MOLENDA, Marek Jarosław, WOSZCZYŃSKA, Oliwia Brygida, RYCĄBEL, Paweł Maciej, ROMANIUK, Mateusz, WACHOWSKA, Maria, PANIAK, Mateusz, SOWIŃSKI, Wojciech Jan, SZYMURA, Marta, WOJCIECHOWSKA, Agnieszka Ewelina, and KRAWCZYK, Michał Bruon. The Impact of Lifestyle and External Factors on Male Fertility. Quality in Sport. 2025;39:59093. eISSN 2450-3118.
https://dx.doi.org/10.12775/QS.2025.39.59093
https://apcz.umk.pl/QS/article/view/59093

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 28.02.2025. Revised: 07.03.2025. Accepted: 17.03.2025. Published: 18.03.2025.

The Impact of Lifestyle and External Factors on Male Fertility

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ABSTRACT

Introduction:

In today's world, where expectations for professional success are constantly increasing, modern men are particularly vulnerable to prolonged stress and its negative health consequences.

Numerous everyday factors, often overlooked, such as diet, physical activity, and proper recovery, can significantly impact male reproductive capabilities. It is estimated that fertility issues affect approximately 15% of couples worldwide, with male-related factors accounting for about half of these cases. This is a concern that cannot be ignored.

This study aims to analyze the influence of lifestyle and various environmental factors on male fertility.

Research Objective: The primary aim of this literature review is to evaluate the impact of lifestyle and broadly understood external factors on sperm quality and male fertility in light of the latest scientific research.

Materials and Methods: This article is a literature analysis based on publications from the PubMed database between 2014 and 2024, using the following keywords: "stimulants", "male fertility", "physical activity", and "diet."

Conclusions: To achieve optimal reproductive function, men should maintain a healthy and balanced diet inspired by the Mediterranean model, along with physical activity tailored to their individual needs. Further research on male fertility is necessary, as current findings do not yet allow for definitive conclusions.

Keywords: stimulants, male fertility, physical activity, diet

1. Introduction and purpose

For some time now, in the face of declining birth rates in many countries worldwide, the causes of this phenomenon have been increasingly analyzed. Given the ineffectiveness of numerous pro-family initiatives implemented by governments—such as tax relief or financial support for large families—research has shifted beyond the socio-economic situation of reproductive-age couples. A hypothesis has emerged suggesting that men's health and long-standing habits, developed from an early age, may play a crucial role in the decreasing number of births. Therefore, a broader and more determined discussion is necessary regarding a healthy lifestyle, including proper nutrition, maintaining a balance between work and personal life, and paying greater attention to fundamental bodily needs, such as adequate sleep and stress reduction.

2. The impact of popular stimulants on male fertility

2.1 Ethyl alcohol

Chronic consumption of ethanol leads to sexual dysfunction and a decline in semen quality. [1]

Prolonged exposure to alcohol negatively affects reproductive health by disrupting the function of the hypothalamic-pituitary-gonadal axis. [2]

As a result, the process of spermatogenesis is impaired. Another factor contributing to reduced

fertility may be abnormalities in sperm maturation and development during their storage in the epididymal tail and transport through the seminal vesicle.

Studies have shown that rats administered ethanol orally during spermatogenesis exhibited histological changes in the epididymal tail and seminal vesicle. These changes included a reduction in epithelial cell height and an increased number of collagen fibers in the muscle layer, indicating a fibrotic process. [3]

Stress contributes to increased alcohol consumption among men; however, the effects of ethanol on male fertility under stressful conditions remain insufficiently understood. [4]

2.2 Caffeine

Most studies have not demonstrated a significant impact of caffeine on semen parameters, at least when derived from coffee, tea, and cocoa. However, some analyses have noted that coffee consumption in men could be associated with a longer time to conception. [5a]

On the other hand, other studies suggest that caffeine, as an adenosine receptor antagonist, may influence fertility by affecting semen quality. It has been observed that the consumption of caffeinated soft drinks and energy drinks was linked to reduced male fertility. [6]

Regarding sperm DNA damage, caffeine may contribute to aneuploidy and DNA fragmentation, although no effect has been found on other genetic damage indicators. [5b]

Caffeine is a widely consumed substance found in many beverages, and its intake, particularly in the form of energy drinks, is increasing among young individuals of reproductive age. It has been identified as a regulator of cellular metabolism, leading to the hypothesis that it may influence metabolic processes and oxidative balance in Sertoli cells (hSC), which are crucial for spermatogenesis.

In studies on hSC cultures, the effects of various caffeine concentrations (5, 50, 500 μM) were analyzed. Lower doses (5 and 50 μM) increased lactate production, whereas the highest dose (500 μM) stimulated lactate dehydrogenase (LDH) activity, supporting lactate synthesis.

Notably, the antioxidant capacity of hSC decreased as caffeine concentration increased, and at 500 μM, a pro-oxidative effect was observed, leading to oxidative protein damage.

Therefore, moderate caffeine consumption does not appear to negatively impact male fertility, as it may support lactate production by Sertoli cells, which promotes the survival of reproductive cells. However, excessive consumption of energy drinks and caffeine-containing products may have detrimental effects on hSC function, potentially leading to spermatogenesis disorders. [7]

2.3 Tobacco smoke and e-cigarettes

Analyses have demonstrated a significant correlation between smoking and the deterioration of semen parameters in men struggling with both primary and secondary infertility. [8]

Regular cigarette smoking has been associated with a substantial decrease in sperm count, progressive motility, and the percentage of morphologically normal sperm. This was observed when comparing smokers with non-smoking men experiencing infertility. [9]

Additionally, a higher level of abnormal sperm chromatin condensation was found in smokers compared to non-smokers. The severity of adverse changes, such as reduced progressive motility, total motility, viability, and impaired sperm morphology, showed a strong correlation with the number of cigarettes smoked. [10a]

Cotinine, a key biomarker of nicotine exposure, has been found to have an inverse correlation with semen quality in smoking men, particularly those facing fertility issues. [11]

These findings confirm that smoking negatively impacts semen parameters, and the extent of these changes depends on the number of cigarettes smoked and the duration of the habit. [10b]

Furthermore, smokers were observed to have lower zinc levels in both serum and semen compared to non-smokers, which may influence their metabolic health. However, no significant differences were noted in hormone levels, such as LH, FSH, inhibin B, testosterone, or estradiol, between smokers and non-smokers. [12]

The impact of e-cigarettes on male fertility also warrants attention. Daily use of electronic cigarettes was linked to a significant reduction in total sperm count—an average of 91 million

compared to 147 million in non-smokers. A similar trend was observed in traditional cigarette users, with an average of 103 million sperm compared to 139 million when additional factors were considered.

The obtained results indicate that both conventional cigarettes and their electronic counterparts may negatively affect sperm count. This information may be particularly relevant for men planning to conceive, as e-cigarettes are often perceived as a less harmful alternative to traditional smoking. [13]

2.4 Drugs

Psychoactive substances have a detrimental impact on the male reproductive system, affecting libido, androgen production, spermatogenesis, and sperm quality. Their effects include direct testicular toxicity, leading to oxidative stress, inflammation, and increased apoptosis of cells. Additionally, these substances disrupt the hypothalamic-pituitary-testicular axis, resulting in lower circulating androgen levels, impaired spermatogenesis, and reduced semen quality. [14a]

One study described a case of a patient who had been undergoing amphetamine-dextroamphetamine (Adderall) therapy for ADHD for eight months before seeking treatment at an infertility clinic. The analysis revealed azoospermia, confirmed by two separate semen analyses conducted two weeks apart. Additionally, the patient exhibited reduced levels of testosterone, prolactin, luteinizing hormone (LH), and follicle-stimulating hormone (FSH). After discontinuing the medication for five months, semen parameters returned to normal, ultimately leading to natural conception. [15]

In summary, chronic use of psychoactive substances negatively affects not only male sexual and erectile function but also testicular activity, including testosterone levels, spermatogenesis, and sperm quality. Furthermore, their use may lead to structural changes in testicular tissue. [14b]

Avoiding psychoactive substances should be a standard health recommendation for all men struggling with fertility issues. However, despite the growing number of studies, there is still a lack of sufficient clinical evidence conclusively confirming the direct harmful effects of recreational drugs on spermatogenesis. [16]

3. the impact of diet and physical activity on fertility

3.1 Diet

Studies confirm that excessive body weight negatively affects male fertility, while its reduction can lead to improvements. [17] Overweight and obesity are associated with poorer semen parameters, such as ejaculate volume, sperm count and concentration, motility, viability, and normal morphology. Moreover, they can lead to hormonal imbalances, including lower levels of inhibin B, testosterone, and sex hormone-binding globulin, as well as increased estradiol levels, which are unfavorable for optimal fertility. [18]

An improper diet and excessive body weight may contribute to the development of metabolic syndrome (MetS), which has been linked to reduced fertility. Men affected by this syndrome exhibit lower testosterone and inhibin B levels, as well as deteriorated semen quality, characterized by reduced sperm count, limited motility, and a higher degree of DNA fragmentation. [19]

The consumption of certain nutrients may positively influence male fertility. A diet rich in omega-3 fatty acids, antioxidants (including vitamins C and E, β-carotene, selenium, zinc, cryptoxanthin, and lycopene), as well as vitamin D and folic acid, may contribute to improved semen quality. Foods particularly beneficial for fertility include fish, poultry, vegetables, fruits, whole grains, and low-fat dairy products. On the other hand, high consumption of red and processed meat, potatoes, soy products, sugary drinks, and sweets may have a negative impact on semen parameters. [20]

Some supplements, such as coenzyme Q10 (CoQ10) and carnitine, have been associated with improved sperm quality. Additionally, nuts and fiber-rich products may have beneficial effects. [21] Numerous studies have also indicated that antioxidants, such as N-acetylcysteine and lycopene, may support fertility by improving semen parameters. [22] Therefore, their supplementation is recommended for men struggling with infertility. [23]

In some parts of the world, a diet naturally rich in antioxidants reduces the need for supplementation. A plant-based diet with a low glycemic index, especially one following Mediterranean dietary patterns, has been shown to be beneficial for fertility. Studies have demonstrated that such a diet helps protect against chronic diseases associated with oxidative stress and may enhance the chances of conception. [24]

Beyond the composition of the diet, the origin of consumed food and its processing methods are also crucial. Research has shown that male fertility can be weakened by various environmental substances, such as disinfection by-products in water, pesticides, persistent chlorinated pollutants, phthalates found in plastic food packaging, and hormones used in animal farming. [25]

3.2 Physical activity

Studies indicate that a sedentary lifestyle may negatively affect male fertility. [26] A statistically significant relationship has been observed between physical activity and improvements in semen parameters, such as sperm concentration, total sperm count, motility, and normal morphology. Regular exercise may therefore play a key role in enhancing semen quality and, in some cases, even contribute to reversing male infertility. [27]

Physical activity can support the process of spermatogenesis by increasing the antioxidant capacity of the testes, reducing pro-inflammatory cytokine levels, and improving steroidogenesis. However, excessive exercise intensity may have the opposite effect, leading to dysfunction of the hypothalamic-pituitary-gonadal axis, increased oxidative stress, and chronic inflammation. As a result, this can lead to lower testosterone levels and deteriorated semen quality, increasing the risk of infertility.

In summary, the impact of physical activity on male fertility depends on an individual's health status, as well as the intensity, duration, and type of exercise performed. [28]

4. The impact of sleep disorders related to shift work on fertility

Research suggests that shift work can negatively impact health, increasing the risk of diabetes, lipid disorders, hypertension, cardiovascular diseases, stomach ulcers, and depression. However, its effects on male urological health have received little attention.

Available data indicate that irregular working hours may contribute to worsened hypogonadism symptoms, reduced semen quality, lower fertility, urinary tract issues, and an increased risk of prostate cancer. A key factor is shift work sleep disorder (SWSD), which affects up to 20% of shift workers. Unfortunately, strategies to mitigate SWSD—such as short naps, controlled light exposure, melatonin supplementation, and sleep aids—show limited effectiveness, and the supporting evidence remains inconclusive. [29]

Shift workers suffering from SWSD tend to have lower testosterone levels and more pronounced hypogonadal symptoms compared to both daytime workers and shift workers without SWSD. This suggests that sleep irregularities commonly associated with shift work may negatively impact male reproductive health. [30]

Summary

Despite the growing number of studies on the impact of lifestyle on male fertility, long-term, randomized, and controlled analyses are still needed to obtain more reliable results. This would allow for a more precise approach to treating male infertility. It is already clear that daily habits and overall lifestyle play a significant role in reproductive capabilities, directly influencing birth rates.

Research indicates that an improperly balanced diet—rich in fatty, high-sugar foods with a high glycemic index—is one of the key factors leading to metabolic disorders, which may negatively affect fertility. Additionally, the consumption of substances such as alcohol, cigarettes, and e-cigarettes can further exacerbate these adverse effects, as they directly harm the male reproductive system.

To support fertility, not only is a healthy diet essential, but also proper body recovery and regular physical activity.

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All authors have read and agreed with the published version of the manuscript.

Funding Statement

The study did not receive special funding.

Institutional Review Board Statement Not applicable.

Informed Consent Statement

Not applicable.

Conflict of Interest Statement

No conflict of interest.

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