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# Impact of pre-conception diet on female infertility

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**Abstract**

**Introduction and purpose**

Infertility is defined as a condition characterized by the inability to become clinically pregnant after 12 months of regular, unprotected sexual intercourse, or because a person's ability to reproduce, either as an individual or with his or her partner, is impaired. Infertility affects between 8% and 12% of couples of reproductive age worldwide. Fertility decline in women begins as early as age 25-30. The purpose of this article is to present the problem of infertility in women, possible diagnostic options, methods of prevention and treatment of infertility. We draw attention to the important role of a proper lifestyle, including diet in the fight against infertility.

**State of knowledge**

The article reviews the literature on infertility with special attention to the problem of infertility in women. Knowing the causes of infertility, it is possible to implement targeted diagnosis and then treatment. Attention is paid to the influence of proper diet on female fertility.

## Material and method

A review of the literature available on PubMed and Google Schoolar was conducted. We focused on presenting different causes of infertility in women, diagnostic options, treatment methods depending on the cause of the problem. We paid special attention to proper diet and its impact on female fertility.


## Summary

In our review, we presented how big a problem female infertility is. We managed to describe the current state of knowledge on the definition, epidemiology of fertility and infertility, and the main causes of female infertility. Based on a number of studies, we have proven the beneficial effects of a proper lifestyle with emphasis on a proper diet.



**Keywords:** Infertility; Female fertility; Diet and female fertility; Metabolic factors; Reproductive health;


## Introduction

Fertility is the ability to have a clinical pregnancy.[1] Worldwide, >186 million people suffer from infertility, most of them living in developing countries.[1] The strongest factor affecting fertility is the increasing age of women at conception.[2] Lifestyle and environmental factors are having an increasing impact on fertility. Female infertility accounts for about 50% of all infertility cases, while about 20-30% are caused by a combination of male and female infertility.[3] Modifiable factors associated with a healthy lifestyle such as preconception dieting, anxiety, stress, and obesity are closely associated with increased risk of infertility and poor fertility outcomes.[4-6] Maintaining a healthy diet before conception is a key modifiable risk factor for infertility. Cross-sectional and prospective studies have shown that adjusting dietary patterns before conception and aligning them with international dietary guidelines can benefit reproductive and fertility outcomes such as ovulation and menstrual regularity.[7-9]

## Purpose

The purpose of this paper is to demonstrate how a properly balanced diet maintained before conception has a huge impact on fertility in women. We also highlight the causes, diagnostic, preventive and treatment options for infertility.

## Material and methods

The World Health Organization (WHO) reports that to date there are as many as 80 million women in the world suffering from infertility. Meanwhile, the prevalence of infertility is approximately 50% of all women in developing countries.[10] The inability to get pregnant is associated with greater vulnerability to psychological disorders in women. In our work, we look at the aspect of infertility in women, possible methods of diagnosis, treatment, and present the positive aspect of a proper diet in preventing and reducing the risk of infertility. For this purpose, we reviewed publicly available article databases such as PubMed and Google Schoolar.

## Results

In our review, we shed light on the positive aspect of adhering to a balanced diet in women suffering from infertility. We presented the potential benefits in improving fertility outcomes in women maintaining a healthy diet before pregnancy. In reviewing a number of articles, we highlighted other possible modifiable and non-modifiable factors of infertility and their diagnostic and treatment options.

## Infertility

Infertility is a problem that affects many couples around the world. In women, infertility is a complex problem that requires accurate diagnosis and a personalized approach to treatment. The problem can have many causes such as hormonal disorders, mechanical obstructions in the reproductive system and environmental factors. Thanks to advances in medicine, there are many methods available that can help couples fulfill the dream of having a child.

## Epidemiology and pathogenesis

Infertility is a global health problem. It is estimated that about 10-15% of couples around the world experience problems getting pregnant. According to the World Health Organization (WHO) in 2021, this is about 48 million couples worldwide Female infertility accounts for only 35%, so it is estimated that about 1 in 6 women of reproductive age, have fertility problems, while 15% of infertility cases remain unexplained. [11]

Infertility in women can result from a variety of factors. Among the most common causes are hormonal disorders that can affect the menstrual cycle and ovulation. Mechanical causes such as obstruction of the fallopian tubes, which can prevent the process of fertilization .[12] Another important factor is endometriosis leading to inflammation, scarring and adhesions, making it difficult to get pregnant. Anatomical defects of the uterus, uterine myomas or polyps can also affect fertility. The age of mothers-to-be is also an important consideration. Women's fertility declines with age, especially after the age of 35. [13]

Hormones play a crucial role in regulating the menstrual cycle and ovulation. Hormonal disorders can affect every phase of the reproductive cycle. The most common cause is polycystic ovary syndrome (PCOS). In this mechanism of infertility, excessive production of androgens by the ovaries contributes to irregular ovulation or anovulation. Many women with PCOS typically have insulin resistance, leading to high insulin levels in the blood. This condition exacerbates hyperandrogenism, further disrupting the hormonal balance necessary for regular ovulation.[14] Thyroid hormones are crucial to many aspects of body function, including fertility. Both hyperthyroidism and hypothyroidism can affect ovulation and fertility. Hypothyroidism (hypothyroidism) affects 1.4 percent of people worldwide and can lead to irregular menstrual cycles, which can make ovulation difficult or impossible, cause decreased production of sex hormones and affect ovarian function.[15] Sustained low levels of thyroid hormones can affect the mucosal layer of the uterus, thereby impeding embryo implantation.[16] On the other hand, excess thyroid hormones can accelerate the depletion of ovarian reserve, which affects the ability to get pregnant. Prolactin is also an important hormone. High levels of

prolactin can inhibit the secretion of gonadotropin-releasing hormone (GnRH), leading to lower levels of luteinizing hormone (LH) and folliculotropic hormone (FSH). This disrupts the normal menstrual cycle and can result in a lack of ovulation.

Women with hyperprolactinemia may experience irregular periods or a lack of menstruation. Additionally, insufficient progesterone production during the luteal phase can lead to implantation problems and early pregnancy loss.[17]

The fallopian tubes play a crucial role in transporting the egg from the ovary to the uterus and facilitating fertilization. Issues within this part of the reproductive tract can lead to infertility. Obstruction of the fallopian tubes may result from infections (such as chlamydia), endometriosis, or pelvic surgery, all of which can cause scarring and adhesions.[18]

Endometriosis is a condition affecting the female reproductive organs, where cells from the endometrium are found outside the uterine cavity. These ectopic cells have secretory activity, leading to scarring and adhesions, which can impact the function of the ovaries, fallopian tubes, and uterus. This can hinder egg release, fertilization, and implantation.[19]

The inflammation and hormonal imbalance caused by endometriosis can affect ovulation, leading to irregular menstrual cycles or lack of ovulation and, in addition, high levels of inflammatory cytokines in the pelvic environment can impair sperm function and embryo development. Especially when the ovaries are affected, it can negatively affect the quality of egg cells, reducing the chances of successful fertilization. Even if fertilization occurs, the altered environment in the uterus caused by endometriosis can impede implantation and embryo development.[20-21]

Anatomical abnormalities such as intrauterine septa and uterine lesions can also lead to infertility. Uterine myomas, or benign tumors, and endometrial polyps, which can cause changes in the structure of the uterus and impede embryo implantation.

Diabetes, both type 1 and type 2, can significantly affect fertility. Mechanisms through which diabetes causes infertility include hormonal disturbances. Insulin resistance and hyperinsulinemia can lead to irregular menstrual cycles and ovulation problems.[22] Prolonged hyperglycemia can result in ovarian ischemia and diabetic neuropathy, affecting the function of the reproductive system. Inflammation and oxidative stress lead to damage to the ovum and impede fertilization and embryo implantation.[23-24] Diseases such as Crohn's disease and ulcerative colitis can affect fertility through chronic inflammation. Also, surgical treatment for IBD can lead to adhesions and scarring, negatively affecting fertility.[25-26] Systemic lupus erythematosus (SLE) is a chronic autoimmune disease that can affect fertility .Severe inflammation and involvement of critical organs, such as the kidneys, can reduce overall health and reproductive capacity. Some drugs used in treatment, such as cyclophosphamide, can have gonadotoxic effects, potentially leading to premature ovarian failure and infertility. Women with lupus may have antiphospholipid antibodies, which are associated with an increased risk of blood clots and pregnancy complications, including recurrent miscarriage. Autoantibodies can also directly attack reproductive tissues, affecting ovarian function and embryo implantation. Chronic inflammation can disrupt the hypothalamic-pituitary-ovarian axis, leading to irregular periods and lack of ovulation. [27-28]

Ovarian and uterine cancers can directly affect fertility by damaging these organs. Treatment of such cancers often involves surgery, which can lead to the removal of part or all of the genital

organ, and in addition, surgeries can cause scarring and other tissue changes that can affect genital function. Chemotherapy and radiation therapy can damage egg cells in women and accelerate ovarian function decline, potentially leading to premature menopause.
Additionally, cancer treatment may include hormone therapy, which affects ovarian function and alters estrogen and progesterone levels. [29-30]
Various drugs can affect female fertility, both directly impacting the reproductive system and through endocrine disruption and other mechanisms. The main groups of drugs include alkylating agents (cyclophosphamide), antimetabolites (methotrexate), topoisomerase inhibitors (etoposide), immunosuppressants (cyclosporine), hormonal drugs (goserelin), antiepileptics (valproate), antipsychotics (haloperidol), antidepressants (risperidone), analgesics (NSAIDs), anti-inflammatories, anabolic steroids, and antibiotics (nitrofurantoin).[31]
Lifestyle has a significant impact on fertility. Factors related to diet, physical activity, habits, stress and environment can affect the ability to conceive. Being overweight, obese and underweight, can lead to hormonal disorders that affect the menstrual cycle and ovulation. Women who face tobacco risk accelerated loss of ovarian reserve resulting in the risk of earlier menopause. On the other hand, alcohol consumption disrupts the menstrual cycle and ovulation. Those subjected to prolonged stress can consequently lead to a disruption in the production of sex hormones, which will affect fertility in the future.[32-33]

**Diagnosis**

Diagnosing infertility in women requires several steps, which may include various tests and analyses. The key, of course, is a detailed medical history, which includes medical history, menstrual cycles, pregnancy history, previous treatment, lifestyle and possible symptoms. Diagnosis is then carried out based on blood tests. Particular attention is paid to the analysis of hormone levels, namely estrogen, progesterone, FSH (folliculotropic hormone), LH (luteinizing hormone) and TSH (thyroid stimulating hormone). The presence of a possible gonorrhea or chlamydia infection should also be checked. Diagnosis is also expanded to include imaging tests such as ultrasonography and hysterosalpingography, an X-ray examination that assesses the patency of the fallopian tubes and the condition of the uterus.[34] Diagnosis also uses ovulation assessment tests, which involve monitoring the menstrual cycle with ovulation tests, body temperature charts or testing progesterone levels during the luteal phase of the cycle. In some cases, laparoscopy may be necessary to directly assess the condition of the ovaries, fallopian tubes and uterus and detect possible endometriosis or other abnormalities. An endometrial biopsy may be performed to evaluate the endometrial mucosal layer, which is important for assessing its preparation for embryo implantation.[35-37]

**Classification**

The classification of infertility in women is based on various criteria that help determine the causes and select appropriate treatments. Primary infertility describes problems getting pregnant after a year of regular, unprotected sexual intercourse. Secondary infertility, on the other hand, is problems getting pregnant after a previous pregnancy, lasting at least a year.[38] There is also a division based on causative factors and by location of the problem.[39]

**Treatment**

Treatment of female infertility depends on the cause of the problem, the ovarian reserve, the patient's age and the duration of infertility. Waiting management is based on extending the total period of natural attempts to get pregnant to a total of 2 years.

In this situation, the patient is advised to make lifestyle adjustments. Making certain changes can significantly improve the chances of getting pregnant. Eating a variety of foods rich in vitamins, minerals and antioxidants supports reproductive health. Particularly important are foods rich in folic acid, vitamin D, iron and omega-3 fatty acids. Limiting the intake of simple sugars, trans fats and processed foods can improve hormonal balance. Being overweight, obese and underweight can negatively affect fertility. Optimal body weight supports the regularity of menstrual cycles and ovulation. Moderate exercise (e.g., walking, yoga, swimming) helps maintain a healthy weight and improves blood circulation. Relaxation techniques such as meditation, yoga, and deep breathing can help reduce stress levels, which affect hormonal balance and fertility.[40-41]

Pharmacotherapy with ovulation-inducing drugs, that is, the use of clomiphene citrate in combination with intercourse. According to studies, ovulation stimulation in women with indeterminate infertility is not recommended, due to its negative effects on the endometrium, reduced chance of pregnancy and increased risk of multiple pregnancy. Women with indeterminate infertility who do not agree to continue a wait-and-see attitude may opt for intrauterine insemination. It involves inserting sperm directly into the uterus at the time of ovulation, which increases the chance of conception.[42] After about 2 years of natural efforts to get pregnant, women whose age is less than 35 may be offered in vitro fertilization. If a woman's age exceeds 35, in vitro fertilization is the procedure of choice after a year of trying. It involves the fusion of reproductive cells outside the woman's body. If the infertility problem is caused by ovarian cysts, endometriosis myomas, adhesions or a septum in the uterine cavity, surgical treatment is the procedure.[43-45]

**Effect of diet on female infertility**

Diet before conception is a modifiable risk factor for infertility. Limiting products that contain higher amounts of trans fatty acids (TFA) and saturated fatty acids (SFA), sodium, and simple sugars, and promoting the consumption of unsaturated fats, as well as whole grains, dairy products, vegetables, and fruits, can improve fertility.[46] Higher intake of unhealthy foods is thought to cause greater oxidative stress and inflammation which is a key role in poorer fertility outcomes.[47-51]

Many publications have compared the effects of different dietary patterns on fertility. The Western pattern has been shown to have a negative effect on fertility, in contrast to the Mediterranean pattern, where an inverse correlation has been observed.[52-54] The Mediterranean diet is characterized by the consumption of plant-based foods, fatty marine fish, poultry, low-fat dairy products, and whole grain cereal products. It is also characterized by limiting the consumption of simple sugars and red meat. Alcohol consumption should be moderate, and olive oil is the main source of fat.[55-56] In women of childbearing age, the Mediterranean diet reduces the risk of weight gain and insulin resistance, which has a beneficial effect on the possibility of pregnancy. The Western diet negatively affects endocrine metabolism.[57-58] This

diet mainly includes carbohydrates with a high glycemic index, sweets, sugary drinks, large amounts of animal protein, saturated fatty acids and trans fatty acids.
This diet is also characterized by low intake of vegetables, fruits, dietary fiber, vitamins, lean poultry and fish. [58-60]
The Nurses Health Cohort Study II (NHS II) conducted in women participating in the "fertility diet" dietary pattern was associated with a lower risk of impaired fertility due to other factors.[61]
Consuming 5% of energy from plant protein instead of animal protein has been shown to reduce the risk of non-ovulatory infertility by up to 50%. This may be due to the fact that the insulin response when consuming plant protein is weaker than when consuming animal protein. In contrast, replacing 5% of energy requirements of carbohydrates with plant protein can reduce the risk of ovulatory disorders by up to 43%.[62] The anti-inflammatory effects of diets have been well proven.[63-65]
Smoking, coffee and alcohol abuse:
In women, smoking is associated with a decrease in ovarian reserves, delayed conception and an increased risk of spontaneous miscarriage.[66-67] Excessive alcohol consumption indirectly affects fertility when associated with eating disorders or secondary health disorders.[68]
Firns and colleagues evaluated the impact of these factors on in vitro fertilization outcomes in 351 couples.[68] The analysis showed that cigarette smoking strongly damages gamete quality in both sexes resulting in reduced ovarian reserve in women and impaired sperm quality in men. In contrast, women's alcohol consumption showed no significant correlation with fertility in either men or women.
Evidence suggests that high caffeine consumption may result in longer time to conception and increased risk of miscarriage.[68] Caffeine consumption may affect ovulatory fertility by affecting reproductive hormone concentrations, changes in hormone metabolism and ovarian activity. Caffeine consumption can negatively affect cycle length. High caffeine intake (>300 mg/day) may inhibit ovulation, while the mechanism is still unclear. [69]

**Discussion**

Infertility has become a big problem that more and more couples trying to have offspring face every year. Our work has highlighted a number of causes of infertility in women. The evidence presented above suggests that a proper lifestyle with the presence of physical activity and an emphasis on a proper diet may contribute to reducing fertility problems in the general population of reproductive age. A proper diet may also be an effective treatment for women with pre-existing infertility. There is strong evidence that healthy dietary habits adopted before conception in both men and women of childbearing age have beneficial effects on fertility.

**Conclusion**

In the present study, we have demonstrated the positive effects of a proper diet on the prevention and treatment of infertility. A well-balanced plant-based diet with a low glycemic index and little processed food has a positive effect on female fertility. A plant-based diet with plenty of plant protein, fruits, vegetables, antioxidants, olive oil and adequate fiber has been shown to be associated with improved fertility. Unhealthy diets characterized by consumption of high amounts of sugars mainly sweets, sweetened beverages, refined grains and processed foods

adversely affect fertility through potential mechanisms such as exacerbating inflammation. We also presented the negative impact of smoking in women trying to get pregnant.
We highlighted the impact of alcohol abuse, finding negative effects of alcohol associated with current nutritional status and secondary health disorders.

## DISCLOSURE

### Author's contribution

Conceptualization, Weronika Kahan and Dominika Poborowska; methodology, Weronika Szafrańska; software, Katarzyna Polańska; check, Marta Wojaczek and Magdalena Kras; formal analysis, Agnieszka Kosińska and Piotr Niedbał; investigation, Marcin Łata and Katarzyna Lelek; resources, Dominika Poborowska; data curation, Weronika Kahan; writing - rough preparation,Katarzyna Polańska; writing - review and editing, Marta Wojaczek; visualization, Magdalena Kras; supervision, Agnieszka Kosińska and Piotr Niedbał; project administration, Marcin Łata and Katarzyna Lelek ; receiving funding - no specific funding.
All authors have read and agreed with the published version of the manuscript.

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The data presented in this study is available upon request from the correspondent author.

### Conflict of interest

The authors deny any conflict of interest

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