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Review Article

Role of nutrition on male fertility: a narrative review

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ABSTRACT

Male infertility is a significant public health concern in India, contributing to nearly half of all infertility cases among couples. While multiple factors can affect male reproductive health, growing attention has been placed on the role of nutrition. This review investigates the association between dietary habits and male fertility by analysing findings from observational studies and clinical trials. Improved sperm concentration, motility, morphology, and overall semen quality have been linked to a balanced diet full of fruits, vegetables, whole grains, legumes, lean meats, and foods high in antioxidants, including vitamins C and E, folate, selenium, and zinc. Conversely, diets high in saturated and trans fats, processed meats, refined sugars, and sugary beverages have been linked to reduced sperm quality and hormonal imbalances. Environmental toxins, pesticide residues in food, obesity, smoking, alcohol use, and physical inactivity further contribute to oxidative stress and hormonal disruption, compounding the problem. In regions of India where dietary patterns are changing due to urbanization and increased consumption of processed foods, these issues are particularly pronounced. The review highlights the importance of improving nutritional awareness and adopting healthier lifestyles as potential strategies to support male reproductive health. Addressing these modifiable factors can significantly enhance fertility outcomes and reduce the burden of infertility in the Indian context.

Keywords: Male infertility, Nutrition, Dietary patterns, Reproductive health, Oxidative stress

INTRODUCTION

Infertility has become an increasingly significant public health challenge in India, affecting both urban and rural populations. Although infertility is often discussed as a female issue, male factors account for nearly half of all cases.¹ Despite this, male infertility tends to be underdiagnosed and underreported due to limited awareness, lack of access to specialized care, and social stigma.² Evidence from clinic-based studies in major Indian cities has revealed a concerning trend in declining semen quality and rising cases of male reproductive dysfunction.³

On the global stage, male infertility impacts approximately 2.5% to 12% of the male population.⁴ A growing body of

research over recent decades has documented a noticeable decline in semen parameters, particularly sperm concentration and motility, even among otherwise healthy men.⁵ These findings have prompted researchers to investigate potential causes, with increasing focus on modifiable factors such as diet, physical activity, and exposure to environmental toxins.⁶

Among these, nutrition has emerged as a particularly influential factor. The quality and composition of a man's diet can directly affect sperm production, hormone regulation, and oxidative stress levels.⁷ Studies have shown that diets high in saturated fats, trans fats, and processed foods are associated with lower sperm quality, while those rich in antioxidants, vitamins, minerals, and

omega-3 fatty acids appear to support optimal reproductive function.⁸

In India, changing dietary habits driven by urbanization and increasing reliance on processed and pesticide-laden foods may further compromise male reproductive health.⁹ Moreover, excessive exposure to chemical residues in food and water, particularly from agricultural pesticides and plastics, has been linked to disruptions in endocrine function and testicular damage.¹⁰ This growing concern underlines the need to explore dietary interventions as a safe and accessible approach to improving male fertility.

This narrative review aims to critically evaluate existing evidence on the relationship between nutrition and male reproductive function. By examining observational studies and clinical trials, it seeks to identify key dietary patterns and micronutrients that influence semen quality and to highlight potential public health strategies for mitigating male infertility through nutritional improvement.

LITERATURE SEARCH

A systematic search of PubMed, ScienceDirect, and Cochrane Library was conducted up to December 2018. Two strategies were used: Observational studies on diet and male fertility (semen quality, DNA fragmentation). Clinical trials examining supplements (e.g., folate, zinc, omega-3) and sperm parameters.

Human studies, English language, defined outcomes related to sperm quality or fertility. Fifty observational and 19 clinical studies were included. quality assessment used the Newcastle-Ottawa scale.

Table 1: Systematic literature.

Search for epidemiology studies	N
Screened	103
Selected by title and abstract	38
Retrieved from references	29
Full- text assessed	67
Includes	50

Table 2: Systematically conducted review of existing studies.

Search for clinical trials	N
Screened	78
Selected by title and abstract	43
Retrieved from references	14
Assessed	57
Included	19

OBSERVATIONS

Healthy diets (rich in fruits, vegetables, lean protein, and whole grains) are consistently associated with improved sperm quality.

Nutrients like vitamin C and E, zinc, folate, and omega-3s positively influence sperm motility, morphology, and concentration.

Conversely, high intake of trans fats, red meat, sugar, and processed foods negatively impacts semen quality. Environmental exposures-like pesticides and plastics-further affect fertility by increasing oxidative stress and disrupting hormones.

Table 3: Effects of antioxidant nutrients on sperm quality.

Author	Sample	Nutrient	Outcome on semen quality
Eskenazi et al ¹¹	97 healthy men	Vitamin C and E	Improved motility and the concentration
Mendiola et al ¹²	6 infertile men	Folate and lycopene	Positive effect on morphology and motility
Minguez-Alarcon et al ¹³	215 students	Beta-carotene and cryptoxanthin	Increased motile sperm count
Zareba et al ¹⁴	189 students	Lutein and lycopene	Improved sperm morphology and motility

Table 4: Dietary patterns and sperm quality.

Authors	Sample	Dietary pattern	Semen effects
Vujkovic et al ¹⁵	161 sub fertile men	Health conscious	Lower DNA fragmentation
Gaskins et al ¹⁶	188 students	Western vs. prudent	Prudent diet improved motility
Cutillas-Talin et al ¹⁷	215 students	Mediterranean	Higher sperm count, better morphology
Liu et al ¹⁸	7282 men	High- sugar, high-fat	Decreased motility and the morphology
Jurewicz et al ¹⁹	336 infertile men	Prudent vs. western	Prudent improved count and DNA integrity

Table 5: Specific foods and sperm quality.

Authors	Sample	Foods	Semen effect
Mendiola et al ²⁰	61 infertile men	Fruits, tomatoes	Improved quality
Maldonado et al ²¹	206 students	Organ meats, red meat	Lower motility, hormone imbalance
Eslamian et al ²²	241 infertile men	Poultry, seafood	Lower risk of asthenozoospermia
Braga et al ²³	250 ICSI	Fruit and cereals	Improved motility
Afeiche et al ²⁴	189 students	Total dairy foods	Reduced morphology, motility

Table 6: Dietary fats and semen quality.

Authors	Sample	Fat type	Impact on sperm parameters
Ataman et al ²⁵	99 infertile men	Saturated fats, omega-3	Saturated fats lowered count, omega-3 improved, morphology
Jensen et al ²⁶	701 men	Saturated fats	No consistent correlation
Minguez-Alarcon et al ¹³	209 students	Trans fats, omega-6	Reduced testosterone and testicular volume

Table 7: Water and food contaminants and male infertility.

Contaminant	Source	Mechanism	Observed impact
Pesticides ²⁷	Agricultural runoff	Endocrine disruption	Reduced sperm count and motility
Phthalates ²⁷	Plastic packaging	Hormonal imbalance	Lower testosterone, DNA damage
Trihalomethanes ²⁸	Chlorinated water	Oxidative stress, DNA damage	Conflicting data on sperm quality
Glycol ethers ²⁹	Industrial solvents	Testicular toxicity	Linked to oligospermia and azoospermia

ALCOHOL AND CAFFEINE

Alcohol consumption leads to testicular shrinkage and causes structural changes in Leydig and Sertoli cells, along with a reduction in luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels.³⁰ Regular alcohol intake negatively impacts sperm quality by reducing ejaculate volume, sperm count, and motility. A comparative study involving 66 alcoholic men and 30 non-alcoholic men revealed a marked decline in sperm concentration, progressive motility, and overall vitality among the alcohol-consuming group.³¹ Long-term excessive alcohol intake, defined as more than 60 grams per day (equivalent to about six glasses of wine), has been associated with the development of azoospermia.³² A significant negative correlation exists between alcohol intake and sperm concentration, total sperm count, and the proportion of normally shaped sperm. Reversing alcohol-induced azoospermia and restoring normal spermatogenesis can be achieved by quitting alcohol.³³

A meta-analysis examining the impact of alcohol on *in vitro* fertilization (IVF) found that even low levels of alcohol consumption-whether in the week or month prior to fertilization-can significantly reduce live birth rates. Even moderate alcohol consumption (e. g., one to two glasses of wine per day) might have detrimental effects on sperm quality and the success of assisted reproductive treatments, whereas excessive alcohol consumption should be rigorously avoided during medically assisted reproduction.³⁴ A systematic review investigating the

impact of coffee and caffeine consumption on semen quality revealed inconsistent and conflicting findings; however, some studies suggested a potential link to sperm DNA damage.³⁵

TOBACCO

Smokers tend to have elevated levels of heavy metals such as lead and cadmium in their seminal fluid, which are negatively associated with sperm concentration, motility, and morphology.³⁶ Smoking induces inflammation in the accessory sex glands, impairing sperm function by disrupting acrosome integrity, mitochondrial activity, and increasing DNA fragmentation.³⁷ In smokers, sperm concentration, overall motility, and the proportion of normally shaped sperm are all reduced.²² Studies assessing sperm DNA fragmentation have found significantly higher levels in smokers compared to non-smokers (32% vs. 25.9%).³⁸ Additionally, in an IVF study, male smoking was strongly associated with a higher risk of early spontaneous miscarriage, with an odds ratio of 2.2.³⁹

CANNABIS

Cannabis interferes with the hypothalamic release of GnRH and suppresses the anterior pituitary's production of LH. It also lowers testosterone secretion from Leydig cells through interaction with specific.⁴⁰ Following cannabis use, its metabolites have been detected in seminal fluid, exposing sperm cells to these substances as they transit through the epididymis.⁴¹ Smoking triggers

inflammation in sex glands, leading to impaired sperm function and increased DNA damage.

OBESITY

Obesity, often resulting from overeating and insufficient physical activity, is linked to a higher incidence of oligospermia and increased sperm DNA fragmentation.⁴² Several interconnected mechanisms contribute to its harmful effects on male fertility.⁴³ Obesity alters the hypothalamic-pituitary axis through hormonal imbalances such as increased estrogen from androgen aromatization, leptin resistance, and elevated endogenous opioids. These disruptions lead to reduced testosterone, impaired spermatogenesis, lower ejaculate volume, and insulin resistance.⁴⁴ Obesity disrupts hormone balance, lowering testosterone and impairing spermatogenesis through altered hypothalamic-pituitary function and increased estrogen production.

L-CARNITINE

L-carnitine (LC) and acetyl-L-carnitine (LAC) are widely used for their beneficial effects on sperm quality and pregnancy outcomes in men with asthenoteratozoospermia.⁴⁵ These compounds enhance the total antioxidant capacity of seminal fluid and protect sperm DNA from oxidative damage.^{46,47} LC supplementation has also been shown to improve outcomes in intracytoplasmic sperm injection (ICSI) procedures.⁴⁸ Obesity impairs spermatogenesis by disrupting hormonal balance, reducing testosterone, and increasing estrogen due to endocrine dysfunction.⁴⁹

VITAMIN E

Seminal plasma levels of vitamin E have been linked to sperm motility, with lower concentrations commonly found in the semen of infertile men.^{50,51} A prospective, multi-center randomized controlled trial demonstrated that vitamin E supplementation can enhance sperm concentration, increase the percentage of progressively motile sperm, and improve rate of natural pregnancies.⁵²

ZINC AND FOLIC ACID

Fertile males have much higher levels of zinc in their seminal plasma than do subfertile men.⁵³ While one study found that supplementation with zinc sulphate and folic acid did not significantly improve sperm function in men with oligoasthenoteratozoospermia, following combined zinc and folic acid administration, both subfertile and fertile men showed an increase in total normal sperm count, according to another double-blind, placebo-controlled study.^{54,55}

PHYTOTHERAPEUTICA

A poly-herbal formulation composed of ingredients such as *Chlorophytum borivillianum* root, *Mimosa pudica* seeds,

Acacia Senegal sap, *Astragalus membranous* root, *Plantago ovata* seed coat, *Bombax ceiba* sap, *Eurycoma longifolia* root, and rocky candy was evaluated for its effects on spermatogenesis in oligospermic men. Following 90 days of treatment, sperm concentration increased by 256%, semen volume increased by 154%, and sperm motility improved by 215%.⁵⁶

CONCLUSION

This comprehensive review clearly shows that, what men eat has a direct impact on their fertility. A diet full of fresh fruits, vegetables, whole grains, and foods rich in antioxidants and healthy fats helps improve sperm quality. On the other hand, consuming too much junk food, processed meat, and sugary drinks can lower sperm count and motility. Lifestyle factors like smoking, alcohol, stress, and obesity make things worse. Taking care of one's diet and overall health isn't just good for general well-being it's also crucial for reproductive health. Simple, healthy changes can make a real difference.

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