# A Western Dietary Pattern is Related with Allergic Rhinitis in Young Women

**Hadis Rezapour**
Birjand University of Medical Sciences
**Mohammad Fereidouni**
Birjand University of Medical Sciences
**Zahra Asadi**
Birjand University of Medical Sciences
**Mansoore Saharkhiz**
Birjand University of Medical Sciences
**Malaksima Ayadilord**
Birjand University of Medical Sciences
**Sara Mahmoudzadeh**
Birjand University of Medical Sciences
**Mohammad Reza Shadmand Foumani Moghadam**
Varastegan Institute for Medical Sciences
**Gordon A. Ferns**
Brighton and Sussex Medical School
**Afsane Bahrami** ( Afsbahramia931@gmail.com )
Birjand University of Medical Sciences

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**Research**

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# Abstract

**Background:** There has been an increasing prevalence of allergic disorders globally, and it may be useful to characterize the predisposing and protective factors for the development of allergy. Diet has been identified as one possible environmental factor implicated in the pathogenesis of allergic diseases. The goal of this study was to evaluate the associations between dietary patterns with the presence of allergies in a group of young women in East of Iran

**Methods:** In total 181 female students enrolled in this study. Presence of allergic diseases including allergic rhinitis (AR), asthma and eczema was confirmed by an expert allergist. Information about dietary intake was collected by using a 65-item validated food frequency questionnaire. Exploratory factor analysis was used to evaluate the relationships among food/nutrition variables.

**Result:** Multivariate odds ratio of having AR was 2.5 (95% CI:1.1-5.1) for the highest compared to lowest tertile of the Western dietary pattern score. But, no significant relationship was found between the traditional dietary pattern and AR, asthma or eczema.

**Conclusion:** Our findings indicate a potential role of Western dietary pattern, characterized by being rich in dairy products, snack, nuts and sugar in the development of AR. Since diet is a modifiable impetus, the relationship between AR and Western dietary pattern may has a clinical application, particularly in those who has risk factors for developing AR.


# 1. Background

Allergic diseases such as allergic rhinitis (AR), asthma, and atopic dermatitis are common health problems around the world and cause a significant economic burden as well as morbidity. Several studies in different parts of the world have shown that the prevalence of allergic disorders has been increasing during the last decades [1–3].

Allergens including indoor and outdoor ones, are the most common triggers of allergic symptoms and the pattern of sensitization vary in different societies. But besides the allergens, genetic and environmental factors have a fundamental role in developing allergic diseases [4, 5]. Considering of the high prevalence and the negative impact of allergies on quality of life, there may be benefit to characterizing the predisposing and protective factors for development of allergies. In this regard, many researchers have focused on the relationship between allergies and lifestyle and diet as these are somehow changeable factors. Previous surveys have found a close association between increased risk of allergic conditions and a more affluent lifestyle [6–8]. Dietary habits may explain at least in part the changes in the prevalence of allergic complications in various regions [9].

A strong risk could be associated with the dietary alterations associated with a Western lifestyle. There are global transformations in dietary behaviors, with elevated intake of fast foods and soft drinks [10], which has been related with a higher prevalence of allergic disorders [11–13]. Diet-related atopy may

account for different symptoms that involve the skin, gastrointestinal and respiratory tracts and might implicate IgE-induced and non–IgE-induced networks [14].

Whilst many food-intake studies have been conducted to demonstrate the association between diet and allergic disease, results have been inconsistent and inconclusive [15]. One suggestion for the higher prevalence of allergic disorders is due to the consuming of polyunsaturated fatty acids (PUFAs) [16, 17]. A diet high in antioxidants, may have protect against allergic conditions [18].

A widespread approach for evaluation of diet has relied on the assessment of single foods and nutrients. The assessment of dietary patterns, compared to individual nutrients and foods or food items, recognizes interactions between foods and nutrients and also the combination effect of several dietary components on likelihood of developing disease [19]. Moreover, the effect of only one nutrients/food groups probably be infinitesimal for detection, while the impact of a dietary habit could be substantially adequate to assists population-level disease prevention approaches [20]. So far, studies have been concerned with favorable dietary patterns, like a “prudent” or “Mediterranean” dietary patterns. An important question is whether an unhealthy dietary pattern enhances the risk of developing atopy, or worsening its symptoms.

Despite some promising findings presented in the literatures, data about the association between Middle Eastern lifestyle and dietary pattern with allergic diseases are scare and therefore, the aim of current study was to evaluate the associations of dietary patterns with the presence of allergies in a group of young women in east of Iran.

## 2. Method

# 2.1. Study design

The study was performed in a group of female students attending our city universities between December 2019–January 2020. Participants were eligible if they were 18–27 years old and were single. The exclusion criteria consisted of presence of acute or chronic major diseases and receiving any medication. The study was approved by ethics committee of our university and participants gave their informed written consent.

# 2.2. Phenotypic characterization of allergic conditions

Diagnosis of allergic disease was performed by an expert allergist through clinical history, physical examination and skin-prick testing (SPT) [21]. SPT was conducted by an expert immunologist with standard protocols [22]. Non-allergic groups were participants having neither allergic sign/manifestations nor any sensitivity to allergens in the SPT.

# 2.3. Dietary intake

Dietary information was gathered by a valid and reliable semi quantitative food frequency questionnaire (FFQ) consisting 65 food items in order to estimation of dietary intakes of subjects [23, 24]. The FFQ was

completed for all participants thorough a face-to-face interview by skilled nutritionists. Five frequency consumption groups (per day, week, month, rarely, and never) and portion size were included for each item of FFQ. Nutrient intakes of each cases, were calculated using the US Department of Agriculture's national nutrient databank [25]. Dietary patterns were recognized by 24 predefined food groups according to the similarity of FFQ food items (Table 1).

## 2.4. Assessment of anthropometric and cardiometabolic variables

Anthropometric parameters as well as systolic blood pressure and diastolic blood pressure were measured in all participants by using the standardized protocols [26]. The body mass index (BMI) was calculated by this formula: weight (kg)/height squared (m2). Waist-to-hip ratio (WHR) was obtained through waist circumference divided to hip circumference.

Blood specimens were gathered from all individuals after overnight fasting. A complete blood count (CBC) was conducted as part of the evaluation of hematological parameters (hemoglobin and hematocrit) using the SysmexK-800.

## 2.5. Statistical analysis

Principal component analysis (PCA) was used to recognize main dietary patterns according to the 24 food groups. Varimax rotation was conducted to create a simple and definitive component matrix. We derived two factors with Eigen values > 1 and interpretation of a scree plot. Thus, two chief dietary patterns were characterized and named concerning to our data interpretation and the previous reports. For all subjects, the factor scores of each identified pattern were acquired by sum up of intakes of foods weighed via their factor loading. Participants were categorized based on tertiles of dietary patterns. All of variables had a normal distribution by the Kolmogorov-Smirnov test. For comparing continuous variables across the tertiles of dietary pattern scores, ANOVA test was applied and presented as mean ± standard deviation (SD). Multinomial logistic regression was applied to assess the relation of tertiles of dietary patterns with incidence of any type of allergy. Adjusted model, was controlled for potential confounders including age and energy intake. A p-value < 0.05 was set as statistically significant.

# 3. Result

In total, 181 women (mean age of 20.7 ± 2.2 years old) were selected from 5 different universities across the our City. The prevalence of AR, asthma and eczema were found in 26.9%, 2.8% and 14.9% of participants, respectively.

## 3.1. Identification of main dietary patterns

The PCA was used to identify dietary food patterns; two main dietary patterns were recognized that we defined as: traditional and Western dietary patterns. A traditional dietary pattern was characterized by a more intake of green vegetables, other vegetables, organs meat, potato, solid oils, fruits, bean, refined

grains, red meat, eggs, whole grains, and sugars. In the Western dietary pattern, the intake of snacks, nuts, dairy products, tea, fast foods, chicken and vegetable oils were higher in the study participants. The factor-loading matrixes for two dietary patterns are presented in Table 2.

## 3.2. General features and dietary behaviors of study population

The clinical features of the study participants across tertiles of two major dietary patterns are presented in Table 3. No remarkable differences was found between weight, BMI, WHR, systolic and diastolic blood pressure, hemoglobin and hematocrit over tertiles of different two dietary pattern scores. Although, age was higher in the 1st tertile of Western dietary pattern compared to the 3th tertile ($p < 0.001$).

Dietary consumptions of food groups and nutrients across tertiles of two dietary patterns are demonstrated in Table 4. Consumption of, protein, total carbohydrates, total fat, total saturated fatty acid (SFAs), total MUFAs, cholesterol, vitamin A, niacin, riboflavin, sodium, potassium, calcium, magnesium, phosphorous, iron, copper, zinc and selenium were significantly higher among subjects in the first tertile of traditional pattern versus those in the third tertile. On the other hand, consumption of fruits, whole grains, green vegetables and other vegetables were higher in the third tertile of traditional pattern versus the first tertile. While, chicken and snacks intakes were lower in the third tertile of this dietary pattern compared to the first tertile. Raised intake of red meat, legumes, refined grains, see foods, eggs, green vegetables, protein, total fat, total SFAs, cholesterol, vitamin C, vitamin A, riboflavin, thiamin, carotene, phosphorous, iron, zinc, selenium and folic acid were seen in the lowest tertile of Western dietary pattern compared to highest tertile. However, dairy products, snacks, nuts and sugars were consumed more often in the highest tertile of Western pattern compared to the lowest tertile of this dietary pattern.

## 3.3. Connection between identified two dietary patterns and allergy

In multinomial logistic regression (adjusted variables for age and energy intake), we found that the odds of AR was higher in the second and third tertile of Western dietary pattern compared to the reference tertile (adjusted odds ratio [aOR] = 2.4, 95% confidence interval [CI]:1.03–5.7/aOR = 2.5, 95% CI: 1.1–5.1, respectively) (Table 5).

# 4. Discussion

In current study, we have investigated the connection between two major dietary patterns and presence of allergic disorders. Adherence to a Western pattern typified by high intake of snacks, nuts, dairy products, tea, fast foods, and chicken was related with a higher risk of AR after adjustment for measured confounders.

Although contributory, genetic risk factors alone cannot account for the increasing prevalence of atopy [27]. Diet has been implicated as one of the environmental factors contributing to the pathogenesis of

this diseases [28, 29]. Epidemiological studies of atopy have focused mainly on relationships with individual intakes and evidences have been inconsistent. An advantage of analysis of whole profile of a diet is that individuals do not eat single foods, but meals, which constitute a dietary pattern. Furthermore, methodological challenges was existed in which consuming of dietary ingredients are increasingly correlated, and chance results may derive from indiscriminate multiple statistical analysis. Actually the cumulative effects of numerous dietary components in a dietary pattern may be more closely show real nutritional or dietary information in a population, and possibly can be translated easily into public health policies [20].

Modern diets routinely include more processed and synthetic foods with increased amounts of fats and refined carbohydrates with decreased values of fiber, fruits and vegetables versus more traditional diets. These alterations have been affected gut microbiome, metabolic reactions and immune activity which all of the may involve in lengthy low-grade inflammation and disturbance of homeostasis and eventually higher risk of atopy [30]. At present in Westernized countries, intake of fruit, vegetables, whole grains and fish is generally low, and intake of fast foods, sweets and snacks is high which are containing a high amount of saturated fats, sugar and salt and poor in fiber and antioxidants. In our study, the Western dietary pattern has the greatest score for snacks, nuts, dairy products and fast foods.

AR is a widespread health challenge influencing many individuals from childhood to adulthood [31]. It is described through nasal itch, rhinorrhoea, sneezing, and nasal congestion [32, 33]. Rhinitis with watery and mucous rhinorrhoea may be happens post eating hot, spicy nutrition and autonomic induction via neuropsychosomatic factors related with food ingestion may be regard for non-immunological rhinitis [34]. Inflammatory and allergic form of rhinitis are considered as multi-factorial disorders, and environmental elements such as diet, are potentially contribute in the etiology [35, 36].

Our results demonstrate that the odds ratio of having AR was 2.5 times more for individuals in the highest versus those at the lowest tertile of the Western dietary pattern. The relationship between allergic rhinitis and habitual dietary habits has been evaluated in a few investigations [37–40]. Associations of AR with fatty acids, high fatty acids foods [37–40], fruit, and antioxidants [39, 40] were evaluated, but findings were conflicting. Along with our findings, in a cross-sectional study of 10 years old children in Taiwan, factor analysis showed that children have high-protein, high-fat, Western diet had a remarkably 1.1 more odds of having AR (95% CI:1.01–1.2). Additionally, children without AR were found to have a lower intakes of fruits, dairy products and meat compared to children with AR [41]. In another study, frequent intake of fast foods was related with AR (OR = 1.5; 95% CI:1.1-2.0) in school children of Mexico [42].

A Western dietary pattern often includes high pro-inflammatory and low-antioxidant food items, which could affect responsiveness to environmental stimuli. Omega-6 fatty acids were existed in greater amounts in fast foods and processed foods in the Western dietary pattern convert to arachidonic acid, which switches to inflammatory mediators, i.e. leukotrienes and prostaglandins [16]. For instance, prostaglandin E2 inhibits T-helper cell type 1 (Th1) and enhances the Th2 phenotype, which is

prominently found in allergic condition [16]. Moreover, low levels of antioxidants cannot prohibit the activation of nuclear factor-κB (NF-κB) by higher levels of reactive oxygen species (ROS) [43], thus inducing the innate immune reactions via cytokine production and devastation of cellular elements such as DNA, and proteins [44].

Many investigations have reported that the consuming of antioxidants rich foods (i.e., fruits and vegetables) protect from allergic conditions [45], whereas others reported a positive [46] or null relationship [45, 47]. We could not detect any relationship between the risk of atopy and consumption of fruits and vegetables across the tertiles of Western dietary pattern.

Dietary consumption of red meats, eggs, green vegetables, legumes and see foods, total fat, saturated fatty acids, fiber, riboflavin, thiamin, carotene, phosphorous, iron, zinc, selenium and folic acid were significantly decreased across tertiles of Western pattern and so inversely related with prevalence of AR. In a study performed on 1002 Japanese pregnant females, no measurable association was observed between intake of meat, eggs, total fat, saturated and monounsaturated fatty acids, and cholesterol or the ratio of n-3:n-6 PUFA and AR [48].

Previous studies have highlighted the allergenic properties of nuts in AR which is confirmed our finding [37, 49]. In a study performed among children, more consumption of nuts was associated with a more than two-times risk of AR [37].

Although asthma, eczema, and AR are associated to allergic immune reactions, the first 2 disorders did not represent any association with the studied dietary patterns. Lower prevalence of asthma and eczema in our study population which causes a smaller samples size might be a reason for lack of association. Consistent with our findings, in a review on 10 observational studies among North American, European, and Asian countries did not revealed any relationship between a Western dietary pattern and incidence or prevalence of asthma [50].

Traditional dietary pattern, which had a more factor loadings for vegetables, organs meat, potato, vegetable oils, eggs, and whole grains was not significantly related with any risk of allergy in our study. Consistently, in a prospective primary school children cohort, dietary pattern rich in meat, seafood, fruits, vegetables, cereals, rice and eggs, was not connected with any risk of rhinitis [51].

Adjustment for energy intake is a standard protocol in nutritional epidemiology for standardization of food and nutrient intake regarding to total food intake. Although most epidemiological surveys on dietary patterns and respiratory manifestations did not adjust for energy intake. Moreover, we collected data on potential confounders, including age, BMI and WHR and adjusted for them in the multivariate regression analysis to remove confounding as a probable explanation for the results.

In spite of careful evaluation of our study population, current research has several limitations. First, the cross-sectional nature of study does not allow determining the causal association and second, the

correlation of dietary patterns with asthma and eczema is based on relatively small cases and might just be a spurious result.

# Conclusion

This study indicates a predisposing role for Western dietary pattern rich in dairy products, snacks, nuts and sugar on allergic rhinitis. Diet has modifiable role and the connections between AR and western dietary pattern may have clinical applications, particularly for those who has other risk factors for developing of allergic rhinitis. Further researches regarding biological mechanisms and cumulative effect of other environmental elements and genetic factors are also need.

# Abbreviations

Allergic rhinitis (AR); Polyunsaturated fatty acids (PUFAs); Skin-prick testing (SPT); Food frequency questionnaire (FFQ); Complete blood count (CBC); Principal component analysis (PCA); Standard deviation (SD); Saturated fatty acid (SFAs); Reactive oxygen species (ROS); Nuclear factor-κB (NF-κB).

# Declarations

### Author's Contribution

AB contributed to research planning, examination, writing and statistical analysis. M.A and S.M. contributed to planning, supervision and correction. MS contributed to recruiting, examination and writing. MF contributed to research planning, case examination, writing and editing the manuscript. HR and ZA contributed to examination, writing. MSFM contributed to statistical analysis and correction. GAF contributed to planning and correction.

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### Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

### Compliance with ethical standards

### Conflict of interest

The authors declare that they have no conflict of interest.

### Ethics approval

Ethical approval was obtained from the Birjand University of Medical Sciences

### Informed consent

Informed consent was obtained from all individual participants included in the study.


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### Transparency Declaration

"The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with CONSORT1/STROBE2/PRISMA3 guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned (please add in the details of any organization that the trial or protocol has been registered with and the registration identifiers) have been explain. Ethical approval was obtained from the Birjand University of Medical Sciences.

None of the authors listed on the manuscript are employed by a government agency that has a primary function other than research and/or education. None of the authors are submitting this manuscript as an official representative or on behalf of the government.

### Disclosure

The authors have no conflict of interest to disclose

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# Tables

Table 1

Food grouping used in factor analysis of dietary patterns

| | |
|---|---|
| Refined grains | White breads (lavash, baguettes), rice, Macaroni, Pasta |
| Whole grains | Dark breads (Iranian), |
| Fast foods | Pizza, processed meat |
| Snacks | Biscuits, cakes and pastries, chocolate, ice-cream, chips |
| Dairy products | Whole milk, low-fat milk, yogurt, breakfast cheese, Dough |
| Solid fats | Butter, cream, solid oil, tall, salad dressing |
| Liquid fats | Liquid oil, olive oil |
| Sugars | Honey, sugar loaf, diabetic sugar, sugar |
| Fruits | Tree fruit, seasonal fruit, fruit compote, fruit juice, dried fruits |
| Carbonated beverages | Soft drinks, beer, diet drinks |
| Teas | tea |
| Coffee drinks | Coffee, coffee and milk, Nescafe |
| Legumes | Beans, soy |
| Pickled foods | Pickles, salty Cucumber |
| Green vegetables | The vegetables, lettuce, spinach |
| Other vegetables | Garlic, onion, tomato, Cucumber, salad (mixed salad of tomato, Cucumber and onion) |
| Potatos | Boiled potato, other potatoes, french fries, cutletand potato cutlets |
| Liquid foods | Soup |
| Eggs | Boiled egg, scrambled eggs |
| Red Meats | Lamb meat, beef, hunting meat |
| Organ meats | Heart, liver and kidney, intestine and viscera |
| Sea foods | Fish, fish tuna, shrimp |
| Chicken | Chicken feed |
| Nuts | Walnut, all types of nuts |

Table 2
Food loading matrix for major dietary patterns

| | Dietary patterns | |
|---|---|---|
| Food group | Traditional | Western |
| Other vegetables | 0.77 | - |
| Organs meat | 0.66 | - |
| Potato | 0.66 | - |
| Green vegetables | 0.58 | - |
| Vegetable oils | 0.46 | - |
| Fruits | 0.44 | - |
| Legumes | 0.37 | - |
| Refined grains | 0.34 | - |
| Red meat | 0.34 | - |
| Eggs | 0.28 | - |
| Whole grains | 0.25 | - |
| Sugars | 0.21 | - |
| Pickled foods | - | - |
| Sea foods | - | - |
| Liquid foods | - | - |
| Snacks | - | 0.82 |
| Nuts | - | 0.78 |
| Dairy products | - | 0.76 |
| Teas | - | 0.51 |
| Fast foods | - | 0.41 |
| Chicken | - | 0.33 |
| Vegetable oils | - | 0.30 |
| Carbonated Beverages | - | - |
| Coffee drinks | - | - |
| *Values less than 0.20 are not reported. | | |

Table 3
General characteristics and anthropometrics parameters of study participants by tertiles (T) categories of dietary pattern score.

| | **Traditional pattern** | | **P- value†** | **Western pattern** | | **P- value†** |
|---|---|---|---|---|---|---|
| **Variables** | **Tertile 1 (n = 60)** | **Tertile 3 (n = 61)** | | **Tertile 1 (n = 60)** | **Tertile 3 (n = 61)** | |
| Age (y) | 20.4 ± 2.9 | 20.7 ± 1.3 | 0.31 | 21.1 ± 1.7 | 20.1 ± 1.2 | **< 0.001** |
| Weight (kg) | 55.7 ± 6.6 | 54.1 ± 9.2 | 0.52 | 54.4 ± 9.2 | 53.9 ± 7.9 | 0.57 |
| BMI (kg/ m2) | 21.2 ± 2.4 | 20.4 ± 3.3 | 0.39 | 20.7 ± 3.5 | 20.5 ± 2.5 | 0.38 |
| WHR | 0.74 ± 0.04 | 0.73 ± 0.04 | 0.44 | 0.74 ± 0.04 | 0.73 ± 0.03 | 0.39 |
| SBP (mmHg) | 10.7 ± 0.95 | 10.6 ± 1.0 | 0.44 | 10.6 ± 0.79 | 10.6 ± 1.1 | 0.88 |
| DBP (mmHg) | 7.1 ± 0.7 | 7.0 ± 0.7 | 0.61 | 7.1 ± 0.72 | 6.9 ± 0.80 | 0.56 |
| Hb(g/dl) | 13.8 ± 1.7 | 14.1 ± 1.1 | 0.66 | 13.7 ± 1.5 | 13.9 ± 1.2 | 0.22 |
| Hct (%) | 41.4 ± 4.1 | 41.6 ± 2.6 | 0.96 | 41.0 ± 3.3 | 41.5 ± 2.6 | 0.31 |

Abbreviations: Body mass index (BMI); Waist-to-hip ratio (WHR); Systolic blood pressure (SBP); Diastolic blood pressure (DBP); Hemoglobin (Hb); Hematocrit (Hct).

†obtained from ANOVA test.

Table 4
Dietary intakes of study participants by tertiles (T) categories of dietary pattern scores

| Variables | Traditional pattern | | P-value† | Western pattern | | P-value† |
|---|---|---|---|---|---|---|
| | Tertile 1 | Tertile 3 | | Tertile 1 | Tertile 3 | |
| Food groups (g/1000 Kcal) | | | | | | |
| Red meat | 19.4 ± 16.9 | 21.9 ± 16.9 | 0.40 | 29.0 ± 41.1 | 14.3 ± 12.4 | **0.019** |
| Dairy product | 94.6 ± 62.5 | 91.5 ± 49.2 | 0.62 | 84.4 ± 43.9 | 90.7 ± 54.4 | **0.027** |
| Fruit | 83.7 ± 63.2 | 124 ± 114 | **0.03** | 99.9 ± 81.9 | 92.0 ± 69.6 | 0.88 |
| Chicken | 25.8 ± 22.8 | 9.0 ± 11.1 | **< 0.001** | 15.4 ± 15.8 | 11.6 ± 13.2 | 0.13 |
| Legumes | 11.6 ± 9.8 | 9.7 ± 9.6 | 0.28 | 15.2 ± 12.7 | 8.1 ± 8.2 | **0.002** |
| Coffee | 250 ± 1758 | 13.3 ± 28.3 | 0.37 | 13.2 ± 30.1 | 278 ± 1839 | 0.29 |
| Whole grains | 9.1 ± 10.4 | 14.1 ± 15.9 | **0.008** | 19.1 ± 29.3 | 12.2 ± 16.7 | 0.19 |
| Refined grains | 96.7 ± 39.8 | 92.1 ± 69.6 | 0.34 | 88.3 ± 44.0 | 76.3 ± 45.5 | **0.031** |
| See foods | 25.2 ± 38.4 | 29.1 ± 34.9 | 0.16 | 8.3 ± 6.3 | 5.1 ± 6.7 | **0.035** |
| Snacks | 32.9 ± 28.8 | 16.9 ± 12.9 | **0.001** | 15.4 ± 8.6 | 38.4 ± 32.8 | **< 0.001** |
| Nuts | 7.6 ± 12.4 | 9.0 ± 11.3 | 0.76 | 4.4 ± 6.4 | 14.9 ± 16.5 | **< 0.001** |
| Vegetables oil | 13.2 ± 12.7 | 16.3 ± 14.0 | 0.12 | 15.5 ± 15.0 | 15.8 ± 13.9 | 0.30 |
| Eggs | 6.1 ± 5.5 | 9.5 ± 10.3 | 0.07 | 10.4 ± 9.5 | 5.3 ± 5.9 | **0.001** |
| Green vegetables | 3.0 ± 3.9 | 8.5 ± 9.5 | **< 0.001** | 7.3 ± 8.7 | 3.4 ± 4.5 | **0.011** |
| Other vegetables | 27.7 ± 25.7 | 85.9 ± 68.4 | **< 0.001** | 54.3 ± 52.3 | 47.4 ± 48.6 | 0.76 |
| Sugar | 7.5 ± 7.4 | 6.6 ± 9.7 | 0.39 | 4.9 ± 5.5 | 10.1 ± 13.9 | **0.018** |
| Nutrients(per1000 Kcal) | | | | | | |
| Protein(g) | 39.9 ± 15.6 | 24.8 ± 11.6 | **< 0.001** | 38.0 ± 17.4 | 22.8 ± 10.4 | **< 0.001** |
| Total carbohydrates (g) | 74.5 ± 32.8 | 50.4 ± 29.9 | **< 0.001** | 66.1 ± 37.4 | 52.4 ± 32.4 | 0.05 |

| Variables | Traditional pattern | | P-value† | Western pattern | | P-value† |
|---|---|---|---|---|---|---|
| | Tertile 1 | Tertile 3 | | Tertile 1 | Tertile 3 | |
| Total fiber (g) | 7.4 ± 3.4 | 6.3 ± 3.7 | 0.27 | 8.2 ± 3.6 | 5.2 ± 3.3 | **< 0.001** |
| Total fat (g) | 20.3 ± 11.1 | 9.6 ± 11.1 | **< 0.001** | 20.0 ± 11.7 | 11.2 ± 9.0 | **< 0.001** |
| Total SFAs (g) | 11.5 ± 5.1 | 6.7 ± 4.8 | **< 0.001** | 11.3 ± 5.1 | 6.5 ± 3.9 | **< 0.001** |
| Total MUFAs (g) | 12.9 ± 9.1 | 5.8 ± 6.3 | **< 0.001** | 9.5 ± 5.3 | 10.1 ± 10.7 | 0.73 |
| Total PUFAs (g) | 13.9 ± 7.2 | 14.9 ± 8.4 | 0.78 | 14.9 ± 8.9 | 15.6 ± 8.1 | 0.098 |
| Cholesterol (mg) | 167.4 ± 68.2 | 116.4 ± 59.7 | **< 0.001** | 168 ± 65.9 | 100.4 ± 42.3 | **< 0.001** |
| Vitamin C (mg) | 57.9 ± 40.7 | 72.6 ± 72.3 | 0.15 | 71.5 ± 53.8 | 46.1 ± 44.7 | **0.045** |
| Vitamin E (mg) | 13.1 ± 7.1 | 13.9 ± 8.4 | 0.86 | 14.6 ± 9.0 | 14.5 ± 6.6 | 0.08 |
| Vitamin A (µg) | 80.2 ± 74.0 | 18.9 ± 24.4 | **< 0.001** | 65.6 ± 68.5 | 19.9 ± 31.2 | **< 0.001** |
| Niacin(mg) | 10.1 ± 5.3 | 6.0 ± 2.8 | **< 0.001** | 8.9 ± 5.0 | 6.8 ± 5.2 | 0.06 |
| Riboflavin (mg) | 0.73 ± 0.27 | 0.48 ± 0.20 | **< 0.001** | 0.65 ± 0.26 | 0.51 ± 0.22 | **0.004** |
| Thiamin(mg) | 0.41 ± 0.17 | 0.32 ± 0.23 | 0.06 | 0.41 ± 0.24 | 0.31 ± 0.16 | **0.028** |
| Carotene (g) | 798 ± 403 | 678 ± 399 | 0.21 | 845 ± 407 | 534 ± 537 | **< 0.001** |
| Sodium(mg) | 1083 ± 825 | 535 ± 287 | **< 0.001** | 827 ± 324 | 720 ± 878 | 0.61 |
| Potassium(mg) | 1526 ± 940 | 1139 ± 560 | **0.007** | 1404 ± 552 | 1146 ± 993 | 0.17 |
| Calcium (mg) | 279 ± 146 | 168 ± 105 | **< 0.001** | 238 ± 142 | 180 ± 138 | 0.03 |
| Magnesium(mg) | 122.1 ± 82.4 | 81.4 ± 46.2 | **0.002** | 107 ± 50.1 | 88.5 ± 12.8 | 0.55 |
| Phosphorous(mg) | 514 ± 193 | 323 ± 141 | **< 0.001** | 468 ± 201 | 339 ± 178 | **0.001** |
| Iron(mg) | 3.8 ± 1.5 | 2.7 ± 1.4 | **0.001** | 3.9 ± 1.4 | 2.6 ± 1.4 | **< 0.001** |
| Copper | 0.48 ± 0.24 | 0.33 ± 0.23 | **0.003** | 0.44 ± 0.23 | 0.35 ± 0.25 | 0.13 |
| Zinc(mg) | 2.9 ± 1.2 | 1.9 ± 0.9 | **< 0.001** | 2.8 ± 1.4 | 1.8 ± 1.0 | **< 0.001** |
| Selenium (g) | 28.1 ± 10.9 | 17.2 ± 10.9 | **< 0.001** | 26.3 ± 11.8 | 15.0 ± 7.4 | **< 0.001** |

| Variables | Traditional pattern | | P-value† | Western pattern | | P-value† |
|---|---|---|---|---|---|---|
| | Tertile 1 | Tertile 3 | | Tertile 1 | Tertile 3 | |
| Folic acid(µg) | 97.9 ± 38.9 | 81.6 ± 47.2 | 0.08 | 99.9 ± 44.1 | 73.3 ± 35.6 | **0.003** |

SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acid.

 All values are mean ± SD and adjusted for energy intake.

By using one-way ANOVA.

Table 5

Univariate and multivariate associations between dietary patterns and allergic disease.

| Dietary pattern | Tertiles | Univariate<br>OR (95% CI); P value | Multivariate*<br>OR (95%CI) ; P value |
|---|---|---|---|
| **Allergic rhinitis** | | | |
| Western | T1 | References | References |
| | T2 | 2.3 (1.1-4.9);*0.023* | 2.4(1.03-5.7);*0.042* |
| | T3 | 2.7(1.3-5.6);*0.009* | 2.5(1.1-5.1); *0.030* |
| Traditional | T1 | References | References |
| | T2 | 0.68(0.33-1.1);0.31 | 0.65(0.31-1.3); 0.35 |
| | T3 | 0.86(0.41-1. 8); 0.86 | 0.81(0.36-1.39); 0.78 |
| **Eczema** | | | |
| Western | T1 | References | References |
| | T2 | 0.76(0.26-2.2);0.62 | 0.77(0.26-2.24);0.32 |
| | T3 | 1.1(0.42-2.9); 0.83 | 1.3(0.43-3.9); 0.74 |
| Traditional | T1 | References | References |
| | T2 | 1.1(0.41-3.2); 0.79 | 1.2(0.41-3.3);0.78 |
| | T3 | 1.08(0.39-3.1);0.88 | 1.1(0.35-3.2); 0.91 |
| **Asthma** | | | |
| Western | T1 | References | References |
| | T2 | 2.1(0.18-23.5);0.56 | 1.7(0.14-20.5);0.66 |
| | T3 | 1.9 (0.17-22.3);0.58 | 0.65(0.04-11.5); 0.58 |
| Traditional | T1 | References | References |
| | T2 | 1.9 (0.17-22.2);0.58 | 1.6(0.14-20.1); 068 |
| | T3 | 1.9 (0.17-22.3);0.58 | 0.71(0.04-12.9); 0.82 |

Tertile 1 is the reference group.

By using multinomial logistic regression.

Adjusted for age and energy intake.