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Current Nutritional Factors Affecting Fertility and Infertility

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Commentary

Ovulatory fertility is defined as the release of an egg from the ovary, must happen in order to achieve pregnancy. In case of a defect in the ovulation process, the final result of anovulation may be encountered. Anovulation is an important gynecological problem that women have adequate estrogens but no ovulation and it commonly presents with irregular menstruation or amenorrhea [1]. Chronic anovulation is a condition as long intervals between menstrual cycles for more than 35 days, or amenorrhea for at least 6 months [1]. Infertility is a widespread disorder which is defined as the inability to achieve conceive after a period of 12 months of unprotected intercourse [2,3].

There are many factors that affect fecundability and infertility. Some of these factors, such as age and genetic factors, cannot be changed unfortunately. However, there is definite evidence that replaceable factors, like unhealthy diet, excessive alcohol, smoking and gaining weight, negatively affect reproductive health [4]. The fact that certain dietary ingredients are deemed responsible for male and female infertility makes it crucial to study the effects of nutrition on infertility and reproductive health. Especially trans fatty acids have adverse effects on male and female reproductive health, cause abnormalities in certain metabolic pathways and damage the metabolism of essential components of the reproductive system [5,6]. When other nutritional factors that may be responsible for infertility are evaluated; saturated fat, red meat, processed meats, fatty dairy products, sugar and sweeteners, alcohol and caffeine come to the forefront. In addition, the high consumption of soy and soy products may increase the risk of infertility in male [7]. On the other hand, protective foods against infertility such as fish, poultry, fruits and vegetables and whole-grains reduce the risk of male and female infertility by various mechanisms of action [8]. While a high western style diet with high saturated fat, trans fat and sugar is associated with a high risk of infertility, whereas prudent diet that contains much more vegetables, fruits, grains and fish is associated with a low risk of infertility. The low-fat dairy products significantly enhance sperm concentration and progressive motility [9]. The hourglass in **Figure 1** summarizes the factors that increase or decrease the risk of infertility in male and female [5].

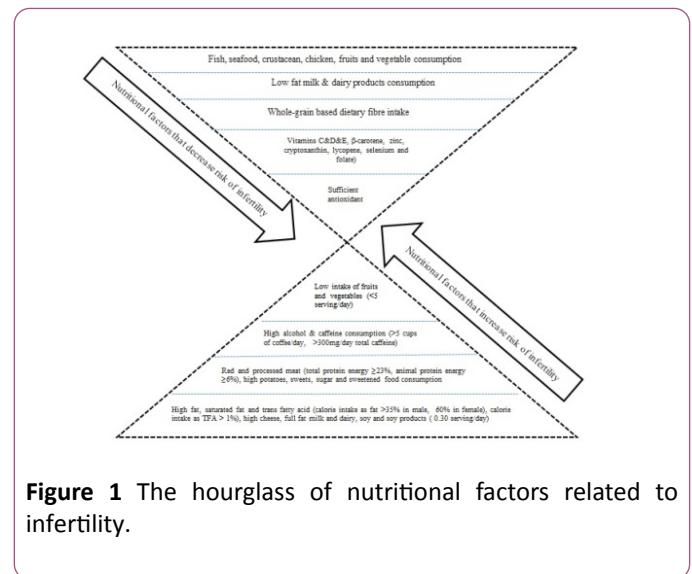


Figure 1 The hourglass of nutritional factors related to infertility.

Various current studies have examined the relationship between nutrients and infertility; saturated fatty acids, monounsaturated fatty acids, energy derived from fat adversely affects semen quality, sperm concentration and sperm parameters [10], processed meat is associated with lower sperm count and lower progressive motile sperm and abnormal sperm morphology [11,12]. Besides, the other factor that decreases to sperm motility and negatively alters the sperm morphology is whole-fat dairy product [13]. Conversely, the higher concentrations of omega-3 improve semen parameters and sperm morphology and motility [14]. When the effects of foods on the female fertility are evaluated, citrus fruits decrease risk of endometriosis [15,16], higher intake of whole grain is related to higher probability of live birth among women [17], poultry consumption is positively associated with fertilization rates and it supports fecundability [18]. **Tables 1 and 2** summarize the studies related with various nutritional factors that affect negatively or positively to male/female fertility [19-49].

The articles considered in this commentary have indicated that dietary ingredients may be deemed responsible for male and female infertility and at the same time some nutrients may significantly decrease the risk of infertility and improve fecundability. As a result, vital regulations in the diet which is a modifiable factor in the risk of infertility, will lead to positive feedbacks on reproductive health.

Table 1 The various nutritional factors that have negative effects on male/female fertility.

Factors	Results	Studies (References)
Trans fatty acids	High intake of trans fatty acids cause significant decline in sperm concentration and sperm count.	[19-25]
	Trans fatty acids play a negative role in reproduction by increasing risk of ovulatory infertility in women with polycystic ovary syndrome.	
	Trans fatty acids demonstrate positive correlation with asthenospermia.	
Alcohol	Alcohol consumption reduces the fertilization rate and negatively affects fecundability.	[16], [26-31]
	Moderate alcohol consumption positively affects levels of serum testosterone and does not harm semen quality.	
	Alcohol consumption found to be related to low sperm volume and high sperm DNA fragmentation. Infertile men who drink alcoholic beverages 2–3 units per day have worse semen quality compared with occasional drinkers (<3 units per week).	
	Alcohol consumption is associated with deterioration of most semen properties.	
	The intake of the modest alcohol (5 units in a week) negatively affect semen quality.	
	Alcohol consumption increases the numbers of morphologically abnormal sperm.	
Red meat and processed meat	Processed meat is the risk factor of asthenozoospermia.	[11], [12], [32-35],
	Processed meat is associated with lower sperm count and lower progressive motile sperm and abnormal sperm morphology.	
	The consumption of red meat is associated with a greater rate of ovulatory disorder infertility. Frequent intake of meat products may adversely affect semen quality.	
	Semen parameters may be enhanced by diets which include restricted processed meats and cheese.	
	Sausage and turkey ham intake may adversely affect assisted reproductive parameters.	
Sugars	Sugar decreases sperm motility.	[36]
Soy foods	A higher intake of soy foods may decrease sperm concentration.	[37]
	The consumption of soy (0.30 serving/day) increases the risk of infertility in males.	
Dairy products	The consumption of whole-fat dairy products decreases to sperm motility and negatively alters the sperm morphology.	[13], [38]
	Higher dairy protein intake ($\geq 5.24\%$ of energy) of women treated with infertility is associated with lower antral follicle counts.	
Caffeine	The live birth rate of couples which male partner consume caffeine ≥ 272 mg/day is approximately 3 times lower than couples which male partner consume caffeine <99 mg/day.	[39]
Coffee	Pre-pregnancy coffee consumption (≥ 4 servings/day) increases risk of spontaneous abortion especially at weeks 8–19. There is no spontaneous abortion relation of caffeinated tea and caffeinated soda.	[40]
Weight gain	During adulthood being overweight or being obesity or gaining weight and being underweight at eighteen years old are associated with a modest reduction in fecundity.	[41]

Lacto-ovo vegetarian diet and vegan diet	Vegetables-based food intake decreases sperm quality.	[42]
	The sperm concentration of lacto-ovo vegetarians was found significantly lower than non-vegetarians.	
	Total sperm motility was found lower in the lacto-ovo and vegan groups than non-vegetarians. Vegans had lowest hyperactive motility.	
Genetically modified food/organism	Genetically modified food/organism can be potential risk on reproduction, through influencing the endocrine metabolism.	[43]
Fat and fatty acids and energy and carbohydrates	While saturated fatty acids, monounsaturated fatty acids, energy derived from fat have statistically significant positive correlation with immotility where as there is a statistically negative correlation between the energy value of the diet and sperm concentration.	[10], [34], [44].
	Energy derived from the carbohydrates is associated with lower semen volume, consistency.	
	The energy derived from fat is associated with lower sperm consistency and immotility.	
	Total fat intake increases testosterone concentrations in healthy women in a very small way and it is inversely associated with the high embryo quality rate.	

Table 2 The various nutritional factors that have positive effects on male/female fertility.

Factors	Results	Studies
Mediterranean diet	Persistence of the Mediterranean diet (characterized by high intakes of vegetables, fruits and seafood) support the higher sperm concentration and total sperm count and sperm motility.	[45], [46]
Poultry	Inadequate intake of poultry was associated with a significantly higher risk of asthenozoospermia. Therefore, intake of poultry decreases the risk of asthenozoospermia.	[12], [18]
	Poultry intake was positively associated with fertilization rates and supports fecundability.	
Fish	Semen parameters may be enhanced by a rich diet from fish.	[32]
	Fish intake positively affects total sperm count and sperm morphology.	
Fruits and vegetables	Daily intake of citrus fruits which are high in beta-cryptoxanthin (≥ 1 servings) decreases risk of endometriosis (approximately 22%) compared to consuming less than 1 per week.	[15], [16], [35]
	Daily intake of cruciferous vegetables (≥ 1 servings) has a 13% higher risk of endometriosis compared to those consuming less than 1 per week.	
	The consumption of fruit is positively associated with sperm motility.	
	Fruits or vegetables may maintain or improve semen quality.	
	Low intake of fruits and vegetables (<5 serving/day) increases the risk of infertility in males.	
Lycopene	Lycopene positively affects sperm morphology	[47]
Low-fat dairy products	It is associated with a higher sperm concentration and progressive motility.	[9], [32]
	Semen parameters may be improved by consumption of low-fat dairy.	
Whole grain	Higher intake of whole grain includes specific nutrients such as phytic acid, vitamin E, and selenium at pre-treatment period was related to higher probability of live birth among women undergoing in vitro fertilization.	[16], [17]
	The consumption of cereals is positively associated with sperm motility.	
Omega-3	Proven fertile men have higher concentrations of omega-3 fatty acids in blood and spermatozoa than infertile men.	[14], [48]

	There is a strong reverse correlation between the arachidonic acid:docosahexaenoic acid and arachidonic acid:eicosapentaenoic acid ratios and total sperm count, sperm motility and sperm morphology.	
	The omega-3 increases antioxidant activity in human seminal fluid and improves sperm count, motility, and morphology.	
	Intake of increased docosapentaenoic acid decreases the risk of anovulation.	
Prudent diet (contains high consumption of fish, poultry, fruit, vegetables, legumes and whole grains)	There is a positive correlation between prudent pattern and the percentage of progressively motile sperm but no strong correlation between prudent pattern and sperm concentration and morphology.	[49]

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