

Major dietary patterns in Iranian adolescents: Isfahan Healthy Heart Program, Iran

Omolbanin Kafeshani⁽¹⁾, Nizal Sarrafzadegan⁽²⁾, Fatemeh Nouri⁽³⁾,
Noushin Mohammadifard⁽²⁾

Original Article

Abstract

BACKGROUND: Limited information exists from the dietary pattern of children and adolescents particularly in developing countries. We aimed to detect major dietary patterns and their association with socio-demographic characteristics of Iranian adolescents.

METHODS: Healthy Heart Promotion from Childhood as one of the “Isfahan Healthy Heart Program”, Iran, projects was conducted in adolescents aged 11-18 years in Isfahan, Najafabad, and Arak districts, Iran, selected randomly by multistage sampling. This survey was conducted on 1992 adolescents in 2007. Dietary intake was assessed using a 50-item food frequency questionnaire in both communities.

RESULTS: Four major dietary patterns labeled “prudent diet,” fast food diet,” “animal fat diet,” and “Mediterranean diet” were identified. We found a significant inverse relationship between prudent and animal fat dietary patterns with age, prudent and Mediterranean dietary patterns with being boy. However, a positive relationship between fast food dietary pattern and age; fast food and animal fat dietary patterns with being boy were detected (all $P < 0.05$). While urbanization and TV watching correlated positively with the fast food diet, an inverse relationship between urbanization and animal fat and Mediterranean dietary patterns were found (all $P < 0.01$). The animal fat and fast food dietary patterns inversely associated with nutrition knowledge; however, Mediterranean diet had a positive relationship with it (all $P < 0.05$). Membership in sport team was positively related to all dietary pattern and regular physical activity associated only with prudent diet (all $P < 0.05$).

CONCLUSION: The study suggests that socio-demographic characteristics and physical activity are related to dietary patterns in Iranian adolescents.

Keywords: Diet, Adolescent, Socio Demographic Factors

Date of submission: 15 Aug 2014, *Date of acceptance:* 22 Oct 2014

Introduction

The nutritional requirements significantly associated with rapid physical and cognitive development as well as maturation in adolescents.¹⁻³ Moreover, adolescence represents an important lifetime for the development of dietary behaviors which usually persist into adulthood.⁴ The diet quality of Iranian adolescents has declined by increasing the intake of fast food, soft drinks, and salty snacks along with decreasing fruit and vegetable consumption.⁵ Thus, these alterations have significantly increased the cardiometabolic risk factors in adolescents.⁶ Most dietary assessments have focused on intake of nutrients, individual foods or food groups.⁷

Although these studies are valuable, separating the food or nutrients effects on disease progress is complicated.⁸ Therefore, using dietary pattern method, which considers a more comprehensive overview of the diet could provide more interpretable findings than studying single nutrients or foods.^{9,10} Methods for studying dietary patterns, such as factor/cluster analysis, have become more widely used in nutrition epidemiology to summarize dietary data and assess the cumulative effect of combined foods on health outcomes.^{3,9,11}

Most dietary patterns studies conducted among adults, however very limited information exists from dietary pattern of children and adolescents

1- Food Security Research Center AND Department of Community Nutrition, School of Nutrition and Food Science, Isfahan University of Medical Sciences, Isfahan, Iran

2- Isfahan Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran

3- Heart Failure Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran

Correspondence to: Noushin Mohammadifard, Email: mohammadifard@crc.mui.ac.ir

particularly in developing countries, therefore; this study is a unique study to identify dietary patterns among a representative sample of Iranian adolescents by using factor analysis. In addition, we aimed to evaluate the association of major dietary patterns and socio-demographic characteristics.

Materials and Methods

Data from the Healthy Heart Promotion from Childhood, one of Isfahan Healthy Heart Program, Iran, project, collected in 2007 from three districts in the central part of Iran, was used to carry out this study. Written informed consent was obtained from the parents or legal guardians of students. The study was approved by the Research Council of the Isfahan Cardiovascular Research Center. Sampling was carried out by multistage random cluster sampling method from 56 middle and high schools of different urban and rural areas. Sampling details were presented elsewhere.¹² In this cross-sectional survey, a total of 2000 students in middle and high schools (1000 girls, 1000 boys) aged 11-18 years were selected from Isfahan, Najafabad, and Arak, Iran, districts. Due to incomplete reports and missing data from questionnaires, almost 93.89% of the participants who successfully fulfilled the questionnaires were enrolled into the study. A total of 1992 students of middle and high schools were studied.

Trained nurses carried out data collection in the schools.¹² The questionnaires covered various health issues including socioeconomic, demographic characteristics, settlement, TV watching time, smoking, membership in sports team, and regular physical activity.¹³ Nutrition knowledge determined through 29 questions about the impact of all food groups on health status. The study design has been described elsewhere.^{12,13} All measurements were conducted according to a standard protocol by using calibrated instruments. Height and weight were measured to ± 0.1 cm and ± 0.1 kg, respectively, with students being barefoot and lightly dressed. Body mass index was calculated as weight (kg) divided by height squared (m^2).

The common foods consumed in Iran were assessed by a validated 50-item-food frequency questionnaire (FFQ).⁵ These items were classified into 35 food categories. The FFQ was adopted from the Non communicable Disease Intervention program questionnaire.¹⁴ Four experts in nutrition and pediatrics assessed the content validity of the FFQ. Moreover, the criterion validity was evaluated compared with three 24 h recall questionnaire. Although these data have not been published yet,

the criterion validity was acceptable.

Food patterns were identified using factor analysis (principal component) of 50 food items conveyed as consumption frequency per week. The factors were rotated by an orthogonal transformation using SPSS for Windows (version 15, SPSS Inc., Chicago, IL, USA) to minimize the number of variables that have high loadings on each factor. This method reaches simpler structure with greater interpretability.

Four major dietary patterns with eigenvalues > 1.29 were extracted based on the screen plot and interpretability of the factors. The factors were rotated by an orthogonal (varimax) rotation to minimize the number of variables. Dietary patterns explained by applying factor loadings > 0.4 .

Factor scores were calculated for a respective dietary pattern in individual participant by multiplying factor loadings with corresponding of standardized value for each food and summing across the food items. Thus, participants were categorized on the basis of factor score of each dietary pattern. The factor scores point out how well they follow a particular dietary pattern. A high factor score for a particular pattern meant a high adherence to those foods while a low factor score showed a low intake of that dietary pattern.

Factor loadings represent correlation coefficients between each food group and dietary pattern. Food groups with positive loading represent contribute to a dietary pattern and food groups with negative loadings are inversely associated with a dietary pattern. The proportion of variance explained by each factor was calculated by dividing the sum of the squares of the respective factor loadings by the number of food groups.

We utilized analysis of variance and chi-square tests to compare the differences of qualitative and qualitative variables among quartiles. Multiple linear regressions were used to identify the association between dietary patterns and sociodemographic characteristics such as sex, school grade, physical activity, and TV watching. $P < 0.050$ was considered significant.

Results

The study participants were 1992 adolescents consist of 1014 boys and 978 girls from whom 1039 were recruited from guidance schools and 953 from high schools. Using factor analysis, 4 major dietary patterns labeled "prudent diet," "fast food diet," "animal fat diet," and "Mediterranean diet" were derived from 50 food items in the study's

participants. These four dietary patterns accounted for 30.65% of the total between-person variance.

Loading factors of food items in these dietary patterns were presented in table 1. The prudent diet was illustrated by a high intake of dried fruits, legumes, raw vegetables, walnut, fruits, fresh fruit juice, pickles, nuts, cooked vegetables, and potato. The fast food diet was described by frequent consumption of junk foods, carbonated beverages, sausages, hamburger, sweet and biscuits, and chocolate. The animal fat diet characterized by the low amount of low-fat dairy products as well as high intake of whole fat dairy products, animal fat, and organ meat. Mediterranean

diet was typified by low intake of hydrogenated vegetable oil and high intake of non-hydrogenated vegetable oil, fish, raw vegetable and olive oil.

Table 2 indicates the basic characteristics of the participant according to the quartiles of the major dietary patterns score. People in the highest quartile of prudent diet were younger and had more nutrition knowledge and were more physically. We also found the prudent dietary pattern was less frequent in high school student (all $P < 0.050$). Compared to the lowest quartile of fast food diet, adolescents in the highest quartile more watched TV and being boy and had less nutrition knowledge (all $P < 0.050$).

Table 1. Factor loading matrix for major dietary patterns in Iranian adolescents: Isfahan Healthy Heart Program

Food groups	Prudent diet	Fast food diet	Animal fat diet	Mediterranean diet
Dried fruit	0.558	-	0.233	-
Legumes	0.553	-	-	-
Raw vegetables	0.542	-	-0.303	0.419
Walnut	0.517	-	-	-
Fruits	0.509	-	-	-
Fresh fruit juices	0.464	-	-	0.303
Pickles	0.454	0.302	-	-
Nuts	0.447	-	-	-
Cooked vegetables	0.412	-	-	-
Potato	0.410	0.332	0.210	-
Jam	0.389	0.225	-	-
Red meat	0.368	-	-	-
Egg	0.319	-	0.223	-
Rice	0.278	-	-	-
Cheese	0.272	-	-	-
Junk food	-	0.651	-	-
Carbonate beverage	-	0.591	0.250	-
Sausages	-	0.511	-	-
Sweet and biscuit	-	0.429	-	-
Chocolate	-	0.413	-	-
Seeds	-	0.396	-	-
Canned food	-	0.362	-	-
Mayonnaise	0.333	0.339	-	-
Low-fat dairy products	-	-	-0.691	-
Whole fat dairy products	-	-	0.680	-
Animal fat	0.246	-	0.484	-
Organ meats	0.286	-	0.437	-
Hydrogenated oil	-	-	0.338	-0.591
Pizza	-	0.374	-	0.391
Hamburger	-	0.442	-	0.332
Liquid oil	-	-	-	0.440
Fish	0.252	-	-	0.435
Olive oil	-	-	-	0.403
Bread	-	-	-	-0.335
Chicken	0.223	0.228	-	0.241
Variance (%)	10.690	7.740	6.320	5.900
Total variance (%)			30.65	

The individuals in the highest quartile of animal fat diet had less nutrition knowledge, settled in urban and being high school student as well as residing in urban compared to the lowest quartile. In addition, being boy and middle school student were more in the highest quartile of animal fat diet compared to the lowest quartile (all $P < 0.010$). In comparison to the participants in the lowest quartile of the Mediterranean diet, someone in the highest quartile had more nutrition knowledge, settled in urban areas, was a member of a sport team, and was less likely to be a boy (all $P < 0.050$).

Table 3 illustrates the adjusted relationship of dietary pattern with demographic and behavioral characteristics. Prudent diet and animal fat had an inverse association with age ($\beta = -0.03$, $P = 0.030$ and $\beta = -0.02$, $P = 0.010$, respectively), whereas fast food diet related straightly with age ($\beta = 0.03$, $P = 0.020$). While the relationship of being a boy with prudent and Mediterranean diets were significantly reversed, it's relationship with fast food, and animal fat dietary patterns were positive (all $P < 0.050$). Urbanization correlated positively with the fast food diet, inversely related with animal fat and Mediterranean dietary patterns (all $P < 0.010$). The all dietary pattern had a significant positive correlation with membership in sports team (all $P < 0.050$), whereas only prudent diet showed a significant positive association with regular physical activity ($P < 0.001$). The fast food diet had a significant positive relationship with TV watching and inverse correlation with nutrition knowledge (all $P < 0.050$). The animal fat diet inversely associated with nutrition knowledge; however, Mediterranean diet had a positive relationship with it ($P < 0.001$).

Discussion

This study sought to recognize dietary patterns among a population-based sample of Iranian adolescents and whether they were related to socio-demographic and behavioral characteristics. The current analysis of adolescents has identified four major dietary patterns "prudent," "fast-food," "animal fat" and "Mediterranean" dietary pattern. The prudent diet was consistent with the findings of another cross-sectional study in Iranian adults; however the other dietary pattern had differences.⁶

A few studies have used factor analysis to examine the dietary patterns of adolescents, however, the identified dietary patterns showed some similarities with previous studies among adolescents. "Prudent diet" was similar to the "healthy diet" that was recognized by Ambrosini et

al.¹⁵ and illustrated by high intakes of whole grain, fruit, vegetable, legumes, and fish. Moreover it was consistent with the "healthy diet" that was greatly loaded by whole grains, yellow or red vegetable, leafy green vegetables, tomato, cruciferous vegetable, other vegetables, fresh fruit, legumes and fish which was recognized by Ambrosini et al.¹⁶ and the "healthy diet" categorized by Kiefte-de Jong et al.¹⁷ characterizing by fruit, vegetables and fish. "fast food diet" was similar to the "junk food diet" that was illustrated by high intakes of fried foods, sweets and soft drinks identified by de Moraes et al.,¹⁸ "unhealthy food diet" was characterized by high intakes of snacks, sweets, biscuits, and desserts in Fitzgerald et al.'s study,¹⁹ the "Western diet" consisted of high intakes of takeaway foods, soft drinks, confectionery, French fries, refined grains, full-fat dairy products and processed meats recognized by Ambrosini et al.¹⁵ as well as the "Snaky diet" was characterized by more frequent consumption of bakery products (buns, cakes and biscuits), sweets, salted snacks and soft drinks that was named by Kiefte-de Jong et al.¹⁷ Mediterranean diet was typified by low intake of hydrogenated vegetable oil and high intake of non-hydrogenated vegetable oil, fish and olive oil. Moreover, the findings of the current study in 3 derived dietary patterns of fast food, animal fat, and Mediterranean dietary pattern were consistent with the results of Mohammadifard et al.'s study among the Iranian adults population.²⁰ Therefore, this similarity indicated the dietary pattern of parents might be affected in their children.

The present population-based study highlights potential roles of socio-demographic and behavioral characteristics in influencing dietary patterns. In this study, we found that prudent and animal fat diets had an inverse association with age whereas fast food diet related straightly with age. It was consistent with McNaughton et al.'s study that showed inverse association between fruit, salad, cereals, and fish intakes with age,³ however it was inconsistent with Kiefte-de Jong et al.'s study that was showed inverse association between snaky pattern and age.¹⁷ Furthermore, the scores of prudent and Mediterranean dietary patterns inversely associated with being boy while fast food and animal fat dietary patterns had a positive relationship with it. This finding was alike of Kiefte-de Jong et al.'s study¹⁷ that was showed girls were more likely to follow the healthy dietary pattern.

In addition, higher nutrition knowledge score in the highest quartile of prudent diet compared to the lowest quartile showed having more nutrition

Table 2. Baseline characteristics of study population according to quartiles of dietary pattern

Characteristics	Prudent diet			Fast food diet			Animal fat diet			Mediterranean diet		
	Q ₁	Q ₄	P	Q ₁	Q ₄	P	Q ₁	Q ₄	P	Q ₁	Q ₄	P
Age (year)	14.6 ± 1.8	14.3 ± 1.8	0.040	14.3 ± 1.9	14.6 ± 1.7	0.080	14.4 ± 1.8	14.4 ± 1.8	0.200	14.5 ± 1.8	14.4 ± 1.9	0.080
Body mass index (kg/m ²)	19.9 ± 3.6	20.0 ± 3.8	0.500	20.0 ± 3.9	19.9 ± 3.5	0.90	20.6 ± 4.0	19.4 ± 3.4	0.100	19.5 ± 3.4	20.7 ± 4.2	0.100
TV watching (h/day)	3.2 ± 1.7	3.2 ± 1.6	0.700	3.0 ± 1.6	3.4 ± 1.6	0.020	3.2 ± 1.6	3.2 ± 1.6	0.600	3.3 ± 1.6	31 ± 1.7	0.100
Nutrition knowledge	45.5 ± 18.4	48.4 ± 19.3	0.005	56.2 ± 17.2	50.7 ± 21.2	< 0.001	48.2 ± 21.6	37.6 ± 22.4	< 0.001	57.0 ± 25.8	74.5 ± 24.1	< 0.001
Being boy (%)	50.4	49.3	0.500	48.1	55.5	0.007	38.2	64.4	< 0.001	58.7	47.2	< 0.001
Education degree												
Middle school (%)	26.0	25.7	0.900	26.9	23.2	0.100	21.5	27.8	0.008	24.5	25.7	0.800
High school (%)	33.8	24.2	0.040	22.8	25.8	0.070	28.8	21.9	0.001	25.5	24.2	0.800
Urbanization	77.2	73.9	0.300	76.8	79.9	0.100	95.2	43.3	< 0.001	63.9	88.8	< 0.001
Regular physical activity (%)	21.1	27.9	< 0.001	23.7	24.5	0.070	24.3	27.7	0.100	24.8	25.4	0.800
Membership in sports team (%)	19.3	29.9	0.001	22.6	27.2	0.300	22.8	25.2	0.200	23.0	28.8	0.030

Q1: Quartile 1; Q4: Quartile 4

Table 3. Linear regression of major dietary pattern with demographic and behavioral characteristics

Dietary pattern	R ²	Age		Being boy		Urbanization		Regular physical activity		Membership in sport team		TV watching		Nutrition Knowledge	
		β	P	β	P	β	P	β	P	β	P	β	P	β	P
Prudent diet	0.08	-0.03	0.030	-0.22	< 0.001	-0.10	0.070	0.25	< 0.001	0.15	0.006	-0.003	0.600	-0.17	0.200
Fast food diet	0.07	0.03	0.020	0.10	0.030	0.46	0.003	-0.04	0.500	0.11	0.040	0.400	0.006	-0.28	0.010
Animal fat diet	0.04	-0.02	0.010	0.40	< 0.001	-1.11	< 0.001	-0.03	0.400	0.14	0.002	-0.006	0.600	-0.35	< 0.001
Mediterranean diet	0.09	-0.02	0.070	-0.20	< 0.001	-0.36	< 0.001	0.07	0.100	0.19	< 0.001	-0.020	0.100	0.65	< 0.001

β: Linear regression coefficient

knowledge more likely to choose healthy dietary patterns and Mediterranean dietary pattern positively related to nutrition knowledge while unhealthy dietary patterns including animal fat and fast food diets had inverse association with nutrition knowledge. This finding was similar to Tsartsali et al.'s study²¹ that was revealed nutrient intake was a close coherence to the degree of nutritional knowledge. Urbanization correlated positively with the fast food diet and inversely with other dietary patterns that were consistent with McNaughton et al.'s study³ in which vegetable dietary pattern positively associated with rural residency. Middle school students more likely to consume animal fat diet, however high school students had less intake of animal fat dietary pattern as well as prudent diet was alike Puska's study²² that determined a clear trend toward lower intakes of fat, especially saturated fat, and increased consumption of vegetables and fruit from childhood to adolescence that These changes are supposed to have happened as a result of a main investing in nutrition education and our finding is contrasting with Mikkila et al.'s study that showed with passage from childhood to adolescence Intakes of fat and saturated fat had decreased, while the consumption of vegetables and fruit had increased.²³ The prudent and Mediterranean dietary patterns had a significant positive correlation with membership in sports team. In was in agreement with de Moraes et al.¹⁸ finding that was demonstrated healthy dietary pattern was positively associated with physical activity level. In addition, some studies have shown physically active girls were more likely to have healthy eating patterns.^{24,25} It might be due to who have healthy lifestyle such as regular physical activity more likely to consume healthy food. Our study illustrated that fast food dietary pattern positively associated with TV watching. It was similar to Ambrosini et al.'s study that was indicated Western and snack dietary patterns positively and healthy dietary pattern inversely correlated with TV watching.¹⁵ Furthermore, other studies found TV watching associated with higher consumption of soft drinks¹⁷ and fried foods.²⁶

Study limitations and strengths

The study sample size was large which enables us to have an adequate power for some analyses. Moreover, the study population was from three districts of Iran with heterogeneous socioeconomic status. Therefore, we believe that the study has covered a wide range of dietary intakes.

Our study has some limitations. Factor analysis,

as being a statistical technique, requires some arbitrary decisions and subjective interpretation of factors. Although a validated FFQ has been used for dietary data collection, we acknowledge the limitations of FFQ regarding individual measurement error; however, the FFQ remains one of the very most practical dietary methods for epidemiological studies. Our FFQ contained 50 common food items. It was shorter than some other FFQs used to obtain information about dietary patterns.²⁷ Moreover, our FFQ was qualitative and did not quantify food and total energy intake. However, some investigators believe that data on portion sizes do not add much to the dietary data.²⁸ Furthermore, among socio-demographic characteristics, some other factors such as family income, parents' education level, number of children have not been detected that can effect on the dietary pattern.

Conclusion

Our study of dietary patterns suggests that adolescent dietary intake is dependent on factors related to the sex, age, urbanization, TV watching, sports, and nutrition knowledge. Unhealthy dietary habits in adolescents are associated with more TV watching, and being boy as well as less nutrition knowledge, and urbanization. The identification of dietary patterns in this study will be useful for future longitudinal analyses of diet and various statuses.

Acknowledgments

This program was supported by a grant (No. 31309304) from the Iranian Budget and Planning Organization, as well as the Deputy for Health of the Iranian Ministry of Health and Medical Education and Iranian Heart Foundation as well as Isfahan Cardiovascular Research Centre and Isfahan Provincial Health Center, both affiliated to Isfahan University of Medical Sciences.

Conflict of Interests

Authors have no conflict of interests.

References

1. Spear BA. Adolescent growth and development. *J Am Diet Assoc* 2002; 102(3 Suppl): S23-S29.
2. Rogol AD, Roemmich JN, Clark PA. Growth at puberty. *J Adolesc Health* 2002; 31(6 Suppl): 192-200.
3. McNaughton SA, Ball K, Mishra GD, Crawford DA. Dietary patterns of adolescents and risk of obesity and hypertension. *J Nutr* 2008; 138(2):

- 364-70.
4. Mikkilä V, Rasanen L, Raitakari OT, Pietinen P, Viikari J. Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study. *Br J Nutr* 2005; 93(6): 923-31.
 5. Mohammadifard N, Sarrafzadegan N, Ghassemi GR, Nouri F, Pashmi R. Alteration in unhealthy nutrition behaviors in adolescents through community intervention: Isfahan Healthy Heart Program. *ARYA Atheroscler* 2013; 9(1): 89-97.
 6. Bahreynian M, Paknahad Z, Maracy MR. Major dietary patterns and their associations with overweight and obesity among Iranian children. *Int J Prev Med* 2013; 4(4): 448-58.
 7. Hoffmann K, Schulze MB, Schienkiewitz A, Nothlings U, Boeing H. Application of a new statistical method to derive dietary patterns in nutritional epidemiology. *Am J Epidemiol* 2004; 159(10): 935-44.
 8. Pala V, Sieri S, Masala G, Palli D, Panico S, Vineis P, et al. Associations between dietary pattern and lifestyle, anthropometry and other health indicators in the elderly participants of the EPIC-Italy cohort. *Nutr Metab Cardiovasc Dis* 2006; 16(3): 186-201.
 9. Nettleton JA, Steffen LM, Mayer-Davis EJ, Jenny NS, Jiang R, Herrington DM, et al. Dietary patterns are associated with biochemical markers of inflammation and endothelial activation in the Multi-Ethnic Study of Atherosclerosis (MESA). *Am J Clin Nutr* 2006; 83(6): 1369-79.
 10. Knol LL, Haughton B, Fitzhugh EC. Dietary patterns of young, low-income US children. *J Am Diet Assoc* 2005; 105(11): 1765-73.
 11. Schulze MB, Hoffmann K. Methodological approaches to study dietary patterns in relation to risk of coronary heart disease and stroke. *Br J Nutr* 2006; 95(5): 860-9.
 12. Kelishadi R, Sarrafzadegan N, Sadri GH, Pashmi R, Mohammadifard N, Tavasoli AA, et al. Short-term results of a community-based program on promoting healthy lifestyle for prevention and control of chronic diseases in a developing country setting: Isfahan Healthy Heart Program. *Asia Pac J Public Health* 2011; 23(4): 518-33.
 13. Kelishadi R, Mohammadifard N, Sarrafzadegan N, Nouri F, Pashmi R, Bahonar A, et al. The effects of a comprehensive community trial on cardiometabolic risk factors in adolescents: Isfahan Healthy Heart Program. *ARYA Atheroscler* 2012; 7(4): 184-90.
 14. Mohammadifard N, Kelishadi R, Safavi M, Sarrafzadegan N, Sajadi F, Sadri GH, et al. Effect of a community-based intervention on nutritional behaviour in a developing country setting: the Isfahan Healthy Heart Programme. *Public Health Nutr* 2009; 12(9): 1422-30.
 15. Ambrosini GL, Oddy WH, Robinson M, O'Sullivan TA, Hands BP, de Klerk NH, et al. Adolescent dietary patterns are associated with lifestyle and family psycho-social factors. *Public Health Nutr* 2009; 12(10): 1807-15.
 16. Ambrosini GL, Huang RC, Mori TA, Hands BP, O'Sullivan TA, de Klerk NH, et al. Dietary patterns and markers for the metabolic syndrome in Australian adolescents. *Nutr Metab Cardiovasc Dis* 2010; 20(4): 274-83.
 17. Kiefte-de Jong JC, de Vries JH, Bleeker SE, Jaddoe VW, Hofman A, Raat H, et al. Socio-demographic and lifestyle determinants of 'Western-like' and 'Health conscious' dietary patterns in toddlers. *Br J Nutr* 2013; 109(1): 137-47.
 18. de Moraes AC, Adami F, Falcao MC. Understanding the correlates of adolescents' dietary intake patterns. A multivariate analysis. *Appetite* 2012; 58(3): 1057-62.
 19. Fitzgerald A, Heary C, Kelly C, Nixon E, Shevlin M. Self-efficacy for healthy eating and peer support for unhealthy eating are associated with adolescents' food intake patterns. *Appetite* 2013; 63: 48-58.
 20. Mohammadifard N, Sarrafzadegan N, Nouri F, Sajjadi F, Alikhasi H, Maghroun M, et al. Using factor analysis to identify dietary patterns in Iranian adults: Isfahan Healthy Heart Program. *Int J Public Health* 2012; 57(1): 235-41.
 21. Tsartsali PK, Thompson JL, Jago R. Increased knowledge predicts greater adherence to the Mediterranean diet in Greek adolescents. *Public Health Nutr* 2009; 12(2): 208-13.
 22. Puska P. Nutrition and global prevention on non-communicable diseases. *Asia Pac J Clin Nutr* 2002; 11(Suppl 9): S755-S758.
 23. Mikkilä V, Rasanen L, Raitakari OT, Pietinen P, Viikari J. Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study. *Eur J Clin Nutr* 2004; 58(7): 1038-45.
 24. Boone-Heinonen J, Gordon-Larsen P, Adair LS. Obesogenic clusters: multidimensional adolescent obesity-related behaviors in the U.S. *Ann Behav Med* 2008; 36(3): 217-30.
 25. Berkey CS, Rockett HR, Field AE, Gillman MW, Frazier AL, Camargo CA, et al. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics* 2000; 105(4): E56.
 26. Newby PK, Weismayer C, Akesson A, Tucker KL, Wolk A. Long-term stability of food patterns identified by use of factor analysis among Swedish women. *J Nutr* 2006; 136(3): 626-33.
 27. Khani BR, Ye W, Terry P, Wolk A. Reproducibility and validity of major dietary patterns among

Swedish women assessed with a food-frequency questionnaire. *J Nutr* 2004; 134(6): 1541-5.

28. Souverein OW, de Boer WJ, Geelen A, van der voet H, de Vries JH, Feinberg M, et al. Uncertainty in intake due to portion size estimation in 24-hour recalls varies between food groups. *J Nutr* 2011; 141(7): 1396-401.

How to cite this article: Kafeshani O, Sarrafzadegan N, Nouri F, Mohammadifard N. **Major dietary patterns in Iranian adolescents: Isfahan Healthy Heart Program, Iran.** *ARYA Atheroscler* 2015; 11 (Suppl 1): 61-8.