adolescents were: 1) Korean traditional dietary pattern recognized with the highest consumption of rice and kimchi, fish and seaweed, and legumes (10), 2) Basic Foods dietary pattern loaded highly with standard milk, other milks, breakfast cereal, and white bread (11), 3) Fruits and Vegetables' pattern loaded highly with fruit, vegetables, cheese, and brown/multigrain bread (11). The similarity of weight

reducing dietary patterns in the current study and two other ones from three previous studies was the lacto vegetarian nature of these dietary patterns. In the third previous study Basic Foods dietary patterns was a dietary pattern highly loaded with plant foods and sea foods and these sea-food-vegetarian dietary patterns associated with low weight in adolescents, too. Reverse correlation between LVDP and anthropometric measurements can be explained by low glycemic index (24, 25), low energy density (26, 27), high fiber (28-30), high protein (20), low fat (20), high short chain fatty acids (31), and low variety of this dietary pattern (32).

The current study showed a reverse correlation between ITDP and weight but not WC and BMI. Significant reverse correlation between this dietary pattern and weight but not BMI was due to low height of adolescents who had high score for this dietary pattern. The current study had some limitations: first, it was a cross sectional study, therefore, causality cannot be inferred. Second, like any other measurement dietary assessments, it may have some inevitable errors. Third, using factor analysis needs several arbitrary decisions (33). Fourth, the study was conducted exclusively on all of the young females in one school. This sampling strategy did not allow generalizing findings to the target population. On the other hand, the same gender and intelligence of subjects controlled some unknown confounders and could be an advantage of the study. Another advantage of the study was its results, which can help the existing knowledge to identify major dietary patterns related to central obesity in the Iranian young females.

In conclusion, the study findings suggest that ICOMDP characterized by high consumption of cruciferous vegetables, green leafy vegetables, soft drinks, tomatoes, other vegetables, and vegetable oils was directly associated with WC (marker of central obesity), while LVDP with high amounts of legumes, potato, other vegetables, dough, high-fat dairy products and margarine was reversely associated with weight, WC and BMI. Special obesity pattern in the Iranian young females can be justified by ICOMDP.

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Authors' Contributions

Study concept and design: Mohammad Alizade and Ahmad Esmailzadeh; data analysis and interpretation: Mohammad Alizade, Alireza Didarloo and Ahmad Esmailzadeh; manuscript drafting: Mohammad Alizade; critical revision of the manuscript for important intellectual content: Alireza Didarloo and Ahmad Esmailzadeh; statistical analysis: Ahmad Esmailzadeh, Mohammad Alizade and Alireza Didarloo.

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