Original Article

Dietary patterns and their association with hypertension among Pakistani urban adults

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Hypertension is one of the most common chronic diseases affecting more than 25% of adults worldwide. In Pakistan, 33% of the adult population suffers from hypertension. Numerous epidemiological studies have demonstrated the critical role of dietary patterns in the causation, prevention and management of hypertension. There's a dearth of evidence from South Asia in this regard. The present study aimed to identify the association between dietary patterns and hypertension among 4304 low income urban adults who participated in the Control of Blood Pressure and Risk Attenuation (COBRA) study in Karachi, Pakistan. Dietary information was collected by a 33-item food frequency questionnaire and 3 unique dietary patterns namely; fat and sweet, fruit and vegetable, and seafood and yogurt patterns were derived using principal component factor analyses. We used univariate and multivariable logistic regression to examine the association between dietary patterns and hypertension. Men were more likely to have hypertension, while increase in age, and body mass index were also associated with hypertension (p<0.001). After adjusting for age, gender, education, marital status, body mass index, and tobacco use; the seafood and yogurt pattern was less likely (OR=0.78: 95% CI: 0.63, 0.98; p-value 0.03) to be associated with hypertension, whereas no significant associations were seen for other two dietary patterns. These findings suggest that certain dietary patterns may be associated with hypertension among Pakistani low income urban adults.

Key Words: dietary patterns, factor analysis, Pakistan, hypertension, lifestyle behaviours

INTRODUCTION

Hypertension or elevated blood pressure is a major contributor to the burden of cardiovascular morbidity and mortality worldwide.[1,2] It is estimated that approximately 25% of the world's adult population suffers from hypertension,[3,4] and is ranked as the third cause of disability-adjusted life-years.[2] The prevalence of hypertension has remained stable or has decreased in some developed countries.[2,4] In contrast, the rates of hypertension have dramatically increased in developing countries.[5] In Pakistan, hypertension is the most common cardiovascular disease (CVD) affecting approximately 33% of the adult population and is considered a major risk factor for renal failure, stroke and other diseases.[6,7]

Diet is one of the main modifiable risk factors in the development of hypertension. The increased rates of hypertension and other chronic diseases in developing countries have been attributed to the nutrition transition and global shifts in food consumption patterns.[8,9] During the past several decades, many studies have assessed the association between diet and hypertension.[10] However, because of the complexity of the relationships between diet and the pathology of hypertension, this association cannot be ascribed to a single food or nutrient, but rather to multiple foods and nutrients.[11-16] Furthermore, studies evaluating the risk posed by single foods or nutrients for hypertension do not allow one to consider the effect of the diet as a whole due to the colliniearity of nutrients within foods, and difficulty in detecting smaller effects of individual foods and nutrients on disease outcome.[12,17]

Identification of dietary patterns using statistical methods, such as factor and cluster analysis, has been used to overcome some of the limitations inherent in a single food or nutrient approach in examining the relationship between diet and disease.[18] Dietary patterns reflect the type and amount of foods as they are consumed together

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and can account for the cumulative effect of foods and nutrients. The results obtained from such studies are also more practical from the public health perspective because the findings can easily be translated into effective health communications by focusing on total diet instead of individual foods or nutrients which are difficult for the public to comprehend and practice.[17]

An increasing body of research in Western countries has examined the relationship between dietary patterns and risk of hypertension using dietary pattern analysis.[18,19] Many of these studies have shown that dietary patterns high in red and processed meats, fast food, fatty foods and sweet desserts can lead to increase in blood pressure, whereas consuming a dietary pattern that is high in vegetables, whole grains, fruits, lean meats, fish and reduced high fat dairy products are inversely related with hypertension and decreased blood pressure among subjects. The epidemiology of hypertension may differ among South Asians due to genetics, ethnicity, culture, economics, and environmental factors.[15,20,21] However, there is limited evidence for Asian populations in this regard. In a recent summary of studies on the association between dietary patterns and risk of hypertension, Shi[22] concluded that the traditional Asian vegetable-rich food pattern was not as protective against hypertension as seen in Western populations. Nonetheless, the majority of such studies were from Korea, Japan, China, and only two studies were from India and one from Iran. Differences in dietary patterns among Asian population of various regions within Asia may also differ and subsequently their risk association may vary too. In our previous study, we have shown that distinct dietary patterns exist among Pakistani adults which are related to sociodemographic, anthropometric and lifestyle factors.[23] The objective of the present study was to look at the association between previously identified dietary patterns and hypertension among Pakistani low income urban adults.

METHODS

Study population

We performed a secondary analysis of the Control of Blood Pressure and Risk Attenuation (COBRA) data. The Study population included individuals aged 15 years or older from Karachi, Pakistan. COBRA was a population based randomized control trial on the effectiveness of home-based health education to prevent and control high blood pressure in low income urban adults in Karachi, the most populous city of Pakistan. Multistage random sampling technique was used to select 12 out of 4200 low income (mean household monthly income $70) geographical census based clusters (about 250 households listed in each cluster). On average, each household contained 7 individuals. One cluster was randomly selected (computer generated) from each area for inclusion in the study. A census was done and all individuals from each household were listed. The population was further divided into three groups: children aged 5-14 years, younger adults from 15-39 years, and older adults from 40 years and above. One individual aged 15 to 39 years from each household was randomly selected and all individuals aged 40 years or above were invited to participate in the study. A total of 6257 individuals aged 15 years or older met the suitability for the COBRA trial and 5491 individuals consented to participate. Out of 5491, 55% were females, 3143 aged 15-39 years and the remaining were 40 years and above. Details of COBRA study have been described extensively in previous publications.[23,24] Since individuals with existing disease conditions tend to modify their eating patterns following diagnosis, we excluded 1187 participants with known self-reported history of hypertension. Thus, the current paper is based on the analysis of 4304 participants aged 15 years or above. The COBRA (Clinical trial-NCT00327574) study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Ethical Review Committee of the Aga Khan University. Written informed consent was obtained from all subjects and their anonymity was maintained. Furthermore, the Internal Review Board of the University of Massachusetts, Amherst reviewed and approved secondary analysis of the COBRA data for academic research.

Outcomes and measurements

All subjects were evaluated by a rigorously trained field team (comprising field workers, nurses, educators and technicians). The team was trained over a 6-week period according to a case based curriculum by a clinicians and nutritionist in performing standardized blood pressure assessments and measurements, in collecting dietary data using the food frequency questionnaire (FFQ), and delivering standardized health education messages. A manual was developed for the purpose of this training and retraining at frequent intervals throughout the study was done to ensure consistency in the skills of the research team.

Dietary assessment

Information on diet was collected by trained field workers using a 33-item FFQ. The Harvard FFQ was used for adaption by a team of nationally known nutrition researchers to develop the FFQ used in the COBRA study.[25] The nutritionists in the study group were knowledgeable about different food items normally consumed in the Pakistani population. They also reviewed available literature and information from various dietary surveys reflecting common dietary habits of low income Pakistani population. The FFQ was later tested in a sample population (not included in the study population) and revisions were made for content, language clarity, & sequential logic for its use among Pakistani people. Each food item in the FFQ had a choice of four frequency categories ranging from 'daily' to 'less than a month' or 'never' but did not take information on portion sizes for individual foods For analysis, all food frequency variables were standardized to consumption per day.

Dietary patterns extraction

Exploratory factor analysis was used to identify dietary patterns among Pakistani adults. Details on extraction of dietary patterns have been described previously.[23] Briefly, principal component factor analysis was used to identify three unique dietary patterns based on the correlation between the food items. The number of patterns retained and labelled was based on interpretation of the data, ei-

genvalue criterion of >1.5, scree plot and previous literature.[26-29] The first pattern was labelled, the fat and sweet pattern, and was characterized by high intakes of *biryani/palow* (rice with some form of meat cooked in oil/saturated fat with spices), *halwa puri* (sweets rich in fat and sugar), and food from outside, such as: *Kata-kat* (organ meat cooked with spices and fat), *Karahi* (meat cooked with fat, tomatoes and spices), *Nihari* (beef cooked in high fat), burgers, pizza, and *tandoori nan* (yeast flat bread). The second pattern was the fruit and vegetable pattern, consisting of fruits, fruit juices, raw and cooked vegetables, lean meat, and low fat dairy products. The third pattern included fish, prawns, potatoes, and yogurt and was labelled the seafood and yogurt pattern (supplemental Table 1). Dietary pattern scores were calculated and all the participants were categorized into 4 groups (Q1-Q4) according to their factor scores.[29] A higher score for any participant in any pattern suggested better adherence to that dietary pattern.

Blood pressure assessment

Blood pressure was measured by trained health workers with a calibrated automated device (Omron HEM-737 Intellisense Blood Pressure Monitor) after the participants sat quietly for more than five minutes. Three consecutive readings were recorded with a five minute gap between each reading. The average of the last two measurements for systolic blood pressure (SBP) and diastolic blood pressure (DPB) was recorded for each subject. For the purpose of this paper, subjects were categorized as normotensive, pre-hypertensive, and hypertensive if their SBP was <120 and DBP <80, SBP 120-139 or DBP 80 to 89 and SBP ≥140 or DBP >90 mmHg, respectively.[30]

Covariates assessment

Information on demographics, anthropometric, and lifestyle were collected and recorded by trained field workers using a questionnaire translated into local languages. Weight, height, waist and hip circumference were measured with standard protocols explained previously.[24] In brief, weight was measured to the nearest 0.1 kg (Tanita Solar Powered Digital Scale model 1631; Tanita, Arlington Heights, IL) and height to the nearest 0.5 cm (portable Stadiometer). Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Waist circumference (WC) was measured with an inelastic tape at the mid-point between the iliac crest and the lower rib margin. Hip circumference was measured at the greatest diameter over the hip. Waist-to-hip ratio (WHR) was calculated as WC divided by hip circumference in cm. Using the recommended cut offs for Asian population, subjects were classified as underweight=BMI <18.5, normal weight=BMI 18.5-22.9, overweight=23.0-24.9, and >25.0 as obese.[24,31,32] Males with WC ≥90 cm, and females with WC ≥80 cm, were considered to have abdominal obesity. WHR values ≥1.0 for men and ≥0.85 for woman were considered elevated.

Data on physical activity was obtained using the International Physical Activity Questionnaire (IPAQ).[33] Average weekly duration of each activity was computed and expressed as metabolic equivalent hour per week (MET-hr/wk) according to the Ainsworth's compendium.[34] Information on tobacco use was based on the various forms used (cigarettes/cigars/biddi, pipe/huqqah, niswar and tobacco chewing with or without pan leaf) in Pakistan. Participants were classified as those who had never used tobacco in any form (never), those who used tobacco in the past but had stopped use in the last year (past) and those who were currently using tobacco in some form (current).

Statistical analysis

The participants were grouped as normotensive, pre-hypertensive and hypertensive according to their blood pressure readings. We calculated mean and standard deviation for continuous variables and frequency for categorical variables. Significance was tested using one way Analysis of Variance (ANOVA) for continuous and chi square for categorical data. For comparison of DBP and SBP across dietary pattern quartiles, we categorized dietary pattern scores into quartiles and used ANOVA to report mean±SD for each quartile. To define the association of hypertension with covariates and dietary patterns, univariate and multivariable odds ratio (OR and 95% CI) were calculated. In the multivariable OR, we adjusted for covariates found to be significant at $p<0.20$ in the univariate analysis. However, dietary patterns were to be retained in the multivariable model as it was the variable of interest. The statistical analyses were performed using SPSS software (16.0 version, SPSS Inc., Chicago, IL, USA). A p-value less 0.05 was considered statistically significant.

RESULTS

Table 1 shows the basic characteristics of 4304 participants (excluding self reported hypertensive) according to their blood pressure status. The hypertensive group on average were older (mean age 44.7, SD 13.6) than the pre-hypertensive (39.1, SD 14.4), and normotensive (34.5, SD 15.6) subjects. There were more overweight and obese subjects in the hypertensive category as compared to the prehypertensive and normotensive subjects. The mean scores for fruit and vegetable and seafood and yogurt dietary patterns were found to be significantly different across three groups of population whereas there was not much difference in the fat and sweet diet pattern scores. All other basic characteristics of the subjects were found to be significantly different across the groups. The association between SBP, DBP and different dietary pattern scores are shown in Table 2. The mean SBP and DBP among subjects decreased significantly as their dietary pattern scores increased among each dietary pattern.

Subjects who were men, married, used tobacco, and had no formal education were more likely to be hypertensive. Furthermore the odds of hypertension increased with increase in age and BMI ($p<0.001$). However no relationship was observed between hypertension and physical activity. In the univariate odds ratio, a non significant relationship was observed between fat and sweet dietary pattern and hypertension, whereas a significant association was seen between hypertension and fruit and vegetable and seafood and yogurt diet pattern. (OR=0.88, $p=0.05$, 95% CI=0.78-1.00 and OR=0.83, $p=0.05$, 95% CI=0.68-1.01, Table 3). After

Table 1. Baseline characteristics of COBRA participants classified according to their blood pressure status (n=4304)[†]

Characteristics	Normotensive[‡]	Pre-hypertensive[‡]	Hypertensive[‡]	*p*-value[*]
n (%)	2200 (51)	1344 (31)	760 (18)	
Men, n (%)	995 (45.2)	727 (54.1)	410 (53.9)	<0.001
Age (years)	34.5±15.6	39.1±14.4	44.7±13.6	<0.001
BMI (kg/m^2)	22.3±4.9	24.6±5.4	25.9±5.1	<0.001
Waist circumference (cm)	78.4±12.9	85.6±13.4	88.9±12.5	<0.001
Waist-to-hip ratio	0.84±0.09	0.88±0.09	0.90±0.09	<0.001
Systolic blood pressure (mmHg)	115 (11.4)	128 (11.6)	147 (18.6)	<0.001
Diastolic blood pressure (mmHg)	71.6 (5.8)	84.4 (2.8)	97.2 (6.5)	<0.001
Dietary pattern scores				
Fat and sweet pattern	0.89±0.60	0.85±0.59	0.85±0.60	0.080
Fruit and vegetable	1.09±0.67	1.01±0.61	1.01±0.62	<0.001
Seafood and yogurt	0.38±0.44	0.31±0.37	0.32±0.39	<0.001
Educational status, n (%)				
No formal education	440 (20.0)	286 (21.3)	220 (28.9)	
Primary -middle school	668 (30.4)	466 (34.7)	249 (32.8)	<0.010
Secondary-intermediate	797 (36.2)	426 (31.7)	206 (27.1)	
Graduate & above	295 (13.4)	166 (12.4)	85 (11.2)	
Marital status, n (%)				
Single/divorce/widow	947 (43.0)	388 (28.9)	195 (25.7)	<0.001
Married	1253 (57.0)	956 (71.1)	565 (74.3)	
BMI, n (%)[§]				
Underweight <18.5	535 (24.3)	160 (11.9)	50 (6.6)	<0.001
Normal weight 18.5-22.9	848 (38.6)	434 (32.3)	194 (25.7)	
Overweight ≥23.0-24.9	500 (22.7)	381 (28.3)	245 (32.3)	
Obese >25.0	316 (14.4)	369 (27.5)	267 (35.2)	
Abdominal obesity, n *(%)*[¶]	677 (30.8)	680 (50.6)	474 (62.7)	<0.001
Physical activity, n (%)[††]				
<5	747 (34.0)	466 (34.7)	301 (39.7)	<0.001
5-10	336 (15.3)	230 (17.1)	116 (15.3)	
>10	1114 (50.7)	648 (48.2)	342 (45.1)	
Tobacco use, n (%)				
Past	95 (4.3)	93 (6.9)	54 (7.1)	<0.001
Current	664 (30.2)	472 (35.1)	286 (37.6)	
Never	1441 (65.5)	779 (58.0)	420 (55.3)	

[†]Continuous and categorical variables were described as mean±SD and percentages

[‡]Hypertension classification was based on the 7th report of the Joint Committee on Prevention, Detection, Evaluation, and Treatment of High Blood pressure: normotensive, prehypertensive and hypertensive were defined as those with systolic blood pressure <120 and diastolic blood pressure <80 mmHg, systolic blood pressure 120-139 or diastolic blood pressure 80 to 89 mmHg, systolic blood pressure ≥140 or diastolic blood pressure >90 mmHg, respectively.

[§]Asian specific criteria for BMI.

[¶]Abdominal obesity: waist circumference >90 cm for men and >80 cm for women.

[††]Physical activity was measured as metabolic equivalent task hours/wk.

[*]*p*-value of ANOVA and chi-square test.

adjusting for age, sex, marital status, education level, BMI, and tobacco use, the seafood and yogurt diet pattern was found to be significantly protective against hypertension (OR=0.78, *p*=0.03, 95% CI=0.63-0.98, Table 3).

DISCUSSION

Cardiovascular diseases are the leading cause of death in Pakistan, with high blood pressure being a major determining factor.[6,35] In this cross-sectional analysis, we have looked at the associations between previously identified three major dietary patterns[23] and hypertension among low income urban Pakistani adults. A negative association was seen between the seafood and yogurt diet pattern and the prevalence of hypertension, whereas no significant associations were found for two other dietary patterns. To our knowledge, this is the first investigation reporting such an association among Pakistani people.

Dietary patterns can be a proxy indicator of the real food consumption and every day eating habits, thereby providing an alternative approach to understand the relationship between diet and risk of diseases.[36] Our study findings showed an inverse association for hypertension and the seafood and yogurt pattern that was characterized by fish, prawns, potatoes, and yogurt. Previous studies have also shown similar results with diet patterns characterized by sea foods, vegetables and yogurt in different population groups. For example, work by Chen[22] showed a lower risk of hypertension among those Bangladeshis who were consuming a dietary pattern including fish, rice, some meat, fruits, and vegetables. Similarly, among 12,490 Japanese adults,[37] a dietary pattern including potatoes, dried fish, soybean products, fruits, citrus, and seaweeds was also found to be inversely related with systolic and diastolic blood pressure in women but not in men. According to our study results, the mean difference in blood pressure between those who were consuming less and more of the seafood and yogurt pattern was only 2.4 mmHg. This difference may seem small, but is clinically relevant because even a 2 mmHg reduction in SBP can

Table 2. Mean blood pressure of participants across dietary pattern quartiles

Characteristics (mean±SD)	Fat and sweet pattern			Fruit and vegetable pattern			Seafood and yogurt pattern		
	Q1	Q4	*p*-trend*	Q1	Q4	*p*-trend*	Q1	Q4	*p*-trend*
n	1013	1126		1091	1094		1061	1087	
Dietary pattern (scores)	0.23±0.14	1.67±0.52		0.33±0.14	1.94±0.43		0.05±0.11	0.92±0.37	
SBP mean (mmHg)	126±18.7	124±17.7	<0.001	126±18.5	123±16.4	<0.010	126±18.0	123±17.7	<0.010
DBP mean (mmHg)	80.6±11.2	79.7±11.2	0.050	80.7±11.0	79.0±10.7	<0.010	80.4±10.9	78.9±10.7	<0.010

SBP: systolic blood pressure; DBP: diastolic blood pressure.
*p-value of ANOVA to test the significance across dietary pattern quartiles but for simplicity reason only the lowest and the highest quartile numbers are shown.

Table 3. Factors associated with the prevalence of hypertension† among participants

Variables	Univariate odds ratio (95% CI)	*p*-value	Multivariable‡ odds ratio (95% CI)	*p* -value
Gender				
Women	Ref (1.00)	-	-	-
Men (n=2134)	1.23 (1.05-1.45)	<0.010	1.48 (1.22-1.76)	<0.010
Age (yrs)	1.04 (1.03-1.04)	<0.010	1.03 (1.02-1.04)	<0.010
Marital status				
Single	Ref (1.00)	-	-	-
Married (n=2777)	1.75 (1.47-2.08)	<0.010	0.97 (0.80-1.12)	0.830
Formal education				
Yes	Ref (1.00)	-	-	-
No (n=947)	1.60 (1.32-1.88)	<0.010	1.31 (1.06-1.60)	0.010
Body mass index (kg/m^2)	1.11 (1.10-1.11)	<0.010	1.10 (1.08-1.11)	<0.010
Physical activity (METS/hrs/wk)	1.00(0.99-1.00)	0.670	-	-
Tobacco use				
No	Ref (1.00)			
Yes (n=1666)	1.36 (1.16-1.59)	<0.010	0.91 (0.75-1.10)	0.340
Dietary patterns scores				
Fat and sweet	0.93 (0.81-1.06)	0.280	1.05 (0.91-1.22)	0.490
Fruit and vegetable	0.88 (0.78-1.00)	0.050	0.93 (0.80-1.09)	0.410
Seafood and yogurt	0.83 (0.68-1.01)	0.050	0.78 (0.63-0.98)	0.030

†Hypertension was defined according to the 7th report of the Joint Committee on Prevention, Detection, Evaluation, and Treatment of High Blood pressure as baseline measurement of systolic blood pressure ≥140 or diastolic blood pressure >90 mmHg or on hypertensive medications.
‡Variables found to be significant (p<0.20) in the univariate analysis were included in the multivariable analyses. All three dietary patterns were retained in the multivariable analysis as it was the variable of interest.

decrease mortality by 7% from heart diseases and vascular diseases in middle aged people.[38]

Fruit and vegetable intake, in particular, has been shown to reduce blood pressure in randomized and prospective population studies.[12,39] However, we found only a slightly reduced risk (12%) of hypertension among those subjects following a higher intake of the fruit and vegetable dietary pattern. These results became non significant after adjusting for subjects age, gender, education and lifestyle variables. There might be several reasons for this observation in our data set. Firstly, dietary pattern by itself may not have a major influence on the prevalence of hypertension in our population in comparison to other risk factors such as: demographics and anthropometric variables. Secondly, some researchers suggest that the Asian cooking method which includes stir frying, use of saturated fat and over-cooking of vegetables may partially explain the null or no association seen among Asians for diets rich in vegetables and fruits.[40,41] However, we do not have enough information on fat and energy intake, and therefore cannot postulate that comparable reasons could apply to Pakistani adults who were following the fruit and vegetable pattern. Nonetheless, there are some Pakistani studies that have shown an increased intake of fats in daily cooking of vegetables.[6,20] Unlike most investigators,[18,42-44] we found no associations between the fat and sweet dietary pattern and hypertension. Though some studies have shown similar results as ours. For example, McNaughton and his colleagues[44] found no associations between high intake of fats and sweets and risk of hypertension among Australian adolescents, even after adjusting for covariates. Similarly in the European Prospective Investigation into Cancer and Nutrition (EPIC)-Potsdam study of 8,552 women, no significant difference was found between the fat and sweet dietary pattern and hypertension.[43] Among Japanese people lower SBP and DBP was seen among those subjects who were eating more of a Western dietary pattern (proxy for the fat and sweet) compared with those eating less of this pattern.[37] An interesting observation that was seen in our data set and that could possibly support our findings for the fat and sweet diet pattern and hypertension was the fact that more physically active subjects were found in the highest quartile of fat and sweet diet pattern intake. Regular physical activity and weight control may have reduced the risk of hypertension and confounded the effect of high fat and sweet intake in our study subjects.[45] However, this needs to be further investigated.

Limitations of our study included the cross-sectional design that precludes any inferences for causality between dietary patterns and hypertension. However we excluded patients who self reported hypertension in the final analysis. The FFQ used in the assessment of food intake did not quantify portion size and thus we could not adjust our results with calories in evaluating the risk of hypertension and diet patterns. This may lead to nondifferntial misclassification of diet and, consequently, may lead us to underestimate the strength of associations between the diet patterns identified and hypertension risk. However, we did adjust for age, sex, BMI and therefore had some control for differences in calorie intake among the participants. The strengths of our study included a large sample size, a good response rate (88.4%), and multiple data on subjects' sociodemographic, anthropometric, and lifestyle characteristics that have not been accounted previously in assessments of the relationships between Pakistani dietary patterns and hypertension.

In conclusion, the seafood and yogurt dietary pattern was found to be inversely associated with hypertension in a Pakistani population. In a setting where there is a high level of poverty, low literacy rates, minimal health awareness, and limited access to health care facilities,[9,46] public health recommendations focusing on dietary patterns may become much easier for Pakistani people to understand, in comparison to individual nutrient recommendations for disease prevention.[24,47]

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AUTHOR DISCLOSURES

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Supplementary Table 1. Factor-loading matrix for the major dietary patterns identified by factor analysis[†]

Food items	Dietary patterns		
	Fat and sweet	Fruit and vegetable	Seafood and yogurt
Eggs	0.273	0.168	0.025
Paratha	0.291	-0.096	-0.111
Tandoori nan	0.376[§]	0.036	0.109
Halwa puri	0.330[§]	-0.120	0.097
Whole milk	0.264	0.045	-0.124
Milk without cream	-0.099	0.401[§]	-0.002
Cream	0.188	0.021	-0.108
Milk dessert	0.321[§]	0.177	0.167
Ice cream	0.439	0.239	0.060
Dahi (yogurt)	0.030	-0.362	0.508[§]
Lassi (yogurt drink)	0.291	0.287	-0.011
Salty lasi (yogurt drink with salt)	-0.081	0.177	0.501[§]
Margarine	0.228	0.276	-0.156
Butter	0.055	0.150	-0.005
Mutton	-0.036	0.374[§]	0.047
Beef	0.339[§]	-0.103	-0.243
Chicken	0.173	0.386[§]	0.131
Fish	0.027	0.018	0.630[§]
Prawn	0.038	-0.097	0.656[§]
Organ meats	0.354[§]	0.003	0.157
Food purchased from outside [‡]	0.540[§]	-0.043	0.005
Cooked vegetables	-0.246	0.304[§]	-0.165
Potatoes	0.163	-0.111	0.403[§]
Raw vegetables	0.066	0.529[§]	0.084
Biryani/ palow	0.422[§]	0.103	0.147
Beans/lentils/dals/peas	-0.072	0.193	-0.137
Fruits	0.090	0.601[§]	0.135
Fresh fruit juices	0.232	0.487[§]	-0.063
Bakery products	0.307[§]	0.099	0.140
Mitai/ halwa (pakistani desserts)	0.342[§]	0.105	-0.020
Fried snacks	0.475[§]	0.017	0.090
Nuts	0.353[§]	0.184	-0.108
Chocolate	0.348[§]	0.042	-0.010
Variance explained (%)	7.7	6.3	5.9

[†]Extraction method: Principal Component analysis, Varimax rotation converged in 6 iterations.
[‡]Includes Pakistani foods such as, kata kat, karahi, nehari as well as burger, pizza.
[§]Foods >0.30 loadings

Original Article

Dietary patterns and their association with hypertension among Pakistani urban adults

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巴基斯坦城市居民膳食模式及其与高血压的关系

高血压是一种常见的慢性疾病，全球超过 25%的成年人受其影响。在巴基斯坦，33%的成年人患有高血压。大量的流行病学研究表明膳食模式在高血压的因果关系、预防和管理中起关键作用。然而，来自南亚的这方面的证据不足。本研究旨在确定巴基斯坦卡拉奇地区参加高血压控制和风险衰减研究的 4304 名城市低收入居民的膳食模式和高血压的关系。采用含 33 个条目的食物频率问卷收集饮食信息，并用主成分因子分析得到 3 个独特的膳食模式，分别被命名为脂肪和甜食、蔬菜和水果、海鲜和酸奶模式。我们采用单因素和多因素 logistic 回归分析研究膳食模式和高血压之间的关系。男性更容易患高血压，而年龄和体质指数的增加也与高血压有关（p<0.001）。校正年龄、性别、教育、婚姻状况、体质指数和吸烟之后，海鲜和酸奶模式与高血压呈显著负相关 (OR=0.78：95% CI：0.63， 0.98；p=0.03)，而未见另外两种膳食模式与高血压存在显著相关性。这些发现表明某些膳食模式可能与巴基斯坦城市低收入居民的高血压有关。

关键词：膳食模式、因子分析、巴基斯坦、高血压、生活方式行为