

Association of dietary patterns with anthropometric, lifestyle and socio-economic factors among women of selected communities from Karachi, Pakistan

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Abstract

Objective: To identify major dietary patterns and examine their association with anthropometric, lifestyle and socio-economic factors among women belonging to different communities living in Karachi.

Methods: This cross-sectional study was conducted in Karachi from June 2014 to August 2015, and comprised women of Aga Khani, Dawoodi Bohra and Memon communities. Dietary data was collected through a 108-item food frequency questionnaire and dietary patterns were derived by factor analysis. Three dietary patterns were extracted: processed, mixed and traditional. SPSS 20 was used for data analysis.

Results: Of the 322 participants, 108(33.54%) belonged to the Aga Khani community, and 107(33.23%) each to Dawoodi Bohra and Memon communities. Moreover, 58(53.7%), 39(36.4%) and 25(23.4%) in the three groups, respectively, had a university degree. Besides, 44(40.7%) women belonging to the Aga Khani community were married, compared to 53(49.5%) and 37(34.6%) in Dawoodi Bohra and Memon communities. The mean factor loading for mixed food pattern was 0.24 among women of the Aga Khani community, whereas respective values for Dawoodi Bohra and Memon communities were 0.005 and -0.25. The mean factor loading for traditional pattern was 0.77 in the Dawoodi Bohra community, in contrast to -0.24 and -0.52 among women belonging to Memon and Aga Khan communities. Processed food pattern was negatively associated with age in the Aga Khani community ($p<0.001$) and Dawoodi Bohra community ($p=0.010$). Mixed food pattern was positively associated with family size in the Aga Khani community ($p=0.007$), with watching television for 1-3 hours ($p=0.007$) and higher family income in the Dawoodi Bohra community ($p=0.009$). Traditional food pattern depicted a positive association for watching television >1-3 hours/day ($p=0.028$) and total calorie consumption/day ($p=0.008$) in Dawoodi Bohra community. A negative trend was noted for watching television (1-3 hours/day $p=0.020$; >3hours/day $p=0.004$) and physical inactivity ($p=0.039$) in the Memon community.

Conclusion: Lifestyle and socio-economic variables were found to be associated with dietary patterns in all communities.

Keywords: Dietary patterns, Factor analysis, Communities, Pakistan. (JPMA 66: 1249; 2016)

Introduction

A tremendous amount of research work has been conducted to investigate the effect of individual nutrients on health and disease. However, food does not consist of a single isolated nutrient, but rather it is a combination of various nutrients. Different foods are often eaten together. Understanding this complexity of diet, nutritional studies over the last few decades mostly covered different measures assessing the quality of diet and dietary patterns and their symbiotic effect on health and diseases.¹ The subsequent approach focusing on whole diet is efficacious in interpreting the diet-disease relationship. Dietary pattern analysis is a comprehensive approach which helps to identify whether people are consuming nutritionally healthier combination of foods²

and explore their association with health. Genetic, cultural, social, health, environmental, lifestyle and economic factors direct food choices of people.

The developed world took the lead in conducting epidemiological researches related to dietary patterns. However, such studies are scarce in developing countries,^{3,4} including Pakistan, most of them being disease-specific.⁵⁻⁷ Due to various lifestyles, social, economic, cultural and dietary differences, the western studies do not represent our entities. Pakistan is a country where various ethnical communities dwell having different lifestyles and dietary patterns. Karachi is the largest and most populated metropolitan city of Pakistan and is the hub of all communities which vary from each other with respect to culture, tradition, language and religious practices. To the best of our knowledge, no study has been conducted so far in Pakistan to explore the dietary habits of these communities. The current study was planned to identify distinct dietary patterns of Pakistani women belonging to Aga Khani, Dawoodi Bohra

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and Memon communities living in Karachi and to evaluate their association with anthropometric, lifestyle and socio-economic factors. All of these three communities differ in sectarian, linguistic and demographic backgrounds. Considering these distinctness, it was hypothesised that they would show contrasting lifestyles and dietary behaviours. Furthermore, these communities caught our attention because obesity and certain health issues are ubiquitous in them and there was a dire need to study the dietary behaviour of these hitherto neglected communities that dwell profusely in South Asia and other parts of the world.

Subjects and Methods

This cross-sectional study was conducted during June 2014 to August 2015 in Karachi, and comprised women aged 18-60 years of Aga Khani, Dawoodi Bohra and Memon communities. The sample size was calculated taking the margin error of 5%, confidence interval (CI) of 95% and frequency of 36% for monthly fast-food consumption among Pakistani women.⁸ Based on these criteria, the required sample size was calculated and increased by 15% for possible non-responses. Data was collected from three union councils densely populated with these communities, using non-probability, purposive, proportionate quota sampling method. Non-mobile, chronically ill or pregnant women were excluded. Participants whose reported energy intake was outside the mean range ± 3 standard deviation (SD) of energy intake were also excluded.⁴ Data was collected by trained dietitians through self-interview at participants' home using a structured pre-tested questionnaire which was translated into Urdu language for ease of communication. Prior to conducting the study, pre-testing on selected subjects was carried out to avoid possible flaws and biases in data collection. This sample was not included in the final study.

The study was approved and reviewed by the Board of Advanced Studies and Research (BASR) of the University of Karachi. Written informed consent was taken from all the subjects.

Data on dietary intake, over the last 12 months, was gathered using a 108-item semi-quantitative food frequency questionnaire (FFQ). Information regarding the frequency of each food item's consumption per day, per week or per month was recorded. The noted frequencies were then converted to per day consumption, e.g. a response of 5 servings per week was converted to 0.71 serving per day. Food items included in the FFQ were categorised into 30 food groups based on their nutrient profile or culinary usage. Considering the distinct

characteristics of certain food items, they were kept separate in an individual food group division (e.g. tea, egg, etc). The questionnaire used in this study was not validated, but it had face validity because similar types of questionnaires have been used previously.^{4,9}

Data on general characteristics such as age, ethnicity, marital status, family size, total family income, academic degree, use of betel quid (paan), family history of obesity and time spent in a day on watching television (TV) was collected through interview-cum-questionnaire from all the respondents.

Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ).¹⁰ The subjects were asked about the frequency and duration of time spent in vigorous and moderate intensity activities at work/home, recreation and travelling in a typical week. Average weekly duration of each activity was computed and the metabolic equivalent task (MET) hour/week was calculated according to the procedure mentioned in GPAQ. The MET hour/week values determined low, moderate or high level of physical activity.

Weight and height were measured with minimal clothing and without shoes. Weight was measured to the nearest 0.1kg using a standard weighing scale and height was taken to the nearest 0.5cm using a portable stadiometer. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. All anthropometric measurements were taken by trained technicians. To classify the subjects according to BMI, World Health Organisation's (WHO) population cut-offs for Asians were adapted (underweight $<18\text{kg/m}^2$, normal = $18\text{--}22.9\text{kg/m}^2$, overweight = $23\text{--}24.9\text{kg/m}^2$ and obese $>25\text{kg/m}^2$).¹¹ Waist circumference (WC) was measured to the nearest 1mm with an inelastic measuring tape at the narrowest point between the lower rib and the iliac crest. Abdominal obesity is defined as WC $> 80\text{cm}$ for females. Hip circumference was assessed at the greatest diameter over the hips. Waist-to-hip ratio (WHR) was calculated as waist circumference divided by hip circumference in centimetres. Subjects were considered as abdominally obese if WHR > 0.85 .

General characteristics of the community-based study population were expressed as mean values and standard deviations ($M \pm SD$) for continuous variables (age, family size, total energy intake, percentage of macro nutrients, BMI, WC and WHR) and analysed using one-way analysis of variance (ANOVA). Contrariwise, categorical variables (education, marital status, total family income, use of betel quid (paan), family history of obesity, physical activity and hours spent on watching TV) were reported

as frequencies and percentages $n(\%)$ and analysed using the chi-square test. Dietary patterns were derived using Principal Component Factor Analysis based on 30 food groups compressed from FFQ. Kaiser-Meyer-Olkin (KMO) statistics and Bartlett's test of sphericity (BTS) were used to assess the suitability of using factor analysis method. The number of factors identified was based on Eigenvalue >1.5 , scree plot, % of variance and interpretability. An orthogonal rotation using the varimax procedure was applied to improve the factor interpretation. Food groups were retained in the identified factor component if the factor loading was >0.30 in the component matrix. The dietary patterns were interpreted and labelled based on the food groups having the highest factor loadings. Factor scores for each dietary pattern were computed by multiplying the factor component matrix score of that pattern with the standardised daily frequency of food group consumption summed up over each food group. Each individual received a factor score for each identified pattern. The dietary patterns were extracted from the entire study population. The association of communities with each of the dietary pattern was determined by ANOVA using the Duncan's test.¹² The factor scores that defined the factor loadings were used without adjustment for any variable. Adherence of the extracted dietary patterns to the socio-economic, anthropometric and lifestyle factors were assessed by Multivariable Linear Regression Analysis (with 95% CI). Factor scores of the dietary patterns were taken as continuous dependent variables and the other associated factors were taken as independent variables (BMI, age, education, family size, total energy intake as continuous data and marital status, total family income, use of paan, family history of obesity, physical activity and hours spent on watching TV as categorical variables). Data was adjusted for all variables simultaneously. SPSS 20 was used for data analysis. $P<0.05$ was considered significant.

Results

The required sample size of 354 was increased by 15% to 407. Of them, 324(79.61%) agreed to participate in the study. After the exclusion of 2(0.62%) subjects, 322(99.38%) were finally selected. The overall mean age was 28.9 ± 12.2 years (range: 18-60 years). Moreover, 108(33.54%) subjects belonged to the Aga Khani community (Group A), and 107(33.23%) each to Dawoodi Bohra (Group B) and Memon (Group C) communities. The education level was below 10th grade in 31(28.7%) women of Group A, 45(42.1%) of Group B and 55(51.4%) of Group C, while 58(53.7%), 39(36.4%) and 25(23.4%), respectively, had a university degree. Besides, 44(40.7%) women in Group A were married, compared to 53(49.5%)

and 37(34.6%) in Groups B and C. Furthermore, 35(32.4%) participants in Group A, 28(26.2%) in Group B and 44(41.1%) in Group C had a monthly family income of above Rs50,000. There were 18(16.7%) paan/betel nut eaters in Group A, 20(18.7%) in Group B and 47(43.9%) in Group C, whereas 41(38%), 29(27.1%) and 70(65.4%) had family history of obesity. Moreover, 84(77.8%) women in Group A, 90(84.1%) in Group B and 72(67.3%) in Group C watched TV for 1-3 hours daily, whereas 22(20.4%), 13(12.1%) and 25(23.4%) for more than 3 hours. The overall mean BMI was 24.9 ± 6.5 kg/m² ($p=0.001$), WC was 80.8 ± 15.2 cm ($p=0.68$), and WHR was 0.85 ± 0.07 cm ($p=0.18$). According to BMI calculations, 28(25.9%) women had normal weight in Group A, 27(25.2%) in Group B and 37(34.6%) in Group C, whereas 60(55.6%), 37(34.6%) and 42(39.3%) were obese. The overall mean energy intake was 2641.4 ± 543.1 kcal/day. The mean percentage of carbohydrates was 50.7 ± 5.7 in Group A, and 52.8 ± 4.9 and 79.2 ± 6.2 in Group B and C, while that of protein was 10.5 ± 1.7 , 10.9 ± 1.4 and 10.1 ± 1.5 , and that of fat was 38.8 ± 6 , 37.7 ± 5.1 and 41.3 ± 6.7 , respectively (Table-1).

Three distinct dietary patterns were extracted by factor analysis. The processed food pattern was characterised by high intake of potatoes, fast foods, bakery items, desserts, snacks, pasta, sugar, sweets and candy, carbonated drinks (non-alcoholic) and juices; the mixed food pattern included vegetables, fresh fruits, dried fruits, legumes, eggs, whole milk and other dairy, poultry, low fat dairy, ispaghol husk (psyllium) and coffee; and the traditional food pattern comprised whole wheat flour products, rice, legumes, vegetables and community-based traditional dishes (haleem, gram flour curry, dhokla, khaosaa and paleedo). Together the three factors explained ~27% variance (Table-2).

The mean factor loading for mixed food pattern was 0.24 among women of the Aga Khan community, whereas respective values for Dawoodi Bohra and Memon communities were 0.005 and -0.25. As for traditional pattern, the mean factor loading value was 0.77 in the Dawoodi Bohra community, in contrast to -0.24 and -0.52 for women belonging to Memon and Aga Khani communities.

Processed food pattern was negatively associated with age ($\beta = -0.03$, $p<0.001$) in the Aga Khan community, and with age ($\beta = -0.02$, $p=0.01$) and being married ($\beta = -0.45$, $p=0.006$) in Bohra community. For the same dietary pattern a positive association was observed for the total calorie consumption/day among all the three communities (Aga Khan $\beta=0.001$, $p<0.001$; Bohra $\beta=0.001$, $p<0.001$; Memon $\beta=0.001$, $p<0.001$) and higher family income of $>Rs50,000$ /month ($\beta=0.46$, $p=0.008$) in

Table-1: General characteristics of Pakistani women (n=322) belonging to three different communities.

Characteristics	Aga Khan		Dawoodi Bohra		Memon		All Communities		P-Value
	Mean or n	SD or %	Mean or n	SD or %	Mean or n	SD or %	Mean or n	SD or %	
Age (years)	29.5	11.4	31.2	13.9	25.9	10.8	28.9	12.2	0.005
Education Level									
< 10th grade	31	28.7	45	42.1	55	51.4	131	40.7	0.001
Secondary	19	17.6	23	21.5	27	25.2	69	21.4	
University degree	58	53.7	39	36.4	25	23.4	122	37.9	
Marital Status									
Married	44	40.7	53	49.5	37	34.6	134	41.6	0.08
Single	64	59.3	54	50.5	70	65.4	188	58.4	
Family Income									
10,000-25,000 Rs.	15	13.9	19	17.8	24	22.4	58	18	0.02
26,000-50,000 Rs.	58	53.7	60	56.1	39	36.4	157	48.8	
> 50,000 Rs.	35	32.4	28	26.2	44	41.1	107	33.2	
Family Size									
2 - 5 persons	62	57.4	65	60.7	47	43.9	174	54	0.09
6 - 8 persons	38	35.2	38	35.5	50	46.7	126	39.1	
> 8 persons	8	7.4	4	3.7	10	9.3	22	6.8	
Owning House									
No	32	29.6	19	17.8	26	24.3	77	23.9	0.12
Yes	76	70.4	88	82.2	81	75.7	245	76.1	
Pan / Betel nut									
No	90	83.3	87	81.3	60	56.1	237	73.6	0.001
Yes	18	16.7	20	18.7	47	43.9	85	26.4	
Family history of obesity									
Positive	41	38	29	27.1	70	65.4	140	43.5	0.001
Negative	67	62	78	72.9	37	34.6	182	56.5	
Physical Activity Level									
Low	27	25	18	16.8	38	35.5	83	25.8	0.01
Moderate	67	62	67	62.6	59	55.1	193	59.9	
High	14	13	22	20.6	10	9.3	46	14.3	
TV watching (hours)									
< 1 hour	2	1.9	4	3.7	10	9.3	16	5	0.01
1 - 3 hours	84	77.8	90	84.1	72	67.3	246	76.4	
> 3 hours	22	20.4	13	12.1	25	23.4	60	18.6	
BMI (kg/m ²)	27.1	6.4	23.2	5.4	24.7	7.1	24.9	6.5	0.001
Waist Circumference (cm)	81.8	14.8	80	14.6	80.6	16.2	80.8	15.2	0.68
Waist to Hip Ratio	0.85	0.07	0.84	0.06	0.86	0.07	0.85	0.07	0.18
BMI									
Underweight	3	2.8	25	23.4	16	15	44	13.7	0.001
Normal weight	28	25.9	27	25.2	37	34.6	92	28.6	
Overweight	17	15.7	18	16.8	12	11.2	47	14.6	
Obese	60	55.6	37	34.6	42	39.3	139	43.2	
Energy Intake (kcal/day)	2532.3	581.7	2725.9	535.5	2667	494.9	2641.4	543.1	0.027
% of Nutrients									
Carbohydrates	50.7	5.7	52.8	4.9	49.2	6.2	50.9	5.8	0.001
Protein	10.5	1.7	10.9	1.4	10.1	1.5	10.5	1.6	0.001
Fat	38.8	6	37.7	5.1	41.3	6.7	39.3	6.2	0.001

TV: Television

BMI: Body mass index

SD: Standard deviation

Table-2: Factor Loading Matrix for the Three Dietary Patterns Identified by Factor Analysis.*

Food groups	Dietary patterns		
	Processed	Mixed	Traditional
Bakery items	0.57+	0.06	0.17
Coffee	0.18	0.38+	-0.33
Carbonated drink (non-alcoholic)	0.44+	-0.09	-0.18
Corn products	0.09	0.24	0.24
Diet drink (non-alcoholic)	-0.11	0.20	-0.01
Dried fruits	0.07	0.54+	-0.13
Eggs	-0.02	0.47+	-0.21
Fast foods	0.60+	0.08	0.02
Fish	0.04	0.03	-0.36
Fruits	0.19	0.59+	-0.13
Ispaghol husk	-0.09	0.40+	0.04
Juices	0.35+	-0.02	0.11
Legumes	-0.04	0.47+	0.38+
Low fat dairy	-0.15	0.41+	0.02
Milk based desserts	0.56+	0.07	-0.05
Organ meat	-0.01	-0.27	0.20
Pasta	0.53+	0.01	-0.04
Potatoes	0.67+	-0.19	0.02
Poultry	0.15	0.42+	-0.11
Red meat	-0.02	-0.01	0.06
Refined flour products	0.01	0.00	-0.74
Rice	0.19	-0.11	0.50+
Sugar, sweets and candy	0.45+	0.18	-0.04
Tea	-0.09	0.03	0.05
Traditional dishes ++	0.41+	0.05	0.48+
Snacks	0.53+	-0.01	-0.01
Vegetable oil and added fat	0.27	0.09	-0.24
Vegetables	-0.10	0.62+	0.35+
Whole milk and other dairy	0.23	0.43+	0.08
Whole wheat flour products	-0.04	0.00	0.78+
Variance explained (%)	10.5	8.4	8.1

*Extraction method: Principal component analysis; Varimax rotation converged in 5 iterations.

+Factor loading values > 0.30

++Includes community based traditional dishes (haleem, gram flour curry, khaoowsa, paleedo, dhookla).

Table-3: Factors associated with adherence to major dietary patterns among women of Aga Khan Community.

Characteristics	Processed Food Patten		Mixed Food Pattern		Traditional Food Pattern	
	β^*	95% CI	β^*	95% CI	β^*	95% CI
Age (years)	-0.03++	(-0.05 - -0.02)	0.02	(-0.01 - 0.05)	0.003	(-0.01 - 0.02)
Education (years)	-0.02	(-0.08 - 0.03)	0.05	(-0.04 - 0.13)	-0.01	(-0.06 - 0.04)
Marital Status						
Single	0 (Ref)		0 (Ref)		0 (Ref)	
Married	-0.05	(-0.44 - 0.35)	0.17	(-0.41 - 0.75)	0.23	(-0.11 - 0.57)
Family Income						
< 50,000 Rs.	0 (Ref)		0 (Ref)		0 (Ref)	
> 50,000 Rs.	0.13	(-0.22 - 0.47)	0.12	(-0.38 - 0.63)	-0.16	(-0.45 - 0.14)
Family Size (No.)	-0.07	(-0.14 - 0.01)	0.15++	(0.04 - 0.26)	0.04	(-0.02 - 0.11)
Pan / Betel nut						
No	0 (Ref)		0 (Ref)		0 (Ref)	
Yes	-0.04	(-0.46 - 0.38)	-0.20	(-0.82 - 0.42)	-0.16	(-0.52 - 0.21)

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BMI	0.003	(-0.03 - 0.03)	-0.02	(-0.06 - 0.02)	0.01	(-0.01 - 0.04)
Family history of obesity						
Positive	-0.03	(-0.34 - 0.29)	0.01	(-0.46 - 0.47)	0.07	(-0.21 - 0.34)
Negative	0 (Ref)		0 (Ref)		0 (Ref)	
Physical Activity Level						
Low	0.25	(-0.28 - 0.78)	0.15	(-0.64 - 0.94)	0.09	(-0.37 - 0.56)
Moderate	0.11	(-0.35 - 0.58)	-0.14	(-0.83 - 0.55)	-0.06	(-0.47 - 0.34)
High	0 (Ref)		0 (Ref)		0 (Ref)	
TV watching (hrs)						
< 1 hr	0 (Ref)		0 (Ref)		0 (Ref)	
1 - 3 hrs	-0.08	(-1.21 - 1.05)	0.50	(-1.17 - 2.17)	-0.94	(-1.93 - 0.05)
> 3 hrs	0.09	(-1.09 - 1.26)	0.98	(-0.76 - 2.73)	-1.07+	(-2.10 - -0.04)
Total calories	0.001++	(0.001 - 0.001)	0.001++	(0.000 - 0.001)	0.000	(-0.001 - 0.000)

CI: Confidence interval

TV: Television

Ref: Reference category

BMI: Body mass index

* The β regression coefficient was calculated using a linear regression model adjusted for all variables listed in the table.

+ P < 0.05, ++ P < 0.01.

Table-4: Factors associated with adherence to major dietary patterns among women of Dawoodi Bohra community.

Characteristics	Processed Food Pattern		Mixed Food Pattern		Traditional Food Pattern	
	β^*	95% CI	β^*	95% CI	β^*	95% CI
Age (years)	-0.02+	(-0.03 - -0.004)	0.02+	(0.002 - 0.03)	0.01	(-0.01 - 0.03)
Education (years)	-0.02	(-0.07 - 0.04)	0.03	(-0.04 - 0.10)	-0.004	(-0.09 - 0.08)
Marital Status						
Single	0 (Ref)		0 (Ref)		0 (Ref)	
Married	-0.45++	(-0.77 - -0.13)	0.002	(-0.44 - 0.44)	0.34	(-0.19 - 0.87)
Family Income						
< 50,000 Rs.	0 (Ref)		0 (Ref)		0 (Ref)	
> 50,000 Rs.	0.10	(-0.167 - 0.36)	0.50++	(0.13 - 0.86)	0.27	(-0.17 - 0.71)
Family Size (No.)	-0.06	(-0.12 - 0.01)	-0.04	(-0.13 - 0.05)	0.08	(-0.04 - 0.19)
Pan / Betel nut						
No	0 (Ref)		0 (Ref)		0 (Ref)	
Yes	-0.04	(-0.32 - 0.25)	-0.36	(-0.75 - 0.04)	0.21	(-0.26 - 0.68)
BMI	0.01	(-0.02 - 0.03)	0.002	(-0.03 - 0.04)	0.01	(-0.04 - 0.05)
Family history of obesity						
Positive	-0.04	(-0.29 - 0.20)	-0.20	(-0.54 - 0.14)	0.23	(-0.18 - 0.63)
Negative	0 (Ref)		0 (Ref)		0 (Ref)	
Physical Activity Level						
Low	0.12	(-0.27 - 0.51)	0.03	(-0.51 - 0.56)	0.23	(-0.41 - 0.87)
Moderate	0.26	(-0.05 - 0.60)	-0.12	(-0.54 - 0.30)	0.27	(-0.24 - 0.77)
High	0 (Ref)		0 (Ref)		0 (Ref)	
TV watching (hrs)						
< 1 hr	0 (Ref)		0 (Ref)		0 (Ref)	
1 - 3 hrs	0.16	(-0.43 - 0.76)	0.80	(-0.02 - 1.63)	1.11+	(0.12 - 2.09)
> 3 hrs	-0.21	(-0.88 - 0.45)	0.79	(-0.13 - 1.71)	1.02	(-0.08 - 2.12)
Total calories	0.001++	(0.001 - 0.002)	0.000+	(0.000 - 0.001)	0.000++	(0.000 - 0.001)

CI: Confidence interval

BMI: Body mass index

TV: Television

Ref: Reference category

* The β regression coefficient was calculated using a linear regression model adjusted for all variables listed in the table.

+ P < 0.05, ++ P < 0.01.

Table-5: Factors associated with adherence to major dietary patterns among women of Memon Community.

Characteristics	Processed Food Pattern		Mixed Food Pattern		Traditional Food Pattern	
	β^*	95% CI	β^*	95% CI	β^*	95% CI
Age (years)	-0.02	(-0.04 - 0.01)	0.01	(-0.02 - 0.03)	0.004	(-0.02 - 0.03)
Education (years)	0.02	(-0.05 - 0.09)	0.03	(-0.05 - 0.10)	0.04	(-0.03 - 0.11)
Marital Status						
Single	0 (Ref)		0 (Ref)		0 (Ref)	
Married	-0.42	(-0.96 - 0.13)	-0.04	(-0.61 - 0.53)	0.46	(-0.06 - 0.99)
Family Income						
< 50,000 Rs.	0 (Ref)		0 (Ref)		0 (Ref)	
> 50,000 Rs.	0.46++	(0.12 - 0.79)	0.44+	(0.09 - 0.79)	-0.24	(-0.57 - 0.08)
Family Size (No.)	-0.05	(-0.13 - 0.02)	0.04	(-0.04 - 0.12)	0.01	(-0.06 - 0.08)
Pan / Betel nut						
No	0 (Ref)		0 (Ref)		0 (Ref)	
Yes	-0.03	(-0.36 - 0.30)	-0.30	(-0.64 - 0.04)	0.32	(-0.003 - 0.64)
BMI	0.002	(-0.02 - 0.03)	0.02	(-0.01 - 0.04)	0.004	(-0.02 - 0.03)
Family history of obesity						
Positive	0.07	(-0.25 - 0.39)	-0.20	(-0.53 - 0.13)	0.04	(-0.27 - 0.34)
Negative	0 (Ref)		0 (Ref)		0 (Ref)	
Physical Activity Level						
Low	0.14	(-0.41 - 0.69)	-0.25	(-0.82 - 0.33)	-0.57+	(-1.10 - -0.03)
Moderate	0.07	(-0.45 - 0.60)	-0.30	(-0.85 - 0.24)	-0.33	(-0.84 - 0.18)
High	0 (Ref)		0 (Ref)		0 (Ref)	
TV watching (hours)						
< 1 hour	0 (Ref)		0 (Ref)		0 (Ref)	
1 - 3 hours	0.22	(-0.32 - 0.76)	-0.07	(-0.64 - 0.49)	-0.63+	(-1.15 - -0.10)
> 3 hours	0.15	(-0.44 - 0.73)	0.02	(-0.59 - 0.62)	-0.84++	(-1.41 - -0.28)
Total calories 0.000)	0.001++	(0.001 - 0.001)	0.001++	(0.000 - 0.001)	0.000	(-0.001 - 0.000)

CI: confidence interval

BMI: Body mass index

TV: Television

Ref: Reference category

*The β regression coefficient was calculated using a linear regression model adjusted for all variables listed in the table.+ $P < 0.05$, ++ $P < 0.01$.

the Memon community. The mixed food pattern scores were positively associated with family size ($\beta = 0.15$, $p = 0.007$) in the Aga Khan community, with age ($\beta = 0.02$, $p = 0.03$) in the Bohra community, with higher family income >Rs50,000/month in both Bohra ($\beta = 0.50$, $p = 0.009$) and Memon ($\beta = 0.44$, $p = 0.01$) communities and total calories consumed /day in all three communities (Aga Khan $\beta = 0.001$, $p = 0.001$; Bohra $\beta = 0.000$, $p = 0.015$; Memon $\beta = 0.001$, $p = 0.002$). For the traditional food pattern, a positive association was noted for watching TV 1-3hours/day ($\beta = 1.11$, $p = 0.03$) and total calorie consumption/day ($\beta = 0.000$, $p = 0.008$) in the Bohra community. An alternate relationship was seen for watching TV in Aga Khan (>3 hours/day $\beta = -1.07$, $p = 0.04$) and Memon (1-3hours/day $\beta = -0.63$, $p = 0.02$; >3hrs/day $\beta = -0.84$, $p = 0.004$) communities. This dietary pattern was also inversely associated with low physical activity ($\beta = -0.57$, $p = 0.04$) in the Memon community (Tables-3-5).

Discussion

The present study revealed three major dietary patterns: processed food pattern, mixed food pattern and traditional food pattern. Aga Khani women tended to consume mixed food pattern while Dawoodi Bohra women were most likely to consume traditional food pattern. The association of these identified dietary patterns with socio-economic, anthropometric and lifestyle factors was investigated in all three communities. Although the dietary patterns identified in different communities were particular to the women living in urban area of Pakistan, they resemble much in context of the food items and food groups forming dietary patterns in various western and Asian studies using factor analysis.

The two most commonly identified dietary patterns throughout the research fraternity included the western pattern and prudent or healthy pattern. However,

assigning names to the extracted factors is a subjective decision and is usually based on researcher's interpretation of results. The western pattern typically included red meat, processed meat, refined grains, sweet and desserts, French fries, high-fat dairy products, butter and eggs.¹³⁻¹⁶ The processed food pattern of the present study has some similarities with the western pattern. The prudent or healthy pattern was generally characterised by vegetables, fruits, legumes, whole grains, poultry and fish.^{4,13,14,16} The mixed food pattern generated in the present study appeared to be similar to the above-mentioned pattern but due to some variations in food groups it was so named.

Modified cultural and religious practices as well as different cooking methods have led to changes in food items or assembled form of dishes in different populations but the overall impact of foods and food groups forming the dietary patterns remained the same. With the increased use of factor analysis for determining dietary behaviour, country-specific 'traditional dietary patterns' have also emerged. For example, the Iranian pattern,¹³ the traditional Lebanese pattern,¹⁴ the traditional pattern of Brazil¹⁵ and the traditional pattern of Japan.¹⁷ In the present study, in addition to the processed and mixed food patterns, a traditional pattern was also identified which shared some elements of mixed pattern since it included legumes and vegetables in addition to rice, whole wheat products and community-based traditional dishes. The traditional pattern identified in our study contained reduced variety of food items. However, this attribute corroborates with the traditional patterns explored in other studies as well.^{14,15} Traditional diets are not always healthy diets; sometimes a little modification can greatly improve them.

The association of social factors and dietary behaviours have been investigated in many other researches. The processed food pattern in our study was inversely associated with age in Aga Khan and Bohra communities. Rezazadeh et al.⁴ and Sánchez-Villegas et al.¹⁷ evaluated that dietary patterns varied with age and mostly younger individuals followed an unhealthy or western pattern. Inverse association of processed dietary pattern with being married in Bohra community revealed that married women in our society are given less freedom of choice in the selection of food items and they mostly follow the traditions. The Spanish project (Seguimiento Universidad de Navarra, or SUN) study also showed similar trend.¹⁷ In the present study, women belonging to Memon and Bohra communities in the high socio-economic group were more likely to follow the processed and mixed food pattern. Generally, a higher socio-economic status (SES)

enables individuals to maintain such dietary patterns. Our results are similar to the previously reported studies in other countries which showed that mostly western and healthy food patterns are followed by higher socio-economic class.^{4,16} Hakeem, Shaikh and Ziaee¹⁸ found that frequency of consuming variety of foods was more in people with higher income. The study reported that higher intake of fruits, vegetables, chicken, lamb and other foods were associated with high SES. Family size was positively associated with mixed food pattern in the Aga Khan community. Customarily, a larger family is a mix of people belonging to different age groups which make them add a variety of food items to their dietary pattern. The association of dietary pattern with level of education, consumption of paan and family history of obesity were found to be insignificant. It was found that traditional dietary pattern was differently associated with watching TV in all three communities. Aga Khan and Memon communities exhibited a negative association of watching TV for >1 hour with traditional pattern. However, Bohra community presented positive association of watching TV for 1-3 hours with traditional food pattern. A number of social and environmental factors including television viewing may shape the dietary habits of youth. Other studies showed that individuals spending long hours watching TV tended to follow an unhealthy dietary pattern.¹⁹ A negative trend was noticed between low physical activity level and traditional dietary pattern in the Memon community. The European Prospective Investigation into Cancer and Nutrition (EPIC)-Potsdam study reported such negative trends with bread and sausage pattern in women.²⁰ Physical activity in Korean women was found to be negatively associated with their traditional food pattern.²¹ Earlier studies have shown that overweight and obesity were emerging as major public health problems in Pakistan and its prevalence was highest (42.8%) among women aged 35-54 years.²² Reanalysis of National health survey of Pakistan according to BMI cut-offs for Asians revealed that 1 in 4 Pakistanis over the age of 15 years was overweight or obese.²³ Women belonging to all three communities in the present study were characterised by significantly higher mean BMI, although their WC and WHR were also slightly crossing the borderline but were not significantly different. Obesity followed the order: Aga Khan community (55.6%) > Memon community (39.3%) > Bohra community (34.6%). Startlingly, no significant association of BMI was shown with any of the three dietary patterns among the communities and similar results were reported in the Mexican-American population.²⁴ Their results also showed no significant association of obesity with four distinct dietary patterns.

Conclusion

Dietary patterns and their association with anthropometric, lifestyle and socio-economic measures varied between different communities. The prevalence of obesity was high in all three communities, particularly in the Aga Khan community. Detailed studies in the future on a larger scale would be helpful in understanding the association of diet with obesity in these three communities. Local dietary guidelines must be proposed in order to avert the problem of obesity among these three communities and Pakistani population at large.

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