

ORIGINAL RESEARCH

Diet and Women Fertility: A Descriptive Cross-sectional Study

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ABSTRACT

Aims: This work was designed to assess the role of diet and dietary habits on women fertility.

Materials and methods: This study was carried out in seven different centers and hospitals in Baghdad in the period between January and September 2014. Participants were 400 adult women selected conveniently; their age ranged from 17 to 47 years and they were divided into two groups. Group I included 300 fertile women and group II included 100 infertile women. A specific questionnaire had been designed and used for data collection.

Results: It was found that there was a significant difference in weight and body mass index (BMI) between the infertile group and control group. The mean of weights was 73.07 vs 69.06 kg for infertile and the control group respectively, while the mean BMI was 28.83 vs 26.70 for the infertile group and the control group respectively. Moreover, the infertile women consumed more of carbonated beverages, tea, chicken, and fish than the control group, while they consumed less milk and red meat than the control group. Also, the infertile group consumed less corn oil and olive oil than the control group (5 and 0% vs 21 and 2%) respectively, while they used to consume more solid fat and combined fat than the control group (2 and 6% vs 0 and 2.7%) respectively.

Conclusion: Although treatment options for infertility are available, their high cost and frequency of adverse events have motivated the identification of dietary factors related to infertility. The current study identified diet as one of the modifiable risk factors that potentially impacts fertility in the selected groups; hence, it is important to focus more on the role of diet in women fertility and increase the awareness of women to it, along with suggesting more educational programs at the primary health care level.

Keywords: Body weight, Case-control study, Diet, Infertility.

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INTRODUCTION

Infertility is defined as the inability of getting pregnant after trying for at least 6 months or 1 year, for women over 35 years old, without use of birth control means and while having normal sexual intercourse.¹ According to the World Health Organization (WHO) published data, approximately 8 to 10% of couples face some kind of infertility problem.²⁻⁵ The incidence of infertility is associated with geographic differences; likewise, differences are observed both in developed countries as well as in less developed countries. It has also been observed that the causes are related to geographical differences.²⁻⁶ It is estimated that worldwide between 70 and 80 million couples suffer from infertility, most of these are residents of developing countries including the Middle East.⁵ The fertility rate in Iraq in 2000 was 5.7, while in 2007 it was 4.9; in Iran, it was 2, in Jordan 3.5, in Kuwait 2.6, in Syria 3.5, in UAE 2.7, in Lebanon 2.3, and in Saudi Arabia 4.1.^{7,8} Although treatment options for infertility are available, their high cost and frequency of adverse events have motivated the identification of potentially modifiable risk factors. It was found that body weight, physical activity, and dietary factors, such as intake of specific fatty acids, protein, carbohydrates, dairy foods, iron, and multivitamins, are related to infertility due to ovulation disorders. In addition to that, caffeine and alcohol have been reported to affect ovulation.⁹⁻¹⁷

Diets evolve over time, being influenced by many factors and complex interactions. Income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, and social and economic factors all interact in a complex manner to shape dietary consumption patterns.¹⁸ Essential dietary nutrients are required to regulate body processes, build and repair tissues, and, thereby, promote health and prevent disease.^{19,20} A woman's diet may ultimately affect her fertility, particularly ovulation. Overall, replacing carbohydrates with animal protein was demonstrated to be detrimental to ovulatory fertility. Adding just one serving of meat was correlated with a 32% higher chance of developing

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ovulatory infertility, particularly if the meat was chicken or turkey. However, replacing carbohydrates with vegetable protein demonstrated a protective effect. Choosing trans fats in the diet instead of monounsaturated fats has been demonstrated to drastically increase the risk of ovulatory infertility.^{18,21} High intakes of sugar compromised the nutrient quality of diets by providing significant energy without essential nutrients. Diets high in added sugars can result in unhealthy weight gain.²² Both the quality and quantity of carbohydrate in diet influence glucose metabolism, affecting insulin demand or sensitivity in healthy individuals.²³ Several reports suggest that diets with a high glycemic index (GI) or glycemic load, or that are high in refined carbohydrates, increase risk of obesity and associated health problems.²⁴⁻²⁷ Increased consumption of low GI foods has been recommended to help prevent and treat obesity. Some studies have reported increased satiety with low GI foods.²⁴⁻²⁷ Lipotoxicity is one mechanism by which fat intake may influence reproductive tissues. This process is characterized by excess circulating long-chain saturated fatty acids, which are produced by adipocytes themselves and are also obtained through the diet. When the adipocytes can no longer store these fatty acids, other nonadipose cell types begin to store fat. This leads to an increase in the production of reactive oxygen species with subsequent mitochondrial dysfunction, endoplasmic reticulum stress, and ultimately cell death. The reproductive tissues affected include granulosa cells and oocytes, leading to impaired oocyte maturation and poor oocyte quality.²⁸⁻³³

Regular consumption of fruit and vegetables is associated with a substantially lower risk of coronary heart disease, stroke, several major cancers, type II diabetes mellitus, cataract and macular degeneration of the eye, hypertension,³⁴ and infertility.¹³ The protective effects of these foods are mediated through numerous beneficial nutrients, including antioxidants, vitamins, minerals, phytochemicals, and fiber.³⁴ This work was designed to appraise the role of diet and dietary habits on women fertility.

MATERIALS AND METHODS

A descriptive cross-sectional study was carried out in seven different centers for primary health care and hospitals in Baghdad in the period between January and September 2014.

Subject

Four hundred adult women were conveniently enrolled in this study; their age range was 17 to 47 years. Participants were divided into two groups: Group I included 300 fertile women considered as control group and group II included 100 infertile women considered as case group.

Collection of Data

A general questionnaire was constructed by the research team. This questionnaire was filled by the researcher through a direct interview with the participants. The inclusion criterion for the fertile group (group I) was to be a fertile female by having a baby of at least 2 years or less of age or to be pregnant. For the infertile (group II) group, it was to be a female not getting pregnant with at least 1 year of regular intercourse and no known cause of infertility.

Approval and Permission

Prior conducting this work, approval from The Arab Board for Health Specializations was obtained. All participants were informed about this study and their permission was taken to be included in the study.

Data Analysis

Two software programs used to present, describe, and analyze data were included in the present study. These were Statistical Package for Social Sciences (SPSS), version 16 and Microsoft Office Excel 2007. Numeric variables were presented as mean, median, standard deviation, and range. Nominal variables were expressed as frequency (number) and percentage out of total. Pearson's Chi-Square test was used to evaluate nominal variable frequency difference between groups. Independent sample student t-test was used to compare numeric variables between groups. A p-value < 0.05 was considered significant.

RESULTS

Sociodemographic Characteristics of the Participants

Table 1 shows that the mean of weight for the infertile group was 73.07 *vs* 69.06 for the control group, and the mean body mass index (BMI) for the infertile group was 28.83 *vs* 26.70 for the control group, and the differences were statistically highly significant among the two groups.

Gravid, para, and age of the last child were highly significantly different between infertility and control groups.

Dietary Habits Differences among Two Groups

Table 2 shows that infertile women used to consume more carbonated beverage, tea, chicken, and fish than the control group, while they used to consume less milk and red meat than control group. There were significant differences ($p < 0.05$) in consumption of carbonated beverage/day, tea/day, milk/day, red meat/week, chicken/week, and fish/week between infertile and control groups.

Table 1: Sociodemographic characteristics of infertile group and control group

Parameter	Infertile (n = 100) (group II)			Control (n = 300) (group I)			p-value
	Mean	SD	SE	Mean	SD	SE	
Age (17–47) years	27.92	7.29	0.73	28.30	6.21	0.36	0.613
Weight (55–120) kg	73.07	12.32	1.23	69.06	11.27	0.65	0.003*
Height (1.4–1.8) m	1.59	0.085	0.00	1.61	0.06	0.00	0.324
Body mass index	28.83	5.10	0.37	26.70	4.36	0.25	0.002*
Marriage age	6.41	3.84	0.38	6.50	4.54	0.26	0.857
Gravida	0.45	0.52	0.05	1.03	0.21	0.01	<0.001*
Para	0.63	0.97	0.10	2.04	1.50	0.09	<0.001*
Age of last child	4.91	2.68	0.43	1.51	1.37	0.08	<0.001*

SD: Standard deviation; SE: Standard error

*Results were significant at p < 0.05 compared with control group

Table 2: Comparison between infertile group and control group regarding dietary habits

Parameter	Infertile (n = 100) (group II)			Control (n = 300) (group I)			p-value
	Mean	SD	SE	Mean	SD	SE	
Carbonated beverage/day	1.36	1.19	0.12	0.87	1.02	0.06	<0.001*
Tea cup/day	1.89	1.31	0.13	1.57	1.03	0.06	0.014*
Coffee cup/day	0.17	0.55	0.06	0.24	0.61	0.04	0.309
Milk cup/day	0.98	0.67	0.07	1.50	1.10	0.06	<0.001*
Vegetable/day	1.52	0.88	0.09	1.59	0.73	0.04	0.411
Fruit/day	1.56	0.90	0.09	1.67	0.93	0.05	0.288
Beans/week	1.69	1.19	0.12	1.92	1.17	0.07	0.095
Red meat/week	2.32	1.96	0.20	2.79	1.97	0.11	0.038*
Chicken/week	3.04	1.89	0.19	2.49	1.40	0.08	0.008*
Fish/week	1.45	1.23	0.12	0.96	0.66	0.04	<0.001*
Rice/week	4.11	2.61	0.26	4.59	2.30	0.13	0.084
Pastry/week	3.50	2.55	0.25	3.28	2.58	0.15	0.465
Fast food/week	1.37	1.49	0.15	1.23	1.44	0.08	0.404

SD: Standard deviation; SE: Standard error

*Results were significant at p < 0.05 compared with control group

Association between Type of Milk and Infertility

Table 3 shows that both groups used to consume full fat milk (92%) more than the skimmed milk (7%), with no significant difference in the types of the consumed milk among the two groups.

Difference in Type of Dietary Oil among Two Groups

Table 4 shows that there were significant differences in consumption of dietary oil among the two groups. The infertile group consumed less corn oil and olive oil than control group (5 and 0% vs 21 and 2%) respectively, while they consumed more solid fat and combined fat than the control group (2 and 6% vs 0 and 2.7%) respectively.

Table 3: Association between type of milk and infertility

	Infertile (group II)		Control (group I)		p-value
	No.	%	No.	%	
Skimmed	6	7.50	20	7.60	0.975
Full fat	74	92.50	243	92.40	
Total	80	100.00	263	100.00	

Association between Type of Bread and Infertility

Table 5 shows that the infertile group used to consume significantly more brown bread than control group (50 vs 35%).

Table 4: Comparison between infertile group and control group regarding type of the consumed dietary oil

	Infertile (group II)		Control (group I)		p-value
	No.	%	No.	%	
Corn	5	5.00	63	21.00	<0.001
Sunflower	87	87.00	223	74.30	
Olive	0	0	6	2.00	
Solid fat	2	2.00	0	0	
Combined	6	6.00	8	2.70	
Total	100	100.00	300	100.00	

Table 5: Comparison between infertile group and control group regarding type of bread

	Infertile (group II)		Control (group I)		p-value
	No.	%	No.	%	
White bread	50	50.00	194	64.70	0.009
Brown bread	50	50.00	106	35.30	
Total	100	100.00	300	100.00	

DISCUSSION

Infertility is a common condition affecting as many as one out of six couples during their lifetime.³⁵ Some authors have proposed that the already high frequency of this disorder is likely to rise as the postponement of childbearing increases, particularly in developed regions of the world.³⁶ Assisted reproductive technologies are the main strategy used to control the burden of infertility. However, their large costs and frequency of adverse events warrant the consideration of alternative approaches to control infertility including prevention.^{9,37} The role of dietary factors in human fertility has not been investigated in detail, but intake of some macronutrients and micronutrients may enhance female fertility.^{16,38}

In the current study, the mean of weight and mean of BMI of the infertile group were 5.8 and 6.36% higher than control group respectively; and these differences were statistically significant. These results reflect a significant association between weight and infertility. Consistent with this, Van der Steeg et al³⁹ demonstrated the declining probability of spontaneous pregnancy for low and high BMI subfertile, anovulatory women. In women with BMI ≤ 21 , a decrease in BMI was associated with 3% lower pregnancy rate, whereas in women of BMI ≥ 29 , an increase in BMI was associated with 4% lower pregnancy rate.

Law et al⁴⁰ also demonstrated significantly reduced fecundity in overweight and obese women of reproductive age, whereas Wang et al⁴¹ showed that in overweight (BMI > 25) women, the probability of pregnancy during assisted reproduction treatment was about 20% lower compared with women with BMI in the normal range.

The biological mechanism responsible for the association between BMI and fecundity is unclear. One hypothesis is that obesity affects the hypothalamic-pituitary-ovary axis. Excess free estrogen, resulting in part from increased peripheral conversion of androgens to estrogens in adipose tissue, combined with decreased availability of gonadotropin-releasing hormone (GnRH) could interfere with hypothalamic-pituitary regulation of ovarian function, causing irregular or anovulatory cycles.⁴² However, Jensen et al⁴³ found that fecundity remained reduced for overweight and obese women with regular menstrual cycles, which suggests that anovulation despite regular menses or the release of ova with reduced fertilization potential or even endometrial abnormalities may be the more likely mechanisms.⁴⁰

From Table 2, the results showed that infertile women significantly used to consume more carbonated beverages and tea than control group; on the other hand, there was no significant difference ($p > 0.05$) in consumption of coffee among the two groups.

In this regard, Hassan and Killick⁴⁴ found that intake of tea and both normal and diet soft drinks were positively related to ovulatory infertility. In support of the later hypotheses, others have previously reported that intake of caffeinated, decaffeinated, sugared, and diet soft drinks have similar relations to the incidence of impaired fasting glucose and metabolic syndrome,⁴⁵ a very relevant finding given the role of insulin sensitivity on ovulation and the pathogenesis of polycystic ovary syndrome (PCOS). Other earlier studies support the notion that the relation between soft drinks and infertility is independent of caffeine. Hatch and Bracken reported a stronger association between soft drinks and delayed conception than between coffee and this outcome at lower levels of caffeine intake from sodas.⁴⁶ Besides, Jorge et al⁴⁷ found that soft drinks may be a risk factor for infertility and this relation is independent of their caffeine content. Accordingly, consuming caffeine in moderation may not affect ovulatory function to the point of increasing the frequency of infertility.

Other results (Table 3) showed that the infertile group used to consume significantly less milk than the control group (0.98 cup compared with 1.5 cup per day respectively). Interestingly, both groups consumed full fat milk (92%) more than the skimmed milk with no significant difference. Bouthegourd et al⁴⁸ found that the changes in milk composition during the fat extraction, such as the addition of some whey proteins including α -lactalbumin have been found to have androgenic effects in animals. Several of these mechanisms may be particularly relevant for anovulatory infertility, in particular, the increased insulin-like growth factor 1 (IGF-1) levels resulting from increased dairy intake, as this association may be driven by the intake of low-fat dairy foods. Some have proposed that IGF-1 may be involved in the pathogenesis of PCOS, and in human ovarian cells, IGF-1 can induce thecal cell function changes observed in PCOS. Thus, greater intake of high-fat dairy foods was associated with a lower risk of anovulatory infertility.⁴⁹⁻⁵¹

Although particular fatty acids in dairy products could potentially have a beneficial effect on ovulatory function, a more likely explanation is that a fat-soluble substance present in dairy products may exert this action. Whole milk and other high-fat dairy products have a higher estrogen concentration than their low-fat counterparts.⁵² Since estrogens decrease circulating IGF-1 levels, it is possible that their presence in high-fat dairy foods could explain the observed association. Alternatively, increased insulin sensitivity among high-fat dairy consumers may have improved ovulatory function.⁵³ Other studies showed that intake of low-fat dairy foods, but not high-fat dairy foods, has been associated with clinical

manifestations of androgen excess, a component of PCOS, which may also lead to anovulatory infertility.^{54,55} Thus, consumption of full fat milk could have essential value in women's health and fertility.

Infertile women consumed significantly more chicken (18.1%) and fish (33.8%) than the control group, while they used to consume less red meat than the control group (Table 2). These results were to some extent consistent with Jorge et al¹³ findings, where it was reported that consumption of protein from animal sources, including chicken and red meat, was associated with an increased risk of infertility due to anovulation, while consuming protein from vegetable sources appeared to have the opposite effect. An estimation was also made of the effect of consuming protein instead of other energy sources on the risk of developing ovulatory infertility.

Consuming 5% of total energy intake as animal protein instead of as carbohydrates was associated with 19% greater risk of ovulatory infertility. In contrast, consuming 5% of energy as vegetable protein rather than as carbohydrates was associated with a 43% lower risk of ovulatory infertility. Furthermore, consuming 5% of energy as vegetable protein as opposed to as animal protein was associated with a more than 50% lower risk of ovulatory infertility.¹³ The possible mechanism underlying the observed associations could be a differential effect of animal and vegetable protein on circulating IGF-1 levels. Elevated levels of free IGF-1 may be involved in the development of PCOS, the most common cause of anovulation. Holmes et al found that, in women, animal protein intake was positively associated with IGF-I levels, while vegetable protein intake was not related to the hormone.^{56,57} Not consistent with these findings, in the current study, it is found that there is no association between the consumption of vegetable protein (beans) and fertility as there is no significant difference in the weekly consumption of beans among the two groups (Table 2).

Further, there are significant differences in consumption of dietary oil among the two groups (Table 4). The infertile group consumed less corn oil and olive oil than control group, while they consumed more solid fat and combined fat than the control group. These results agreed with the findings of Jorge et al,¹³ where they reported that trans-unsaturated fats may increase the risk of ovulatory infertility when consumed instead of carbohydrates or unsaturated fats commonly found in nonhydrogenated vegetable oils.¹² Therefore, consuming corn oil and olive oil could have a role in women fertility.

In the current study, the infertile group consumed more brown bread than control group (50 vs 35%) (Table 5). However, the WHO guide for promoting a healthy diet

for the Eastern Mediterranean region⁵⁸ states that the beneficial effects of cereal fibers and whole grains help in lowering fat consumption and in reducing risk of obesity, which affects women fertility. Hence, these results need further investigations.

In addition, the current results (Table 2) also showed that there are no significant differences ($p > 0.05$) in consumption of vegetables, fruit, rice, pastry, and fast food among the two groups. In contrast with this, Jorge et al¹³ reported that regular consumption of fruit and vegetables is associated with a substantially lower risk of women infertility.

CONCLUSION

In summary, the current study has clearly identified diet as one of the modifiable risk factors that potentially impacts fertility in the selected groups as there are a significant associations between consumption of carbonated beverage, tea, milk, animal protein (red meat, chicken, and fish), type of dietary oil, type of bread and infertility. However, there are no significant associations between consumption of fruit, vegetables, beans, rice, pastry, fast food, coffee and infertility. In addition to that, this study confirmed the association between weight, BMI, and infertility. So, it is necessary to focus more on diet's role in women fertility and on increasing women's awareness about their diet.

CLINICAL SIGNIFICANCE

Increased awareness about healthy foods and weight control through educational programs in media and public health care centers and promoting healthy life style and dietary habits can help in management of infertility.

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