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Healthy Eating Index in Patients With Cataract: A Case-Control Study

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Background: Nutritional factors play an important role in cataract disease and the healthy eating index (HEI) is a unique approach to study the relationships between diet and diseases.
Objectives: The current study aimed to evaluate and compare healthy eating index among the patients with cataract and healthy individuals.
Patients and Methods: This case-control study was conducted on 97 patients with cataract and 198 healthy people (as a control group) in Iran. Individuals were selected by the convenience sampling method and the food frequency questionnaire (FFQ) was completed for them. At first, HEI was calculated and then the HEI scores were compared in cataract patients and healthy individuals.
Results: The analysis of FFQ showed that the scores of vegetables (7.81 v. 10), nutritional variation (5.5 v. 7) and sodium (2 v. 6) groups ($P < 0.001$) were significantly lower among the patients with cataract than the healthy individuals. Also this significant difference was observed in the scores of total HEI and fruits (respectively 73.26 v.79.30 and 7.1 v. 9.8) ($P < 0.01$). On the other hand, the scores of saturated fatty acids (10 v. 9; $P = 0.02$), total fat (8 v. 7; $P = 0.004$) and cereals (10 v. 10; $P < 0.001$) were higher among the patients with cataract than the healthy individuals. The comparison of dietary intake among all types of cataract shows that the scores of the meat group were significantly higher in the patients with nuclear cataract and mixed cataract than the ones with posterior cataract (respectively 9.4 v. 6.5 and 9 v. 6.5) ($P = 0.02$). In addition, after adjusting the confounding factors the results showed that the HEI high score was associated with reducing the risk of coming down with cataract (OR = 0.18, CI: 95%, $P < 0.001$, 0.08 - 0.41).
Conclusions: The results of the current study suggest that increasing the quality of the diet calculated according to HEI can reduce the risk of coming down with cataract.

Keywords: Cataract; Nutritional Status; Nutrients

1. Background

Cataract is known as one of the preventable causes of blindness in the world, and 75% of blindness cases in the world are attributed to cataract (1, 2). In Iran 31.7% of blindness cases and 47.5% of severe and chronic visual disorders are attributed to this disease, and in recent years there was a significant increase in the rate of cataract surgery; furthermore, many of these patients had the second surgery (3, 4). Therefore, it is important to identify the risk factors for its prevention and treatment. There are various reasons for developing cataract among people. In previous studies the role of aging, genetics and exposure to UV rays were mentioned. But it is observed that other factors such as environmental factors and metabolic diseases, which were rather ignored, also have a critical role in increasing the risk of cataract. Recent studies show that obesity and overweight have a direct relationship with the risk of cataract (5). Among the environmental factors, diet has an important role, and most of foods can be considered as either protective or risk-making factors to develop cataract. Diet can reduce the risk of cataract by decreasing the oxidative stress or systemic inflammation in various aspects. Studies show that adequate intake of antioxidants (like lutein and xanthine) and multivitamins

have a major effect on prevention and treatment of cataract (6-9). The conducted studies meant to determine the relationship between diet and cataract, revealed contradictory results. The difference in results can be due to different population as well as the method used in such studies. Researchers offer various methods such as healthy eating index (HEI) to evaluate dietary patterns. In 1995 the HEI was designed to examine the overall quality of diets and their conformity and concordance with food guides and food pyramid (10). This index was determined in order to evaluate diet quality in different societies with different dietary diversity and specific patterns in each community. Since most studies on the effect of dietary factors and their relationships with the risk of cataract had been done in European and American countries (11), the present study was conducted to investigate the relationship between HEI with the risk of cataract based on a case-control study among people over 40 years old in Tehran. (Ethic code: 051525,12.10.2013)

2. Objectives

The current study aimed to evaluate and compare HEI among the patients with cataract and healthy individuals.

3. Patients and Methods

3.1. The Study Population

In the current study that employed convenience sampling method people in the case and control groups were respectively selected among people referring to Farabi (ophthalmology teaching hospital, with 220 beds and 10 sections) and Shariati hospitals in Tehran considering the inclusion and exclusion criteria. Since in a similar study on the relationship between cataract and vitamin C the Odds Ratio was equal to 0.5, sample size was calculated using the following method:

(1) $$C = \frac{\text{Control}}{\text{Case}} = \frac{2}{1}, P_1 = 0.68, \text{OR} 0.5$$

(2) $$P_2 = \frac{P_1 \times \text{OR}}{1 + P_1(\text{OR} - 1)}, P_2 = 0.51$$

(3) $$P = \frac{P_1 + P_2}{2}$$

(4) $$\text{Neach Group} = \frac{\left(1 + \frac{1}{c}\right) \times \left(Z_{1-\beta} + Z_{1-\frac{\alpha}{2}}\right)^2 \times P(1-P)}{(P_1 - P_2)^2}, \alpha = 0.05, Z_{1-\frac{\alpha}{2}} = 1.96, \beta = 0.2, Z_{1-\beta} = 0.84$$

Based on the above formulas, a total of 202 controls and 101 cases were included. At the end of the study, eight persons from cases and controls whose daily intake calories was lower than 702 kcal or higher than 5016 kcal, were excluded from the study. The inclusion criteria for the case group were: it should not exceed one month since the diagnosis of the cataract, detection of cataract at least in one of the two eyes, the eyesight should be less than 0.6, and being in the age range of above 40 years. The inclusion criteria for the control group were: non-hospitalized or hospitalized patients without cataracts, being in the age range above 40 years, and the degree of eyesight less than 0.6. The exclusion criteria for the case and control groups were: catching other eye diseases (cataract for the control group), being on a special diet one year before the interview, a history of previous eye injury, and the history of radiation therapy or eye surgery.

The control group was matched according to age (with a five-year interval) and gender with the case group. Therefore, in each age and gender group the number of people in the control group was twice. The required information regarding age, family history of cataract, heart disease, hypertension, hyperlipidemia, arthritis, diabetes, smoking, alcohol consumption, physical activity, past consumption of vitamin C and multivitamin supplement, corticosteroids, oral contraceptives, estrogen therapy as well as the number of hours exposing to sunlight and using special equipment against the sun was obtained through face to face interviews. The weight of each subject was measured with minimum clothing, and 100g sensitivity and height by a tape and the sensitivity of 0.1 cm.

3.2. Dietary Assessment

The usual dietary intake of individuals in the previous year (for the case group a year before the diagnosis of the disease and the control group a year before the interview) was collected by the interviewer using the valid and reliable food frequency questionnaire (FFQ) (12-14). This questionnaire included 147 foods and the food consumption frequency of each nutrient is determined per day, week, month, or year. The mentioned amount of each nutrient was converted into gram using household scale guide and the amount of each nutrient consumed per day in grams was measured for each person (15). Calories and sub nutrients for all food items were calculated using food ingredient table United States department of agriculture (16, 17). Then the data were transferred into SPSS software. Dietary factors examined in the study included total fat, grains, dairy, meat, fruit and vegetable, saturated fatty acids and cholesterol intake. At the end of the study eight persons (four from each group), who consumed daily

calories less than 702 kcal or more than 5016 kcal, were excluded from the study.

All served nutrients were converted into serving pyramid using a food guide pyramid and were assessed based on the healthy eating index (HEI). This index was designed by Kennedy et al. based on the food guide pyramid and dietary guidelines (18). This index is composed of 10 components with the Likert scale from 0 to 10. The scores assigned for the consumption degree of each five food groups (vegetable, fruits, grains, milk and meat) were calculated based on the recommended serving food pyramid. The way to score the fat was considered as follows: the individuals, whose total intake energy contained up to 30%fat, received the highest score (10) and the ones that fat formed 45% or more of their total calories, were considered as minimum point (zero); the calculation method of saturated fatty acids was as follows: score of 10 for people whose total intake energy included 10 or less saturated fatty acid; and zero for the ones that saturated fatty acid formed 15% or more of their total energy. Receiving less than 300 mg/dL cholesterol obtained 10 scores and the intake of 450 mg/dL cholesterol or more was considered as a zero score. Sodium intake less than 2400 mg/dL obtained the highest score (10) and receiving 4800 mg/dL or more the minimum score (zero). The degree of diversity was calculated based on the McCullough method (10). Antioxidant and vitamin supplements consumption were interrogated.

3.3. Statistical Methods

Statistical analyses were conducted using SPSS version 19.0 (SPSS Inc., Chicago, IL, USA). Normal distribution of quantitative data was measured by the Kolmogorov-Smirnov test and normal distribution of qualitative data was measured by the Chi-square test. Due to the lack of normal distribution of the data, nonparametric tests were employed. To compare differences between the case and control groups, Wilcoxon and McNemar tests were used for continuous variables and categorical variables, respectively. To compare differences between the subgroups, the Kruskal-Wallis test was used. Logistic regression was used to evaluate the relationship between HEI score and cataract, with the individuals in the lowest quartile of HEI as the reference category. A P for trend was calculated using logistic regression and the median of HEI in each quartile as the independent variable. The study also adjusted the impact of confounding factors such as age (four age groups: 40 - 50 years, 50 - 60 years, 60 - 70 years and 70 > years), gender (male and female), education (four categories: uneducated, primary, junior high school, high school, and higher), cataract family history, body mass index (BMI) (four categories: underweight, normal, overweight, and obese), energy intake, physical activity and history of diabetes, and hypertension for the subjects.

4. Results

Table 1 presents baseline characteristics of 97 patients with cataract as cases and 198 controls. Prevalence of age-related cataract in males and females was 34% and 66%, respectively. In short, the case and control groups matched in terms of gender, and age; however they indicated significant differences in BMI, education, family history of cataract, diabetes, blood pressure, physical activity, use of special equipment in front of sunlight, and education ($P < 0.05$).

Table 2 shows HEI scores, and components of 97 patients with cataract as the case and 198 healthy individuals as the control groups. Total HEI score ($P = 006$), vegetable score ($P < 0.001$), fruit ($P = 003$), sodium ($P < 001$) and diversity scores ($P < 001$) were significantly higher in the control group than the case group. On the other hand, cereals ($P < 0.001$), total fat ($P = 0.004$), and saturated fatty acids ($P = 0.02$) scores were significantly lower in the control group than the case group. Table 3 compared total HEI and its components in three subgroups of patients (nuclear cataract, mixed cataract, and posterior cataract). Two subgroups of nuclear cataract, and mixed cataract had higher scores of the meat group ($P = 0.02$). However, no significant differences existed between the three subgroups of patients in the overall scores and other components. Table 4 indicates the risk of cataract disease in four categories of HEI points. After adjusting the variables such as age, gender, BMI, energy intake, the risk of cataract disease with an increasing HEI score reduced from the lowest to the highest quarter (OR = 0.19; CI: 95%; $P < 0.001$ (0.09 - 0.40)). After adjusting the additional confounding variables such as hypertension, family history of cataract, diabetes, education, and physical activity, the observed relationships between the HEI score and reduced risk of cataract did not change (OR = 0.18 CI: 95%; $P < 0.001$ (0.08 - 0.41)).

Table 5 shows five main food groups of the pyramid and their daily consumed units in the control group and the three groups of patients. The control group, compared with the case group (separated by the three types of cataract), had consumed the greatest amount of the vegetable group ($P < 0.001$), fruit group ($P < 0.001$), dairy group ($P = 0.01$) per day. Further analysis by two comparisons between the groups in a bimodal manner indicated no significant difference between the three subgroups of the case group regarding their consumption. But two by two comparison between the control group and the three subgroups of the case group showed significant differences.

Table 1. Baseline Characteristics of the Case and Control Groups [a,b]

Characteristics	Case Group [c]	Control Group [d]	P Value [e]
Energy intake, kcal	2850 (2354 - 3220)	2728 (1256 - 4291)	0.41
Age group, y			0.95
40 - 50	25 (25.8)	50 (25.3)	
50 - 60	36 (37.1)	79 (39.9)	
60 - 70	28 (28.9)	52 (26.3)	
> 70	8 (8.2)	17 (8.6)	
Gender			0.86
Male	33 (34)	67 (33.8)	
Female	64 (66)	131 (66.2)	
BMI, kg/m^2			0.001
< 18.5	0 (0)	1 (5)	
18.5 - 25	28 (28.9)	101 (51)	
25 - 30	37 (38.1)	64 (32.3)	
> 30	32 (33)	32 (16.2)	
Education			< 0.001
Non	42 (43.3)	29 (14.6)	
Primary school	23 (23.7)	69 (34.8)	
Secondary school	17 (17.5)	39 (19.7)	
Higher education	15 (15.5)	61 (30.8)	
Cataract family history			0.001
Yes	53 (54.6)	81 (40.9)	
No	44 (45.4)	117 (59.1)	
Hypertension [f]			0.001
Yes	53 (54.6)	81 (40.9)	
No	44 (45.4)	117 (59.1)	
Smoking status			0.28
Never	81 (83.5)	178 (80.9)	
Before	2 (2.1)	3 (0.5)	
Current	14 (14.4)	17 (8.6)	
Diabetes [g]			< 0.001
Yes		23 (11.6)	
No	27 (27.8)	175 (88.4)	
Physical activity [h]	70 (72.2)		0.04
Inactive	83 (85.5)	140 (70.7)	
Active	14 (14.4)	58 (29.3)	
Regular use of vitamin C supplement			0.08
Yes	12 (12.4)	16 (8.1)	
No	85 (87.6)	182 (91.9)	
Post-menopausal			0.50
Yes	55 (83.3)	97 (72.9)	
No	11 (16.7)	36 (27.1)	
Ever used oral contraceptives			0.11
Yes	13 (13.4)	27 (13.6)	
No	84 (86.6)	171 (86.4)	
Use of equipment [i]			0.01
Yes	9 (9.3)	57 (28.8)	
No	88 (90.7)	141 (141)	

[a] Abbreviation: BMI: body mass index.
[b] Data are presented as median (IQ: 25 - 75) or No. (%).
[c] Data are presented for N = 97.
[d] Data are presented for N = 198.
[e] P values of the comparison between groups, using Wilcoxon or McNemar tests.
[f] Hypertension defined as systolic blood pressure > 160 mmHg or diastolic blood pressure > 100 mmHg or the use of antihypertensive medication.
[g] Diabetes defined as fasting blood glucose > 126 mg/dL.
[h] Physical activity ≥ 3 times/per week and each time > 30 minutes.
[i] Use of sun glasses or hats in front of the sun.

Table 2. A Comparison Between the Case and Control Groups Based on Scores of the Healthy Eating Index (HEI) and Its Components [a,b]

	Case Group [c]	Control Group [d]	P Value [e]
Total HEI	73.26 (65.6 - 79.5)	79.30 (71.8 - 85.0)	0.006
Meat	7.79 (6.2 - 10.0)	8.66 (6.3 - 10.0)	0.55
Vegetable	7.81 (5.4 - 10)	10 (9.27 - 10.0)	< 0.001
Grain	10 (10.0 - 10.0)	10 (9.3 - 10.0)	< 0.001
Dairy	8.9 (6.09 - 10)	10 (7.59 - 10.0)	0.15
Fruit	7.1 (4.3 - 9.3)	9.8 (7.2 - 10.0)	0.003
Total fat	8.0 (4.0 - 10.0)	7.0 (3.0 - 10.0)	0.004
Cholesterol	10.0 (8 - 10.0)	10.0 (7.75 - 10.0)	0.69
Saturated fatty acid	10.0 (9.0 - 10.0)	9.0 (7.0 - 10)	0.02
Sodium	2.0 (2.0 - 6.0)	6.0 (3.0 - 8.0)	< 0.001
Variety	5.5 (4.5 - 6.5)	7 (6.0 - 8.0)	< 0.001

[a] Abbreviation: HEI: healthy eating index.
[b] Data are presented as median (IQ: 25 - 75).
[c] Data are presented for N = 97.
[d] Data are presented for N = 198.
[e] P values of the comparison between groups, by Wilcoxon test.

Table 3. A Comparison Between Types of Cataract Based on Scores of the Healthy Eating Index (HEI) and Its Component [a,b]

	All Types [c]	Nuclear Cataract [d]	Posterior Cataract [e]	Mixed Cataract [f]	P Value [g]
Total HEI	73.2 (65.6 - 79.5)	75.09 (68.6 - 79.2)	70.1 (60.9 - 80.5)	67.8 (62.5 - 78.9)	0.33
Meat	7.7 (6.2 - 10.0)	9.4 (6.6 - 10.0)	6.5 (5.4 - 9.9)	9.0 (7.3 - 10.0)	0.02
Vegetable	7.8 (5.4 - 10)	7.4 (5.5 - 10)	9.0 (5.2 - 10.0)	7.4 (5.3 - 9.5)	0.68
Grain	10 (10.0 - 10.0)	10.0 (10.0 - 10.0)	10.0 (10.0 - 10.0)	10.0 (9.4 - 10.0)	0.58
Dairy	8.9 (6.09 - 10)	9.7 (6.5 - 9.7)	8.1 (4.5 - 10.0)	8.1 (5.0 - 10.0)	0.17
Fruit	7.1 (4.3 - 9.3)	9.7 (6.5 - 9.7)	6.8 (3.7 - 8.9)	5.9 (3.8 - 10.0)	0.40
Total fat	8.0 (4.0 - 10.0)	8.0 (6.0 - 10.0)	7.0 (3.0. - 10.0)	6.0 (1.5 - 8.5)	0.07
Cholesterol	10.0 (8 - 10.0)	10.0 (10.0 - 10.0)	10.0 (9.0 - 10.0)	10.0 (8.0 - 10.0)	0.29
Saturated fatty acid	10.0 (9.0 - 10.0)	10.0 (10.0 - 10.0)	10.0 (9.0 - 10.0)	9.5 (8.2 - 10.0)	0.11
Sodium	2.0 (2.0 - 6.0)	10.0 (0.0 - 6.5)	3.0 (0.0 - 10.0)	3.0 (0.0 - 6.75)	0.55
Variety	5.5 (4.5 - 6.5)	5.5 (50. - 6.0)	5.0 (4.0 - 6.7)	5.0 (4.0 - 6.0)	0.28

[a] Abbreviations: HEI: healthy eating index.
[b] Data are presented as median (IQ: 25 - 75).
[c] Data are presented for N = 97.
[d] Data are presented for N = 44.
[e] Data are presented for N = 37.
[f] Data are presented for N = 16.
[g] P values of the comparison between sub groups, by Kruskal Wallis test.

Table 4. Odds Ratio and 95% Confidence Interval of Cataract According to Quartiles of the Healthy Eating Index [a]

	T1	T2	T3	T4	P Value for Trend
Case/control [b]	40/33	23/55	20/55	14/60	
Crude	1.00	0.38 (0.19 - 0.40)	0.28 (0.14 - 0.57)	0.19 (0.95 - 0.41)	< 0.001
Model 1 [c]	1.00	0.38 (0.19 - 0.74)	0.30 (0.15 - 0.59)	0.19 (0.09 - 0.40)	< 0.001
Model 2 [d]	1.00	0.39 (0.19 - 0.80)	0.27 (0.13 - 0.57)	0.18 (0.08 - 0.41)	< 0.001

[a] Abbreviations: T1: Quarter 1, T2: Quarter 2, T3: Quarter 3, T4: Quarter 4.
[b] Data are presented for 97/198.
[c] Adjusted for age, gender, BMI, and energy intake.
[d] Adjusted for age, gender, BMI, energy intake, physical activity, diabetes, education, hypertension and cataract family history.

Table 5. Intake of Food Groups Among the Subgroups of the Case Group Compared With Those of the Healthy Group [a]

Food Group [b]	Control [c]	Case [d]			P Value [e]
		Nuclear Cataract [f]	Posterior Cataract [g]	Mixed Cataract [h]	
Grain	9.8 (7.5 - 13.2)	13.2 (10.6 - 15.2)	12.5 (9.1 - 15.3)	11.5 (8.8 - 12.6)	0.2
Vegetable	4.07 (3.3 - 4.5)	2.4 (1.9 - 3.0)	2.8 (2.1 - 4.0)	2.4 (1.7 - 3.8)	< 0.001
Fruit	2.8 (1.9 - 3.7)	2.0 (1.4 - 2.7)	1.8 (1.0 - 2.5)	1.6 (1.1 - 2.7)	< 0.001
Dairy	2.0 (1.5 - 2.5)	1.9 (1.3 - 2.6)	1.6 (0.9 - 2.3)	1.6 (1.0 - 2.0)	0.01
Meat	1.6 (1.2 - 2.1)	1.7 (1.1 - 2.4)	1.2 (0.96 - 1.8)	1.7 (1.0 - 2.3)	0.08

[a] Data are presented as median (IQ: 25 - 75).
[b] Data are presented as serving/day.
[c] Data are presented for N = 198.
[d] Data are presented for N = 97.
[e] P values of the comparison between sub groups, by Kruskal Wallis test.
[f] Data are presented for N = 44.
[g] Data are presented for N = 37.
[h] Data are presented for N = 16.

5. Discussion

The results of the current research showed that being on a diet according to the food guide pyramid and the healthy eating index (HEI) is correlated with the reduced risk of cataract. Among the HEI components, the scores of fruits, vegetables, sodium and food diversity in the patients with cataract were lower than those of the control group but scores of cereals, total fat and saturated fatty acids were higher than control group. In addition, the subgroup comparison among all types of cataract (mixed, posterior, and nuclear) showed that HEI score for meats in posterior cataract was lower than the other.

The current study findings indicated that high intake of fruits and vegetables reduces the risk of cataract; therefore, they confirm the results of previous studies (19-22). In a case-control study carried out recently, a significant inverse relationship was observed between fruit (OR = 0.69; P < 0.001) and vegetable (OR = 0.47; P < 0.001) consumption with the risk of cataract (23). Also through a cross-sectional study in 2013, Pastor-Valero et al. (24) found that receiving high amounts of fruit and vegetable, reduces the risk of cataract (P for trend = 0.008). In a prospective Cohort study (females healthy study) Christen et al. investigated the association between fruit and vegetable consumption with the incidence of cataract, and found that females receiving highest amount of fruit and vegetable quintile (10 units in a day) compared with the lowest receiving quintile (3.6 unit in a day) were 10% to 15% less susceptible to cataract (21). The inverse relationship between the fruit and vegetable consumption and the risk of cataract may be due to high content of dietary antioxidants. The results of a study by Moeller et al. (22) showed that the consumption of whole grains can reduce the opacity of the lens. There are limited studies on the relationship between the grains and cataract, and they have mainly focused on the effect of carbohydrates. Chiu et al. (25) found that people receiving the highest amount of carbohydrates were more at risk of cortical cataract than the ones receiving the lowest amount of carbohydrates (OR = 3.19; P trend = 0.017). Increased and decreased risks of cataract are reported in some studies regarding receiving high amount of carbohydrates, but not in most of the studies (26-28). In the present study a reverse relationship was observed between total fat, saturated fatty acids and cataract. Studies on the fat consumption associated with cataract are unclear. In some studies a positive correlation was observed between total fat and cholesterol (23) and some other denied this relationship (29). On the other hand, in a cohort study Lu et

al. (30) found a strong positive relationship between receiving polyunsaturated fatty acid (PUFA) and the risk of cataract (P trend = 0.02; OR = 2.3). Since PUFA tends to become oxidized, high concentration of these fatty acids in the membranes of eye lens may have similar pathological effects on the like other tissues (31).

In the current study, meat consumption was concerned to the risk of taking nuclear and mixed cataract. The result of a study that investigated the relationship between the risk of cataract and vegetarian diet was inconsistent with the results of the current study and showed that the restricted vegetarian diet can increase the risk of age-related cataract (32). On the other hand, Appleby et al. investigated the relationship between cataract and eating diet. In the current study a strong correlation was observed between diet and the risk of cataract. The result of the study showed that the risk of cataract among females and males who consumed high levels of meat and dairy products (more than 100g per day) was higher than vegetarian and people who consumed less meat than the others (27). In addition, a case-control study conducted in India showed that consumption of animal foods in the patients with cataract was significantly more than the healthy subjects (33). The existence of all types of known antioxidants (such as lutein and zeaxanthin) in plant sources causes a protection against cataract. It can be observed as one of the protective roles of vegetarian diet as opposed to the rich meat diet (34). The study concluded that the score of receiving sodium in patients with cataract was significantly lower than those of the healthy individuals, and that patients with cataract receive higher amounts of sodium. In this context the study result s were consistent with those of the other studies. A cross-sectional study conducted in Australia showed that higher sodium intake is associated with greater risk of posterior subscapular cataract (35). In general the nutritional factors can affect the prevention and incidence of cataract; therefore, nutrition education, which can be considered as an effective way to increase the awareness of individuals in order to follow a healthy diet (36), is recommended.

The appropriate sample size and careful selection of people using slit lamp, using a valid questioner and the validated questionnaires and reviews of the role of nutritional agents in all types of cataract can be noted as the strengths of the study. On the other hand, the lack of review of mechanisms justifying the relationship between diet and cataract, lack of attention to the race of people and the amount of receiving food antioxidants associated with cataract are considered as the study weaknesses.

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Authors' Contributions

Study concept and design: Matin Ghanavati; acquisition of data: Damoon Ashtary Larky; data analysis and interpretation, manuscript drafting and critical revision of the manuscript for important intellectual content: Meysam Alipour; statistical analysis: Maryam Behrooz; administrative, technical, and material support: Seyed Davood Zameni; study supervision: Bahram Rashidkhani.

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The funding organizations are public institutions and had no role in the design and conduct of the study; collection, management, and analysis of the data; or preparation, review, and approval of the manuscript.

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