

# Dietary Patterns and Non Communicable Disease Among Iranian Women: A Systematic Review

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**Context:** Diet is an important component of life and plays a key role in the prevention or development of non-communicable diseases. The aim of this systematic review was to determine different dietary patterns and their association with non-communicable diseases in Iranian women.

**Evidence Acquisition:** Sources of Information: an electronic literature search was conducted on websites such as Pubmed, Science direct, Google scholar, Sid, and Iranmedex to identify original human studies, published in English and Persian up to August 2013 that included keywords or phrases relevant to the aim of this study.

**Results:** Studies were classified into eight groups according to their objectives and outcomes, including the relationship between dietary patterns and aspects such as bone mineral density, metabolic syndrome, obesity, cardiovascular disease, cancer, markers of inflammation, hypertension, coagulation abnormalities, life style and factor analysis. Compared to healthy dietary patterns, the western and Iranian patterns were positively associated with conditions related to non-communicable diseases. The dietary approach to stop hypertension (DASH) is rich in fruits, vegetables, whole grains, low-fat dairy products, and is low in saturated fat, total fat, cholesterol, refined grains, and sweets. This diet is associated with greater high-density lipoprotein (HDL) cholesterol and lower body weight, waist circumference, fasting blood glucose, low-density lipoprotein (LDL) cholesterol and systolic and diastolic blood pressures.

**Conclusions:** Adherence to a healthy dietary pattern is expected to secure a protective effect against non-communicable disease.

**Keywords:** Communicable Disease; Diet; Women; Iran

## 1. Context

Diet is an important component of lifestyle and plays a significant role in the development of chronic diseases such as cardiovascular disease, cancer, obesity and diabetes (1). Although traditionally, nutritional studies have focused on single nutrients or food groups, interest in dietary patterns which considers the complexity of the overall diet is growing (2). Based on epidemiological perspective reports, foods and nutrients are never eaten separately, thus their effects are likely to interact (3). This finding incorporates all food and nutrient interactions in the diet and makes it possible to identify diet-related diseases, without knowing about the exact nutrient or food component involved (4). Therefore, dietary patterns reflect actual consumption, and their analysis can provide reasonable insight that allows their change in a healthy way. This may help facilitate the translation of approaches into public health recommendations (5, 6). Hence, it is suggested to consider the analysis of dietary pattern as an approach to detect the links between diet and disease (5). Some studies have explored different types of dietary patterns includ-

ing healthy, unhealthy (western) and traditional (Iranian) dietary patterns among Iranian populations (7). The aim of this systematic review was to examine the associations between different dietary patterns and non-communicable diseases in the Iranian population.

## 2. Evidence Acquisition

### 2.1. Data

An electronic literature search was conducted on websites such as Pubmed, Science direct, Google scholar, Sid, and Iranmedex to find human-related studies published in English and Persian language up to August 2013, including relevant keywords or phrases; i.e. dietary pattern, food patterns, eating patterns, dietary index, dietary score, dietary approach to stop hypertension (DASH), Mediterranean diet, non-communicable disease, obesity, diabetes, coronary heart disease, cardiovascular risk factors, metabolic syndrome, cancer, osteoporosis, lifestyle,

inflammation and Iran. Specific searches also included the following words and phrases: dietary patterns and metabolic syndrome (MetS), dietary patterns and insulin resistance, eating patterns and MetS, eating patterns and insulin resistance, food patterns and MetS, food patterns and insulin resistance, DASH and MetS, DASH and insulin resistance, Mediterranean diet and MetS, Mediterranean diet and insulin resistance. The design of the study was approved by the Ethical Committee of Academy of Medical Sciences, Islamic Republic of Iran.

## 2.2. Study Selection

Potentially relevant papers were selected with a hierarchical approach on the basis of title, abstract and the full manuscript, and were then evaluated to determine whether they met the inclusion criteria as follows: 1) published in English and Persian in the last 18 years, 2) conducted on a sample of an Iranian population, 3) including a dietary pattern analysis; and 4) analyzing the association between dietary pattern and non-communicable diseases. Finally, out of the 48 potential articles obtained which evaluated the effect of dietary patterns on non-communicable disease, 27 were excluded for the following reasons: irrelevant research hypothesis and inappropriate samples composed of adolescents or children. Eventually, 21 studies were eligible for inclusion in this systematic review.

## 2.3. Data Extraction

The following data were extracted from the original reports: study design (clinical-trial, cross-sectional, or prospective cohort studies), leading author, year of publication, country of origin, number of participants, characteristics of participants (i.e. mean age, gender, health status), length of follow-up, effect size measurements (i.e. relative risk, odds ratio) and dietary assessment tools. Two investigators collected the relevant reports, whereas two other authors independently reviewed the published data, and reported different dietary patterns as evaluated by different studies. Disagreements were solved by the opinion of a fiftieth author, if necessary. All articles with the objective of determining dietary patterns among Iranians were assessed and the major dietary pattern was determined.

## 3. Results

From a total of 21 articles, 14 were cross-sectional, three were cohort and the remaining were randomized clinical trials. Studies were classified into eight groups according to their objective and outcome measures; including the relationship between dietary patterns and aspects such as bone mineral density, metabolic syndrome, obesity, cardiovascular disease, cancer, markers of inflammation, hypertension, coagulation abnormalities, lifestyle and factor analysis. The overall characteristics of the 21 studies reviewed in this report are presented in Table 1.

**Table 1.** Summary of Characteristics and Findings From Reviewed Studies

Author/Year Publication	Patient/Sample Size	Study Design and Follow up	Dietary Assessment Method	Findings
<b>Dietary patterns and obesity</b>				
Hosseini-Esfahani F. (2011) (8)	206 healthy subjects (82 males and 124 females)	Cross-sectional (6 years)	168-item-FFQ	Adherence to the healthy dietary pattern and avoidance of western dietary patterns could prevent central fat accumulation and adiposity. The change in mix dietary pattern score was not associated with alterations in BMI and WC
Sherafat-Kazemzadeh R. (2010) (9)	141 adults	Cohort study (mean follow up 6.6 ± 0.9 years)	2-days 24 h recalls	Traditional pattern and fifth Pattern (egg) showed an increase in BMI, WHR and WC, indices of obesity. Dairy pattern showed an increase in trend across quintiles, but the magnitude of effect was not statistically significant. For fiber and PUFA, as well as fiber and dairy patterns there was a decreasing trend (although not significant) in WHR and waist circumference changes.
Amini M. (2012) (10)	425 subjects with abnormal glucose homeostasis (35-55 y)	Cross-sectional	39-item-FFQ	The Western pattern had a positive association with BMI. The high-fat dairy pattern was inversely associated with WHR and had a significant positive association with general obesity.
Rezazadeh. (2010) (11)	460 women (20-50 y)	Cross-sectional	168-item-FFQ	The prevalence of general and central obesity and the mean of BMI and WC and energy intake/day were higher among subjects in the highest quartile of the unhealthy dietary pattern. The healthy dietary pattern was inversely associated with general and central obesity.
Esmailzadeh A. (2008) (12)	486 women aged (40-60 y)	Cross-sectional	168-item-FFQ	Individuals in the upper quintile of the healthy dietary pattern were more physically active and less likely to be generally and centrally obese compared with those in the lowest quintile. Subjects in the top quintile of the Western dietary pattern were less likely to exercise and had higher prevalence of general and central obesity. Individuals in the upper quintile of the Iranian dietary pattern were older, slightly more physically active, less likely to be generally obese, and more likely to be centrally obese.
<b>Dietary pattern and cardiovascular risk factors</b>				
Azadbakht L. (2011) (13)	31 type 2 diabetic patients (13 male and 18 female)	A randomized crossover clinical trial 8 weeks	3-d food diaries.	After following the DASH eating pattern, body weight and waist circumference reduced significantly. Fasting blood glucose levels and A1C decreased after adoption of the DASH diet.
<b>Dietary patterns and metabolic syndrome</b>				

<b>Amini M. (2011) (14)</b>	425 subjects (35 to 55 y) who were first-degree relatives of patients with type 2 diabetes	Cross-sectional	39-item-FFQ	The Western pattern was associated with an increased risk of metabolic syndrome. The prudent pattern was positively associated with prevalence of low high density lipoprotein cholesterol levels. The vegetarian dietary pattern was inversely associated with a risk of an abnormal fasting blood glucose level.
<b>Agajani Delavar M. (2009) (15)</b>	984 women (30-50 y) with and without metabolic syndrome	Cross-sectional (6 months)	150-item-FFQ	Food component 1 was inversely associated with waist circumference, total cholesterol, fasting blood glucose, LDL-cholesterol and triglycerides and positively associated with HDL cholesterol levels. Food component 3 was positively associated with total cholesterol, triglyceride, LDL cholesterol. Food component 4 was inversely correlated with waist circumference, systolic blood pressure and triglyceride, and positively correlated with HDL cholesterol levels. The first and fourth dietary pattern decreased the likelihood of having metabolic syndrome. Food components 2 and 5 were not associated with indices of the metabolic syndrome (except for waist circumference and component 5)
<b>Hosseini-Esfahani F. (2010) (16)</b>	2504 adults (1120 men and 1384 women), (19 to 70 y)	Cross-sectional	168-items-FFQ	Those in the highest quartile category of DGAI had a 21% lower prevalence of MetS risk factor clustering than those in the lowest quartile. Highest quartile category of DGAI score was shown to significantly reduce the prevalence of hyperglycemia, hypertension and low high-density lipoprotein cholesterol. Participants whose dietary patterns were in close concordance with 2005 DGA had a lower risk of overall MetS prevalence and some of its risk factors
<b>Esmailzadeh A. (2007) (17)</b>	486 Tehranian female teachers (40-60 y)	Cross-sectional	168-item-FFQ	Subjects in the highest quintile of healthy dietary pattern scores had a lower odds ratio for the metabolic syndrome and insulin resistance than those in the lowest quintile. Women in the highest quintile of Western dietary pattern scores had greater odds for the metabolic syndrome and insulin resistance. Higher consumption of traditional dietary pattern was only significantly associated with abnormal glucose homeostasis.
<b>Dietary patterns and cancer</b>				
<b>Hajizadeh B. (2010) (18)</b>	47 patients with esophageal squamous cell carcinoma and 96 controls (40-75 y)	Case-control, 1 year study	125-item-FFQ + twelve 24 h recalls	A healthy diet might be negatively associated with the risk of esophageal squamous cell carcinoma, Western diet might be positively associated with esophageal squamous cell carcinoma.
<b>Islami F. (2009) (19)</b>	131 healthy participants (35-65) y	Cohort study, 1 year	Twelve, 24 h recalls	The severe deficiency in vitamin intake among women and rural dwellers and marked differences in nutrient intake between rural and urban dwellers may contribute to the observed epidemiological pattern of esophageal cancer, with high incidence rates among women and people with low socioeconomic status, and the highest incidence rate among rural women.
<b>Dietary patterns and Bone mineral density</b>				
<b>Karamati M. (2012) (20)</b>	160 menopausal women (50-85 y)	Cross-sectional	168-item-FFQ	Menopausal women in the upper category of the first and second dietary patterns had a higher risk of having BMD below the median in the lumbar spine and femoral neck regions, respectively, compared to those in the lower categories. No significant association was observed between other dietary patterns and femoral neck or lumbar spine BMD values.
<b>Dietary patterns and abnormalities</b>				
<b>Esmailzadeh A. (2007) (21)</b>	486 healthy women (40-60 y)	Cross-sectional	168-item-FFQ	The healthy pattern score was inversely related to plasma concentrations of CRP, E-selectin and sVCAM-1. The Western pattern score was positively related to CRP, SAA, IL-6, sICAM-1, and sVCAM-1 levels. The traditional dietary pattern was positively associated with the plasma IL-6 concentration.
<b>Azadbakht L. (2011) (22)</b>	44 patients with type 2 diabetes mean age was 55.0 ± 6.5 y	randomized, crossover clinical trial	3-d food diaries	Decreases in both alanine aminotransferase and aspartate aminotransferase levels were greater after adopting the DASH diet compared with the control diet. The decrease in plasma fibrinogen level during the DASH diet period was greater than that during the control diet, amongst diabetic patients.
<b>Association of dietary patterns with lifestyle factors</b>				
<b>Rezazadeh A. (2010) (23)</b>	460 women (20-50 y)	Cross-sectional	168-item FFQ	A positive relationship between a healthy dietary pattern and a background of a chronic disease such as hypertension underscores the long-standing perception that the diet is healthy and protective
<b>Dietary patterns derived from factor analysis</b>				
<b>Mohammadifard N. (2012) (24)</b>	12,514 participants (age ≥ 19 y)	Cross-sectional	48-item-food ffq	The Western and traditional dietary patterns had a significant negative relationship with education, whereas the Mediterranean diet showed a significant positive correlation with education in both men and women. The relationship between dietary pattern and marital status was insignificant, except for the Western diet. Income had a significant relationship with the Mediterranean diet in both men and women.
<b>Mirmiran P. (2011) (25)</b>	2,510 subjects (1,121 men and 1,389 women) (19-70 y)	Cross-sectional	168-item-FFQ	The dietary patterns of most Tehranian adults did not comply with the 2005 DGA and nutritional goals of WHO/Food and Agriculture Organization
<b>Asghari G. (2012) (2)</b>	132 subjects (age ≥ 20 y)	Cohort study, followed-up for 8 years	168-item-FFQ + twelve 24 h recalls	Indication of reliability and validity of the dietary patterns defined by factor analysis. Although the Western pattern was found to be fairly stable, the Iranian traditional pattern was mostly unstable.

### 3.1. Dietary Patterns and Obesity

Three prospective and two cross-sectional studies investigated the association between dietary patterns and obesity (8-12). In a cohort lipid and glucose study of a Tehranian population, change in body mass index (BMI) and waist circumference with three dietary patterns (healthy, Western and mix) was evaluated among 82 male (mean age 45-11 y) and 124 female (mean age 39-14 y) participants, who were followed for six years. The results showed that increased Western dietary pattern score, but not healthy dietary patterns, was directly related to change in BMI and waist circumference among overweight/obese individuals (8). In another prospective study, with six-year follow-up, five dietary patterns were identified that included, traditional, fiber and polyunsaturated fatty acid, fiber and dairy, dairy, and egg. Of these only the egg pattern with high egg content, in addition to salty snacks, fresh and dry fruits showed increasing trends for waist circumference and waist-hip ratio, after adjustment for potential confounders (9). The results of two cross-sectional studies documented conflicting findings, regarding the effect of Western dietary patterns on general and central obesity, of which one report indicated no effect (10), and the other found detrimental impacts (11). Yet another study conducted on a Middle-Eastern population showed a significant association between the Western dietary pattern and central and general obesity (12).

### 3.2. Dietary Patterns and Cardiovascular Risk Factors

Risk factors of cardiovascular diseases are more prevalent in Middle Eastern countries than in other parts of the world (26). Esmailzadeh et al. studied the relationship between food intake patterns and the prevalence of cardiovascular risk factors among healthy Iranian women aged between 40 and 60 years; three major eating examples were healthy, Western and Iranian patterns. This study reported an inverse association between Iranian dietary pattern with dyslipidemia (odds ratio (OR), 0.36; 95% CI, 0.19-0.53) and hypertension (OR, 0.33; 95% CI, 0.17-0.60); however, the Western dietary pattern was positively associated with cardiovascular risk factors and the Iranian dietary pattern was significantly associated with dyslipidemia (OR, 1.73; 95% CI, 1.02-2.99) (26). A clinical trial investigated the effect of DASH diet, which is rich in fruits, vegetables and whole grains, while low in fat, dairy products, saturated fat, total fat, cholesterol, refined grains and sweets, on cardiovascular risk factors among diabetic patients. It was found that, compared with the control diet, adherence to the DASH diet was associated with higher HDL cholesterol and lower body weight, waist circumference, fasting blood glucose, LDL cholesterol and systolic- and diastolic blood pressure (13).

### 3.3. Dietary Patterns and the Metabolic Syndrome

Four cross-sectional studies investigated the relation-

ship between dietary patterns and metabolic syndrome (MetS) (14-16). Amini et al. examined the relationship between major dietary patterns and MetS among subjects with impaired glucose tolerance (14). The five major dietary groups found were the Western, prudent, vegetarian, high-fat dairy, and chicken and plant patterns. Greater odds for increased triacylglycerol (odds ratio 1.76, 95% CI 1.01-3.07) and blood pressure (odds ratio 2.62, 95% CI 1.32-5.23) were associated with the Western dietary pattern while the prudent pattern was positively correlated with the prevalence of low HDL cholesterol level (odds ratio 0.55, 95% CI 0.31-0.96). In addition, adherence to the vegetarian pattern can lower an abnormal fasting blood glucose level (odds ratio 2.26, 95% confidence interval 1.25-4.06) (14). In another study, Delavar et al., investigated the relationship between dietary patterns and MetS in middle-aged women. Regarding fat intake, women with low fat intake had higher OR than those with high and moderate fat intakes after adjusting for the MetS (OR = 2.92; 95% CI = 1.36, 6.28). Also MetS was less likely to occur in subjects that had a good dietary pattern, rich in fruits, legumes, vegetables, cereals and fish, as well as high intake of dairy products and eggs (15). Hosseini-Esfahani et al., examined the association between dietary patterns as measured by the modified Dietary Guidelines for American Adherence Index (DGAI) 2005 and reported the prevalence of MetS and its components among adults. They found that the prevalence of hyperglycemia (OR, 0.64; CI, 0.47-0.86), hypertension (OR, 0.76; CI, 0.70-0.93), and low HDL cholesterol (OR, 0.69; CI, 0.54-0.94) could be significantly reduced in the highest quartile category of DGAI which had 21% lower incidence of MetS clustering, than those in the lowest quartile (odds ratio OR, 0.79; CI, 0.63-0.92; P for trend = 0.02) (16). Recently a cross-sectional study conducted in Iran examined the relationship between dietary patterns, insulin resistance and prevalence of MetS among Tehranian women, by investigating healthy, Western and traditional dietary patterns. People in the highest quintile of healthy dietary pattern had lower odds ratio for the MetS (odds ratio: 0.61; 95% CI: 0.30, 0.79) and insulin resistance (odds ratio: 0.51; 95% CI: 0.24, 0.88) compared to those in the lowest quintile. Also, compared to women in the lowest quintile those in the highest quintile of Western dietary pattern, had greater odds for the MetS (odds ratio: 1.68; 95% CI: 1.10, 1.95) and insulin resistance (odds ratio: 1.26; 95% CI: 1.00, 1.78). However, higher intake of the traditional dietary pattern was only significantly associated with abnormal glucose homeostasis (odds ratio: 1.19; 95% CI: 1.04, 1.59) (17).

### 3.4. Dietary Patterns and Cancer

Two studies investigated the relationship between dietary patterns and esophageal cancer (18, 19). Hajizadeh et al., conducted a case-control study on 143 individuals including 47 patients with esophageal squamous cell

carcinoma and 96 controls. This hospital-based study examined the association between dietary patterns and the risk of esophageal squamous cell carcinoma. Finally, two kinds of dietary patterns were reported which included the healthy dietary pattern (high in vegetables, nuts, fruits, low-fat dairy and fish) and the Western pattern (high in solid oil, sugar, sweets, tea, eggs, pickles and processed meat). The Western dietary pattern significantly increased the risk of esophageal squamous cell carcinoma (OR, 10.13; 95% CI, 8.4-43.6), while the healthy dietary pattern was significantly associated with a decreased risk of esophageal squamous cell carcinoma (OR, 0.17; 95% CI, 0.19-0.98) (18). The second phase of the study examined the patterns of food and nutrient consumption in Golestan province, and compared the level of vitamin intake between women and men. Their findings showed that rural women had a very low level of daily vitamin intake. In this context, vitamins A and C were lower than lowest threshold intakes (LTIs) in 67% and 73% of rural women, respectively ( $P < 0.01$ ); whereas, among urban women the vitamin intakes were significantly lower than the recommended dietary allowance (RDA) but were significantly higher than LTIs. Among rural men however the vitamin intakes were not significantly different from LTIs, (19).

### 3.5. Dietary Patterns and Bone Mineral Density (BMD)

Karamati et al., conducted a study on 160 menopausal women, aged from 50 to 58 years, and identified six dietary patterns. Subjects who had the first (high in high-fat dairy products, organ meats, red or processed meats and non-refined cereals) and second (high in French fries, mayonnaise, sweets and desserts and vegetable oils) dietary patterns were more likely to have BMD below the median in the lumbar spine (OR, 2.29; 95% CI, 1.05-4.96) and the femoral neck (OR, 2.83; 95% CI, 1.3-6.1), respectively. Other dietary patterns were not significantly associated with BMD (20).

### 3.6. Dietary Patterns and Markers of Inflammation, Hypertension, and Coagulation Abnormalities

The relationship between dietary patterns and inflammation markers was investigated in a cross-sectional study of healthy women, aged 40-60 years. It was found that plasma concentrations of C-reactive protein (CRP) ( $b = 20.09$ ,  $P > 0.001$ ), E-selectin ( $b = 20.07$ ,  $P > 0.05$ ) and soluble vascular cell adhesion molecule-1 (sVCAM-1) ( $b = 20.08$ ,  $P > 0.001$ ) were significantly reduced when a healthy dietary pattern was adopted (high in fruits, vegetables, tomato, poultry, legumes, tea, fruit juices, and whole grains). In contrast, CRP ( $b = 0.08$ ,  $P > 0.001$ ), serum amyloid A ( $b = 0.11$ ,  $P > 0.05$ ), IL-6 ( $b = 0.09$ ,  $P > 0.001$ ), soluble intercellular adhesion molecule-1 ( $b = 0.05$ ,  $P > 0.05$ ) and sVCAM-1 concentrations ( $b = 0.07$ ,

$P > 0.05$ ) were significantly increased by consuming the Western pattern (high in refined grains, red meat, butter, processed meat, high-fat dairy, sweets and desserts, pizza, potato, eggs, hydrogenated fats, and soft drinks). On the other hand, a third pattern termed the traditional diet which is high in refined grains, potato, tea, whole grains, hydrogenated fats, legumes and caseroles was associated with higher plasma IL-6 concentrations ( $b = 0.04$ ,  $P > 0.05$ ) (21). The CRP level, coagulation abnormalities and hepatic function were examined after eight weeks of consumption of the DASH diet by type 2 diabetic patients (22). The effect of the DASH diet was identified by the mean percentage change of plasma CRP level  $-26.9 \pm 3.5\%$ ; after the control diet period the mean percentage change was  $-5.1 \pm 3.8\%$  ( $P = 0.02$ ). Also, decreases in alanine aminotransferase, aspartate aminotransferase and plasma fibrinogen levels were greater after consuming the DASH diet compared with the control diet (22).

### 3.7. Association of Dietary Patterns With Lifestyle Factors

A cross-sectional study was conducted to investigate the associations between major dietary patterns, termed the healthy and unhealthy patterns, and their relationships with demographic, socioeconomic, and lifestyle factors in 460 women, aged between 20 and 50 years. Positive association was found between healthy dietary pattern and aforementioned variables after adjusting some characteristics like age ( $b = 0.31$ ,  $P < 0.01$ ), university degree ( $b = 0.85$ ,  $P < 0.01$ ), housing size  $> 20$  m<sup>2</sup>/head ( $b = 0.30$ ,  $P < 0.01$ ), physical activity ( $b = 0.01$ ,  $P < 0.05$ ) and history of hypertension ( $b = 0.36$ ,  $P < 0.05$ ), while duration of residence in Tehran ( $b = -0.01$ ,  $P < 0.05$ ) was negatively associated with a healthy dietary pattern. Conversely, confounders like ethnicity (Turk versus Fars;  $b = 0.30$ ,  $P < 0.01$ ) and smoking ( $b = 0.64$ ,  $P < 0.01$ ) were positively associated with an unhealthy dietary pattern while age ( $b = -0.33$ ,  $P < 0.01$ ) was negatively associated with an unhealthy dietary pattern (23).

### 3.8. Dietary Patterns Derived From Factor Analysis

Dietary patterns of Iranian adults were identified using factor analysis among 12514 participants aged  $\geq 19$  years from the Isfahan Healthy Heart Program with major diets including Western, animal fat, traditional and Mediterranean. The only significant positive association was reported between age and Mediterranean diet, whereas both the Western and traditional dietary patterns showed a significant negative relationship with education in both genders ( $P > 0.01$ ) (24). Using cross-sectional assessment, dietary intakes of 2,510 subjects (1,121 men and 1,389 women), aged 19-70 years, from Tehran were compared with recent dietary guidelines for Americans. In the categories of DGAI; elderly, non-smoking and physically active female participants were

more likely to be in the highest quartile category than in the lowest quartile ( $p < 0.001$ ). A few participants met the DGAI recommendations, especially for starchy vegetables (2.3%), orange vegetables (16.2%), lean meat (9.2%), grains (12.0%), and legumes (6.4%). Almost half of the participants were reported to over-consume grains, while approximately 20% of the subjects excessively consumed milk and meat groups. There were only three micronutrients (vitamin E, B12, D) which were not associated with the DGAI 2005 score, however intakes of most nutrients were significantly associated with the DGAI 2005 score ( $p < 0.001$ ) (25). Recently, by using three food frequency questionnaires (FFQ), the reliability, comparative validity and stability of dietary patterns, as defined by factor analysis for participants of the Tehran Lipid and Glucose Study, were assessed and three dietary patterns were identified including, Iranian traditional, Western and combined. The reasonable reliability and validity of the dietary patterns were defined by factor analysis after eight years of study. The Western pattern was found to be fairly stable and the Iranian traditional was mostly unstable (2). The current study investigated the role of overall dietary patterns in predicting non-communicable disease. The findings of this review indicate a negative correlation between the healthy dietary pattern and non-communicable disease, but a positive association between Western and traditional (Iranian) dietary patterns and non-communicable disease. There was an inverse relationship between the healthy dietary pattern and non-communicable disease such as general and central obesity (8, 11, 12), esophageal squamous cell carcinoma (18, 19), the metabolic syndrome, insulin resistance (17) and cardio metabolic risk factors (16). This inverse association could be attributed to the pattern's healthy constituents, including vegetable, fruits, low fat dairy products, legumes, nuts, poultry, fish, liquid oil, whole grain, and low intakes of salt, hydrogenated fat, non-leafy vegetables and sweets. Fruits and vegetables rich in dietary fiber and antioxidants increased serum concentrations of the major antioxidant provitamins and vitamins found in plant foods ( $\beta$ -carotene, vitamins C and E and magnesium) and folate, which can prevent the development of diabetes (16) and reduce cardio metabolic risk factors (27). Dairy products are another major component of a healthy dietary pattern, which attenuate lipogenesis, accelerate lipolysis, and decrease high blood pressure (28). An additional protective effect of other constituents of these patterns is exhibited by legumes and nuts, which might prevent general and abdominal obesity and subsequent obesity-related co-morbidities (29). A meta-analysis of ten studies of dietary patterns concluded that the patterns most consistently associated with the prevention of diabetes were characterized by high consumption of fruit and vegetables, whole grains, fish and poultry, and decreased consumption of red meat, processed foods, sugar-sweetened beverages and starchy foods (30). In the current study, the

Western dietary pattern was associated with an increasing risk for non-communicable disease. Based on the US Dietary Guidelines, nutritional adequacy is achievable with diets in which half of the grain foods are refined (31). Finally evidence shows that consumption of up to 50% of all grain foods as core refined-grain foods is not associated with any increase in disease risk (32). Among the Iranian population, the average percentage of total energy intake from carbohydrate is 65% and those of total carbohydrate consumption from bread and white rice are 34.2% and 14.8%, respectively (33). Nonetheless, eating more whole-grain foods remains an important health recommendation, and most consumers need to reduce their current consumption of refined grains to one-third to half of all grains in order to meet the targets for whole-grain foods. This conclusion about refined grains only applies to core refined-grain cereal foods. Meat cooked at high temperatures may result in the formation of mutagens, heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs) (34), which are multiple-site carcinogens in animal models (31, 35). Additionally, red meat is a source of heme iron, which contributes to carcinogenesis in rodents by generating free radicals, a condition also consistent with human data (36-38). Processed meat is a source of nitrate and nitrite 55 which may cause cancer at a variety of anatomic sites in animals (34, 39). The Iranian traditional dietary pattern was associated with increase in BMI, WHR, WC, indices of obesity (9), plasma IL-6 concentration (21) and abnormal glucose homeostasis (17); the nature of this pattern may, to some extent explain this finding. This dietary pattern includes both healthy and unhealthy ingredients. However, there is higher intake of unhealthy constituents than healthy ingredients in the traditional dietary pattern.

#### 4. Conclusions

Among the Iranian population three dietary patterns was recognized. These included the healthy pattern, western pattern and traditional pattern. Adherence to the healthy dietary pattern is expected to exert a protective effect against non-communicable disease, and the Western dietary pattern was positively associated with non-communicable disease. Since the effect of traditional dietary pattern on non-communicable disease is not consistent, further work is needed to elucidate the role of dietary patterns in non-communicable diseases. Adherence to the healthy dietary pattern was recommended for prevention of non-communicable disease among the Iranian population.

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## Authors' Contributions

The idea behind this project was presented by Parvin Mirmiran, batol ahmadi and Fatemeh Nayeri. The study was designed by Parvin Mirmiran, Arefeh fallah and Somayeh Hosseinpour. Arefeh Fallah and Somayeh Hosseinpour analyzed and interpreted the data. The manuscript was prepared by Somayeh Hosseinpour and Parvin Mirmiran. All authors read and approved the final manuscript. Fereidoun Azizi supervised the project and approved the submission of the final version of the manuscript.

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