



## The Dietary Pattern in the Iranian Population, Findings of Bandare-Kong Non-communicable Disease Cohort Study: A Brief Report

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### Abstract

**Background:** The association between dietary patterns and chronic diseases and mortality risk has been demonstrated in recent studies. Considering that dietary patterns can provide an approach that is comprehensive to both disease prevention and treatment, this study was conducted to find out prominent dietary patterns among Bandare-Kong participants.

**Materials and Methods:** This population-based cross-sectional study was performed on Bandare-Kong non-communicable disease (BKNCD) Cohort study participants aged 35-70. A food frequency questionnaire was used to determine food intake. The factor analysis method with the principal component analysis approach was employed to extract major dietary patterns.

**Results:** Healthy, Western, and traditional diets were identified as the three major dietary patterns. The healthy pattern was the prominent dietary pattern (10.2%). Healthy, Western, and traditional nutritional patterns explain 10.20%, 6.30%, and 4.28% of the variance in food intake, respectively.

**Conclusion:** Our findings indicated that consumption of a healthy dietary pattern in BKNCD participants tended to be high, followed by Western as the second pattern. It is recommended that further longitudinal studies be conducted to assess the role of dietary patterns in cardiometabolic disease incidence.

**Keywords:** Dietary pattern, BKNCD, PERSIAN

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### Introduction

The human diet as a complex consists of hundreds of ingredients and mixtures of foods, as well as over 140 specific nutrients and compounds (1). There is a wide variation in dietary intake among individuals, which is one of the most important factors affecting health. From 1980 through 2015, the American Dietary Guidelines have gradually shifted from focusing on single nutrients to dietary patterns as a whole (2). The term “dietary patterns” refers to the entire diet consumed by individuals and populations over months and years (1). The analysis of food consumption based on dietary patterns could provide a unique insight compared to the traditional single-nutrient focus and allow for an approach that is comprehensive to both the prevention and treatment of disease (3). People consume foods and nutrients frequently according to their habits and particular dietary patterns, not separately; in addition, synergistic and antagonistic interaction of consumable food can be

effective on health and incidence of different diseases (4). To identify the association between diet and risk of chronic disease, dietary pattern analysis has operated effectively as the complementary method that assesses the outcomes of overall death rather than considering individual nutrients or foods (5). This study aimed to determine the dietary patterns in the Bandare-Kong non-communicable disease (BKNCD) cohort study.

### Materials and Methods

#### Study Design

We evaluated participants of the BKNCD Cohort study, a prospective population-based cohort study. This cohort study as a part of the PERSIAN Cohort study consisting of 4063 subjects in the age range of 35-70 years old, was conducted in Bandar Kong city, an ancient port located in the western part of Hormozgan province, and registered between November 17, 2016, and November 22, 2018 (6).

The inclusion criteria of this cohort study were

showing willingness to participate in the study, being in the age range of 35-70, dwelling for one year and at least nine months each year, signing written informed consent, and having Iranian nationality. On the other hand, the exclusion criteria were showing reluctance to attend, being a guest, and suffering from mental or physical disabilities.

The data of the cross-sectional phase of BKNCD were chosen for analysis. The food intake of participants was collected by employing a customized semi-quantitative food frequency questionnaire (FFQ) composed of 132 food items which were completed by trained nutritionists. The frequency and amount of consumption of each food item per year were recorded according to its consumption pattern in the day, week, month, or year. In the next step, food intakes were calculated into gr/day based on the household portion sizes of the consumed food. In addition, the amount of energy and nutrients were extracted from the Nutritionist IV software. Data related to the demographic characteristics of participants including age, gender, education, marital status, and smoking and physical activities, were collected through the questionnaire. Smoking status was considered based on smoking at least 100 cigarettes in a lifetime. In this cohort study, height was measured by using a Height Rod Wall, FAZZINI S208, Italy, 2015 standardized to the nearest 0.5 centimeters in cm. Further, weight was measured in kilograms via a transportable Weighing scale, RGZ 160, China, to the nearest 10 g.

### Statistical Analysis

SPSS, version 25, was utilized for statistical analysis. After entering the data, to determine dietary patterns, because of the large number of food items in FFQ, first, food items were categorized into 38 predefined groups according to the similarity of nutrients or cooking methods and what was discussed in previous studies (7, 8). Table 1 presents food groups. Finally, by using the factor analysis method with the principal component analysis approach, food items were placed next to each other according to the degree of correlation they had with each other and the major dietary patterns were established. The orthogonal rotation process evaluated to preserve the unrelated features of factors, and a screen test for each factor determined the number of remaining factors. For each pattern, we determined the factor score according to their factor loading based on the weighted sum of the food groups. Factor loading values greater than or equal to 0.20 were considered to determine the dietary patterns while excluding values less than 0.20. Factor loading demonstrates the correlation coefficient between groups of foods and specific patterns. Each person acquired a factor score based on each identified pattern. For evaluating sampling adequacy, the Kaiser-Meyer-Olkin (KMO) test was employed, the result of which was

**Table 1.** Food Grouping Utilized for Factor Analysis

| Food Groups             | Food Items   |
|-------------------------|--|
| Red meats               | Red meat, Kebab, hamburgers  |
| Processed meats         | Sausages   |
| Organ meats             | Beef liver and lamb organ (Tongue, tripe, head and trotters, brain, foot, and abomasum)  |
| Fish                    | Fish, salted fish, shrimp, crab, Bandar Kong fish  |
| Canned fish             | Canned fish  |
| Poultry                 | Chicken and other parts of chicken (Liver, heart, and gizzard)   |
| Eggs                    | Eggs   |
| Hydrogenated fats       | Hydrogenated fats  |
| Butter                  | Butter   |
| Margarine               | Margarine  |
| Dairy products          | Milk and yogurt  |
| High-fat dairy products | Cheese, ice-cream, flavored milk, chocolate milk, coffee milk, honey milk, cream, and curd   |
| Fruits                  | Pears, apricots, cherries, sour cherry, apples, grapes, bananas, cantaloupe, melons, watermelon, kiwi, strawberries, peaches, mulberry, plums, persimmons, pomegranates, figs, dates, greengage, pineapples, jam, mango, Konar, and citrus fruits, as well as all types of canned fruits and all types of natural fruit juices |
| Cruciferous vegetables  | Cabbage, white cabbage, red cabbage, and broccoli  |
| Yellow vegetables       | Carrots  |
| Dried fruit             | Dried fig, dried plum, dried apricot, dried peach, dried mulberry, raisin, and dried berry   |
| Tomatoes                | Tomatoes and tomato paste  |
| Vegetables              | Cucumber, vegetables, cooked vegetables, squash, celery, cooked celery, green peas, onion, beetroot, turnip, ripe mushrooms, corn, sweet pepper, green pepper, green beans, and garlic   |
| Legumes                 | Mung bean, lentil, beans, soy, soybean, cotyledon, peas, and broad beans   |
| Potatoes                | Potatoes and French fries  |
| Whole grains            | Barbari and Taftoon bread, Sangak bread, cooked barley and bulgur, bread barely, diet bread, Kakeh and Chamchamoo bread, and seed marrow   |
| Refined grains          | Lavash bread, Baguette and baget bread, cooked pasta, and cooked rice  |
| Pizza                   | Pizza  |
| Snacks                  | Potato chips, corn puffs, and biscuit wafer  |
| Nuts                    | Walnut, peanut, and other nuts (Almond, almond Hindi, pistachio, and hazelnut), squash, and sunflower and watermelon seeds   |
| Mayonnaise              | Mayonnaise sauce   |
| Olive                   | Olives and olive oil   |
| Vegetable oils          | Vegetable oils (except for olive oil)  |
| Sugars                  | Sugar + sugarloaf  |
| Sweets and desserts     | Honey, jam, chocolates, dry cakes and sweets, creamy cakes and sweets, types of halva, palm sap, and other sweets  |
| Condiments              | Local spices, industrial lemon juice, tamarind, salted fish juice, Mahyave, Soragh, and other pastes   |
| Soft drinks             | Soft drinks and non-alcoholic beer   |
| Yoghurt drink           | Doogh  |
| Salt                    | Salt   |
| Pickles                 | Pickles, pickled cucumber, and salinity  |
| Garlic                  | Garlic   |
| Coffee                  | Coffee   |

suitable (KMO: 0.775).

Furthermore, Bartlett's test, which shows the correlation between variables, was significant ( $P < 0.001$ ). Chi-square test was performed to evaluate variables such as education, gender, marital status, and smoking between three dietary patterns. Moreover, variables such as physical activity, age, energy, and body mass index (BMI) were assessed by one-way analysis of variance. The percentage was used to report qualitative variables. Additionally, the mean and standard deviation were utilized for quantitative variables.

## Results

### Identification of Dietary Patterns

Three dietary patterns were identified in this study. Dietary patterns account for 10.20%, 6.30%, and 4.28% of the variance in food consumption, respectively. The variance percentage of dietary patterns is shown in Figure 1. The patterns of food were named by the factor loadings of food groups that played the most significant role in each dietary pattern. Table 2 provides the factor loading for each food group based on the identified dietary patterns.

The healthy dietary pattern comprises a high intake of other vegetables, fruits, yellow vegetables, green leafy vegetables, cruciferous vegetables, nuts, tomatoes, dried fruits, olives, dairy products, pickles, yogurt drinks, legumes, red meat, whole grains, butter, and fish. A Western dietary pattern is recognized with soft drinks, sweets and desserts, condiments, pizza, red meat, snacks, poultry, refined grains, mayonnaise, tuna fish, eggs, processed meats, high-fat dairy, organ meats, pickles, potatoes, legumes, and whole grains. Finally, the traditional dietary pattern is identified with high sugar, tea, salt, potatoes, solid fat, and coffee consumption.

Table 3 provides the report of demographic characteristics, BMI, and energy intakes of participants, as well as their smoking and physical activity status in each dietary pattern.

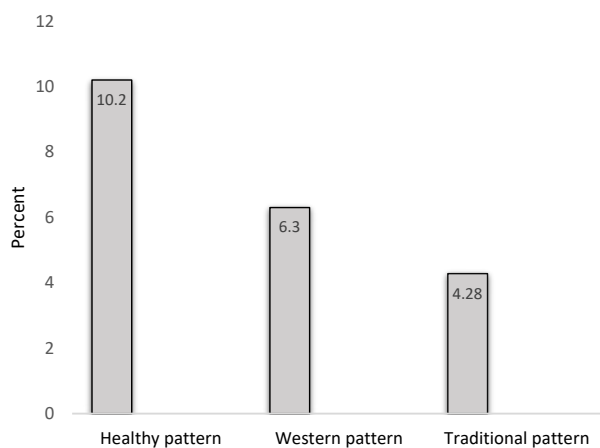


Figure 1. Variance Percentage of Each Dietary Pattern in the Population

## Discussion

Today attention to dietary patterns and their effect on health is more important than focusing on each nutrient or a specific food. The critical aspect is that the assessment of dietary patterns reflects the real world better because

Table 2. Factor Loadings of Food Groups in Each Dietary Pattern

| Food Groups                          | Dietary Patterns |         |             |
|--------------------------------------|------------------|---------|-------------|
|                                      | Healthy          | Western | Traditional |
| Other vegetables                     | 0.664            |         |             |
| Fruit                                | 0.658            |         |             |
| Yellow vegetables                    | 0.572            |         |             |
| Green leafy vegetables               | 0.560            |         |             |
| Cruciferous vegetables               | 0.531            |         |             |
| Nuts                                 | 0.483            |         |             |
| Tomatoes                             | 0.478            |         |             |
| Dried fruits                         | 0.477            |         |             |
| Olive                                | 0.407            |         |             |
| Dairy product                        | 0.335            |         |             |
| Pickles                              | 0.281            | 0.253   |             |
| Yogurt drink                         | 0.259            |         |             |
| Legumes                              | 0.241            | 0.234   |             |
| Butter                               | 0.203            |         |             |
| Fish                                 | 0.202            |         |             |
| Margarine                            |                  |         |             |
| Vegetable oils                       |                  |         |             |
| Soft drink                           |                  | 0.521   |             |
| Sweets dessert                       |                  | 0.496   |             |
| Condiment                            |                  | 0.472   |             |
| Pizza                                |                  | 0.455   | -0.201      |
| Red meats                            | 0.206            | 0.449   |             |
| Snacks                               |                  | 0.446   |             |
| Poultry                              |                  | 0.441   |             |
| Refined grain                        |                  | 0.390   |             |
| Mayonnaise                           |                  | 0.378   |             |
| Tuna fish                            |                  | 0.345   |             |
| Eggs                                 |                  | 0.338   |             |
| Processed meats                      |                  | 0.320   |             |
| High-fat dairy                       |                  | 0.317   |             |
| Organ meats                          |                  | 0.278   |             |
| Whole grains                         | 0.206            | 0.220   |             |
| Sugars                               |                  |         | 0.825       |
| Tea                                  |                  |         | 0.816       |
| Salt                                 |                  |         | 0.254       |
| Potatoes 1                           |                  | 0.237   | 0.242       |
| Solid fats                           |                  |         | 0.233       |
| Coffee 1                             |                  |         | 0.223       |
| Percentage of explained variance (%) | 10.20            | 6.30    | 4.28        |

Note. Values < 0.20 were excluded.

**Table 3.** Characteristics of Participants in Each Dietary Pattern

|                                      | Healthy Dietary Pattern |                |         | Western Dietary Pattern |                |         | Traditional Dietary Pattern |                |         |
|--------------------------------------|-------------------------|----------------|---------|-------------------------|----------------|---------|-----------------------------|----------------|---------|
|                                      | Q1                      | Q5             | P Value | Q1                      | Q5             | P Value | Q1                          | Q5             | P Value |
| Body mass index (kg/m <sup>2</sup> ) | 25.80±5.32              | 27.33±4.91     | <0.001  | 26.98±5.44              | 26.47±4.92     | 0.133   | 26.61±5.18                  | 26.51±5.04     | 0.548   |
| Physical activity (MET-min/wk)       | 40.00±6.18              | 40.82±6.10     | 0.160   | 40.00±5.56              | 41.06±6.62     | <0.001  | 40.18±5.67                  | 41.08±6.86     | 0.025   |
| Energy (kcal)                        | 2269.95±594.11          | 3174.95±594.38 | <0.001  | 2124.62±555.77          | 3395.60±466.56 | <0.001  | 2549.40±663.50              | 3022.96±643.75 | <0.001  |
| Age (year)                           | 47.47±9.53              | 46.69±8.51     | 0.524   | 50.88±9.96              | 43.66±7.29     | <0.001  | 44.40±8.03                  | 47.67±8.74     | <0.001  |
| Gender (%)                           |                         |                |         |                         |                |         |                             |                |         |
| Male                                 | 40.1                    | 45.4           | 0.091   | 20.4                    | 67.00          | <0.001  | 40.1                        | 46.1           | 0.010   |
| Female                               | 59.9                    | 54.6           |         | 79.6                    | 33.00          |         | 59.9                        | 53.9           |         |
| Marital status (%)                   |                         |                |         |                         |                |         |                             |                |         |
| Single                               | 3.5                     | 2.8            |         | 4.1                     | 2.8            |         | 4.8                         | 2.1            |         |
| Married                              | 85.3                    | 89.9           | <0.001  | 80.9                    | 94.3           | <0.001  | 88.7                        | 89.4           | 0.144   |
| Widowed                              | 7.1                     | 4.6            |         | 10.8                    | 2.0            |         | 4.6                         | 6.2            |         |
| Divorced                             | 4.1                     | 2.7            |         | 4.3                     | 0.9            |         | 2.0                         | 2.3            |         |
| Education (%)                        |                         |                |         |                         |                |         |                             |                |         |
| Illiterate                           | 53.9                    | 24.3           |         | 53.9                    | 27.0           |         | 26.4                        | 45.0           |         |
| Secondary school                     | 35.8                    | 41.7           |         | 26.8                    | 46.8           |         | 42.0                        | 38.5           |         |
| Diploma                              | 7.4                     | 16.3           | <0.001  | 11.3                    | 13.5           | <0.001  | 16.8                        | 9.8            | <0.001  |
| Bachelor's degree                    | 2.5                     | 14.0           |         | 6.6                     | 10.6           |         | 11.9                        | 5.9            |         |
| Master's degree and higher           | 0.4                     | 3.7            |         | 1.4                     | 2.1            |         | 2.8                         | 0.9            |         |
| Smoking status (%)                   |                         |                |         |                         |                |         |                             |                |         |
| Never smoker                         | 86.2                    | 87.0           | 0.356   | 93.2                    | 76.7           | <0.001  | 92.0                        | 77.6           | <0.001  |
| Current smoker                       | 13.4                    | 13.0           |         | 6.8                     | 23.1           |         | 7.8                         | 22.4           |         |

people do not consume nutrients individually; instead, people's diet consists of a wide range of foods with various composition of nutrients that may have reactive impacts on each other. Therefore, determining the main dietary patterns and how they relate to various disease risk factors can help preserve nutritional advice and prevent different diseases. The present study indicated three main dietary patterns in the BKNCD cohort study, including healthy, Western, and traditional dietary patterns. The main and prominent pattern in our study was the healthy pattern. Dietary patterns identified in this study were somehow aligned with previous studies. A healthy dietary pattern that was illustrated by a high intake of other vegetables, fruits, yellow vegetables, green leafy vegetables, cruciferous vegetables, nuts, tomatoes, dried fruits, olives, dairy products, pickles, yogurt drinks, legumes, red meat, whole grains, butter, and fish was consistent with the prudent dietary pattern recognized by Sarkhosh-Khorasani et al that was loaded by refined grains, vegetable oils, fruits, whole grains, and dairy but low consumption of pizza, vegetables, soft drinks, and snacks (9). Further, the Mediterranean diet consisted of a frequent intake of fruits, non-hydrogenated vegetable oils, fish, poultry, olive oil, and vegetables, while low consumption of hydrogenated vegetable oils recognized

by Mohammadifard et al in a cohort study in Isfahan (10), which is somehow in line with the healthy dietary pattern identified in this study. In their study in Saudi Arabia, Bawazeer et al derived five different dietary patterns, and their healthy dietary pattern comprised healthy foods, including vegetables, fruits, and seafood (11), which is in conformity with our healthy dietary pattern. Vegetable and Mediterranean-type patterns in another study recognized by Kamali et al in Shiraz are in accordance with our healthy dietary pattern. The vegetable pattern contained a high intake of other vegetables, tomatoes, green leafy vegetables, garlic, cabbage and potatoes, legumes, and yellow vegetables. In addition, the Mediterranean-type pattern consisted of high consumption of canned fruit, nuts, fruit, fruit juice, low-fat dairy, fish, and olive (12). These similarities in healthy dietary patterns represent that a healthy dietary pattern is loaded at least with different vegetables and fruits. Based on the findings of different studies, it is indicated that these two components (vegetables and fruit) are the common part of this dietary pattern (healthy). Another component that is common in these studies is seafood or fish which is noticed in most of them. Furthermore, the healthy dietary pattern of our study was similar to the sum of two food patterns (fruit-veg-sweets-snacks and animal food) in

the study by Satija et al in India (13). A Western dietary pattern characterized by soft drinks, sweets and desserts, condiments, pizza, red meat, snacks, poultry, refined grains, mayonnaise, tuna fish, eggs, processed meats, high-fat dairy, organ meats, pickles, potatoes, legumes, and whole grains was similar to the sum of two dietary patterns (dietary pattern of fast food and refined-grains/poultry) identified in the study by Ausman et al in Kuwait (14). Likewise, the fat and sweet pattern of the study by Safdar et al in Pakistan composed of fried snacks/foods, desserts, organ meats, bakery products, Pakistani bread, and food obtained from outside of the home (15), which is consistent with our Western dietary pattern. Traditional dietary pattern highly enriched with vegetables, fish, red and processed meats, olive group, nuts, pickles, soft drinks, fruits, legumes, eggs, dairy, mayonnaise, potatoes, refined grains, poultry, sweets, snacks, vegetable oils, and sugars, coffee, and tea recognized by Sarkhosh-Khorasani et al was near to our Western dietary pattern but the difference was in its fruits, vegetables, and nuts (9). The fast-food diet and Western diet in a study conducted by Mohammadifard et al were consistent with our western dietary pattern (10). First, their Western diet was characterized by potatoes, fried foods, legumes, hydrogenated vegetable oils, red meat, pickles, rice, and second fast food diet containing high amounts of pizza, hamburgers, carbonated beverages, sausages, and sweets. These common components, namely, pizza, burgers, sweets, and snacks, followed by meats, fried foods, and mayonnaise repeated in these studies made similarity in this type of diet which was called Western in this study. Additionally, findings related to the Western pattern with high consumption of processed meats, soda, refined grains, salt, red meats, hydrogenated oil, sugar, organ meats, eggs, and mayonnaise identified in the study by Kamali et al (12) are in line with our western dietary pattern. Moreover, the Western dietary pattern of Tarighat-Esfanjani et al determined four dietary patterns in Tabrizi adults, including refined grain, types of traditional breads and baguette, red and processed meat, egg, butter, types of solid and liquid oils, potato, pizza and fast food, sugar, honey and jam, types of sweets, mayonnaise sauce, cream, cocoa milk, soft drink, potato chips, and corn puffs (16), which is in line with our Western dietary pattern. Finally, the traditional dietary pattern is identified with high sugar, tea, salt, potatoes, solid fat, and coffee consumption, which conforms to the date and coffee pattern in the study of Bawazeer et al (11). It included the intake of dates and coffee; the similarity of these two patterns was consuming coffee and date with high sugar. Furthermore, the similarity of these two patterns may be because of the proximity of the cultures of two regions, namely, the area of BKNCD and the area of the study of Bawazeer et al. Thus, dietary patterns seem to change based on the diversity of cultures. In

addition, they seem to alter based on gender, the status of socioeconomic, race, and food accessibility, and the meaning of a dietary pattern could shift depending on population and over time; hence, it is important to confirm the findings in various populations by considering the related factors of dietary patterns and chronic diseases. The results of different studies revealed that some of the determined dietary patterns are approximately similar, only their naming may be different. This similarity may be because of their similar measurement method and methods used for analysis. This study had some limitations. The study did not evaluate the correlation between diseases, health status, and dietary patterns; therefore, the possibility exists that dietary patterns are affected by health status, which was not considered in this study. It is recommended that other studies be conducted by considering the health status of participants and the correlation between diseases and dietary patterns. The second limitation is that the cohort study is conducted in a population with almost special ethnicity without diversity who have special food intake; thus, findings cannot be generalized to other populations.

### Conclusion

Generally, the results of this study in BKNCD participants indicated that consumption of a healthy dietary pattern was a principal pattern followed by the Western pattern. Ultimately, it is suggested that more detailed studies should be conducted regarding dietary patterns and their correlation with metabolic diseases.

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### Competing Interests

The authors declare that they have no Conflict of interests.

### Consent for Publication

Not applicable.

**Data Availability Statement**

The corresponding author can provide the datasets used and/or analyzed in the present study on reasonable request.

**Disclaimer**

The views expressed here are those of the authors and do not necessarily reflect the views of the Ministry of Health and Medical Education.

**Ethical Approval**

The study received ethics approval from the Ethics Committee of Hormozgan University of Medical Sciences under the ethics code: IR.HUMS.REC.1398.130 and agrees with the statements of the Declaration of Helsinki. Written informed consent was obtained from all the participants.

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