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Diet Influencing the Fertility in Humans

Rashmi Bhardwaj
Department Of Medical
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

ABSTRACT: ***Over the past decade, the studies of the relationship between diet and human reproduction has substantially increased, culminating in the discovery of a few simple trends. Supplemental folic acid intake, particularly at doses higher than those prescribed for the prevention of neural tube defects, has been consistently associated with lower infertility rates, lower risk of failure of pregnancy and greater progress in the treatment of infertility. In the other hand, vitamin D does not seem to play an important role in human reproduction in the absence of deficiency, in view of positive results from animal models. Antioxidant supplementation does not seem to provide any advantage to women seeking infertility therapy, although where the male partner is augmented, it tends to be of benefit. While it is uncertain to what degree the toxicity of shared food supplies, such as fish with high levels of environmental toxicants, will dampen this gain, long-chain omega 3 fatty acids tend to boost female fertility. Finally, commitment to balanced diets in favour of fish, meat, whole grains, fruit and vegetables is linked to increased female fertility and better male semen quality. The accumulated proof has also been stacked against common assumptions. Once suggested as reproductive toxicants, dairy and soy have not been reliably linked to poor fertility. Similarly, as results from massive, high-quality trials begin to mount, the evidence of a potentially deleterious impact on the capacity to become pregnant from mild alcohol and caffeine consumption looks less strong than it once did. Although a complete picture of nutrition's position in fertility is far from complete, there has been a lot of improvement.***

Keywords: Diet, Fertility issues, Meat, Nutrients, Proteins, Health care, Toxicants, Folic acid.

INTRODUCTION

It is of significant clinical and public health importance to recognise modifiable lifestyle factors, like diet, that influence human fertility. Infertility, the inability after 12 months or more of daily unprotected sexual activity to attain a therapeutic birth, affects 15-25 percent of western countries' couples. It is projected that reduced fecundity, which covers miscarriage and trouble bringing a baby to term, affects twice as many couples. Medical therapy for fecundity deficiency is now on the rise. In the United States, the use of assisted reproductive technologies (ART) has gradually risen from approximately 60,000 cycles in 19954 to 209,000 cycles in 2015, but there has been no comparable change in live birth rates per implemented cycle over the last decades. There is a lack of comparative evidence for intrauterine insemination and ovulation induction procedures, but because these procedures are much more widespread, they are estimated to account for 2-6 times more births in the United States than ART.

In tandem with the high financial costs and restricted regional proximity to infertility care, the high incidence of compromised fecundity motivates the need to classify adjustable predictors of couple fertility. While there is an increasing awareness that diet in both men and women can be related to reproductive success, there is still no specific guidelines for couples of reproductive age. The aim of this analysis is to summarise the nutrition and fertility epidemiological literature and provide realistic dietary guidelines based on the best data available.

ANTIOXIDANTS

A 2013 Cochrane review of randomised controlled trials (RCTs) of antioxidant supplementation during infertility therapy concluded that existing research does not indicate benefits for increasing conception or live birth rates from antioxidant supplementation. The

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authors pointed out that there are many shortcomings in the available data, including a high likelihood of bias, inadequate documentation, and high inconsistency in the approaches examined in the studies. For instance, the experiments included in the meta-analysis to assess the impact of antioxidants on placebo included treatments as varied as several micronutrient blends, pentoxifyline, N-acetyl-cysteine, melatonin, larginine, vitamin E, myo-inositol, vitamin C, vitamin D+calcium, and omega-3 polyunsaturated fatty acids, several of which are not technically antioxidants. In comparison, no two meta-analysis analyses evaluated the same intervention, rendering it virtually difficult to draw clear conclusions from this systematic review other than the need for higher-quality studies broad enough to assess results on clinically important outcomes like live birth rates [1].

Fatty Acids

In vitro experiments have shown that in early reproductive activities, including oocyte maturation and embryo implantation, fatty acids are major substrates. In addition, animal and human research indicate that polyunsaturated fatty acids (PUFAs) may directly influence fertility by influencing the production of oocytes and implantation of embryos, whereas trans fatty acids may encourage greater tolerance to insulin that could adversely affect ovulatory function [2].

Dairy

Owing to their high content of galactose, which in mice has been shown to decrease ovulation and contribute to premature ovarian failure, and their ability to produce high levels of environmental oestrogen, dairy foods have been proposed as potential reproductive toxicants. An ecological analysis was reported in 1994 in 31 countries showing that the decrease in fertility with age is more pronounced among populations with higher per capita milk intake. A subsequent case-control research, however, showed that women who drank three or more glasses of milk a day had a 70% lower infertility chance than women who did not drink milk. No association was observed between total dairy food consumption and incidence of ovulatory nfertility in NHS-II, the largest prospective cohort to date (aRR=1.12 [95 percent CI 0.69,1.82] relative to ≥ 4 vs. <1 serving per day), but this overall null result was attributed to the fact that full-fat dairy foods were associated with lower risk of ovulatory infertility (aRR=0.73 [95 percent CI 0.52, 1.01] compared to ≥11 percent CI 0.52, 1.01] compared to ⁇ 11.

A prospective cohort of women undergoing assisted reproduction in the US found that women over 35 years of age had a multivariable-adjusted chance of live birth of 55 percent (95 percent CI 39, 69 percent) compared to 23 percent (95 percent CI 11, 42 percent) for women in the lowest quartile among those in the highest quartile of pre-treatment milk food intake [5]. And while this relationship was only present in older women, there was no disparity between full-fat and low-fat dairy foods in the association. Finally, there were minor and contradictory correlations between dairy consumption and fecundity between the Danish and American cohorts in the most recent research on pre-conception dairy intake and time to pregnancy (pooled FR=1.11 [95 percent CI: 0.94, 1.31] contrasting ≥ 18 vs. <7 servings a week). Taken together, considering the contradictory results, no clear conclusions can be taken as to the impact on fertility of the consumption of maternal milk, although there is poor evidence supporting milk as a possible reproductive toxicant.

Meats, fish and soy

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In the sense of reproduction, the consumption of protein sources has gained attention mainly because of their ability to produce elevated levels of environmental pollutants which may adversely affect reproductive health. Although red meat may be a great source of protein and other essential nutrients, high amounts of saturated fat may also be present and may act as a medium for exposure to hormonal residues, antibiotics and polybrominated diphenyl ether. Similarly, though seafood is considered to be a strong source of long-chain omega-3 fatty acids, organochlorines, dioxins, and mercury can also be a primary route of exposure. In addition, while soy-based products, in terms of cardiovascular and metabolic effects, are generally safer alternatives to animal proteins, some have raised questions about the possible adverse reproductive implications of soy phyotoestrogens [3].

Dietary Patterns

To date, the association between pre-conception dietary habits and infertility risk has been investigated in two studies. In the NHS-II, women developed a "fertility diet" score in the top decile of the investigator that prioritises higher protein intakes from vegetable sources, full-fat dairy foods, iron, the ratio of MUFAs to trans fats and more frequent multivitamin use and lower protein intakes from animal sources, dietary glycemic load, and low-fat dairy foods had 66 percent (95 percent CI 52, 7 7 percent CI 52, 7 percent CI 52). Likewise, in the Seguimiento Universidad de Navarra (SUN) experiment, a nested case-control analysis of women showed that women with the greatest commitment to a Mediterranean-style diet, marked by higher intakes of vegetables, fruit, fish, poultry, low fat dairy and olive oil, had 0.56 (95% CI 0.35-0.95) times the likelihood of obtaining medical assistance for trouble becoming pregnant. Two studies from cohorts of in vitro fertilisation further confirm that healthy dietary patterns of pre-conception could have a beneficial effect on fertility. Two independent cohorts showed higher adherence to the Dutch dietary guidelines (characterised by high intake of whole grains, monounsaturated or polyunsaturated oils, fruits, fruit, meat or meat substitutes and seafood) and higher adherence to the 'Mediterranean' diet (characterised by high intake of olive oil, fish, legumes and vegetables and low intake of snacks) prior to high intake of meat and meat. Even so, despite the growing indications that a balanced pre-conception diet could improve fertility (or the likelihood of a woman becoming pregnant), the findings of the NHS-II cohort showed no link between pre-pregnancy adherence to certain healthy pre-pregnancy dietary habits and the threat of pregnancy loss [4].

Alcohol and caffeine

With more than 30 research on this subject to date, intake of caffeine and alcohol are arguably the most researched dietary factors as probable disruptors of fertility. However, findings are contradictory, with many studies suggesting deleterious effects of caffeine and alcohol, but almost as many studies indicate no correlation or even increased fertility of such caffeinated or alcoholic drinks being drank. The fact that most of the experiments are retrospective, and thus subject to memory and other forms of bias, is one possible reason for these contradictions. Indeed, systematic analyses of the relationship between caffeine and reproductive results have found that the detrimental effects of caffeine on reproductive health, particularly fertility, are documented more often in retrospective research and studies of poor methodological quality; studies connecting alcohol to reduced fertility could be in a similar position. Although concerns about the adverse effects of maternal alcohol consumption on foetal development are justified, as are concerns about the increased risk of birth loss due to the intake of caffeine, it is unclear

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whether the intake of these substances has a deleterious effect on the ability to become pregnant. Moreover, data among couples receiving ART or other therapies for infertility remains comparatively slim [5].

Paternal Diet

In several systematic studies, the effect of paternal diet on the quality of semen and couple fertility was recently explored and summarised. It is worth briefly noting any general developments. Second, a Cochrane analysis of randomised studies of male antioxidant supplementation in patients seeking infertility therapy found proof of the value of antioxidant supplementation in improving the consistency of semen and clinical pregnancy rates. The vast heterogeneity of the sample designs of the experiments used in the meta-analysis, along with the limited concept of 'antioxidants' used for the meta-analysis, does not allow for the detection of the individual agents, the mixture of agents or the doses responsible for the effects observed, despite the evidence of profit. Second, a wide variety of studies in North America, Europe, the Middle East and East Asia have reliably correlated "healthy" dietary habits with improved semen parameters.

The "unhealthy" diets had the opposite relationship. It still needs to be determined if these results can be replicated in randomised trials. Third, the ingestion of trans and saturated fats has historically been linked to poor semen quality; trans fat intake, in compliance with animal models, has also been linked to other indicators of poor testicular activity, including lower testosterone and lower testicular length. Last, mild alcohol and caffeine consumption may not have a substantial effect on the consistency of semen. It remains to be determined if these results can be replicated in randomised trials. Third, trans and saturated fat consumption has historically been linked to poor semen quality; trans fat intake has also been linked, in compliance with animal models, to other indicators of poor testicular function, including lower testosterone and lower testicular length. Last, mild alcohol and caffeine consumption may not have a major effect on the consistency of sperm. It is important to remember that while most of the dietary and male fertility study was using clinical semen consistency criteria as study findings, and these remain the cornerstone for the clinical assessment of the contributions of the man to the reproduction of a family, they are unreliable fertility predictors. Therefore, semen consistency associations do not indicate fertility associations, and vice versa, as shown by many recent findings of couples undergoing infertility care [6].

CONCLUSIONS

Over the last decade, the research on the relationship between diet and human fertility has grown significantly and contributed to the emergence of several strong trends. Supplemental folic acid consumption has been reliably linked to various indicators of female fertility, from lower anovulation level to greater reproductive success in the ART environment, indicating that folate's reproductive advantages reach beyond NTD prevention. In the other hand, vitamin D does not seem to play an important role in human reproduction in the absence of deficiency, in view of positive results from animal models. Although antioxidant supplements does not seem to provide much advantage to women seeking infertility care, when the male partner is supplemented, this does seem to be helpful. The available data, however, does not make it possible to distinguish the particular antioxidants are essential for this advantage, nor at what doses. While it remains uncertain if environmental pollution of fish, their most common food source, will dampen this benefit, higher intakes of long-chain omega 3 fatty acids tend to

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promote female fertility. Finally, adherence to balanced diets that prefer fish, meat, whole grains, fruits and vegetables is correlated with better female reproduction and increased male semen consistency. Although a complete picture of nutrition's position in fertility is far from complete, there has been a lot of improvement. Continued developments should rely on solidifying existing research and addressing female and male diets jointly. In addition, it is important that the most consistent associations be evaluated in sufficiently powered randomised controlled trials to address the shortcomings inherent in clinical studies focused on validated diet evaluation techniques or nutritional biomarkers.

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