Journal of Clinical and Experimental Reproductive Medicine

Yang, J Clin Exp Reprod Med. 2024;1(1):40-42.

Editorial

The role of selenium in combating infertility: A vital yet overlooked nutrient

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Received date: August 30, 2024
Accepted date: September 25, 2024

Editorial

Millions of couples around the world experience emotional, social, and financial hurdles due to infertility. Selenium, a nutrient that has recently gained significant attention, is often overlooked in discussions about reproductive health. This trace element plays a crucial role in enhancing fertility in both men and women. Understanding the connection between selenium and fertility could pave the way for improved reproductive outcomes and a greater chance of conception for many struggling couples.

Selenium: A Powerful Antioxidant

Selenium is an essential trace element that is integrated into 25 human proteins (selenoproteins) as the 21st amino acid, selenocysteine. These selenoproteins are critical for numerous cellular functions, including oxidative stress defense, immune response, thyroid hormone metabolism, and the unfolded protein response [1,2]. The antioxidant properties of selenium are particularly significant in the context of fertility. Oxidative stress, characterized by an imbalance between free radicals and antioxidants in the body, is a well-known factor contributing to infertility. In men, oxidative stress can damage sperm DNA, impair sperm motility, and reduce sperm viability [3]. In women, it can disrupt the delicate balance required for oocyte maturation and embryo development [4,5]. Studies have shown that selenium supplementation can significantly reduce oxidative stress, highlighting the potential of selenium as a natural, antioxidant treatment option for human infertility [6-8].

Selenium and Male Fertility

Male fertility is highly dependent on the quality and function of sperm, which are influenced by various factors, including oxidative stress. Selenium's role in the formation and function of selenoproteins, such as glutathione peroxidase, is critical in protecting sperm from oxidative damage. Glutathione peroxidase acts as a powerful antioxidant within the sperm cell, helping to neutralize harmful free radicals and protect sperm DNA from oxidative damage [9,10].

Furthermore, selenium is involved in the structural integrity of the sperm tail, which is crucial for sperm motility. Research indicates that selenium deficiency can lead to abnormal sperm morphology and reduced motility, both of which are significant contributors to male infertility [11]. A study focusing on men with low selenium levels and suboptimal sperm quality offers compelling evidence of selenium's pivotal role in male fertility. Following three months of selenium supplementation, the researchers observed significant enhancements in both sperm motility and morphology. These findings underscore selenium's essential contribution to male reproductive health, suggesting that adequate selenium intake is crucial for optimizing sperm function and increasing the likelihood of successful conception [12].

Selenium and Female Fertility

While much of the research on selenium and fertility has focused on men, emerging evidence underscores its equally vital role in female reproductive health. Selenium is indispensable for proper thyroid function, and thyroid hormones are crucial in regulating the menstrual cycle, ovulation, and overall reproductive function [5]. Notably, a deficiency in selenium has been significantly linked to an increased risk of polycystic ovary syndrome (PCOS), a condition that can severely impact fertility [13].

In women, selenium's protective role also extends to safeguarding the developing oocyte (egg) from oxidative stress, which is particularly critical during folliculogenesis - the maturation process of the oocyte in preparation for ovulation. Oxidative stress during this stage can lead to compromised oocyte quality, a major factor contributing to infertility and poor outcomes in assisted reproductive technologies (ART) like *in vitro* fertilization (IVF) [4]. Research has shown that women with higher selenium levels tend to have better oocyte quality and higher fertilization rates during IVF treatments [14-16]. These findings suggest that selenium supplementation could offer significant benefits to women undergoing fertility treatments, potentially enhancing their chances of successful conception [17].

The Importance of Balanced Selenium Intake

While the benefits of selenium for fertility are clear, it is important to note that selenium must be consumed in appropriate amounts. Both selenium deficiency and excess can have adverse effects on health. Selenium toxicity, known as selenosis, can lead to symptoms such as gastrointestinal distress, hair loss, cardiovascular and neurological damage [18]. Therefore, it is crucial to maintain selenium levels within the recommended dietary allowance (RDA), which is typically around 55 micrograms per day for adults (14–50 years age group) [19]. Dietary sources of selenium include Brazil nuts, seafood, meat, eggs, and whole grains. For those with difficulty maintaining adequate selenium levels through diet alone, supplements are available. However, it is advisable to consult with a healthcare provider before starting any supplementation, especially for individuals undergoing fertility treatments.

Future Directions in Selenium and Fertility Research

As the research on selenium and fertility continues to expand, several promising avenues for further exploration have emerged. A critical area of study involves determining the optimal dosage and duration of selenium supplementation to ensure maximum efficacy in improving fertility outcomes. Additionally, investigating the potential synergistic effects of selenium when combined with other antioxidants and nutrients could uncover novel strategies for enhancing reproductive health [20].

Furthermore, genetic variations in the genes responsible for selenium uptake, metabolism, and regulation have been reported to significantly influence fertility [21]. Recent clinical discoveries, such as the identification of *de novo* missense variants in human selenophosphate synthetase 1 (SEPHS1) - an enzyme essential for selenoprotein synthesis - offer new insights into the molecular mechanisms linking selenium to human disorders [22,23]. These findings could pave the way for more targeted approaches in addressing fertility issues, particularly those rooted in genetic anomalies.

In addition, the rise of personalized medicine presents a unique opportunity to tailor selenium supplementation based on an individual's specific selenium status, genetic background, and fertility challenges. This approach holds the potential to significantly enhance the effectiveness of selenium in treating infertility, offering more precise and customized treatment plans for couples struggling to conceive.

Conclusion

Selenium is a crucial nutrient with a significant impact on reproductive health. Its potent antioxidant properties help protect against oxidative stress, thereby improving sperm quality and enhancing oocyte development. This makes selenium a valuable asset in the fight against infertility. As emerging research continues to highlight the benefits of selenium, it may become an integral component of fertility treatments, offering renewed hope to couples striving to conceive. However, it is essential to approach selenium supplementation with caution, as maintaining the right balance is key. By effectively harnessing the benefits of selenium, we can make meaningful progress in enhancing reproductive health and increasing the likelihood of successful conception.

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