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Relationship Food Consuming Oxidative Stress and Antioxidant with Female Infertility: A Case-Control Study "Food Oxidative Stress and Antioxidant Stress and Infertility"

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ABSTRACT

Background: Infertility with an unknown cause in women has increased and the lifestyle of people has changed.

Objective: This plan was conducted with the aim of studying and comparing the use of nutrient factors in fertile and infertile women.

Materials and Methods: This case-control study was conducted between may 2014 to January 2018 years at the Yazd Infertility Center, in this study 200 samples in the case group (infertile women) and 400 samples in the control group (fertile women) were selected by random sampling. The data collection tool was a valid and reliable questionnaire.

Results: The mean (±SD) age of fertile women was 28.06 (±0.23) years and that of infertile women 29.04 (±0.35) years. Consumption of chips and puffs, sausages, grilled foods, reuse of oil, green tea, coffee and exposure to cigarette smoke and hookah was significantly different in two groups.

Conclusion: In this study, consumption of foods including chips and puff, sausages, grilled foods, re-use of oils and exposure to cigarette smoke and hookah were associated with infertility and antioxidants such as coffee and green tea were associated with fertility, It is suggested that proper nutrition education is given to couples Infertile should be considered.

KEYWORDS: Nutrition, Oxidative stress, Antioxidant, Infertility

INTRODUCTION

Infertility refers to the failure to get pregnant despite at least one year of unprotected sex, indicating a decline in the ability to conceive and reproduce [1]. A research project conducted by Ibn Sina Research Institute of University Jihad has shown that the incidence rate of infertility across Iran is 20.2%, which is much higher than the global average (12%-15%). According to the WHO, if the infertility rate is 10%-15% across the world, Iranian couples account for about 2-3 million of the infertility cases [2]. Epidemiological studies have reported the most recent incidence rate of idiopathic infertility as being 10% [3]. Oxidative stress is a condition associated with increased cell damage caused by known oxygen oxidants, and more frequently reactive oxygen species (ROS). All living aerobic cells are normally exposed to a background level of oxidative stress. Different stressful conditions such as chronic diseases, aging, and exposure to detoxification, physical injury, and consumption of various types of foods can increase the

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oxidative process and cause cell damage [4]. Studies have shown that nutrition is associated with infertility, and certain foods can disrupt the balance of substances and reactions (e.g., oxidative stress) in the body, which can lead to the destruction of the body's systems and develop infertility [5,6]; Antioxidant supplements can be effective in controlling the development of oxidative stress, remaining a potential strategy to overcome reproductive disorders associated with infertility [7]. It seems that diets rich in fruits and vegetables contain antioxidants, and are recommended to be used in efforts to prevent diseases [8]. Oxidative stress-inducing nutrients also include nitrite, caffeine, cigarette, and carbonated drinks. in a study to investigate the relationship between female infertility and caffeinated beverage consumption, the risk of infertility due to Uterine tubes diseases or endometriosis was observed to substantially increase due to increased caffeine consumption [9]. However, women play a very important role in fertility, with smoking and alcohol drinking being known to reduce fertility in women. The use of vitamin supplements and antioxidants is effective to increase fertility, but pregnancy studies via assessing nutrients and collecting biological samples before ovulation are necessary to determine the time of conception and early delivery [10]. Therefore, the present study was conducted to investigate oxidative stress-inducing and antioxidant nutrients in fertile and infertile women.

MATERIALS AND METHODS

The present case-control study was conducted in two groups of women, namely, fertility and infertility, between May 2015 and January 2018. To this end, 200 women with idiopathic infertility referred to the Yazd Fertility Center as case (infertility) group and 400 healthy women referring to health care centers in Yazd as control (fertility) group were selected by convenience, random sampling method. A fertility fellowship was asked to comment on infertility in the case group, and the dietary habits of the two groups were compared before treatment.

The sample size was calculated by assuming a test power of 80%, an odds ratio of 1.5%, according to a previous study [4], and the incidence rate of 10%.exclusion criteria for the case group included infertility with a history of the metabolic disease and taking supplements and minerals in the last year.

All participants in the fertility group were randomly selected from among the women referring to health care centers in Yazd who had at least one child without a history of infertility. The two groups were matched for age, and the control group did not suffer from any specific disease. The demographic characteristics of the subjects included in data analysis were age, occupation, duration of marital life, marriage age, fertility history, medication, weight, and height.

Participants' weights were measured with the scale (Seca), (Measurement accuracy: 155 g) and heights by using a tape measure in standing position beside the wall (Measurement accuracy: 1 cm). BMI was calculated by the division of weight (kg) by the square of height (m^2) [11,12]. Data on intake of common nutrients were gathered by interviewing participants using the Food Frequency Questionnaire whose reliability and validity have been confirmed in previous studies [13, 14]. The questionnaire contains 147 food items to obtain information on how many times per day, week, month, or year the specified foods are consumed. The items were answered by interviewing participants.

Statistical Analysis

Finally, data analysis was carried out by the using the chi-square, t-test and logistic regression. Significance level (P) was considered <0.05. Eg: Statistical Package for the Social Sciences, version 11.0, SPSS Inc, Chicago, Illinois, USA (SPSS).

Ethical considerations

All participants were assured that all of the information would be kept confidential and filled out an informed consent form to participate in the study. The present study protocol was approved at the Yazd Fertility Center (Research Project Code: 3907, Ethics Code: 443).

RESULTS

The mean (±SD) age of fertile women was 28.06 (±0.23) years and that of infertile women 29.04 (±0.35) years. The two groups were matched for the number of miscarriages, age and BMI. No significant relationship between age and BMI was observed in the two groups. **Table 1** shows the mean (±SD) values of quantitative variables in the case and control groups. The majority of women in both groups (89% of the case group and 79% of the control group) were housewives. Most women in both groups (58.50% of the case group was 80.50% of the control group) had a high school diploma. Among the demographic characteristics, education level was significantly associated with infertility (P=0.01). Out of illiterate participants, 81% were fertile and 19% had idiopathic infertility, and out of literate ones, 45% were fertile. Employment was significantly associated with infertility (P=0.01).

Out of housewives and unemployed women, 69.3% were

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fertile and 30.6% had idiopathic infertility, and out of employed women, 52% were infertile; therefore, the incidence of infertility was higher in employed women. The history of exposure to cigarette and hookah smoke was significantly associated with infertility (P=0.02). Out of the women who had exposure to cigarette and hookah smoke, 42.10% were fertile, and out of women who did not, 73.90% were fertile. The incidence of infertility was higher in the women with exposure to cigarette and hookah smoke.

Table 1: Mean (± standard deviation) values of qualitative variables in case and control group.

Studied Group	Case (infertile)	Control (fertile)	Test Result
Variables	Mean (±SD)	Smean (±SD)	
Age	29/04 ± 0/35	28/06 ± 0/23	P=0.66
BMI	26/00 ± 0/27	26/09 ± 0/23	P=0.36
Abortion Number	0/26 ± 0/54	0/33 ± 0/35	P=0.28
*t-test. BMI: body mass index			

Regarding the nutrients consumed, consumption of chips and puff, sausages, grilled foods, and used fry oil was significantly associated with infertility. **Table 2** shows the absolute and relative frequency distribution of the foods consumed by fertile and infertile women.

Table 2: The absolute and relative frequency distribution of foods consumed by fertile and infertile women.

Food consumption Status		Daily		Weekly 2 to 3 times		Monthly 2 to 3 times		Once a month		Rarely		P value
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Chips and puffs	Infertile	4	66/70	22	35/50	53	41/10	71	33/60	50	26/00	0/04
	Fertile	2	33/30	40	64/50	76	58/90	140	66/40	142	74/00	
Re-use of an oil	Infertile	10	66/70	22	71/00	18	32/10	150	30/10	0	0	0.01
	Fertile	5	33/30	9	29/00	38	67/90	348	69/90	0	0	
Grilled Food	Infertile	0	0/00	17	48/60	53	44/90	86	30/20	44	27/30	0.02
	Fertile	1	100	18	51/40	65	55/10	199	69/80	117	72/70	
Sausages	Infertile	4	57/10	16	45/70	36	43/40	46	25/30	98	33/40	0/01
	Fertile	3	42/90	19	54/30	47	56/60	136	74/70	195	66/60	
*chi-square												

The consumption of food and hot liquids in plastic and disposable containers, cooking in Teflon containers, and consuming cooked foods that were kept outside the refrigerator for more than one day and smoked foods such as smoked fish were not significantly different between the two groups. Out of the beverages, the consumed amounts of green tea, and coffee were significantly associated with infertility and the consumed amounts of carbonated drinks, regular tea were not significantly different between the two groups. **Table 3** shows the absolute and relative frequency distribution of the beverages consumed by fertile and infertile women, and **Table 4** shows the absolute and relative frequency distribution of the antioxidant beverages consumed fertile and infertile women.

There was no significant relationship between the consumption of antioxidants, including fruits and vegetables, and infertility. The P value for vegetable consumption was 0.13 and the P value of fruit consumption was 0.25.

DISCUSSION

Given the increased number of infertile women for unknown reasons and life-style changes in the people, this study was conducted to comparatively investigate the use of dietary risk factors in fertile and infertile women.

In this study, which examined the history of consumption of various types of nutrients, consuming all studied foods, including chips and puff, sausages, grilled foods, and used fry oil was significantly associated with infertility. To our knowledge, no study has yet been conducted to investigate the association of food items with infertility, strongly demonstrating that foods such as puffs and chips, sausages, grilled foods, and used fry oil contribute to developing oxidative stress. However, studies that examined the diets associated with high fertility (15), have suggested. Lower consumption of trans and Oxidative fats, animal protein, and high-fat foods, and higher consumption of vegetables, fiber, and low-glycaemic index carbohydrates, and consumption of non-heme iron, and multivitamins; and more adherence to dietary regimen is associated with reduced risk of ovulatory dysfunction. In general, the risk of infertility and ovarian disorders decreases with increasing numbers of low-risk lifestyle habits. Low-risk lifestyle is considered to include an appropriate diet, maintaining BMI between 20 and 24.90, and physical activity, but the constituents of diet have more marked effects than other factors. In order to precisely explain

Table 3: The absolute and relative frequency distribution of the beverages consumed by fertile and infertile women.

Food Consumption Status		4 to 6 Cups Per Day		Daily 2 to 3 Cups		Daily 1 Cup		2 to 3 Cups Per Week		1 to 2 Cups Per Month		Never		P Value
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Regular Tea	Infertile	40	36/40	75	31/40	47	32/00	28	45/20	6	30/00	4	18/20	0/20
	Fertile	70	63/60	164	68/60	100	68/00	34	54/80	14	70/00	18	81/80	
Carbonated Drinks	Infertile	4	50/00	10	41/70	12	42/90	43	25/70	87	37/30	44	31/40	0/10
	Fertile	4	50/00	14	58/30	16	57/10	124	74/30	146	62/70	96	68/60	
*chi-square														

Table 4: The absolute and relative frequency distribution of antioxidant beverages consumed by fertile and infertile women.

Food Consumption Status		4 to 6 Cups Per Day		Daily 2 to 3 Cups		Daily 1 Cup		2 to 3 Cups Per Week		1 to 2 Cups Per Month		Never		P value
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Green Tea	Infertile	2	50/00	2	25/00	4	40/00	19	24/40	38	25/30	215	70/60	0/02
	Fertile	2	50/00	6	75/00	6	60/00	59	75/60	112	74/70	135	38/40	
Coffee	Infertile	0	0	2	66/70	4	57/10	10	38/50	56	41/50	301	70/80	0.03
	Fertile	0	0	1	33/30	3	42/90	16	61/50	79	58/50	128	20/20	
*chi-square														

the relationship between these nutrients and infertility, further laboratory studies should be carried out.

In this study, there was a significant correlation between consumption of coffee and green tea and fertility, other studies have also shown the antioxidant properties, green tea and coffee [6-18]. Especially, green tea has been reported as one of the most active strong antioxidants, whose unique feature is related to catechins that can potentially improve the reproductive system's health. This deserves further investigation [19].

We observed no significant relationship between consumption of fruit and vegetable and infertility. This may be due to differences in the amount of intake per day or exposure to other oxidative stress-inducing factors in women with idiopathic infertility. In a similar study on the effect of the consumption of fruits and vegetables on infertility, the consumption of fruits and vegetables was not generally associated with the semen quality parameters but was related to the residual toxins [20]. This confirms that other factors may also interfere with the use of the antioxidant substance, and also the way and quality of the product consumption.

Today, antioxidant therapies with pharmaceutical supplements including vitamin C, vitamin E, selenium, zinc, glutathione, L-Carnitine and N-acetyl cysteine are being studied for reduction of oxidative stress in sex and reproductive organs; however, since there is no precise evidence on dosages of the supplements or other side effects of the drugs [21], it is recommended to examine dietary therapies.

Based on the results of the study, among the demographic characteristics, occupation and education level were found to be associated with infertility, which is consistent with other studies [22,23]. Studies have shown that students experience the highest academic pressure, and the levels of stress are comparatively higher in women than in men [24]. Since stress relief during infertility treatment can also change the outcome of the treatment [25], it can be argued that employed and educated women are more likely to be infertile due to experiencing higher levels of stresses. In addition, there was no significant relationship between age and infertility, but recent studies have reported age and weight are associated with infertility, so that increasing age and weight leads to an increase in infertility [26, 27]. Probably, with increasing age, oocytes are exposed to harmful environmental factors for longer durations, and also the characteristics of semen decline, but it has been reported that generally, age progression is not the main cause of infertility [28]. The present study showed a positive correlation between smoking and exposure to cigarette smoke, and infertility, which is consistent with other studies. Smoking directly induces oxidative stress in men

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and therefore causes sperm motility disorder and infertility [29]. Besides, chronic exposure to cigarette smoke leads to stable oxidative stress, and the transcription of the GCLC gene significantly increases in exposed cells, and high oxidative stress is one of the effective factors in developing infertility [30].

CONCLUSION

In this study, consumption of certain foods such as chips and puff, sausages, grilled foods, and used fry oil, exposure to cigarette and hookah smoke, and drinking carbonated drinks, tea, and the antioxidant substances coffee and green tea were associated with infertility. Given that infertility can be prevented by quitting consumption of certain nutrients, appropriate nutrition and lifestyle are recommended to prevent infertility.

Conflict of Interest

The authors declare that they have no competing interests.

Limitations

1. The limitations of the current study include lack of differentiating causal and associated factors and potential recall bias due to the retrospective design of the study in which participants were asked to recall the consumption of nutrients with a self-report tool.

2. Investigating the relationship between the mentioned foods in the manuscript and fertility and infertility status of women should be calculated by calculating the frequency of food intake per day or per week.

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