

Review

## Coronavirus COVID-19 and its Effect on Erection and Patients' Sexual Disorders: A Narrative Review

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### HIGHLIGHTS

- The newly severe acute respiratory syndrome coronavirus was caused by the coronavirus pandemic 2019 (COVID-19).
- A serious disease affects male reproductive organs, resulting in erectile dysfunction (ED).
- COVID-19 infection can influence men's sexual performance via endothelial harm in erectile tissue, testicular damage, and mental changes.

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### Introduction

During the coronavirus disease pandemic 2019 (COVID-19), significant attention has turned to the consequences of this viral infection. Although the respiratory system is considered the leading site of infection, some research has shown that COVID-19 can also affect other organs, including the vasculature, heart, and kidneys (1).

The general sense of uncertainty and unpredictability connected to this virus as the pandemic and the approved limited steps, along with peoples' increased levels of experienced emotional distress, also affected interpersonal and intimate relationships during this critical period and in the long term (2).

### ABSTRACT

The newly severe acute respiratory syndrome coronavirus caused by the coronavirus pandemic 2019 (COVID-19) resulted in 150 million infections and 3.5 million deaths worldwide. COVID-19 influenced men more than women, with more severe disease and higher mortality rates. A serious illness affects male reproductive organs, resulting in erectile dysfunction (ED). Although the exact pathophysiology of this disease has not been entirely determined yet, this review highlights the possible mechanisms of COVID-19-related sexual disorders led by COVID-19. In summary, the research shed light on COVID-19 infection can influence men's sexual performance via endothelial harm in erectile tissue, testicular damage, and mental changes. Still, longitudinal studies should be performed to determine the mechanism of COVID-19 in ED.

**Keywords:** Coronavirus; COVID-19; Heart and Blood Vessels; Sexual Disorders; Erection

The most important factors influencing the experience of sexual problems and dissatisfaction of a person during this period can be mentioned as individual worries associated with intimate/secure sexual relationships, compelled divorce of friendly couples, and Intensification of marital tensions and aggravation of communication. Differences in sexual need or sexual expression and the absence of respect for privacy during quarantine also aggravate sexual problems and discomfort (3).

This pandemic crisis presents a great chance to study the influence of negative effects on sexuality and sexual performance in individuals. It emerged as a result of increasing research in the past years. In most studies, evidence shows a paradoxical increase in libido and sexual

activity during this critical period in males and females (4, 5), probably as an approach to dealing with negative emotional conditions and regulating emotions. There have been reports on the adverse effects of the COVID-pandemic and related alleviating measures on sexual performance and consent (6-9). A remarkable decrease in men's sexual performance, which significantly worsens the erectile response, has been reported and indicated as linked to the symptoms of anxiety and depression felt during the recent pandemic crisis (10). As a result, lower levels of psychological adaptation during required cells hurt erectile function, libido, and sexual satisfaction in men, which were more significant than the effects of the personal impacts of quarantine (11).

Great attention has been drawn to visualizing male sexual performance within a contextual framework and highlighting the importance of current life stressors (such as critical life events) and their intersection with psychological adjustment in modulating male sexual desire and performance (12). Therefore, this review considers COVID-19-related sexual disorders in men with endothelial dysfunction, testicular failure, and psychological hardship.

### Coronavirus

The coronavirus is a diverse family of RNA viruses. Moreover, after the rhinovirus, it is the most significant cause of common colds, but unlike the rhinovirus, it is challenging to grow and develop in the laboratory. The structure of the coronavirus consists of two layers; Genetic materials in the center of the virus, and its outer layer is formed by spike proteins (13). Due to the characteristic appearance of veins (the infectious form of the virus) seen under the electron microscope, this type of virus refers to having a large, bulbous surface border reminiscent of an image of a royal crown or solar crown. Therefore, the coronavirus is also called a spike virus (14). Most mammals and birds are at risk of this virus, and bats are the hosts of many of their genotypes. However, the human body's respiratory system can also suffer from diseases caused by the coronavirus in such a way that after entering the host cell, the virus mentioned above is uncovered, and its genome enters the cytoplasm and infect the cell. Animal and human coronaviruses are generally placed in 4 genera or different groups (15).

1- Alpha Corona: Viruses have two types of human pathogens (HCOV-229E and HCOV-NL63) and animals (transmissible from the gastrointestinal tract of pigs and the cause of peritonitis infection in cats and include some bat viruses).

2- Beta-Coronaviruses: There are viruses whose human types include HCOV-OC43 and HCOV-HKU1, and their animal one includes murine hepatitis virus, which is a laboratory model for both hepatitis virus and demyelinating disease of the central nervous system, and bovine coronavirus, which causes diarrhea in calves, and several

bat viruses (SARS and MERS). Bovine coronavirus is very similar to HCOV-OC43; therefore, both viruses are placed in the same species known as "beta-coronavirus 1". Also, in 2019, a virus called Covid-19 was identified, which is a part of beta coronaviruses.

Gamma Corona: Viruses include the primary chicken coronavirus; the most common type is the virus that causes bronchitis in chickens. These viruses are vital veterinary pathogens that cause respiratory and airway disease in chickens.

Delta Corona: Viruses that include recently discovered coronaviruses in several species of songbirds (16).

According to the type of coronavirus, COVID-19 can present as a common cold-like illness, with symptoms such as loss of smell and taste, fever, cough, shortness of breath, Smelling stench in the nose, and acute respiratory problems. Also, the patient may have had coughs for a few days. Unlike SARS, MERS affects the respiratory system and other organs, like the kidneys and liver. In acute cases, digestive problems such as diarrhea, respiratory failure, blood coagulation disorders, and renal failure have also been reported, requiring the patient to undergo hemodialysis (17).

In the research and studies on the coronavirus group, various molecular and biochemical research tools are available, including antibodies, immunoassays, and PCR kits. Immunoassays such as ELISA method detect and measure coronavirus proteins such as spike protein. PCR-based methods including reverse transcription PCR and real-time (quantitative) QRT-PCR assay can also detect the coronavirus genome. In addition, recombinant coronavirus proteins, including the tentacle protein (protein S) and the nucleocapsid protein, have been commercially produced, for the virus study and made available to virology researchers (14).

Acute respiratory disease is caused by the new coronavirus, formerly known as 2019-nCoV. The name 2019 coronavirus disease (COVID-19) first became an epidemic in China and other countries. Its origin, like SARS and MERS, was declared the bat genome. On January 30, 2020, the World Health Organization (WHO) declared the coronavirus (COVID-19) outbreak a global pandemic. SARS-CoV-2 is the third large-scale infectious disease after SARS and MERS (15).

The SARS-CoV-2 virus is transmitted through direct contact, airborne droplets, fecal-oral, and mouth from the symptomatic and asymptomatic carriers during incubation (Virus carrier). However, the symptoms of this disease appear differently in different people: Sneezing, sore throat, fever above 38 degrees for a long time, dry cough, fatigue, sputum, respiratory diseases, headache, dizziness, diarrhea, vomiting, septic shock, and bleeding are the apparent symptoms of this disease. In the latest research on this disease, skin allergies, loss of sense of smell and taste, and minor abnormal symptoms in each person's body are signs of COVID-19. It is also

necessary to mention that people with certain underlying diseases such as asthma, high blood pressure, diabetes, cardiovascular diseases, and the elderly are more exposed to COVID-19; in such a way that this disease leads to severe infections, exacerbation of the disease and even death in these people (16).

Some characteristics of the coronavirus family include rapid mutation, transfer to different tissues, easy transfer between different species, and adaptability to various epidemiological situations. From 2019 to 2021, mutated viruses resulting from SARS-CoV-2 emerged with more rapid spread and transmission, more severe symptoms, and mortality beyond the original virus. Many assumptions have been reported about the symptoms of the stability of COVID-19, and children are generally at low risk of infection. The best method to prevent this disease is to avoid contact with infected people and objects. So, Items such as no hand-to-eye, mouth, and nose contact and washing hands continuously with soap for at least 20 seconds, using disposable masks and latex gloves in the outdoor environment, keeping a distance of at least two meters from people who cough, and sneeze, and runny nose, disinfecting equipment with an alcohol pad or disinfectant solution, strengthening the body's immune system by consuming citrus fruits, getting enough sleep and exercise, and drinking fluids are also very effective (18).

To diagnose COVID-19, the World Health Organization introduced the reverse transcription-polymerase chain reaction test by sampling through a throat swab or a chest sputum sample, the most standard known method; the results are usually announced within a few hours to two days. A blood test can only be effective in the case of COVID-19 when a person needs information on COVID-19 infection. Alternatively, two blood samples, two weeks apart, are required for the initial diagnosis of COVID-19 infection, whose results have no immediate value. Chinese scientists were able to isolate a strain of the coronavirus and publish the nucleic acid sequence so that laboratories around the world could independently develop polymerase chain reaction tests to detect infection caused by the virus. Remdesivir, Favipiravir, Lopinavir, and Ritonavir have been used to treat, prevent progression and reduce complications of COVID-19 and have been effective against this disease. Before the discovery of the corona vaccine, doctors discovered that by transferring the plasma of patients recovered from COVID-19 of patients with severe conditions, a defensive shield from the immune system of the recovered against the coronavirus enters the body of the patients and causes them to recover. Finally, in 2020, Russia was the first country to register the first COVID-19 vaccine for use officially, and until now, many countries in the world, including Iran, have produced and injected the vaccine for this disease. Nevertheless, the infection

with COVID-19 continues, and the world is still affected by this disease (19).

#### **Effect of COVID-19 on sexual desire**

New research shows that loss of smell, a symptom of COVID-19, can impact libido. Researchers found a link between loss of smell, or "anosmia," decreased libido and emotional satisfaction in older adults. The sense of smell plays a vital role in sexual motivation, and the association between these two cases is very close. The researchers in this article examined adults aged 65 and older; therefore, this association increases with age and may be less common among young adults. Hence, it is said that the potential causes of olfactory dysfunction may be treated to improve libido and quality of life. Sensory functions are reduced and have various effects on older adults. Previous studies indicate that patients with olfactory dysfunctions report having a sexual desire disorder (20).

In one study, they investigated the effect of decreased sense of smell on desire and sexual satisfaction in the elderly and evaluated 2,084 American adults aged 65 and older. In this research, they considered the effect of reduced sense of smell on the level of sexual desire and satisfaction of older people and assessed 2084 American adults who were  $\geq 65$  years. Through a questionnaire, the olfactory sensitivity of the participants and their level of sexual desire were investigated. According to this research, the decline in olfactory function in adults was associated with a decrease in sexual desire and emotional satisfaction, but it did not reduce the amount of sexual activity. In this study, the participant's ages, gender, race, cognition, disease, and depression were examined, but the researchers could not determine the cause of this problem (20). Studies showed that a decline in olfactory function might affect the sexual pleasure of the elderly. Physicians should discover and eliminate treatable causes of loss of smell to enhance patients' sexual health. This issue can be caused by neural connections between the olfactory function and sexual desire. The sense of smell has a strong and progressive link with the emotional, nervous, or "limbic" system, which plays an essential role in the treatment of emotions and sexual tendencies. The neurons of the olfactory bulb are another major mediator of sexual excitement. The olfactory system is connected to centers in the brain that make it possible to experience pleasure. However, other factors that lead to sexual dysfunction are stress, anxiety, and corona. Its side effects and anxiety over recovery conditions are the reasons that cause stress and, consequently, sexual disorders. Research conducted during the same period indicated that the rate of sexual disorders ranged from 32% to 87% of the study population. Anxiety, depression, and posttraumatic stress disorder have been associated with increased rates of sexual dysfunction. It can be concluded that the corona pandemic is also linked to the increase in the rate of sexual

disorders due to the onset of stress and anxiety.

The more anxiety and depression, the more severe this disorder will be. People working in treatment and health centers are at increased risk of post-traumatic stress disorder (PTSD) and sexual disorders. Consequently, men can reduce the sexual side effects caused by this disease by controlling the stress and anxiety caused by Corona (11, 13, 14). whereas COVID-19 affects all age groups, it is more common among men with hypertension, diabetes, and obesity (19). Immune inflammatory responses induced by SARS-CoV-2, such as cytokine storm and microvascular thromboembolic cases, may lead to critical clinical manifestations related to the lung and cardiovascular system.

On the other hand, it most highly likely causes multifaceted dysfunction for many sexually active individuals encountering economic and psychological pressures and health problems caused by COVID-19. Affecting sexual and reproductive health is inevitable on many levels. Sexually active individuals experienced a decrease in the frequency of sexual intercourse and a reduction in sexual satisfaction as a result of COVID-19 (20). Therefore, the COVID-19 pandemic has disrupted relationships between partners for sex life and sexual performance (20). Among the complications of COVID-19, immediate or permanent ED has been reported as an alternative indicator for cardiovascular disease, particularly endothelial dysfunction. As presented in real life, the relationship between ED and COVID-19 is consistent with the pathophysiological mechanisms connecting link ED, endothelial dysfunction, and COVID-19 (21-23). A growing number of studies in the relevant literature make it possible to associate predominantly organic or psychogenic ED with diseases associated with SARS-CoV-2 infection (24).

#### **Impact of COVID-19 infection on man's reproductive system**

Although most studies conducted on the complications of this virus have focused on the magnitude and manner of damage to vital organs, in particular the lung, limited initial studies indicate the possibility that infection with the coronavirus can cause involvement of the hormone-producing and sperm-producing cells of the testes (19, 20, 25). Due to the emerging and unknown nature of the coronavirus, it is still impossible to state with absolute certainty about the long-term effects of this virus, and the few current studies do not show the occurrence of severe complications in sexual function. However, due to the presence of receptors that the virus uses to go into the cell, they are also on the surface of the male sex hormone-producing cells, i.e., testosterone. It has been suggested that infection with this virus may have lasting effects on men's sexual and reproductive performance (22, 26). High fever is one of the complications of these

viruses and can cause damage to the hormone-producing and sperm-producing cells of the testicles as it increases in the body, but this damage is usually not permanent and resolves within a few months. Nevertheless, if infection with these viruses causes inflammation in the testicles, its destructive effects will be long-term. Evidence shows that these assumptions result from generalizing the studies conducted on similar viruses, and comprehensive and extensive studies have not yet been conducted on the long-term effects of this virus.

The epidemic, the Corona pandemic, and the spread of news related to the COVID-19 disease have caused fear and anxiety in people. Stress and nervous pressures can also cause sexual dysfunction. As a result, this aspect of the illness outbreak should also be considered. Stress and anxiety caused by bad news, fear and worry for oneself, family and future lifestyle changes, and usual relationships are stressful factors that can cause a decrease in sexual desire and sexual dysfunction (27). According to studies, some enzymatic receptors, which are more present in men's testicles, are the main target for coronavirus entry. However, alarming research shows that male sexual dysfunctions are a long-term and worrying complication of coronavirus. They explained that due to the nature of the "cytokine release syndrome" caused by viral infection, there is an increased risk of heart disease, micro thrombosis, and blood clots, all of which can increase the possibility of ED. Cytokine storm is a vicious cycle observed in coronary patients; As a result of this inflammatory disorder, two types of proteins are produced more than needed in the body, and then, in addition to infected cells, healthy cells are also destroyed. Additionally, since the cells that produce testosterone are also greatly affected by the corona infection, doctors are concerned that damage to these cells could lead to subsequent hypogonadism (extremely low levels of natural testosterone production) (23, 28). Doctors published similar findings and warned that erectile dysfunction is likely a long-term consequence of coronavirus infections. The recent follow-up on this initial Italian research shows that these findings are still valid; in addition, it seems that apart from erectile dysfunction and decreased testosterone levels, the number and motility of male sperm have been also significantly decreased due to corona infection (29-31). They also showed that male sexual dysfunction is a possible side effect of viral infection, but erectile dysfunction may be a specific biomarker for those referred to as "long-haulers" or "long-term corona patients". Long-haulers experience prolonged, persistent, and disabling symptoms long after recovering from the virus. These symptoms include "brain fog" (a feeling of confusion or mental fatigue) and reported fatigue, often associated with cardiovascular dysfunction (24, 32).



### **Effect of COVID-19 on testicles**

The testicles are an excellent hideout for viruses, as the eyes and the central nervous system are also safe places for some viruses. In these sites, viruses such as Ebola, Mumps, and Zika can persist in tissues, and even after being cleared from other parts of the body, they can still escape from the immune system in this area (33). By a recent study in this field, it can be assumed that the testicles may act as a reservoir of the virus that causes COVID-19. This virus justifies why 11% of men admitted to the hospital with Corona suffer from testicular pain (28). Infection of the Leydig cells that produce testosterone may also explain the lower levels of the male sex hormone in Langhaller individuals, so this factor alone can cause a decrease in sexual desire. In this situation, a vicious cycle occurs: testosterone production decreases when men have no sex. In other words, Corona causes a decrease in testosterone production, followed by sexual dysfunction. On the other hand, reducing sexual intercourse encourages a decrease in testosterone production, and this vicious cycle repeats continuously (29). The latest research (23) in this field analyzed the autopsy tissues of the testicles of six men who died due to Corona. It was observed that the COVID-19 virus was found in the tissue of one of the men. Also, a decrease in sperm count was observed in three cases, i.e., 50% of the study population. Another patient who survived COVID-19 underwent a testicular biopsy three months after the initial infection cleared, and the biopsy showed that the coronavirus was still present in his testicles. An analysis of penile tissue from two men who received penile implants showed that the COVID virus was present about seven to nine months after being diagnosed with COVID-19. Both men had experienced severe erectile dysfunction, possibly due to reduced blood supply to the penis following the COVID-19 infection. One of the men showed only mild symptoms of COVID -19, but the other was hospitalized. These symptoms suggest that even people with relatively few virus cases can develop severe erectile dysfunction after recovery. These findings are not surprising from the researchers' point of view because scientists know other viruses invade the testicles and affect sperm production and fertility. For example, researchers examined the testicular tissue of six patients who died of the SARS virus in 2006; they found that all had extensive cell destruction with reduced sperm counts. It has also been found that the Mumps and Zika viruses can enter the testicles and cause inflammation. About 20% of men infected with these viruses also experience impaired sperm production (34). However, additional research by this group brought good news. A study of 45 men found that Pfizer's and Moderna's mRNA vaccines are safe for the male reproductive system.

Thus, this is another reason for vaccination to preserve male fertility and sexual function. This research

is only the first step into the impact of COVID-19 on men's sexual health. The samples examined were limited, and these studies should be continued to determine all dimensions of this issue. However, in men who have had COVID-19 and then experience testicular pain, it is reasonable to assume that the virus has invaded testicular tissue, and erectile dysfunction could be one of the results. These people should see a urologist. One of the reasons for doubting and fearing the vaccine is at this point. There are a theory and speculation among many people that the COVID-19 vaccine affects male fertility, but current research shows the opposite of this theory. There is no evidence that the vaccine harms the male reproductive system. However, ignoring the vaccine and contracting COVID-19 can affect men's sexual health (35). In another study, using online questionnaires, the topic of Corona and its effects on sexual disorders were investigated. In this study, 6,500 men worldwide infected with Corona answered the questions. According to their responses, 18% of men reported sexual disorders. About 13% of them had pain in their testicles, 8% mentioned other sexual organ problems, and about 4% of men have observed a decrease in the size of their penis or testicle (22). A study by Quinn et al., (2022) showed that 1,108,3653 male patients were identified through a retrospective analysis of the TriNetX database. A total of 246,990 men were diagnosed with corona on January 1, 2020, while others had no COVID-19. Before propensity score adjustment, men with COVID-19 were older than men without COVID -19 (21. 4±47. 1 vs. 24. 3±42. 4 years). The cohorts were similar in terms of racial and ethnic demographics. In addition, males with coronavirus had an increased prevalence of diabetes mellitus (DM), and hypertension (HTN) compared to men without COVID-19 (14% DM and 27% HTN vs. 9% DM and 22% HTN). After propensity score matching, 230,517 men with prior COVID-19 were compared with 232,645 men without a history of COVID-19. A diagnosis of the corona was found to be remarkably connected with ED and new-onset ED in men with COVID-19 infection. This diagnosis may be due to virus-induced endothelial cell dysfunction. However, an underlying mechanism and cause have not yet been elucidated. While it appears that the COVID-19 infection may be a risk factor for ED, further research is needed to establish causality (36).

### **The effect of coronavirus on blood vessels and male erection**

Since the virus can cause many health problems in the body, poor overall health is one concern associated with erectile dysfunction and other complications. Erectile dysfunction can be a reflection of the overall health of the body. Also, since age is considered a risk factor for erectile dysfunction and severe cases of coronary disease, it should be considered an essential factor. Erectile

dysfunction is a sign of heart disease in the future, and for this reason, it is clear that the body's vascular system is related to the reproductive system. Also, corona disease can cause inflammation throughout the body, especially the heart and surrounding muscles. Circulation of blood through the heart can be blocked by new or aggravated vascular diseases caused by the virus. Some researchers say that corona disease may cause cardiovascular problems and other diseases. Confirmation or rejection of these statements, the detailed statement of the long-term effects of the corona disease has not been made, and the passage of time is needed. Although corona disease can cause erectile dysfunction in various ways, much more research is needed to prove this knowledge. Researchers are still studying the possible and long-term damage of corona disease (14, 15, 18, 36). Although our vascular system is interconnected, vascular problems may manifest in the genitals because these vessels are tiny and can be the first warning of the risk of broader cardiovascular problems. Erectile dysfunction and cardiovascular disease share common risk factors, such as being overweight, metabolic diseases like diabetes, smoking, and old age, all of which increase the likelihood of severe disease from COVID-19 (33).

The penile artery is about one-tenth the size of the coronary artery. Erectile dysfunction may lead to a heart attack after about five years, and this sexual complication may be an early sign of other underlying risk factors. When I see a man for erectile dysfunction, it is not just about prescribing Viagra or Cialis; these men are referred to a primary care physician or consult with a cardiologist to make sure their cholesterol is in the normal range, their diabetes is under control, and to discuss weight management and lifestyle and dietary changes (28). Damage to the endothelial cells that cover blood vessels is the most likely cause of poor sexual performance. While some mammals have bones in their penises, erections in humans depend on blood flow. For a healthy erection, arteries must be open, and veins must be constricted. This is because weak and narrow blood vessels do not allow the spongy tissue to swell with blood or retain blood to maintain an erection. Without enough blood, cells are deprived of oxygen, and tissues become inflamed; Veins also lose their elasticity. Since the penis is one of the body's most vascular organs, it would not be surprising that erectile dysfunction is more common in men with long-term covid. The significance of identifying the virus's short- and long-term effects on the man's genitalia is reinforced by new research that observed COVID-19 particles in penile tissue via transmission electron microscopy and Hematoxylin and Eosin (H&E) staining. Endothelial dysfunction and erectile function depend on functional endothelium and proper vascular flow. Erectile dysfunction is usually a symptom of an underlying problem. Men with poor health are at a higher

risk of having erectile dysfunction as well as having a severe reaction to corona disease (15). Research based on medical imaging and sampling shows that the coronavirus can infect the tissues inside the male genital tract, and this genital infection may continue long after the initial respiratory infection subsides. Scientists say it is still too early to say that there is a causal relationship between corona infection and erectile dysfunction because many factors, including psychological and physiological factors, effectively create and maintain an erection. The corona pandemic has led to social isolation and increased depression and anxiety levels, which may play a role in sexual dysfunction (15). The corona pandemic is a perfect combination of overlapping factors causing erectile dysfunction. Erection in men is much more complicated than it is usually thought: to create an erection, there must be proper blood flow, proper functioning of nerves, and an average level of hormones, especially testosterone. At the same time, there is a need for a good mental state and excitement. If these factors do not work correctly, the erection will be disturbed (14).

#### **COVID-19 vaccine and sexual disorders**

Regarding the effect of the corona vaccine on the testicles, we have much evidence that the harmful effects of Corona are more severe and dangerous than any vaccination effects. So far, in none of these studies, there has been no evidence of an adverse effect of the vaccine on the male reproductive system, including physical reactions such as swelling or shrinking. Due to the different preparation of mRNA vaccines, the immune response generated is not the same as that of other vaccines. People may have inadequate immune responses to live vaccines. However, vaccines like Pfizer and Moderna are not live vaccines, and these vaccines have a different response and do not integrate with the host's DNA. Instead, they break down rapidly in the body once injected. Therefore, no mechanism can cause swelling of the testicle due to the injection of these vaccines (37). According to the research results, Corona's mRNA vaccines did not inhibit sperm production. This research examined corona vaccines and studied the variables related to semen before and after vaccine injection. This research examined corona vaccines, and variables related to semen before and after vaccine injection were studied. There were no specific adverse effects on sperm variables or their function. Even sperm parameters improved, although this effect was not noticeable. This does not mean that the mRNA vaccine improves fertility, but we know it does not harm it (38). No connection has been seen between corona vaccines and ED. However, there seems to be a connection between contracting corona disease and erectile dysfunction. A study in Italy indicates that erectile dysfunction can be a short-term or long-term complication caused by the COVID-19 virus. This study

examined 25 corona-positive men and 75 negative corona men. The prevalence of erectile dysfunction in men who got coronavirus (28%) was much higher than in men who did not (8%).

The researchers also stated that "universal vaccination against COVID-19 and personal protective equipment [such as masks] could have another benefit, which was the prevention of sexual disorders" (37). Coronavirus can cause fertility problems and reduce sperm count. Studies on people who died due to the coronavirus showed that the virus was present in their penises, along with evidence of erectile dysfunction. However, more studies are needed to determine if the disease is sexually transmitted (35). Although there are no reports of testicular pain or discomfort (the effect of the COVID-19 vaccine on the testicles), after vaccination, a joint statement from the Society for Male Reproduction and Urology (SMRU) and the Society for the Study of Male Reproduction (SSMR) mentions About 16 percent of people who participated in the Pfizer-Biotech vaccine clinical trial developed a fever after the second dose. These groups say that fever can cause a temporary decrease in sperm production.

However, this reduction may be similar to or less than the amount that occurs in the case of corona infection (38). Therefore, according to the studies and research done so far, there is no evidence of the negative effect of COVID-19 vaccines on sexual performance or fertility. However, much more information exists about how the virus affects erections and causes fertility problems. Instead of thinking about the problems of the vaccine, consider the harmful effects of coronavirus on your health.

### Conclusions

Until now, no definitive agreement exists about the infection of COVID-19 and its impact on the man's reproductive system. Research on SARS-CoV-2 mRNA or virus in semen or testicular tissue has shown conflicting results. Some studies report no evidence of SARS-CoV-2 in semen or testicular tissue; on the other hand, other research indicates the existence of SARS-CoV-2 in testicular tissue with clinical evidence of hypergonadotropic hypogonadism or damage to spermatogenesis. Like new items, Regarding the effects of COVID-19 on the male reproductive system, there are more doubts and hypotheses than certainties (39). However, based on current knowledge, the healthcare system should study male reproductive system involvement in critically ill patients. Hypothesized mechanisms of this injury include direct viral attack of testicular tissue via ACE2 receptors, temperature-related testicular injury caused by persistent high fever, secondary inflammatory and autoimmune responses, and oxidative stress associated with a viral infection. As

clinical and epidemiological evidence on the effects of COVID-19 on reproductive health and future infertility in male patients is rare, further studies, including long-term follow-up of patients after COVID-19 infection, are needed.

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All authors contributed equally.

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The author declares that there are no conflicts of interest.

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### Ethical statements

Not applicable.

### Data availability

Data will be provided on request.

### Abbreviations

DM	Diabetes mellitus
ED	Erectile dysfunction
H&E	Hemoxylin and eosin
HTN	Hypertension
PTSD	Post-traumatic stress disorder
SMRU	Male Reproduction and Urology
SSMR	Study of Male Reproduction

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