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Dietary Patterns and Their Association with Sociodemographic and Lifestyle Determinants in Kashan, Iran: A Cross-Sectional Study

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ABSTRACT

Background: Dietary patterns (DPs) are a combination of nutrients which are determined through feeding behaviors of a particular population. Paying attention to DPs gives us a good picture of the diet and eating habits of people in the community. DPs help identify people at risk of chronic nutrition-related illnesses and give them nutritional advice. In the present study, the authors determine the DPs of people in Kashan city, Iran**. Methods:** This cross-sectional study was conducted to determine the DPs of the Kashan population from September 2019 to March 2020. A validated food frequency questionnaire (FFQ) was used to collect sociodemographic and dietary data. Then, DPs were assessed using principal component analysis. **Results:** The results showed that the average consumption of food items in cereals and products based on cereals, fruits and fruit products, vegetables and their products, meat and meat products, and milk and dairy products were 282.38±65.71, 287.58±8.89, 364.17±21.05, 34.48±3.81, and 456.65±39.16 g/day, respectively. The identified DPs included: 1) Unhealthy and processed, 2) fruit and fruit-based products, 3) Kashan traditional food, 4) Healthy diet, and 5) Mixed diet. **Conclusion**: Findings of the present study reveal that sociodemographic factors and lifestyle are associated with food choices. In addition, the authors found the low consumption of grains, fruits, vegetables, and meat and their products in the studied population. The researchers call for nutritional interventions to modify the consumption pattern for these food items.

Keywords: Cross-sectional; Dietary pattern; Lifestyle; Factor analysis

Introduction

Access to sufficient and healthy food is one of the main axes of societal development and health (Gholizadeh *et al.*, 2017). The nutritional status of any individual in society depends on several factors, such as age, gender, cultural factors, economic status, level of education, etc. (Keramati *et al.*, 2015, Rostami *et al.*, 2016). Nutritionists adopt a dietary pattern perspective to investigate the impact of diet on health outcomes (Esmaeilzadeh *et al.*, 2007, Fabiani *et al.*, 2016). In the past, the lack of food and diseases were the main health problems of human societies. However, the main problem today is inadequate attention to healthy nutrition and improper food

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consumption (Rostami *et al.*, 2016). DPs are related to obesity, metabolic syndrome, diabetes, cancer development, and other risk factors of cardiovascular diseases (Batis *et al.*, 2016, Rashidkhani *et al.*, 2008, Sun *et al.*, 2016), and chronic diseases resulting from improper diet and lifestyle are the leading causes of death (Pasdar *et al.*, 2014). Sufficient food consumption during pregnancy plays a vital role in women's health, fetal growth, and birth weight (de Castro *et al.*, 2016, Ghasab Shirazi *et al.*, 2016). Over the last few decades, many epidemiological studies have confirmed that diet notably affects mental health (Li *et al.*, 2017), and studies in Europe have shown the effects of diet quality on developing depression, anxiety, and cognitive impairment in the elderly (Milte and McNaughton, 2016). Given the role of people's dietary habits and patterns in nutrient consumption over time and the development of nutrition-related diseases, addressing the DP in general and specific nutrients in particular are critical, albeit complicated (Tarighat-Esfanjani *et al.*, 2016). In addition to food-based dietary guidelines, promoting healthy DPs can help improve diet and health within a population (Ax *et al.*, 2016, Haghighatdoost *et al.*, 2012). In general, DPs can be defined as the amount, proportion, variety, or combination of different foods and drinks in diets and the frequency of their consumption (Schulze *et al.*, 2018). The DPs consisting of food intake complexity could give us a clear picture of the diet and of the nutritional habits of people in society. Moreover, these patterns help identify people with nutrition-related chronic diseases and offer nutritional recommendations due to their less familiarity with nutrient contents in food choices (Hosseyni Esfahani *et al.*, 2008). In other words, it is necessary to consider the combination of different foods that people often consume together based on diet recommendations and guides (Golabi *et al.*, 2016). Therefore, DPs reflect an individual's nutritional behavior; hence, analyzing dominant DPs can provide detailed information on the relationship between diseases and diet, interaction among nutrients, and to a large extent, the correlation between food intake and nutrients (Mohammadshahi *et al.*, 2015). Nutrition training interventions combine educational strategies and environmental support to facilitate the adoption of healthy nutritional behaviors, which can be delivered at individual, community, and policy levels (Ghasab Shirazi *et al.*, 2016). Therefore, there is an urgent need to understand and compare broader DPs among the countries representing different geographic regions and developmental stages (Mikkilä *et al.*, 2015). It is quite evident that pinpointing dominant dietary patterns is different across different regions and cultures, and no comprehensive study has been conducted in Kashan in this domain. Therefore, this study reports on the DPs of people in Kashan.

Materials and Methods

Study population and dietary intake assessment

This cross-sectional study intended to determine the dietary patterns of people in Kashan from September 2019 to March 2020. The sample size based on the consumption ratio of vegetables, fruit, milk, yogurt and buttermilk, legumes, and rice was 0.17, 0.38, 0.13, 0.325, 0.18, and 0.36, respectively (Rostami *et al.*, 2016). The first kind of error of 5% and estimated error of 4% were obtained as 338, 565, 272, 526, 354 and 553, respectively. In this study, more samples (n=562) were selected. Since cluster sampling was used, the total number of samples was equal to 562*1.7=955 based on the effect design of 1.7. Kashan was divided into seven districts based on socioeconomic status, and then, blocks were made based on neighborhoods in each district. According to the weight of each district and the number of blocks, the number of households in each cluster was determined using systematic random selection (the weight of the categories was obtained from the cooperation of the health centers at Kashan University of Medical Sciences. The centers in each district were considered clusters, and the experts of those centers were recruited. The authors conducted a study in each neighborhood by considering the high number of referrals to the

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centers and the distribution of the covered population). The households were randomly selected from the list of households in each cluster. Households were contacted and mothers were asked (Azadbakht *et al.*, 2012) to refer to the center for examination**.** In order to collect information on people's diet, the food frequency questionnaire (FFQ), which is already validated in Iran, was used (Pasdar *et al.*, 2014). Moreover, the validity and reliability of this questionnaire were confirmed in many studies in Iran (Esfahani *et al.*, 2010, Hosseinpour-Niazi *et al.*, 2013, Rashidkhani *et al.*, 2011). FFQ is a tool to determine the consumption of food items over the past year (Xu *et al.*, 2016).

Participants were excluded if they had at least one of the following characteristics: 1) No FFQ was completed; 2) Less than 30 items were consumed according to the completed FFQ; 3) There was no data for sociodemographic and lifestyle determinants.

Ethical considerations

It is worth mentioning that this paper was part of the research project 98173 of the Vice-Chancellor for Research, Kashan University of Medical Sciences, Kashan, with an ethics code of IR.KAUMS.MEDNT.REC.1398.114 approved by the University Ethics Committee.

Data analysis

In this study, the food data extracted from the questionnaire was first converted into grams by Nutrition4 software for each person. Finally, SPSS was used to analyze the relevant information**.** The data obtained from the 144 food item FFQs were used to determine dietary patterns using factor analysis by SPSS. Then, the researchers described the data using descriptive statistics, such as measures of central tendency and dispersion for the quantitative variables. Absolute and relative frequency was used to describe the qualitative variables. Moreover, the authors drew essential tables and diagrams for the variables. Then, the dominant dietary patterns were obtained from th factor analysis. In this study, factor loading values greater than 0.2 were considered to determine dietary groups in each dietary pattern. Factor loading indicated the correlation coefficient between a dietary group and any dietary pattern, with larger values showing a greater correlation and a positive or negative sign representing a direct or inverse relationship between that dietary group and the patterns. As such, the dietary patterns were obtained by placing the consumed food items in these factors and the factor loading values of the groups.

Results

Demographic information, including age, marital status, and level of education is presented in **Table 1**. The results of the principal components analysis are shown in **Table 2**.

Five dietary patterns were identified, explaining 35.4% of the overall variance. The DPs included: 1) Unhealthy and processed, 2) Fruit and fruit-based products, 3) Kashan traditional, 4) Healthy, and 5) Mixed.

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Table 1. Demographic and anthropometric variables in the studied population (n=955).

Variables	
Age (year)	39.69 ± 13.80[a]
Height (cm)	165.72 ± 5.80
Weight (kg)	67.65 ± 10.53
Body mass index (kg/m^2)	24.71 ± 4.14
Employment status	
Housewife	565 (59.2)[b]
Employed	390 (40.8)
Education status	
High school diploma	272 (28.5)
High school diploma to Bachelor's degree	591 (61.9)
Master's degree and higher	92 (9.6)
Economic status	
Poor	120 (12.6)
Average	473 (49.5)
Good	362 (37.9)
Frequency of people with hypertension	164 (17.2)
Frequency of diabetics	85 (8.9)
Frequency of people with cardiovascular disease	131 (13.7)
Frequency of people with cancer	28 (2.9)
Frequency of obese people	237 (24.8)
Frequency of people with anemia	343 (35.9)
Smoking	17 (1.8)
Alcohol consumption	2 (0.2)
Frequency of people with a family history of hypertension	403 (42.2)
Frequency of people with a family history of diabetes	266 (27.9)
Frequency of people with a family history of cardiovascular disease	305 (31.9)
Frequency of people with a family history of cancer	148 (15.5)
Frequency of people with a family history of obesity	275 (28.8)
Frequency of people with a family history of anemia	231 (24.2)

[a]:Mean±SD; [b]: n(%)

Table 2. Factor load of food groups in dietary patterns in Kashan population.

Unhealthy and processed		Fruit and fruit-based products		Kashan traditional food		Healthy		Mixed	
Food items	**FLV**	**Food items**	**FLV**	**Food items**	**FLV**	**Food items**	**FLV**	**Food items**	**FLV**
Puff Paste	0.705	Peach	0.776	Homemade Halva	0.297	Cooked Beans	0.233	Macaroni	0.235
Mayonnaise	0.678	Nectarine	0.770	Tea	0.252	Bean	0.391	Grapefruit	0.348
Pizza	0.630	Plum	0.734	Tongue	0.795	Cream	0.353	Tuna	0.273
Industrial Ice-cream	0.612	Apricot	0.707	Brain	0.793	Buttermilk	0.265	Coffee	0.255
Confetti	0.610	Persimmon	0.684	Head	0.784	Soya	0.338	Almond	0.217
Sauce	0.602	Kiwi	0.676	Feet	0.770	Groundnut	0.240	Mushrooms	0.220
Pickle	0.559	Cherry	0.662	Tripe	0.612	Margarine	0.200	Thin green pepper	0.259
Chips	0.558	Tangerine	0.657	Sohan	0.541	Corn	0.293	Stewed pumpkin	0.216
Baguette Bread	0.545	Pomegranate	0.631	Haslet	0.525	Dried mulberry	0.351	Potato	0.227
Soda	0.542	Pear	0.622	Gaz	0.503	Vermicelli	0.573	Tomato	0.648
Acerbity	0.541	Fig	0.607	Animal Oil	0.411	Lettuce	0.568	Full fat yogurt	0.601

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Cookie	0.539	Lemons	0.607	Taftoun bread	0.321	Peas	0.540	Cooked vegetables	0.580
Biscuit	0.539	Apple	0.547	Beef	0.288	Lentil	0.539	Cabbage	0.558
Raw onion	0.537	Strawberries	0.536	Whey	0.256	Green live	0.510	Raw onion	
Candy	0.536	Banana	0.531	Vetch	0.203	Sweet Oil	0.502	Full fat milk	0.517
Sugar	0.536	Greengage	0.517	Traditional ice-cream	0.294	Bulgur	0.486	Chicken	0.516
Chocolate	0.534	Berry	0.516			Squash	0.480	Lemon juice	0.514
Sausage	0.530	Watermelon	0.501			Ash Reshteh	0.478	Strained yogurt	0.484
Butter	0.513	Date	0.450			Fruit compote	0.462	Cucumber	0.474
Fried potato	0.509	Cantaloupe	0.445			Baked green beans	0.441	Barbari bread	0.473
Cake	0.500	Orange	0.445			Celery	0.434	Minced meat	0.456
Bologna	0.488	Melon	0.382			Turnip	0.415	Salty pickle	0.434
Salt	0.480	Grape	0.376			Pea	0.413	Sangak bread	0.429
Cream pastries	0.470	Dried fig	0.213			Eggplant	0.397	Mutton	0.418
Hamburger	0.465	Dried fruit	0.283			Split pea	0.395	Fried onion	0.416
Chocolate milk	0.464	Sour lemon	0.250			Low-fat milk	0.394	Hazelnut	0.396
Halva	0.464					Raw carrot	0.393	Bell pepper	0.386
Jam	0.452					Raisin	0.386	Cream cheese	0.381
Seed	0.440					Fish	0.348	Egg	0.340
Lavash bread	0.335					Walnuts	0.325	Rice	0.322
Liquid oil	0.299					Vegetable	0.317	Garlic	0.295
Crackers	0.231					Pistachio	0.253	Cheese	0.253
Juice box	0.252					Spinach	0.376		
						Cooked carrots	0.247		
						Honey	0.214		
						Apple juice	0.309		
						Orange Juice	0.232		
						Yogurt	0.215		

FLV: Factor loadings values of less than 0.2 were removed for simplification.

The results showed that the consumption of unhealthy, processed, and Kashan traditional dietary patterns was reduced in accordance with age. With weight gain, the consumption of unhealthy and processed dietary patterns and fruit and fruit-based products declined. Furthermore, the consumption of unhealthy and processed dietary patterns and fruit and fruit-based products showed a declining trend based on BMI. The results of comparison are shown in **Table 3**. The association between sociodemographic and lifestyle of the participants and the five dietary patterns are summarized in **Table 4**. The results showed that a higher level of education was associated with the consumption of unhealthy and processed dietary patterns (P<0.001) and fruit and fruit-based products (P<0.034). On the other hand, low educational level corresponded to consuming mixed dietary patterns (P<0.001). The results further indicated that people with diabetes rarely ate unhealthy and processed patterns (P<0.001) and relied more on healthy patterns (P<0.001). The authors found that people suffering from cardiovascular diseases frequently had healthy dietary patterns (P<0.001) and rarely used unhealthy and processed (P<0.004) traditional (P<0.027) and mixed patterns (P<0.001). In addition, people with cancer consumed less unhealthy, processed (P<0.041), and mixed patterns (P<0.049) and relied more on fruit and fruit-based products (P<0.014) and healthy patterns (P<0.014).

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Table 3. Correlation coefficient between dietary patterns, age and anthropometric variables in the studied population.

Variables	Unhealthy and processed food	Fruit and fruit-based products	Kashan traditional food	Healthy	Mixed
Age	-0.28 (<0.001)[a]	0.06 (0.07)	-0.16 (<0.001)	0.19 (<0.001)	0.02 (0.56)
Weight	-0.11 (0.01)	-0.08 (0.02)	0.07 (0.04)	-0.04 (0.23)	0.05 (0.15)
Body mass index	-0.14 (<0.001)	-0.05 (0.11)	0.06 (0.05)	-0.02 (0.49)	0.07 (0.02)

[a]: r (P-value)

Table 4. Association between sociodemographic and lifestyle and dietary patterns in the studied population.

Variables	Unhealthy and processed food	Fruit and fruit-based products	Kashan traditional food	Healthy	Mixed
Employment status	<0.001	0.99	0.18	0.004	<0.001
Education status	<0.001	0.034	0.137	0.736	<0.001
Economic status	<0.001	<0.001	<0.001	<0.001	<0.001
Diabetes	<0.001	0.332	0.528	<0.001	0.258
Cardiovascular diseases	0.004	0.485	0.027	<0.001	0.001
Cancer	0.041	0.014	0.162	0.014	0.049
Overweight and obese	0.005	0.007	<0.001	0.616	<0.001
Hypertension	<0.001	0.370	0.664	<0.001	0.849
Anemia	<0.001	0.022	0.165	0.151	0.031
Smoking	0.585	0.143	0.834	0.127	0.684
Alcohol consumption	0.318	0.270	0.061	0.052	0.332
Family history of diabetes	0.017	0.517	<0.001	0.701	<0.001
Family history of cardiovascular diseases	0.280	0.340	<0.001	0.040	0.818
Family history of cancer	0.426	0.904	<0.001	0.148	0.131
Family history of overweight and obesity	0.016	<0.001	<0.001	0.825	<0.001
Family history of hypertension	0.003	0.031	0.211	0.070	0.061
Family history of anemia	0.032	<0.001	0.825	0.007	0.794

To determine the average consumption of dietary groups, first the average daily consumption of food items in g was obtained. Then, based on the given dietary groups, their per capita consumption was acquired. The results are shown in **Table 5**. Based on the studied dietary groups, the per capita consumption was compared with the one in 4 clusters from around the world. Iran was in $G_{6,}$ and the European Union countries were in $G_{7,}$ according to GEMS/Food Consumption Cluster Diets (**Table 6)**.

Discussion

In this study, based on per capita consumption of dietary cluster, the average consumption of fruit and fruit-based products, vegetables and vegetable-based products, cereals and cereal-based products, and meat and meat-based products in Kashan was lower than the national standard (G_6). Nonetheless, the consumption of milk and dairy products was higher than the standard. The results showed the consumption of fruit and fruit-based products, vegetables and vegetable-based products, and milk and dairy products in the developing Asian countries of the G_1 and $G_{5,}$ such as Tunisia, Afghanistan, Pakistan, and India, was lower compared to people from Kashan. In addition, the consumption of grain and meat in those countries was higher than Kashan. Moreover, it was found that the consumption of fruit and fruit-based products, vegetables and vegetable-based products, cereals and cereal-based products, and milk and dairy products in

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the developed countries in Europe and America- G_7 and G_{10}- such as Canada, New Zealand, Switzerland, Australia, and Norway, was lower compared to the one in Kashan. Their meat consumption was also higher than that of Kashan population.

Table 5. Per capita consumption of food groups in Kashan population.

Food groups	Standard value G6	Per capita consumption in Kashan (gram)	P-value[b]
Grains and grain-based products	484	282.38±65.71[a]	<0.001
Fruit and fruit-based products	420	287.58±8.89	<0.001
Vegetables and vegetables-based products	441	364.17±21.05	<0.001
Meat and meat-based products	77.1	34.48±3.81	<0.001
Milk and dairy products	162	456.65±39.16	<0.001

[a]: Mean ±SD; [b]: Independent t-test.

Table 6. Comparing per capita consumption in diet cluster of European Union countries with the diet cluster in Kashan.

Food groups	Per capita consumption in Kashan (g/day)	Cluster of European Union countries				
		G1	G5	G6	G7	G10
Fruit and fruit-based products	287.58	151	160	420	175	201
Vegetables and vegetables -based products	364.17	155	150	441	217	303
Grains and grain-based products	282.38	380	365	484	247	284
Meat and meat-based products	34.48	51	62.7	77.1	230	204
Milk and dairy products	456.65	261	177	162	325	279
Egg	23.95	9.26	11.6	17.1	29.8	29.3
Fats	12.22	39.1	33.6	40.2	79.9	75
Fish and seafood	7.23	8.77	16.7	24.6	45.3	56.1
Spices, seasonings and sauces	35.70	4.97	4.81	4.82	6.72	7.84
Legumes and nuts	50.07	20.5	50.6	38.3	15.7	27.3
Sugar and sweets	84.09	102	86.7	116	106	134

The study results showed that people with hypertension rarely ate processed and unhealthy food and depended more on healthy diets. Western, healthy, and traditional food included three dietary patterns in the studies by Rousta, Haghighat Doust, Motaghi, and Shin (Haghighatdoost *et al.*, 2012, Mottaghi *et al.*, 2015, Roosta *et al.*, 2015, Shin *et al.*, 2013). People with a healthy diet had a lower chance of developing hypertension. In contrast, those who followed western dietary pattern had a higher chance of cardiovascular diseases and hypertension. The study results showed that the cases with cardiovascular diseases frequently consumed healthy food and used less unhealthy, processed, traditional, and mixed foods. In the studies by Hou and Eilat-Adar (Eilat-Adar *et al.*, 2013, Hou *et al.*, 2015), people who consumed healthy food had a lower chance of cardiovascular diseases. The results showed that people with diabetes rarely had unhealthy and processed food and frequently used healthy food. Qian, Alhazmi, and Jannasch identified vegetarian (mostly healthy), healthy, unhealthy, and Mediterranean dietary patterns (Alhazmi *et al.*, 2014, Jannasch *et al.*, 2017, Qian *et al.*, 2019). In these studies, people who consumed more vegetarian and healthy food had a lower chance of diabetes. The results showed that those who were overweight and obese seldom ate unhealthy, processed, and fruit-based products and often had Kashan traditional and mixed food diets. In the studies by Esmailzadeh, Ghorbannejad, and Shanshin, healthy, western, traditional, high-protein, prepared foods, and salty snacks were identified (Esmaeilzadeh *et al.*, 2011, Ghorbannejad *et al.*, 2020, Nazary, 2015). People who consumed healthy food had a lower chance of

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developing general and abdominal obesity, while those in the highest quintile of Western dietary patterns had a higher chance of general and abdominal obesity. Moreover, the high-protein dietary pattern was directly related to thinness. In this study, people with cancer hardly consumed unhealthy, processed, and mixed food, and frequently used healthy food and fruit and fruit-based products. In the same vein, Tazhibi *et al.* identified four dominant dietary patterns in the studied population (Tazhibi *et al.*, 2011). Moreover, no significant relationship was detected between dominant dietary patterns and colon cancer risk.

The present study had several limitations to note. The cross-sectional setting of the work only permitted establishing associations, and no causal inferences could be drawn. Furthermore, the portion size was self-reported and might have been misevaluated by the participants. Still, this is a common issue among self-reported dietary intake, and dietary patterns do not change significantly when input variable quantification changes. One of the strengths of this study was the use of state-of-the-art dietary assessment tools, which limited the possibility of bias. Besides, this analysis was carried out by nutritionists using N4 software. The data collection method for food intake was common in epidemiological studies, especially large-scale studies (Li *et al.*, 2017). Overall, the results implied that dietary patterns were closely related to lifestyle.

Conclusion

Five dietary patterns, namely unhealthy and processed, fruit and fruit products-based, traditional Kashan diet, and healthy, and mixed were identified in Kashan population. Then, numerous associated modifiable behaviors were determined. The data on sociodemographic determinants might adequately target the most vulnerable groups in public health interventions.

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Authors' contributions

Mostafaii GH and Sharafati Chaleshtori R designed the research. Asgari Tarazoj F and Mazandaranianfard M collected the data. Sharifi N and Atoof F conducted statistical analysis. Sharafati Chaleshtori R, Dehghani R, Rabbani D and Miranzadeh MB wrote the manuscript. Mostafaii GH, Sharafati Chaleshtori R and Asgari Tarazoj F had primary responsibility for final content, and all the authors read and approved the final manuscript.

Conflicts of interest

The authors declared no conflict of interests.

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