

Progress in the influence of high blood pressure, diabetes, lifestyle and environmental factors on the quality of male semen

Li Ren^{1, a}, Chiyu Huang^{1, b}, Heng Hao^{1, c, *}

¹ Hubei University of Chinese Medicine

^a 754007367@qq.com, ^b 1371950068@qq.com, ^{c,*} 2405755091@qq.com

Abstract. Male infertility is a common problem among couples, and about 50% of infertilities are caused by male partners, mainly due to poor sperm quality. The quality of semen is influenced by many factors, including male physical condition, lifestyle and environmental factors. In recent years, there has been widespread concern about the impact of high blood pressure, diabetes, lifestyle and environmental factors on semen quality. In order to study the relationship between high blood pressure, diabetes, lifestyle and environmental factors and sperm quality, we reviewed the relevant literature in the following databases: PubMed/Medline, EMBASE (Elsevier), Scopus, Web of Science and Google Scholar. The study concluded that the decline in male sperm mass, especially in sperm quality associated with high blood pressure, diabetes, poor lifestyle and environmental factors, had a significant impact on human fertility and had become an important public health problem of this century. Infertility can therefore be prevented through a structured plan for lifestyle change, such as education, improved environment, reasonable nutrition, adequate amount of physical exercise and psychological support, to prevent and control high blood pressure and diabetes. This helps couples improve their quality of life and increase their chances of natural conception, or optimize their chances for conception.

Keywords: Male semen quality, High blood pressure, diabetes, Nutrition, Weight Index, physical activity, environmental factors.

1. Introduction

Infertility is recognized as a disease by the World Health Organization. According to large population surveys, approximately 72.4 million couples worldwide are facing infertility problems. The World Health Organization estimates that 9 per cent of couples worldwide have problems with fertility, with male factors accounting for 50 percent of under-fertile couples [1]. As several studies have shown, the net effect is a

7% decrease in fertility [2]. Studies have shown that male infertility may be due to the development or failure of sperm, as well as the presence of mechanical barriers that prevent the bonding of healthy sperm and egg [3]. It is recommended that a sperm test be performed after 2-7 days of abstinence and evaluated on the basis of normal parameters determined by the World Health Organization. Analysis of sperm parameters should be done manually by a professional diagnostic or using methods such as computer-aided sperm analysis (CASA) that can accurately assess sperm vitality in sperm [4]. The World Health Organization's sperm parameters include sperm count, sperm vitality, morphology, progressive sperm counts, pH and sperm volume [5].

A number of factors have been shown to influence the quality of semen, including, but not limited to, high blood pressure, diabetes, lifestyle and environmental factors. This paper summarizes the relevant literature and aims to gain a more comprehensive understanding of the impact of high blood pressure, diabetes, lifestyle and environmental factors on semen quality.

2. High blood pressure

High blood pressure is the leading cause of cardiovascular disease and premature death globally. Although the global average blood pressure has remained stable or slightly decreased over the past four decades, thanks to the widespread use of antihypertensive drugs, the incidence of

hypertension has increased [6]. The study found that men with high blood pressure were more likely to develop one or more sperm abnormalities compared to men without hypertension [7]. In addition, males diagnosed with hypertension showed impaired sperm parameters, with lower sperm volume, sperm vitality, total sperm count and overall sperm number [8]. According to the World Health Organization (WHO) sperm quality criteria (V edition), stratification of males showed that males with high blood pressure were lower in terms of sperm volume, sperm concentration and fertility. Although there are some unoptimal trends in sperm in men with hypertension in terms of motor capacity and total motor count, these trends are not statistically significant [9].

Currently, few studies link high blood pressure to certain aspects of sperm physiology. A group of researchers in Brazil, using a model of renal-vascular hypertension in mice, found a decrease in sexual behavior and impaired sperm health, attributed to imbalances in hydrochloride, testosterone and ovarium stimulants [10]. In addition, a group of Italian researchers found that a small group of men with high blood pressure had higher levels of magnesium protein, which was more associated with abnormal sperm patterns [11]. The study also found changes in the testicular pattern in hypertensive mice, mainly related to vascular changes and impaired testicular vasoconstrictive function [12]. In addition, hypertensive rats showed a decrease in sperm concentration, decreased DNA integrity, and fibroblast dysfunction, increased intra-cellular hyperoxygenic ion activity, and an increase in the percentage of abnormal sperm. These findings provide a deeper understanding of the effect of arterial hypertension on testicles and confirm that the testicles are another organ affected by high blood pressure and have the ability to affect sperm mass [12]. It should be noted that these studies are of a small scale and are exploratory in nature.

3. Diabetes

Diabetes (DM) is a disease that causes a range of complications, including malfunction of the male reproductive system. It has been observed that the number of male diabetics is increasing, with almost half of the diabetic males having problems with low sperm quality and decreased reproductive function [13]. In people with diabetes, prolonged high blood sugar can lead to oxidative stress, diabetes neuropathy and insulin resistance. Insulin resistance and its deficiency can cause damage to the abdomen, peritoneum, gland and gland. In addition, it can damage the testicles, germ cells and basal cells, affecting the structures of the small veins and male genitals [13]. During sperm development, glucose metabolism plays an important role, because the basic cell activity and its specific characteristics, such as the ability to exercise and maturity of female sperm, are dependent on glycemic activity.

A survey found that the motility, vitality, survival rate, normal morphological arrangement ratio, semen volume, semen pH, and density of diabetic men decreased significantly [15]. In addition, the levels of interleukin (IL)-18 and IL-17 in the semen of diabetic men increased significantly and were positively correlated with the blood glucose level and sperm DNA fragmentation index [15]. These abnormal cytokine expressions may lead to the decline of semen quality and male infertility [15]. Another study found that the decrease in reproductive hormone concentration led to sexual dysfunction in diabetic patients, and the abnormal parameters were lower than the normal level [16]. In addition, the data show that diabetes not only leads to the decline of sperm parameter quality but also affects sperm quality by affecting the sperm maturation process and increasing sperm DNA and chromatin levels [17]. Further research found that the semen volume, sperm concentration, and total sperm count of diabetic patients decreased significantly, while transmission electron microscopy showed that the mitochondrial structure of the sperm tail of diabetic patients was damaged [18]. Protein interaction network research shows that the decrease of cystatin C and dipeptidyl peptidase 4 may be one of the reasons for the decrease of sperm motility in diabetic patients [18]. Generally speaking, diabetics face a higher risk of infertility, and the damage mechanisms of type 1 diabetes (DM1) and type 2 diabetes (DM2) to the reproductive system are slightly different [19]. There are significant differences in routine sperm parameters between diabetic patients and the control group.

DM2 causes increased inflammation and oxidative stress, resulting in decreased sperm motility and increased sperm DNA fragmentation. DM1 changes epididymal micturition and causes mitochondrial damage, resulting in decreased sperm motility [19].

4. Lifestyle

4.1 Nutrition

A number of studies have shown that dietary patterns have an impact on semen quality and male fertility [20]. A study found that following healthy eating habits can improve semen quality, especially the indexes related to sperm activity [21]. Another study found that high-fat foods have a bad effect on male fertility [22]. However, a large intake of fruits and vegetables may have a positive impact on sperm quality parameters by improving the antioxidant status of sperm and blood [23]. Vitamin D has an obvious correlation with sperm motility and further motility [24]. Lack or excess of vitamin D may affect the health of sperm and lead to poor reproductive results [25]. Appropriate vitamin C supplementation is related to the improvement of sperm quality [26]. Selenium, vitamin E, vitamin C, folic acid, carotenoids, zinc, and carnitine are all antioxidants in semen [27]. Clinically, taking antioxidants can improve sperm quality and pregnancy [27].

Long-term alcoholism, coffee drinking, or caffeine intake may have adverse effects on the male reproductive system [28]. A Western-style diet rich in trans and saturated fats, high simple carbohydrates, and animal protein but lacking unsaturated fatty acids and dietary fiber is related to the risk of male infertility [29]. On the contrary, the Mediterranean diet, which includes a large number of beans, grains, fruits, and vegetables, a moderate amount of fish and wine, and a small amount of milk and meat, has the function of preventing infertility [29].

Therefore, it is suggested to increase the intake of vegetables, fruits, fish, seafood, nuts, seeds, grains, high-fiber products, poultry, and low-fat dairy products in the diet, which can enhance the fertility of men [30].

4.2 Weight Index

Studies have shown that attaining a normal weight is important for improving sperm quality and male fertility [31]. The study typically uses the body mass index (BMI) to assess the weight of the participants. One study found that weight was correlated with abnormal sperm volume and concentration, with only 6% of men with normal BMI having low sperm, compared to 17% of obese men who had lower sperm. [31] Another study found that excess weight had a negative effect on sperm volume, concentration and progressive total sperm count. The study also found that overweight people had a higher percentage of DNA damage compared to the control group [32]. In addition, obesity, abdominal obesity and excessive intestinal fat can lead to a decrease in non-progressive sperm activity and abnormal sperm shapes [33].

In general, attaining a normal weight is crucial to improving sperm quality and male fertility. Obesity and excessive intestinal fat are associated with decreased sperm mass and abnormal sperm shapes. Therefore, reasonable weight control and reduction of abdominal fat accumulation can promote improved male fertility.

4.3 Physical activity

While some studies have shown that physical activity has no effect on semen quality [35], most studies have confirmed that recreational sports have a positive effect on the quality of semen in healthy and infertile males [36-39]. Moderate exercise is considered an integral part of a healthy lifestyle. Studies show that continued and regular exercise can improve the sperm quality in infertile males [40]. Researchers suggest that moderate intensity physical exercise may be associated with proper sperm-quality indicators, while too much or too little physical activity may lead to a decrease in sperm Quality [41]. Therefore, moderate and regular physical exercise can be beneficial for male fertility.

5. environment

Adverse environmental factors seriously affect the quality of sperm, resulting in decreased sperm density, quantity, vitality, and activity; abnormal sperm morphology; and increased DNA fragments, ultimately leading to male infertility [42]. These include air pollution, pesticide use, exposure to harmful chemicals in the working environment, high temperatures, and excessive radiation [42]. Studies have shown that exposure to gaseous pollutants in the atmosphere, especially sulfur dioxide and carbon monoxide, will adversely affect the quality of semen [43]. Especially in the early stage of sperm development, exposure to pollutants is more likely to cause a decrease in sperm count [43]. Many environmental factors or lifestyles will affect the development and function of the testis in fetus and adulthood. For example, smoking, alcohol, stress, cell phone use, and endocrine-disrupting chemicals [44].

It is worth noting that adverse environmental factors have a significant impact on sperm quality. Reducing exposure to air pollutants, chemicals, and other adverse environmental factors, improving lifestyles, and avoiding bad habits will help improve sperm quality and male fertility.

6. Conclusion

To sum up, men with hypertension are more prone to abnormal semen than men without hypertension, and diabetes also has a negative impact on male reproductive health and fertility, which may lead to decreased sperm quality and infertility. It is suggested to increase the intake of vegetables, fruits, fish, seafood, nuts, seeds, grains, high-fiber products, poultry, and low-fat dairy products to enhance male fertility. Maintaining a normal weight, reducing abdominal fat accumulation, and carrying out moderate and regular physical exercise are very important to improving sperm quality and male fertility. In addition, reducing exposure to air pollutants, chemicals, and other adverse environmental factors, improving lifestyles, and avoiding bad habits will also help improve sperm quality and male fertility.

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