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Identification of dietary patterns associated with blood pressure in a sample of overweight Australian adults

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Abstract

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Keywords

blood, pressure, sample, associated, overweight, patterns, australian, adults, dietary, identification

Disciplines

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ORIGINAL RESEACRH

Identification of dietary patterns associated with blood pressure in a sample of overweight Australian adults

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Running title: Dietary patterns and blood pressure

Abstract

The DASH diet provides strong evidence for an optimal dietary pattern for blood pressure (BP) control; however investigation at the level of key foods in a dietary pattern is sparse. This study aimed to assess the relationship between dietary patterns driven by key foods with BP in a sample of obese Australian adults. Secondary analysis was conducted on baseline data of 118 participants (45.1 ± 8.4 y, mean BP = 124.1±15.8 /72.6 ± 9.2 mm Hg) recruited in a weight reduction randomized controlled trial (ACTRN12608000425392). Dietary assessment was by a validated diet history interview. The average of three office BP measurements was taken. Factor analysis extracted dietary patterns and their relation to systolic blood pressure (SBP) and diastolic blood pressure (DBP) was analysed using multiple linear regression. Eight dietary patterns were identified based on leading foods: meat & alcohol, seafood, fats, fruits & nuts, legumes, confectionery, sweet foods, and yeast extracts & seasonings. A lower SBP was associated with alignment with the fruit & nuts pattern (β = -4.1 (95% CI -7.5 to -0.7) mm Hg) and with seafood for DBP (β= -2.4 (-4.6 to -0.3) mm Hg). SBP and DBP were higher with yeast extract & seasonings (β= 4.3 (1.4 – 7.3); 2.5 (0.9 – 4.0) mm Hg, respectively). In obese adults attending for weight loss, dietary patterns that included larger amounts of fruits & nuts and/or seafood were associated with lower BP at baseline, while patterns that were characterised by yeast extract & seasonings were associated with higher BP.

Key Words: dietary patterns; blood pressure; factor analysis; fruits; nuts; fish; seasonings; DASH diet

Introduction

The landmark Dietary Approaches to Stop Hypertension (DASH) randomized controlled trial provided evidence that adoption of a dietary pattern that is rich in fruits, vegetables and low fat dairy products can reduce blood pressure (BP) as much as some anti-hypertensive drugs.[1] The observed increased efficacy of the DASH diet among African Americans supports other data suggesting ethnic differences in blood pressure response to diet,[2] which may be related to differences in habitual dietary patterns.[1] These differences might come down to a different emphasis on particular food groups. The follow-up DASH Sodium study demonstrated additional BP lowering benefits of salt restriction over and above the merits of the DASH diet, although the greatest benefits in sodium restriction were seen in those with a high fat and micronutrient-poor diet (i.e. typical American control diet).[3]

The DASH diet studies signalled a move by health professionals away from a preoccupation with salt alone to that of a holistic, composite diet for the prevention and management of hypertension.[1] The subsequent PREMIER trial investigated the effects of combining the DASH diet with "established" lifestyle modification recommendations (weight loss, exercise, and restriction of sodium and alcohol).[4] Surprisingly, the addition of the DASH diet to lifestyle modification resulted in only a small incremental decrease of systolic blood pressure (SBP) and diastolic blood pressure (DBP) of only 0.6/0.9 mm Hg respectively (1.7/1.6 mm Hg in hypertensive individuals) which suggests the lack of an additive effect of combined interventions on BP.[5] It needs to be noted, however, that the PREMIER trial achieved only a small difference in urinary sodium excretion (~30mmol) between the experimental and control groups, which suggests poor compliance with dietary prescriptions related to sodium restriction.

Further, in the Trials of Hypertension Prevention II (TOHP II) study,[6] involving overweight hypertensive participants, the effect of adding sodium restriction to weight loss produced no further decrease of BP, even though moderate sodium restriction alone produced a modest, but significant, decrease. In this study, achieving weight loss using a low-calorie version of the DASH diet, resulted in a net reduction of 9.5 mm Hg SBP and 5.3 mm Hg DBP in the ambulatory condition.[6] However, not all studies are consistent. The ENCORE study reported that in overweight or obese persons with above-normal BP, the addition of exercise and weight loss to the DASH diet resulted in even larger BP reductions, greater improvements in vascular and autonomic function, and reduced left ventricular mass than the DASH diet alone.[7] Clinic-measured BP was reduced by 16.1/9.9 mm Hg (DASH plus weight management); 11.2/7.5 mm (DASH alone); and 3.4/3.8 mm (usual diet controls) ($P < .001$).

Despite the body of evidence that identifies a DASH-style diet to be optimal for blood pressure control, this type of eating plan may be difficult to achieve in various populations. In the PREMIER trial [4] participants were required to purchase their own food,[4] rather than be provided with carefully prepared meals as occurred in the DASH studies. In the original DASH study, patients were provided with 9.6 daily servings of fruits and vegetables, but in the PREMIER study, the intake increased from 4.8 servings at baseline to 7.8 servings, (and indicated by changes in urinary potassium excretion). Similarly, the effects of sodium restriction in the DASH Sodium follow-up study greatly exceeded the changes observed in almost all other studies in which participants prepared their own low salt meals,[8] presumably due to the greater compliance with a low sodium regimen when meals were pre-prepared .

Thus, while the DASH dietary pattern and sodium restriction may form the basis for dietary advice, the realities of actual food consumption patterns remains an issue for clinicians. Food

intake is a complex variable because the effects of different foods may be synergistic or cancel each other out. Nevertheless, analyses of food choice patterns indicate that the intakes of specific foods tend to cluster, highlighting different patterns in different populations.[9] Factor analysis has emerged in nutritional epidemiology as a statistical way to extract these food patterns. [10,11] It has been used in various populations to demonstrate associations between dietary components and non-communicable diseases including myocardial infarction,[12] hypertension,[13] and diabetes.[14] Examining dietary patterns on entry to a weight loss trial may provide insights into specific food choices that need to be modified to better support changes in blood pressure alongside weight loss. This study aimed to identify patterns of food consumption that were associated with lower or higher BP in a sample of overweight Australians that had enrolled for a 12-month weight loss trial.

Methods

Study Design & Study population

This cross sectional study was conducted on the baseline data of a 12 month randomized controlled trial, studying the effect of Fish and LCn3PUFA on weight reduction in 118 obese Australian adults (ACTRN12608000425392).[15] The study was conducted in accordance to the Declaration of Helsinki guidelines and ethical approval was given by the University of Wollongong Human Research Ethics Committee. Written informed consent was taken from all the participants. The study participants were aged between 20 and 60 years, and had a BMI > 25 kg/m^2. Those with major illnesses, diabetes mellitus, and LDL ≥6 mmol/L, having food allergies, inadequate conversational English, low literacy, taking fish oil supplements, pregnant / lactating, unstable weight (± 3 kg for the past six months) or on a weight loss diet were excluded.

Dietary and physical activity assessment

Dietary data was collected through a validated diet history interview,[16] administered by Accredited Practising Dietitians. This data was analysed using the FoodWorks software system (Version 6, 2009, Xyris Software, Spring Hill, QLD, Australia). Food intake data was converted to energy intake and micronutrients (sodium (Na) and potassium (K)) using the AUSNUT1999,[17] and AusFood2001 databases (revision 11, from FoodWorks 2009 version 6, Xyris Software, Spring Hill, QLD, Australia). The food items were categorized into 21 food groups, based on the food groups suggested in the National Nutrition and Physical Activity Survey (NNPAS) by the Australian Bureau of Statistics .[18] These food groups are shown in Table 1. To see the effect of convenience & takeaway food on the BP, this food group was dealt with as an independent

category. Habitual physical activity was assessed using a waist-mounted RT3 triaxial accelerometer (StayHealthy, Inc; Monrovia, California) for three days.

Anthropometric measures

Body weight was measured in kilograms (kg) in an upright position without shoes, in minimal clothing, using digital scales with a bioelectrical impedance component (Tanita TBF-622; W.W. Wedderburn Pty Ltd, Ingleburn, NSW, Australia). A stadiometer was used to measure height in meters (m), without shoes. Body mass index (BMI) was calculated by the formula weight in kg/height in m^2.

Blood Pressure assessment

SBP and DBP were measured using a medical grade blood pressure monitor (Dinamap XL Vital Signs Monitor). Participants sat for 10 minutes, then three readings were taken from the same arm, and the mean of the three readings was used as the final reading.

Statistical analysis

Data were analysed in SPSS (Version 19.0,2010, IBM Corp, Armonk, NY). Descriptive statistics were computed: mean and standard deviation (± SD) for continuous variables (as continuous variables had normal distribution), frequency and percentage for categorical variables. Factor analysis was conducted for factor (dietary pattern) extraction by using Principal Component Analysis (PCA) technique. Varimax rotation was applied to maximize the relationship between the variables (food groups) and the factors. Factors having Eigenvalue greater than 1 were retained. The Kaiser-Meyer-Olkin (KMO) measure was calculated, which provides an indication of adequacy of sample size. KMO should be greater than 0.5 for a satisfactory factor analysis. Factor loading cut-off of 0.71 implies statistical significance for a food group to be included in

the respected factor (dietary pattern).[19, 20] Factor scores were determined by regression techniques. A positive score represents alignment to the dietary pattern and negative scores indicates non-alignment to that pattern. In order to characterise quantities of foods representing the major dietary patterns that were identified by factor analysis, mean intakes of food groups were compared for participants considered to more aligned with a specific dietary patterns and those that were not.

Multivariable linear regression modelling was performed separately for SBP and DBP, with the factor scores, age, gender, BMI and activity calories included as the independent variables. The student's t-test was conducted to assess whether intakes of Na and K differed according to whether study participants were adherent or not with particular dietary patterns that were found to be significantly associated to SBP or DBP. A p-value of < 0.05 was considered statistically significant.

Results

Baseline characteristics

The mean age of the study population was 45.1 ± 8.4 years and 25.4% (n = 30) were male. The mean BMI was 31.3 ± 3.5 kg/m^2, with mean energy consumption per day of 2397 ± 834.2 kcal and 24 hours activity calories 825.2 ± 361.3 kcal. The mean SBP was 124.1 ± 15.8 mm of Hg and mean DBP 72.6 ± 9.2 mm of Hg. Nineteen percent of the sample (n = 22/114) had hypertension, according to the definition of systolic BP ≥ 140mmHg and/or diastolic BP ≥ 90 mmHg, or taking prescribed hypertension medication. The mean reported sodium (Na) consumption was 2463.8 ± 1206.8 mg/day and mean potassium (K) intake was 3691.7 ± 1125.7 mg/day.

Dietary patterns

Factor analysis extracted eight lead dietary patterns characterised by specific foods, namely meat & alcohol, seafood, fats, fruits & nuts, legumes, confectionery, sweet foods, and yeast extract & seasonings. Dietary patterns along with the factor loadings of the 21 food groups applied in the analysis are shown in Table 2. These dietary patterns explained 66.3% cumulative variance in the food intake of this sample of obese Australian adults. The KMO value was 0.635, indicating that the sample size was adequate for factor analysis by the PCA technique.

Association of dietary patterns with SBP and DBP

SBP was lower with alignment with the fruits & nuts dietary pattern: β = -4.1 (95% CI -7.5 to -0.7) mm Hg, p-value 0.018; and higher with alignment with the yeast extract & seasonings dietary pattern: β= 4.3 (1.4 – 7.3) mm Hg, p-value 0.004, adjusting for age, gender, BMI and

activity calories in the model (Table 3). DBP was lower with alignment with the seafood pattern: β = -2.4 (-4.6 to -0.3) mm Hg, p-value 0.028; and was higher for the yeast extract & seasonings pattern: β = 2.5 (0.9 – 4.0) mm Hg, p-value 0.003, adjusting for age, gender, BMI and activity calories in the model (Table 4). BMI was found to be significantly associated with SBP and age & gender with DBP (Table 3 & 4 respectively).

Intake of food groups in significant dietary patterns

Mean intake of fruit products and dishes consumed by participants whose diet was aligned with the fruits & nuts dietary pattern was 291.7 ± 168.6 g/day compared to 120.3 ± 63.1 g/day in participants whose diets did not fit this pattern (p-value < 0.001). Consumption of seed and nut products/ dishes was 34.7 ± 30.1 g/day in the group aligned with the fruits & nuts dietary pattern, compared to 4.9 ± 6.9 g/day in those not aligned with this pattern (p-value < 0.001). Consumption of yeast extracts and seasonings was 45.55 ± 56.9 g/day in the group aligned with this dietary pattern vs. 2.85 ± 10.3 g/day in others (p-value < 0.001). The group aligned with the seafood dietary pattern consumed a mean of 67.7 ± 46.6 g/day of seafood products and dishes, compared to 23.7 ± 21.7 g/day in those with other dietary patterns (p-value < 0.001).

Intake of Sodium & Potassium in significant dietary patterns

Study participants whose diets were aligned with the fruits & nuts and seafood patterns were consuming significantly more potassium as compared to those not aligned with these dietary patterns (p-value 0.027 and 0.003 respectively). Sodium consumption did not differ between participants either aligned or not aligned with any of the dietary patterns that were found to be significantly associated with SBP or DBP (Table 5).

Discussion

While the DASH diet confirms the effects of a dietary pattern based on minimally processed foods, this analysis confirmed that dietary patterns dominated by certain foods may be associated with BP in overweight adults. The analysis adds to our understanding of the relationship between food and health, given that this may be examined from the perspective of single nutrients, foods and whole diets. The three are interrelated and it is often difficult to differentiate between levels of association.[21] In the case of BP, the nutrient sodium stands out and this is likely to be due to its ubiquitous presence in processed foods. Whole dietary patterns have been shown to be effective in weight loss and in reducing blood pressure,[3, 22, 23] but in clinical practice, dietary advice needs to work from the basis of usual dietary patterns.[24] This means being able to identify the foods most likely implicated and from which dietary change can occur.

Amongst overweight volunteers for a weight loss trial, a fifth of whom were hypertensive, usual dietary patterns that comprised larger amounts of fruits & nuts were associated with lower SBP (β = - 4.1; P= 0.018) while larger amounts of seafood were associated with lower DBP (β = - 2.4; P= 0.028), adjusting for age, gender, BMI and activity calories. In contrast, dietary patterns with more yeast extract spreads & seasonings were associated with higher SBP (β = 4.3; P= 0.004) and DBP (β = 2.5; P= 0.003). Bearing in mind that this is an observational analysis, the results are consistent with that of the DASH studies in that minimally processed foods were found to be favourable for BP control. They were also consistent from a nutrient perspective, given that the favourable dietary patterns characterised by fruits & nuts or seafood were also aligned with higher potassium intakes. Increased potassium intake was shown to lower SBP and DBP by 3.49 and 1.96 mm Hg in a meta-analysis of 22 randomised controlled trials.[25]

The key nutrient known to influence blood pressure is sodium. Reduced sodium intake was shown to lower blood pressure in a recent meta-analysis[26] but results were more reliable for hypertensive populations.

The yeast extract & seasonings dietary pattern in the present study was associated with an increase of 4.3 and 2.5 mm Hg in SBP and SBP respectively. This pattern included seasonings and stock cubes, most of which are high in salt content. Reported sodium intakes did not differ according to alignment with the various identified food patterns, but dietary assessment of sodium is considered unreliable, particularly given its ubiquitous presence in food and culinary use. The gold standard method of 24 hour urinary sodium measurements would be required to better assess this variable, [27] and further studies investigating the impact of dietary patterns on BP should strive to include this biomarker. It is well documented that under-reporting of energy intake occurs in obese individuals,[28, 29] and this too may have introduced error in estimates of sodium intake. In our previous weight loss trials, this method has been shown to result in under-reporting in 35% of participants.[30] This is consistent with findings from a systematic literature review that showed the percentage of under-reporters to be about 30% and energy intake to be underestimated by approximately 15%, regardless of whether 24 hour recalls or estimated or weighed food records are used.[31] Our analysis assumes that any under-reporting is consistent across food groups, thus avoiding systematic bias, however this cannot be confirmed.

Since nutrients are delivered in food that is consumed as whole diets or cuisines, multiple interactions may occur.[9] The DASH diet was rich in minimally processed foods such as fruits, vegetables, legumes, nuts, seeds, low-fat dairy and fish, and the sodium intake was kept constant at 3000mg/day in the intervention and control groups.[1] This led to a reduction of 5.5 mm Hg and 3.0 mm Hg in SBP and DBP, respectively. This is comparable to the analysis we report here whereby

SBP was lower by 4.1 mm Hg with the fruits & nuts dietary pattern and DBP lower by 2.4 mm Hg with the seafood dietary pattern. Other dietary patterns that are related to lower blood pressure include the Nordic diet,[32] and the Mediterranean diet.[23] The Nordic diet consists of foods of Nordic origin such as whole grains (rye, barley and oats), rapeseed oil, berries, fruits, vegetables, fish, nuts and low-fat dairy products, [32] while the Mediterranean diet is high in cereals, fruits, vegetables, legumes, nuts and seeds, poultry (and sometimes fish), olive oil and moderate amounts of wine. [33]

While the recommended dietary patterns may be ideal in lowering blood pressure, it is important to consider different cuisines or habitual food intake. For example, a previous study investigated the effects of a Brazilian dietary pattern on blood pressure by incorporating DASH-sodium diet principles and adapting them to local production and eating habits.[34] In that study, there was a significant reduction of SBP and DBP by 7.7 and 5.1 mm Hg respectively. The present study investigated dietary patterns of an Australian population sample whose dietary intake may be influenced by local food production and eating habits.

The dietary patterns identified in this analysis as being associated with lower BP are led by unprocessed 'core' foods, in contrast to those characterised by high use of yeast spreads and seasonings. In a recent review of diet quality in 187 countries, a disturbing picture of dietary patterns showing a great propensity of 'unhealthy items' signalled caution for countries such as Australia which also enjoy plentiful healthy food items.[35] Combined with early releases of data from the Australian Health Survey (AHS) showing around 35% energy from 'discretionary' food choices, amongst Australian adults,[18] the findings of our analysis suggest more attention may need to be given to foods that may appear on the periphery of the diet. The Australian dietary guidelines define discretionary food choices as "most sweet biscuits, cakes, desserts and pastries; processed meats and sausages; ice-cream and other ice confections; confectionary and chocolate; savoury

pastries and pies; commercial burgers; commercially fried foods; potato chips, crisps and other fatty and/or salty snack foods; cream, butter and spreads which are high in saturated fats; sugar sweetened soft drinks and cordials, sports and energy drinks and alcoholic drinks".[36] Our food categorization was based on that used in the most recent national nutrition survey (AHS) but in the case of dietary effects on BP, it was informative to consider the various food sub-categories within the discretionary food group. Food categorisation is always problematic, and it is likely that there are some healthy foods within our 'cautionary' food categories, but taken as a whole, it is likely that the foods to focus amongst spreads and condiments are those with high sodium content. Our analysis confirms that core foods such as fruits, nuts and seafood should be encouraged. These foods are likely to bring along with them a healthier dietary pattern, but this is the topic of further research. On the other hand, spreads and condiments add variety and taste to foods and there is always opportunity to improve their nutrient content. As such they should not be overlooked in discussions on improving diet quality overall and in weight loss interventions as per our study context.

The use of office BP, rather than ambulatory blood pressure monitoring (ABPM) may be considered a limitation. ABPM is generally considered to be a preferable alternative to traditional methods for measuring BP, at least in clinical trials, [37-41] due to enhanced precision, elimination of observer bias, and prevention of 'white coat' hypertension. ABPM reduces the variability of estimates of BP change in response to interventions.[42-45] In the DASH study ABPM was more efficient than three to four sets of daily random zero readings, resulting in detection of a given BP change with a smaller sample size.[46] Given that the current analysis is based on a cross sectional estimate of both blood pressure and dietary intake patterns, variability in BP for repeated measurements is of little concern. Further, automated office blood pressure

measurement, as collected in the present study, has been shown to produce mean BP values comparable to awake ambulatory BP and is recommended for use in primary care settings.[47]

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Authorship

KC and LT conceived the study; SA performed the statistical analyses and modelling, assisted by MB. YP assisted with extraction of the dietary data and food group classification. SA wrote the first draft of the paper while all authors contributed to editing of the paper and read the final manuscript.

Conflict of Interest

No authors have any conflicts of interest to declare.

Summary Table

What is known about topic
• The key dietary factor known to influence blood pressure (BP) is sodium. • Lower blood pressure is also associated with a diet rich in fruits, vegetables and low fat dairy products (DASH diet) as well as Mediterranean and Nordic diets. • Not all people follow these patterns, and one way of discriminating between individuals is by identifying foods that characterise a dietary pattern using factor analysis.
What this study adds
• In a clinical sample of overweight Australians, usual dietary patterns that include larger amounts of fruits & nuts were associated with lower systolic BP. • Dietary patterns characterised by larger intakes of seafood were associated with lower diastolic BP. • Dietary patterns that included more yeast extract spreads & seasonings were associated with higher systolic and diastolic BP. • Factor analysis enables the identification of foods that may drive poor overall dietary patterns that can be targeted in clinical practice for improved blood pressure.

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Table 1: Description of food group classification*

Food Group	Food items
Non-alcoholic beverages	Fruit & vegetable juice, hot drinks (tea & coffee), mineral water, soda & energy drinks, soft drinks & flavoured water
Cereal and cereal products	Bread, cereals, grain & grain dishes, pasta & noodle dishes
Cereal based products and dishes	Biscuits/bars & crackers, savoury bakery, sweet bakery
Fats & Oils	Butter, margarine & table spread, plant oils, other fats (avocado)
Seafood products and dishes	Fish & seafood products, mixed dishes with seafood or fish as the major component
Fruit products and dishes	Canned fruit, dried & preserved fruit, Fresh fruit, Mixed dishes where fruit is the major component
Egg products & dishes	Eggs, dishes where egg is the major component
Meat, poultry, game product and dishes	Beef, sheep & pork, deli meat, poultry and feathered game, mixed dishes where beef, sheep or pork is the major component, mixed dishes where poultry and feathers game is the major component, mixed dishes where sausage, bacon, ham or other processed meat is the major component
Milk products and dishes	Dairy milk (cow, sheep and goat), yoghurt, cream, cheese, frozen milk products, custards, other dishes where milk or a milk product is the major component, flavoured milks and milkshakes
Soups	Soup, homemade from basic ingredients, dry soup mix, soup, prepared from dry soup mix, canned condensed soup (unprepared) or commercial ready-to-eat soup
Seed and nut products & dishes	Seeds and seed products, nuts and nut products
Sauces, dips and condiments	Gravies and savoury sauces, pickles, chutneys and relishes, salad dressings, stuffings, dips
Vegetable products and dishes	Potatoes, cabbage, cauliflower and similar brassica vegetables, carrot and similar root vegetables, leaf and stalk vegetables, peas and beans, tomato and tomato products, other fruiting vegetables, other vegetables and vegetable combinations, dishes where vegetable is the major component
Legumes and pulse products and dishes	Mature legume and pulse, mature legume and pulse products and dishes
Snack food	Potato snacks, corn snacks, extruded or reformed snacks, Other snacks
Sugar products and dishes	Sugar, honey and syrups, jam and lemon spreads, chocolate spreads, sauces, dishes and products other than confectionery where sugar is the major component
Confectionery	Chocolate and chocolate-based confectionery, fruit, nut and seed bars, muesli or cereal style bars, other confectionery
Alcoholic beverages	Beers, wines, spirits, cider and perry, Other alcoholic beverages
Convenience & takeaway	Any takeaway food including KFC, Mc Donald, pizza, tacos, sausage roll, sushi
Yeast extract and seasonings	Yeast, vegetable and meat extract spreads, herbs, spices, seasonings and stock cubes
Special dietary foods (Food replacement or supplement)	Formula dietary foods (artificial sweeteners, oral supplement powder, high protein, other flavours, almond meal, psyllium)

*Food categories as described in the 2011-13 Australian Health Survey (Australian Bureau of Statistics). Available at: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.007Appendix22011-12

Table 2: Dietary patterns and Factor Loadings

Lead Dietary patterns extracted from Factor Analysis (Principal component analysis)	Meat & alcohol	Seafood	Fats	Fruits & nuts	Legumes	Confectionary	Sweet foods	Yeast extract & seasonings
	1	2	3	4	5	6	7	8
Food Groups	**Factor Loadings**							
Non-alcoholic beverages	.302	.288	.143	.116	-.101	.358	.359	.171
Cereal and cereal products	.226	.228	.129	.481	.284	.242	.360	-.053
Cereal based products and dishes	.203	-.061	-.089	.230	-.122	.161	.660	.022
Fats & Oils	-.042	.116	.850	.113	.056	.037	-.036	-.113
Seafood products and dishes	.163	.740	.042	.010	.094	-.046	-.143	.213
Fruit products and dishes	.231	.053	.115	.751	-.055	.002	-.127	-.011
Egg products & dishes	.335	.259	.520	.099	.069	-.037	-.016	.364
Meat, poultry, game product and dishes	.725	.047	.060	.189	.211	.022	.126	-.325
Milk products and dishes	-.117	.687	-.034	-.069	.103	-.059	.292	-.184
Soups	-.096	.018	.563	-.083	-.030	-.006	.429	.216
Seed and nut products and dishes	-.032	.026	-.060	.788	.156	-.073	.098	.055
Sauces, dips and condiments	.414	-.111	.480	-.032	-.051	.126	.159	-.033
Vegetable products and dishes	.099	.689	.211	.319	-.143	.051	-.071	-.181
Legumes and pulse products and dishes	.015	.043	.008	.162	.874	-.019	-.034	-.109
Snack food	.064	-.290	.266	-.031	.010	.628	-.052	-.274
Sugar products and dishes	.052	.031	.163	-.134	-.042	-.074	.738	-.116
Confectionery	-.091	.089	-.114	-.020	-.057	.858	.046	.131
Alcoholic beverages	.823	.197	-.065	.146	-.078	-.201	.020	.102
Convenience & takeaway	.621	-.094	.111	.004	-.019	.477	.178	.032
Yeast extract and seasonings	-.073	-.074	.031	.019	.081	.028	-.036	.853
Food replacement	.012	.014	.021	-.017	.831	-.056	-.114	.217

Factor Loadings are coefficients that represent the correlation between the food groups and the lead dietary patterns. Factor loading cut-off of 0.71 implies statistical significance for a food group to be included in the respected factor (dietary pattern).

Table 3: Association of dietary patterns with systolic blood pressure adjusting for age, gender, BMI and activity calories

Variable	β	95 % Confidence Interval for β		P-value
		Lower Bound	Upper Bound	
Age (years)	0.282	-0.085	0.650	0.131
Gender Male(reference) Female	 0 -7.01	 - -15.69	 - 1.67	 0.112
BMI (kg/m^2)	0.93	0.05	1.82	0.037*
Activity Calories (kCal)	0.006	-0.004	0.016	0.210
Meat & Alcohol Factor score	-3.90	-9.23	1.42	0.149
Seafood Factor Score	-2.22	-6.24	1.79	0.275
Fats Factor score	-1.44	-4.42	1.54	0.340
Fruits & nuts Factor Score	-4.15	-7.57	-0.73	0.018*
Legumes Factor Score	0.68	-2.20	3.57	0.640
Confectionary Factor Score	0.91	-2.09	3.90	0.549
Sweet foods Factor Score	-0.36	-3.81	3.09	0.837
Yeast extract & seasonings Factor Score	4.38	1.47	7.29	0.004*
(Constant)	89.49	53.28	125.71	0.000

*Statistically significant association, β : regression coefficient, BMI : Body mass index

Table 4: Association of dietary patterns with diastolic blood pressure adjusting for age, gender, BMI and activity calories

Variable	β	95 % Confidence Interval for β		P-value
		Lower Bound	Upper Bound	
Age (years)	0.24	0.039	0.438	0.020*
Gender Male(reference) Female	 0 -7.94	 - -12.65	 - -3.23	 0.001*
BMI (kg/m^2)	0.37	-0.104	0.85	0.123
Activity Calories (kCal)	0.001	-0.004	0.007	0.625
Meat & Alcohol Factor Score	-2.07	-4.96	0.81	0.156
Seafood Factor Score	-2.44	-4.63	-0.26	0.028*
Fats Factor score	-1.53	-3.15	0.085	0.063
Fruits & nuts Factor Score	-1.37	-3.23	0.48	0.145
Legumes Factor Score	-1.18	-2.74	0.38	0.138
Confectionary Factor Score	-1.36	-2.99	0.26	0.100
Sweet foods Factor Score	-0.83	-2.71	1.041	0.379
Yeast extract & seasonings Factor Score	2.46	0.89	4.05	0.003*
(Constant)	62.95	43.29	82.60	0.000

*Statistically significant association, β : regression coefficient, BMI : Body mass index

Table 5: Reported intakes of sodium and potassium, according to dietary patterns found to be associated with blood pressure

Dietary pattern	Na intake in mg/day in[a]:			K intake in mg/day in:		
	Aligned with this dietary pattern	Not aligned	P-value	Aligned with this dietary pattern	Not aligned	P-value
Fruits & nuts	2517.3 ± 1371.9	2461.3 ± 1112.7	0.813	3929.8 ± 1249.6	3462.4 ± 941.4	0.027*
Yeast extract & seasonings	2645.3 ± 1641.2	2347.9 ± 811.1	0.193	3563.8 ± 1251.3	3773.4 ± 1038.5	0.236
Seafood	2304.4 ± 851.7	2612.8 ± 1454.7	0.166	4003.5 ± 1144.4	3400.4 ± 1034.4	0.003*

*Statistically significant difference ($P<0.05$) between participants whose dietary pattern is aligned with this category and those whose diets are not

[a]The mean amount of sodium consumed from food for the total sample was 2464 ± 1207 mg/day (equivalent to 6.16 g salt/day). This amount includes sodium naturally present in foods as well sodium added during processing, but excludes the discretionary salt added by consumers in home-prepared foods or to foods at the table. The average amounts of sodium presented here are therefore likely to be an underestimate of total intake.