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Dietary patterns and ovulatory infertility: a case-control study

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ABSTRACT

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Objective: To investigate the relationship between female ovulatory infertility and major dietary patterns among women attending fertility clinics.

Methods: This case-control study was conducted on 167 infertile women with polycystic ovary syndrome (PCOS) and 251 controls. PCOS was determined by using the Rotterdam 2003 criteria. Usual dietary intake was assessed using a validated 168-item semiquantitative food frequency questionnaire. Major dietary patterns were identified using factor analysis.

Results: Two main dietary patterns, namely, healthy dietary pattern and western dietary pattern, were identified. Cases were statistically more overweight and abdominally fat than controls ($p < 0.01$). No statistically significant difference was seen in total energy intake, nutrient intakes and dietary fiber between the two groups. Lower adherence to the Western dietary pattern was associated with decreased chance of infertility (OR = 0.61; 95% CI, 0.41-0.91; $p = 0.01$). The association remained significant even after taking other confounders into account (OR = 0.62; 95% CI, 0.41-0.96; $p = 0.03$). However, after adjusting for energy and macronutrient intakes, the association altered to a marginally significant relation ($p = 0.07$). Associations between following a healthy dietary pattern and PCOS-associated infertility was not statistically significant ($p = 0.45$).

Conclusion: Lower adherence to the Western dietary pattern may protect women of reproductive age against infertility. Further studies are needed to confirm the role of different dietary patterns on fertility outcomes.

key words:
dietary pattern,
nutrition,
infertility,
polycystic ovary syndrome

Introduction

According to the World Health Organization (WHO), infertility, a public health issue, is a disease of the reproductive system defined by the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected intercourse [1, 2]. The latest estimates are that approximately 15% of couples in developed countries are affected by infertility in their reproductive lifetime [1, 3-5]. It has been reported that the overall prevalence of infertility is about 8% to 12% among Iranian population [6]. However, varying definitions and geographical variations have resulted in different estimates of its prevalence [1, 2, 7]. The wide range of the causes of infertility includes ovulation problems, tubal disease, endometriosis, chromosomal abnormalities, male factors, and unexplained infertility [4, 8]. Among these causes, 18% to 30% of couples have

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ovulatory disorders [4, 8].

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder, with uncertain etiology, affecting up to 15% of women during their reproductive age [9-11]. PCOS appears to be associated with ovulatory infertility, menstrual dysfunction, endometrial cancer, hirsutism, and acne [9-12]. Women with PCOS are more likely to have insulin resistance, excess body weight, type 2 diabetes, and cardiovascular disease [13-15].

Recent treatment methods for infertility have placed the main burden of health expenditure on both patients and the government. Therefore, the identification of modifiable risk factors is advocated for infertility prevention [4, 10, 16]. Earlier studies suggested that dietary factors and physical activity may have a potential role in the etiology of ovulatory infertility [4, 16-23]. Many studies have shown that overweight and a sedentary lifestyle are strongly associated with infertility due to ovulatory dysfunction [24-26]. It has been reported that weight loss interventions and regular physical exercise might enhance insulin resistance and reduce androgen levels among infertile women [24, 27-29]. However, controversies arose over the effect of exercise training on reproductive outcomes [30, 31]. The association between dietary patterns and infertility has not been extensively examined. However, an increased risk of infertility has been linked to higher consumption of animal proteins, total carbohydrates, foods with a high glycemic index, and low-fat dairy products in recent reports of Nurses' Health Study cohort by Chavarro and colleagues [4, 16, 18-23]. Beneficial effects of a Mediterranean-type diet on weight loss and insulin resistance may lead to fertility enhancement [32, 33]. Moreover, it is suggested that DASH diet, rich in fruits, vegetables, whole grains, and low-fat dairy products, can decrease insulin resistance, serum hs-CRP levels, abdominal fat accumulation, serum triglycerides, and very low-density lipoprotein cholesterol among women with PCOS [34, 35]. Recent studies have given considerable attention to dietary patterns and their association with various diseases. However, the association between dietary patterns and infertility has been examined in a limited number of studies, and such an association has not been investigated in Iranian population [32]. Moreover, previous studies have assessed nutritional status and examined the effect of nutrient intakes on ovulatory infertility among infertile women [10, 36]. In addition, those studies have focused on a single or few dietary nutrients. Therefore, we aimed to examine the association of female infertility with main dietary patterns identified in the prior approaches.

Methods

Study design and participants

This retrospective case-control study was conducted on women (mean age: 28.78 ± 5.4 y) attending 2 principal fertility clinics (Isfahan Central Fertility Clinic and Shahid Beheshti Hospital) in Isfahan, Iran. Diagnosis of ovulatory infertility due to PCOS was made by gynecologists according to Rotterdam 2003 criteria. These criteria include the presence of at least two of the following features: (I) Clinical hyperandrogenism (Ferriman-Gallwey score > 8) or biochemical hyperandrogenism (elevated total/free testosterone), (II) oligomenorrhea (less than 6 to 9 menses per year) or oligo-ovulation, and (III) polycystic ovaries on ultrasound (≥ 12 antral follicles in one ovary or an ovarian volume of ≥ 10 cm3) [37-40]. The sample size was determined by using the following equation (with the alpha and beta values considered 0.05 and 0.2, respectively):

$$n=\left(\frac{\varphi+1}{\varphi}\right)\frac{\left(Z1-\frac{\alpha}{2}+Z1-\beta\right)2}{\Delta 2}+\frac{\left(Z1-\frac{\alpha}{2}\right)2}{\varphi}$$

Saturated fatty acid variable [14] was used to detect the standardized difference of 0.3. A total of 178 overweight and obese women (BMI ≥ 25 kg/m2) who met the criteria were selected as cases. The cases were matched with 276 women (a control:case ratio of 1.5) who had at least one child and entered the clinics in company with their close relatives. The controls reported regular menstrual cycles. To reduce selection bias, cases and controlled were matched according to their age. Moreover, confounders were adjusted to reduce this error. The exclusion criteria included having a history of diabetes, thyroid dysfunction, congenital adrenal hyperplasia, hyperprolactinemia, androgen-secreting tumors, Cushing syndrome, and taking medication for any condition other than ovulatory dysfunction. After excluding women who reported total daily calorie intake outside the range of 800-4200 kcal/day (mean of total energy intake ± 3SD) (n = 26) and missing values (n = 10), a total of 167 cases and 251 controls participated in the study.

Written informed consent was obtained from all participants and their husbands. The ethics committee of Isfahan University of Medical Sciences, Isfahan, Iran, also approved the study.

Dietary intake assessment

Data on usual dietary intake was assessed by using a previously validated 168-item semiquantitative food frequency questionnaire (FFQ) [41], and major dietary patterns were identified using factor analysis. The FFQ included a list of typical Iranian foods with standard serving sizes. A nine-choice consumption frequency list for each food item was prepared from which participants could report their average dietary

Table 1. Food grouping used in the dietary pattern analyses

Food groups	Food items
Processed meat	All types of sausages and salami
Red meats	Beef, lamb, hamburger
Organ meats	Beef liver, heart, kidney, intestine, and viscera
Fish	All types of fish
Poultry	Chicken
Eggs	Eggs
Butter	Butter
Margarine	Margarine
Low-fat dairy products	Skim or low-fat milk, low-fat yogurt, low-fat cheese, yogurt drink (dough), curd (kashk)
High-fat dairy products	High-fat milk, chocolate milk, cream, high-fat yogurt, cream yogurt, cream cheese, ice cream
Tea	Tea
Coffee	Coffee
Fruits	Melon, apples, cherries, pears, grapes, apricots, fresh figs, dates, strawberries, bananas, cantaloupe, watermelon, oranges, tangerine, grapefruit, kiwi, peaches, nectarine, plums, pomegranates, pineapples
Natural fruit juices	Apple juice, orange juice, grapefruit juice, other fruit juices
Cruciferous vegetables	All types of cabbages, cauliflower, Brussels sprouts, kale
Yellow vegetables	Carrots
Tomatoes	Tomatoes, tomato paste, tomato sauce
Green leafy vegetables	Spinach, lettuce
Other vegetables	Cucumber, eggplant, squash, green beans, green peas, green pepper, mixed vegetables, onions, garlic, celery, turnip, mushrooms
Legumes	Chickpeas, beans, peas, soy, lentils, broad beans
Potatoes	Potatoes
French fries	French fries
Whole grains	Whole bread, dark bread (Iranian), barley bread, bulgur
Refined grains	White bread (lavash, baguettes), toasted bread, rice, pasta, noodles, white flour
Pizza	Pizza
Snacks	Corn puffs, chips, popcorn
Nuts	Walnuts, peanuts, almonds, pistachios, hazelnuts
Mayonnaise	Mayonnaise
Dried fruits	Raisins, dried berries, dried mulberries
Starchy sweets	Biscuits, cake, cookies, pastries
Hydrogenated fats	Hydrogenated fats, animal fats
Vegetable oils	Vegetable oils, olive oils, non-hydrogenated oils
Sugars	Sugars, candies, tamarisk, jam, jelly, honey
Soft drinks	Soft drinks
Salt	Salt
Pickles	Pickles

intake during the previous year. The list included never, 1-3 times per month, once a week, 2-4 times per week, 5-6 times per week, once daily, 2-3 times per day, 4-5 times per day, and 6 or more times a day. Portion sizes of each food item were converted into grams by using standard Iranian household measures [42]. Then, frequencies of consumed foods were transformed into daily intakes. The nutrient composition of each food was derived by using modified Nutritionist IV software. For dietary pattern analysis, energy-adjusted food items were grouped into 36 different categories (Table1). The basis for placing a food item in a certain food group was the similarity of nutrients. A limited number of food items were categorized as a distinct group due to their special nutrients (e.g., eggs, margarine, coffee, and tea). The Mifflin equation was used to predict resting metabolic rate (RMR) based on weight, height, and age of the participants [43]. Misreporting of energy intake was evaluated based on the EI:RMR ratio [44]. We used the Goldberg and Black cutoff points, which defined overreporting as an EI:RMR ratio of ≥ 2.4 and underreporting as < 1.35 [45]. Therefore, in the present study, a range of 1.35 to 2.39 was considered a normal reporting of energy intake [44, 46].

Anthropometric measurements

Participants' weight was measured using a standard digital Seca scale (made in Germany) while wearing light clothes without shoes. Measurements were recorded to the nearest 100 g. Height was measured using a mounted tape in a standing, relaxed-shoulder position with no shoes to the nearest 0.5 cm. We calculated body mass index (BMI) using weight in kilogram divided by height squared in meters. Waist circumference (WC) and hip circumference (HC) were measured by using an unstretched tape in a standing position over the light clothes. Waist circumference was measured at the narrowest circumference between the costal margin and the iliac crest and hip at the maximal circumference between the waist and thigh. All measurements were recorded to the nearest 0.5 cm. Waist to hip ratio (WHR) was calculated as WC in centimeters divided by HC in centimeters. A trained dietician did all of the measurements in order to reduce error.

Assessment of other variables

A self-reported questionnaire was used to gather information on age, education (below the diploma, diploma, bachelor's degree, and above the bachelor's degree), smoking status (yes or no), current use of fertility medications (yes or no), and multivitamin and iron supplements (no, ≤ 2 tablets per week, 3-5 tablets per week, or ≥ 6 tablets per week). Data on physical activity was obtained using the short form of validated International Physical Activity Questionnaire (IPAQ) (www.ipaq.ki.se) [47], which was presented as metabolic equivalent-minutes per week (MET-min/week), and physical activity level was determined as high, moderate, or low [48].

Statistical analysis

Descriptive findings were presented as mean ± SD for quantitative data and frequency (percentage) for qualitative ones. The independent t test and chi-square test were used to compare the values between groups using for quantitative and qualitative variables, respectively. Exploratory factor analysis with varimax rotation was conducted to identify the major dietary patterns based on the 36 food groups (five groups, i.e., organ meat, margarine, coffee, tea, and legumes were not included because they had low communality and were not loaded on any extracted factors). The natural interpretation of the factors in conjunction with eigenvalues 1 and the scree test determined whether a factor should be retained. The scree plot is a plot of the eigenvalues of derived factors. The scree plot was used to determine the number of factors to be extracted. Food group loadings > 0.20 were considered relevant components of the dietary patterns. Two factors were identified. We obtained the scores for subjects by summing the consumption of each food group weighted by the factor loadings. The obtained scores were then categorized into two categories according to the median values of factor scores. Two binary predictors were created and used in multiple binary logistic regressions for predicting infertility as the outcome variable. We calculated odds ratios (OR) along with their 95% confidence intervals (95% CI) for the association of dietary pattern with infertility by using logistic regression in crude and different adjusted models. Model 1 was adjusted for age, BMI, and physical activity level. Additional adjustments for current supplement use and smoking status were done in model 2, and further adjustments were made for energy and macronutrient intakes in model 3. All statistical analyses were conducted using SPSS version 16 (SPSS Corp., Chicago, IL, United States).

P values less than 0.05 were considered statistically significant.

Results

We identified 2 major dietary patterns by using factor analysis: a "healthy dietary pattern" (high in green leafy vegetables, fruits, low fat dairy products, nuts, fish, poultry, vegetable oils, and whole grains) and a "Western dietary pattern" (high in red meat, processed meats, refined grains, French fries, high-fat dairy products, snacks, starchy sweets, soft drinks, and hydrogenated fats). Factor loadings of the identified dietary patterns are presented in Table 2. Baseline characteristics of cases (n = 167) and controls (n = 251) are shown in Table 3. Cases had significantly higher BMI and WC compared with controls (p < 0.01). No significant difference was observed in physical activity level (p = 0.75), smoking status (p = 0.40), and current dietary supplements use (p = 0.88 for iron supplements and

Table 2. Factor loadings for the two major dietary patterns identified by factor analysis

Food groups	Dietary patterns	
	Healthy	Western
Processed meats	-	0.54
Red meats	-	0.35
Organ meats	-	-
Fish	0.28	-
Poultry	0.21	-
Eggs	0.25	-
Butter	-	0.31
Margarine	-	-
Low-fat dairy products	0.40	-
High-fat dairy products	-	0.46
Tea	-	-
Coffee	-	-
Fruits	0.68	-
Natural fruit juices	0.48	-
Cruciferous vegetables	0.58	-
Yellow vegetables	0.24	-
Tomatoes	0.56	-
Green leafy vegetables	0.70	-
Other vegetables	0.76	-
Legumes	-	-
Potatoes	-	0.23
French fries	-	0.47
Whole grains	0.21	-
Refined grains	-	0.39
Pizza	-	0.39
Snacks	-	0.53
Nuts	0.33	-
Mayonnaise	-	0.35
Dried fruits	0.48	-
Starchy sweets	-	0.39
Hydrogenated fats	-	0.26
Vegetable oils	0.33	-
Sugars	-	0.36
Soft drinks	-	0.51
Condiments	-	0.27
Pickles	-	0.33
Percentage of variance explained (%)	0.052	0.076

Table 3. Baseline characteristics and dietary intake of cases and controls

	Cases (n = 167)	Controls (n = 251)	P value*
Age, y	29.55 ± 5.82	28.27 ± 5.03	0.06
BMI, kg/m^2	25.65 ± 4.54	23.72 ± 3.76	< 0.01
WC, cm	87.01 ± 10.6	80.59 ± 9.28	< 0.01
WHR	0.84 ± 0.06	0.80 ± 0.06	< 0.01
Physical activity level, %			0.75
High	9.6	11.6	
Moderate	24.0	25.1	
Low	66.5	63.3	
Current smoker, %	0.6	2	0.40
Current iron supplement use, %			0.88
No	59.9	57.4	
≤ 2 tablets per week	15.0	14.3	
3-5 tablets per week	5.4	5.2	
≥ 6 tablets per week	19.8	23.1	
Current multivitamins supplement use, %			0.94
No	42.5	44.6	
≤ 2 tablets per week	12.0	10.8	
3-5 tablets per week	7.8	6.8	
≥ 6 tablets per week	37.7	37.8	
Dietary intake			
Total energy (kcal/d)	1924.9 ± 740.81	2061 ± 758.04	0.07
Carbohydrate, %	56.89 ± 8.01	58.09 ± 10.92	0.22
Protein, %	13.53 ± 3.16	12.99 ± 3.12	0.08
Fat, %	31.47 ± 7.30	30.65 ± 8.19	0.29
SFA, %	9.46 ± 3.55	9.44 ± 4.02	0.97
MUFA, %	9.89 ± 2.93	9.87 ± 3.15	0.96
PUFA, %	8.00 ± 3.70	7.84 ± 3.62	0.66
Cholesterol, mg/d	144.7 ± 82.06	153.7 ± 106.53	0.35
Dietary fiber, g/d	18.70 ± 9.51	19.94 ± 11.20	0.23
Vitamin D, µg/d	0.88 ± 1.24	1.01 ± 1.37	0.32
Selenium, mg/d	0.08 ± 0.39	0.10 ± 0.10	0.02

BMI, body mass index; WC, waist circumference; WHR, Waist to hip ratio; MET, metabolic equivalent.
SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids
** Obtained from independent* t test *or chi-square test as appropriate.*
All values are mean ± SD unless otherwise stated.

Table 4. Multivariable adjusted odds ratios for infertility across the median values of the two main dietary pattern scores

	Healthy pattern score			Western pattern score		
	>mean	≥ mean	(ref)P value	>mean	≥ mean	(ref)P value
Crude	1.165 (0.780, 1.742)	1	0.45	0.613 (0.410, 0.916)	1	0.01
Model 1	1.108 (0.731, 1.679)	1	0.63	0.636 (0.418, 0.969)	1	0.03
Model 2	1.127 (0.742, 1.711)	1	0.57	0.629 (0.412, 0.962)	1	0.03
Model 3	1.212 (0.736, 1.996)	1	0.44	0.624 (0.370, 1.054)	1	0.07

Model 1: Adjusted for age, BMI, and physical activity level
Model 2: Additionally adjusted for current supplement use and smoking status
Model 3: Additionally adjusted for energy and macronutrient intakes

p = 0.94 for multivitamin supplements), between the two groups. Total energy intake, nutrient intakes, and dietary fiber were not significantly different between cases and controls. Regarding misreporting, no significant differences were seen between the two groups (p = 0.76). However, cases were more likely to underreport their total energy intake than controls (52.1% vs 42.2%). Fertile women in the control group were more educated in comparison with cases (p = 0.02).

Multivariable adjusted OR for infertility across the median values of the main dietary pattern scores are presented in Table 4. Lower adherence to the Western dietary pattern was associated with a 39% lower chance of infertility in the crude model. After controlling for confounding variables including age, BMI, and physical activity level, we found that women consuming a Western diet less than the median had 37% lower odds of infertility (OR = 0.63; 95% CI, 0.42-0.97; p = 0.03) compared with women with a higher adherence. The association remained significant even after taking other confounders into account (OR = 0.62; 95% CI, 0.41-0.96; p = 0.03). However, after adjusting for energy and macronutrient intakes, the relationship between the Western dietary pattern and infertility altered to a marginally significant association (p = 0.07). No statistically significant overall association was seen between having a healthy dietary pattern and infertility due to PCOS (p = 0.45). This association remained negligible even after adjusting for the aforementioned confounders.

Discussion

We studied the association between dietary patterns and infertility and found that a decreased adherence to the Western dietary pattern was related to significantly lower chances of infertility due to PCOS. However, adherence to a healthy dietary pattern does not seem to be related to ovulatory infertility. All associations were examined independently of other lifestyle factors.

Some epidemiological studies have examined the association of single dietary nutrients and food items with infertility [16, 19-23, 49]. However, scarce data are available on the role of dietary patterns in this regard [4, 32, 33]. The Nurses' Health Study suggested that increased intake of carbohydrates with high glycemic index may increase adverse reproductive outcomes by contributing to insulin resistance, a key factor in ovulatory function [4, 23, 50]. Moreover, the risk of infertility may be reduced by consuming vegetable proteins instead of animal protein or carbohydrate, because of glucose- and insulin-like growth factor I–lowering effect of vegetable proteins [20]. It is also reported that the intake of trans fatty acids instead of carbohydrate or monounsaturated fats is related to a higher risk of ovulatory dysfunction [16]. Furthermore, intake of polyunsaturated fatty acids (PUFAs) can improve ovulation rate in women with high iron intake through PPAR-γ expression and PUFA oxidation pathway [16]. Clinical trials have reported that improved menstrual regularity and greater reduction in insulin resistance and weight can be reached by a low-calorie, low-carbohydrate, low-glycemic index diet high in fiber and protein in women with PCOS [51-55]. Epidemiological studies have indicated that women with PCOS generally consume diets high in saturated fats and low dietary fiber [56, 57].

Regarding micronutrient intakes, a direct association was seen between regular folic acid and iron supplement use and the reduced risk of ovulatory infertility owing to their effects on transferrin receptors in ovarian function [19, 21]. However, there is no definite conclusion regarding the association of micronutrients intake with infertility [58]. Recently, it was shown that vitamin D deficiency may lead to ovulatory dysfunction [59-61].

With respect to food items and food groups, Chavarro et al observed that women consuming low-fat dairy products had a greater risk of infertility than those who consumed high-fat dairy foods [18]. In nutritional epidemiology, food patterns examine overall diet and represent a broader picture of foods compared with individual food items. Single food analyses are likely to be confounded by the effect of dietary pattern, [62]. Therefore, the observed association between dairy products and infertility deserves further studies [18, 32]. Douglas et al reported that women with PCOS consumed significantly more white bread and fried potatoes compared with the control group [49]. The association of caffeine and alcohol consumption with ovulatory infertility has not been identified clearly [28]. However, consumption of 2 or more soft drinks per day may decrease fertility rate independently of caffeine or fructose content of the drinks [22].

Concerning dietary patterns as a complementary approach, a nested case-control study of 485 women with difficulty getting pregnant revealed that adherence to a Mediterranean-type pattern (high in vegetables, fish, fruits, poultry, low-fat dairy products, and olive oil) lowered risk of infertility by 34%. However, greater adherence to the Western-type dietary pattern high in processed and unprocessed red meat, fast food, whole-fat dairy products, commercial bakery, potatoes, eggs, refined grains, sauces, processed meals, and sugar-sweetened soda showed no association with this outcome [32]. These findings were in agreement with a prospective study by Vujkovic et al on couples with fertility problems, which found that Mediterranean diet rich in vegetable oils, vegetables, fish, and legumes, and low in snacks was positively correlated with 40% increase in the probability of pregnancy [33]. Moreover, Chavarro et al defined "fertility diet" score based on monounsaturated to trans fats ratio, vegetable protein, high-fat dairy, iron, and multivitamins. These findings indicated that an increasing adherence to a "fertility diet" pattern in combination with weight control and physical activity was associated with a lower risk of ovulatory infertility [4]. In accordance with these limited data, our findings showed that lower adherence to a Western dietary pattern, high in red meat, processed meats, refined grains, French fries, high-fat dairy products, snacks, starchy sweets, soft drinks, and hydrogenated fats, decrease the risk of ovulatory infertility. Nevertheless, no association was seen between adherence to the healthy dietary pattern (rich in green leafy vegetables, fruits, low-fat dairy products, nuts, fish, poultry, vegetable oils, and whole grains) and infertility. However, the latter bears a close resemblance to the Mediterranean dietary pattern in the studies of Toledo and Vujkovic, which could potentially protect against ovulatory infertility [32, 33]. Possible mechanisms might explain the associations between dietary patterns and ovulatory infertility. It has been reported that some nutrients, including folate, long-chain omega-

3 fatty acids, vitamin B_{12}, and iron, highly found in healthy and Mediterranean dietary patterns, increase ovarian response to gonadotropin, resulting in improved ovulation [63]. Moreover, healthy dietary pattern rich in green leafy vegetables, fruits, low-fat dairy products, nuts, fish, poultry, vegetable oils, and whole grains is correlated with increased red blood cell folate, blood vitamin B_6, and follicular fluid [64]. However, a Western dietary pattern has been associated with an increased risk of insulin resistance and ovulatory dysfunction. Moreover, there is a link between the increased production of reactive oxygen species and female infertility [65].

We observed no statistically significant difference in physical activity level between the two groups, although there is evidence for a beneficial effect of exercise—either alone or in combination with energy restriction—on fitness, hormonal, reproductive, and psychological outcomes in women with PCOS [30, 31]. Because of methodological limitations, determining precise exercise guidelines in this field requires well-controlled randomized studies.

We acknowledge that our study had several limitations. The case-control nature of the study, as well as the multifactorial character of infertility, may have led to misclassification of our participants. Although dietary pattern approach provides a comprehensive analysis by using food items or nutrients which are limited by biological interactions, several challenges in factor analysis include making decision on putting food items into food groups, the number of factors to be extracted, and the labeling of the components [62, 66]. We assessed dietary patterns by using a self-reported FFQ, which is susceptible to measurement errors and the misreporting of habitual energy intake. This study was a hospital-based case-control study. Therefore, the results cannot be generalized to the whole population. Moreover, these findings cannot be generalized to all Iranian population because infertile couples have different social, cultural, and educational backgrounds. It is worth mentioning that this is the first study conducted in relation to dietary patterns and infertility among the Iranian population.

In conclusion, our results suggest that a lower adherence to a Western dietary pattern may enhance fertility. The western dietary pattern has become increasingly popular among Iranian population recently. However, no statistically significant association was seen in relation to healthy dietary pattern and ovulatory infertility. Further well-designed controlled trials are needed to confirm the role of different dietary patterns in fertility outcomes. Given the considerable prevalence of infertility among women of reproductive age, developing dietary guidelines is advocated.

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