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Research Article

Reduced Libido Is a Major Factor in Decreased Erectile Function among Men with Mild COVID-19

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During the Corona Virus Disease-2019 (COVID-19) pandemic, among men infected with SARS-CoV-2, little attention has been given to reduced libido and its associations with decreased erectile function, even though there may be physical and psychological factors that contribute to the two. So the purpose of the study is to determine the correlation between decreased erectile function and reduced libido in SARS-CoV-2 infected people during the COVID-19 pandemic and to describe the associated clinical, psychic, and lifestyle parameters. We recruited 321 eligible men with SARS-CoV-2 infection in the urology clinic of our hospital. We used the International Index of Erectile Function-5 (IIEF-5), the Patient Health Questionnaire-9 (PHQ-9), 7-item Generalized Anxiety Disorder (GAD-7) module, and Pittsburgh Sleep Quality Index to independently evaluate the subjects, collect relevant data, and analyze the data. In this study, we show that both libido and erectile function were decreased after SARS-CoV-2 infection ($p < 0.0001$), and reduced libido was strongly correlated with decreased erectile function ($p < 0.0001$; odds ratio (OR) = 11.33). In addition, anxiety (OR = 2.41, CI = 1.13–5.23), ($p < 0.05$), symptomatic infection (OR = 3.293, CI = 1.11–11.48), ($p < 0.05$), and body mass index (OR = 0.88, CI = 0.83–0.92), ($p < 0.05$) were also associated with decreased erectile function. So, we think that during the COVID-19 pandemic, for erectile dysfunction patients who decreased erectile function after SARS-CoV-2 infection, we should not only pay attention to patients' erectile function status but also to patients' reduced libido status.

1. Introduction

Corona Virus Disease-2019 (COVID-19) refers to disease caused by SARS-CoV-2 infection, which broke out in 2019 and swept the world. COVID-19 is mainly a disease of the respiratory system [1], but it has a great impact on the circulatory system, digestive system, nervous system, endocrine system, and even the genitourinary system [2–6]. As COVID-19 continues to spread, people are increasingly concerned about its impact on fertility and sexual function. It has been reported that the SARS-CoV-2 can infect the testicles, the male reproductive tract, and cause damage to male fertility [7]. It can also lead to sexual dysfunction in men, such as erectile dysfunction (ED) [8].

ED is one of the most common male sexual dysfunction disorders, which was defined as the consistent or recurrent inability to attain and/or maintain penile erection sufficient for sexual satisfaction at the Fourth International Consultation on Sexual Medicine [9]. ED is a syndrome affecting mental and physical health, it can cause psychological problems (such as, poor self-esteem, depression, and anxiety) in patients, thus decreasing their quality of life [10]. At the same time, the female partners of ED patients are less satisfied with their sexual relations, their sexual life cannot be satisfied, and their frequency of sexual activities decreases significantly, thus worsening the relationship between sexual partners [11], and it can affect the life quality of both the patient and partner [12].

At present, there are few ED articles related to COVID-19, mainly including the following viewpoints: (i) SARS-CoV-2 infection causes extensive endothelial cell dysfunction, which leads to ED [13], (ii) COVID-19 causes ED by directly damaging the testes and reducing testosterone levels [14], and (iii) infection with COVID-19 causes patients to develop mental

disorders (anxiety and depression), which can lead to ED [15]. In addition, a study has shown that people infected with SARS-CoV-2 can experience symptoms of reduced libido [16], but among men infected with SARS-CoV-2, little attention has been paid to the relationship between reduced libido and ED. The concomitant presence and associations of decreased erectile function and reduced libido among men infected with SARS-CoV-2 have not yet been described. Based on the collected relevant questionnaire, we conducted a study on the correlation between decreased erectile function and decreased libido in SARS-CoV-2 infected patients. The aim of the present study was to determine whether reduced libido was the main cause of decreased erectile function in SARS-CoV-2 infected men during the COVID-19 pandemic and to describe the associated clinical, psychic, and lifestyle parameters.

2. Materials and Methods

2.1. Subjects. Subjects were selected from male patients who had been infected with SARS-CoV-2 between December 2022 and March 2023. To be included in the study, all subjects had to meet the following criteria: (i) male patients aged ≥18 years and ≤60 years; (ii) have stable sex for at least 6 months; (iii) no other vascular disease; (iv) no diabetes, hypertension, and other basic diseases; (v) no previous history of depression, anxiety, and other mental disorders; (vi) no history of SARS-CoV-2 infection before this study; (vii) no history of prostate cancer or pelvic radiotherapy; and (viii) with mild COVID-19. The men who met the above criteria could be included in the study, including healthy men. In addition, men on medication that could have affected their erectile function were excluded (e.g., phosphodiesterase 5 inhibitor).

This study was conducted by collecting subjects to fill in questionnaires. After the country's open-door policy on COVID-19 was implemented, we recruited subjects in the outpatient department, asked them to fill in relevant questionnaires, and conducted follow-up visits. With the further spread of SARS-CoV-2, most of the subjects were infected with SARS-CoV-2, and this part of the subjects would be asked to fill in the relevant questionnaire again during our regular follow-up. Each subject's selection was evaluated by an experienced clinician based on the subject's basic condition and medical history. Each subject was explained by a researcher while filling out the questionnaire to ensure the authenticity of each questionnaire. Prior to the start of this study, the subjects had agreed and signed the relevant informed consent. This study was reviewed and approved by the Anhui Medical University Research Subject Review Board (Quick-PJ 2022–03-27).

2.2. Questionnaire. The content of the questionnaire mainly includes the basic information of subjects (e.g., age, height, weight, education level, marriage, residence, occupation, and others), self-assessment scale of erectile function before and after SARS-CoV-2 infection (e.g., IIEF-5), self-assessment of patients' libido before and after SARS-CoV-2 infection, and the subject's psychological status questionnaire.

The International Index of Erectile Function-5 (IIEF-5) is one of the important tools for ED diagnosis [17]. According to the assessment results of IIEF-5, the severity of ED can be divided into three grades: mild, moderate, and severe. In general, an IIEF-5 score of less than 7 is classified as severe ED, 8–11 as moderate ED, 12–21 as mild ED, and 22–25 as no ED. We collected the IIEF-5 scores of subjects before and after SARS-CoV-2 infection and analyzed the score changes to evaluate the changes in subjects' erectile function before and after SARS-CoV-2 infection. Then, we determined the extent to which SARS-CoV-2 infection affected subjects' erectile function by analyzing the magnitude of changes in erectile function before and after SARS-CoV-2 infection.

Sexual desire inventory is the most commonly used sexual desire rating scale, and it is a questionnaire with 13 items [18]. The resulting score (0–101) of the questionnaire represents the subjects' level of sexual desire. The higher the score, the higher the level of libido. For ease of calculation, we divide the final score by 10 to represent the final result. Subjects filled in the questionnaire to obtain the corresponding score before and after SARS-CoV-2 infection and analyzed the change of libido after SARS-CoV-2 infection through the change of the score. At the same time, we divided the subjects into no reduction, mild reduction, moderate reduction, and severe reduction groups according to the degree of score change.

The Patient Health Questionnaire-9 (PHQ-9) is a simple and effective self-rating scale for depressive disorders based on nine items of diagnostic criteria in DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) [19]. It has good reliability and validity in auxiliary diagnosis of depression and symptom severity assessment [20]. The score of 0–4 is normal, with a score greater than 4 indicating possible depression. 7-item Generalized Anxiety Disorder-7 (GAD-7) module is one of the simple and effective methods for evaluating generalized anxiety disorder. It can be applied for screening, diagnosis, and severity assessment of anxiety disorders [21]. We collected subjects' PHQ-9 and GAD-7 scores to determine whether they were prone to depression or anxiety during COVID-19.

Pittsburgh Sleep Quality Index is one of the most commonly used sleep quality assessment scales [22]. Through questionnaire scores, sleep quality is divided into four levels: 0–5 is very good sleep quality, 6–10 is good sleep quality, 11–15 is average sleep quality, and 16–21 is poor sleep quality.

2.3. Data Analysis. All statistical analyses were performed using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarize the subjects' characteristics. Continuous data were expressed in the form of mean ± standard deviation (SD), and the data were compared and analyzed by independent t-test or paired t-test. Categorical data are expressed as numbers (percentages), and chi-square tests are used to compare the data. When $p < 0.05$, the test is considered to be statistically significant. Then, variables univariately associated with decreased erectile function with statistically significant were included in a stepwise multivariate binary logistic regression model for decreased erectile function. To evaluate whether erectile function and

TABLE 1: Demographic information of all subjects.

Characteristics	Total (321)	Decreased erectile dysfunction (114)	Consistent erectile dysfunction (207)	p Value
Age (years)	41.62 ± 10.95	39.59 ± 10.81	42.72 ± 10.92	0.0564[a]
BMI (kg/m^2)	25.32 ± 3.01	24.60 ± 2.87	25.72 ± 3.02	**0.0131**[a]
Lifestyle, n (%)				
Smoking	102 (31.78)	45 (39.47)	57 (27.75)	0.8744[b]
Exercise	196 (61.06)	66 (57.89)	130 (62.80)	0.3882[b]
Educational status, n (%)				0.1017[b]
High school or less	84 (26.17)	36 (31.58)	48 (23.19)	
University graduate	237 (73.83)	78 (68.42)	159 (76.81)	
Resident, n (%)				0.3030[b]
Urban	247 (76.95)	84 (73.68)	163 (78.74)	
Rural	74 (23.05)	30 (26.32)	44 (21.26)	
Occupational status, n (%)				0.6257[b]
Student	18 (5.61)	7 (6.14)	11 (5.31)	
Unemployed	95 (29.60)	30 (26.32)	65 (31.40)	
Employed	208 (64.79)	77 (67.54)	131 (63.29)	

Data are the means $\pm$ standard deviation or number (percentage of patients in that erectile function changes category). [a]Student's t-test and [b]chi-square test. Bold indicates significant p values. BMI, body mass index.

TABLE 2: IIEF-5 and libido before and after COVID-19.

Characteristics	Before COVID-19	After COVID-19	p Value
IIEF-5 scores	17.50 ± 6.34	15.48 ± 7.8	**<0.0001**[a]
Libido scores	6.37 ± 2.56	5.32 ± 2.52	**<0.0001**[a]

Data are the means $\pm$ standard deviation. IIEF-5 = International Index of Erectile Function-5. [a]Paired t-test test. Bold indicates significant p values.

libido reduced, we used the difference value between the IIEF-5 score before and after COVID-19 and the difference value between the libido score before and after COVID-19 to determine.

3. Results

A total of 329 subjects were approached, among which one subject was over 60 years old and seven subjects did not have sex before and/or after COVID-19. After excluding these eight subjects, the questionnaire data of 321 eligible subjects were enrolled. The subjects were divided into two groups: one group with decreased erectile function after COVID-19 (subjects with decreased IIEF-5 scores after COVID-19) and the other group with consistent erectile function after COVID-19, and the demographic information of the two groups is shown in Table 1. The mean age of the subjects was 39.59 years (SD $\pm$ 10.81) in the decreased erectile function group and 42.72 years (SD $\pm$ 10.92) in the consistent erectile function group. There were no significant differences in lifestyle, education, place of residence, or occupation between the two groups. Comparison of body mass index (BMI) data between subjects in the two groups showed $p < 0.05$.

As seen in Table 2, after adjusting for age in subjects, the differences in IIEF-5 scores and libido scores of subjects before and after COVID-19 were statistically significant ($p < 0.0001$). In the univariate analysis, decreased erectile function was significantly associated with anxiety, symptomatic infection, and reduced libido ($p < 0.05$) (Table 3).

To identify the variables independently and significantly associated with decreased erectile function when compared with those with consistent erectile function, the following were entered into the stepwise multivariate binary logistic regression model: BMI, anxiety, symptomatic infection, and reduced libido. After adjusting for age in subjects, the significant associations of decreased erectile function in the multivariate analysis were reduced libido (odds ratio (OR) = 11.33, confidence interval (CI) = 5.52–24.49), ($p < 0.0001$), anxiety (OR = 2.41, CI = 1.13–5.23), ($p < 0.05$), symptomatic infection (OR = 3.293, CI = 1.11–11.48), ($p < 0.05$), and BMI (OR = 0.88, CI = 0.83–0.92), ($p < 0.05$) (Table 4).

We divided the subjects into four levels based on their extent of reduced libido (the reduced value of 1–3 as mild reduction, 3–5 as moderate reduction, >6 as severe reduction, and equals to 0 as no reduction), and the proportion of subjects with decreased erectile function at each level is shown in Figure 1, they were 13.68%, 55.88%, 67.86%, and 93.75%, respectively.

4. Discussion

This is the first study to characterize the relation of decreased erectile function and reduced libido in SARS-CoV-2 infection population. In this study, we analyzed the correlation between decreased libido and decreased erectile function during the COVID-19 pandemic and compared it with clinical, psychological, and lifestyle factors that may contribute to decreased erectile function, and finally found that decreased libido and decreased erectile function during the COVID-19 pandemic are most correlated. So we think that reduced libido is a major factor in decreased erectile function among men with mild COVID-19.

Previous studies have shown that SARS-CoV-2 infection plays an important role in erectile function in men [13, 21], it can cause male sexual dysfunction both physically and psychologically [23]. Kresch et al. [13] explained the physiological and

TABLE 3: Correlation between possible factors and decreased erectile function after COVID-19 (univariate analysis).

Characteristics, n (%)	Total (321)	Reduce erectile dysfunction (114)	Consistent erection function (207)	p Value
Anxiety (GAD-7)				**0.0024**[a]
Anxiety (score > 4)	169 (52.65)	73 (64.04)	96 (46.38)	
No anxiety (score ≤ 4)	152 (47.35)	41 (35.96)	111 (53.62)	
Depression (PHQ-9)				0.1647[a]
Depression (score > 4)	155 (48.29)	61 (53.51)	94 (45.41)	
No depression (score ≤ 4)	166 (51.71)	53 (46.49)	113 (54.59)	
Symptomatic (COVID-19)				**<0.0001**[a]
Symptomatic	265 (82.55)	107 (93.86)	158 (76.33)	
Asymptomatic	56 (17.45)	7 (6.14)	49 (23.67)	
Sleep quality (PSIQ)				0.1960[a]
No good (11–21)	48 (14.95)	21 (18.42)	27 (13.04)	
Good (0–10)	273 (85.05)	93 (81.58)	180 (86.96)	
Libido				**<0.0001**[a]
Reduced	128 (39.88)	88 (77.19)	40 (19.32)	
Normal	193 (60.12)	26 (22.81)	167 (80.68)	

Data are the number (percentage of patients in that erectile function changes category). [a]Chi-square test. Bold indicates significant p values.

TABLE 4: Factors predicting decreased erectile function (decreased erectile function compared with consistent erectile function in multivariate analysis).

Variable	Significance p value	Odds ratio (exponent of beta)	95% Confidence interval
Presence of reduced libido	<0.0001	11.33	5.516–24.49
Anxiety	0.0239	2.41	1.13–5.23
Symptomatic COVID-19	0.0418	3.29	1.11–11.48
BMI	<0.0001	0.88	0.83–0.92

BMI, body mass index.

pathological effects of SARS-CoV-2 infection on erectile function by collecting penile tissue from patients with and without SARS-CoV-2 infection with ED. Endothelial dysfunction is the most studied physiological mechanism leading to ED after SARS-CoV-2 infection [24, 25], and it is the most accepted mechanism. Hu et al. [26] analyzed the psychological status of patients infected with SARS-CoV-2 through long-term follow-up and explained the influence of SARS-CoV-2 on decreased erectile function from a psychological perspective. In our study, 35.38% of subjects infected with SARS-CoV-2 showed decreased erectile function, and the IIEF-5 scores of subjects before and after COVID-19 were statistically different ($p < 0.0001$). This is consistent with previous research.

In our study, we also found that SARS-CoV-2 infection has a significant impact on men's libido ($p < 0.0001$). Meanwhile, previous studies have shown that SARS-CoV-2 infection has a significant effect on reduced libido [27, 28]. Testosterone is generally considered to be one of the main factors affecting men's libido [29]. We hypothesized that reduced libido after COVID-19 infection might be related to decreased testosterone levels. But there are articles suggesting that testosterone levels drop after severe COVID-19 [30]. Salar et al.'s [21] study also showed that mild to moderate COVID-19 did not affect testosterone levels. On the other hand, reduced sexual activity due to physical discomfort after COVID-19 infection may also be a possible cause of reduced libido [31], so the frequency of sexual activity should

also be considered. In addition, some studies have shown that chronic fatigue after COVID-19 is also a potential factor that may lead to reduced libido [32].

There is a fairly close relationship between reduced libido and ED [33], and it has been shown that even mild COVID-19 can lead to reduce libido [34]. But most of studies did not focus on the relationship between reduced libido and ED during the COVID-19 pandemic. Fear has gripped the world during the COVID-19 lockdown [35], most of the literature focused on the effects of anxiety and depression on erectile function. They think that people's fear of SARS-CoV-2 infection and loneliness lead people to depression and anxiety, which leads to ED [28]. But in China, when open-door policy was implemented, people's fear of COVID-19 infection dropped dramatically, and the sense of loneliness disappeared. In this study, we performed a univariate analysis of the relevant factors that might contribute to ED after COVID-19 infection, and then variables univariately associated with decreased erectile function with statistically significant were included in a stepwise multivariate binary logistic regression model for decreased erectile function. The results showed that decreased libido was associated with decreased erectile function the strongest of all factors (OR = 11.33) (Table 4). Among the subjects, only 13.68% of those with normal libido had decreased erectile function, 55.88% of those with mild reduced libido had decreased erectile function, 67.86% of those with moderate reduced libido had decreased erectile function, and 93.75% of those with severe reduced libido had decreased
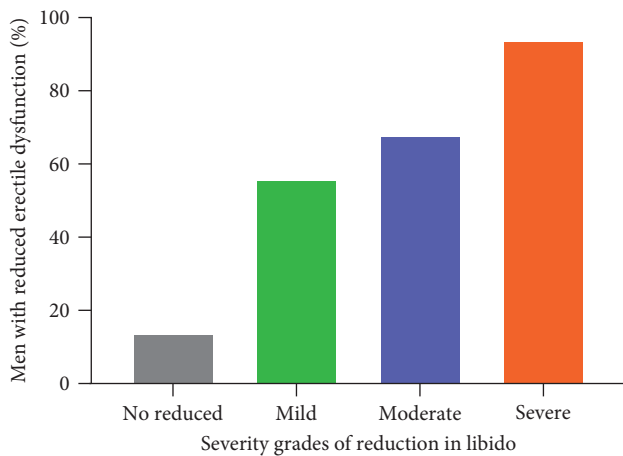
FIGURE 1: Association of reduced erectile dysfunction with severity grades of reduced libido ($p < 0.0001$). The extent of reduced libido: the reduced value of 1–3 as mild reduction, 3–5 as moderate reduction, and >6 as severe reduction.

erectile function (Figure 1). Therefore, we consider that the decline in erectile function in patients with COVID-19 infection during the COVID-19 pandemic is mainly related to reduced libido.

Besides reduced libido, there are several other factors that play a role in decreased erectile function after COVID-19, such as anxiety and symptoms of infection. Previous reports have shown that the rates of anxiety and depression were increased in the population during the COVID-19 pandemic [36, 37]; moreover, anxiety and depression are considered to be the most important factors affecting the psychological aspects of ED [38, 39]. Some studies have shown that fear of COVID-19 infection and isolation lead to anxiety and depression [28], while others have shown that lack of sexual activity during lockdown was associated with a significantly higher risk of developing anxiety and depression [40]. But as seen in this study, it was found that anxiety was significantly correlated with reduced libido after COVID-19, while depression was not significantly correlated with decreased erectile function. Because the time point of our study was during the outbreak of COVID-19 after the government implemented open-door policy, the subjects we studied only experienced a temporary mild symptom, and the virus was very widespread and did not cause serious sequelae. So we consider that people are less likely to feel depressed because of infection and more likely to feel anxious because of discomfort. The main symptoms of COVID-19 infection include fever, cough, myalgia, and, in severe cases, respiratory failure [41]. In this study, we found that symptomatic infections were more likely to lead to decreased erectile function. It may be caused by the physical discomfort caused by the symptoms of patients, and the specific physiological mechanism still needs further research and exploration. Sleep quality is also an important factor in ED [42]. A study has shown a correlation between ED and sleep disturbances after COVID-19 [43], but we did not find any correlation in our study.

There are also several limitations of this study. First, the subjects we recruited were all patients with mild and moderate COVID-19, and the relationship between libido and erectile function in patients with severe COVID-19 was not analyzed. Second, recall bias was inevitable in the process of collecting subjects' questionnaires, but we have developed a clear questionnaire collection method, with professional personnel to evaluate the quality of questionnaires, and we regularly follow-up and collect questionnaires in time, which can reduce recall bias. Finally, we did not analyze subjects' testosterone levels which can lead to reduced libido and ED, it can be studied further.

5. Conclusion

Through the results of this study, we can conclude that ED is closely related to reduced libido in patients after the COVID-19 pandemic. Therefore, in the clinical diagnosis and treatment of ED patients after SARS-CoV-2 infection, we should focus on patients' decreased libido and achieve holistic treatment of patients.

Data Availability

The questionnaire data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no potential conflicts of interest.

Authors' Contributions

Xiansheng Zhang and Hui Jiang were responsible for the conceptualization, resources, funding acquisition, and supervision of the study. Peng Yang and Jingjing Gao completed the data curation and writing—original draft and formal analysis of the study. Tianle Zhu and Yukuai Ma completed the investigation methodology and validation of the study. Pan Gao and Rui Gao completed the project administration and writing—review and editing of the study. Xi Liu completed the software of the study. Peng Yang, Tianle Zhu, Yukuai Ma, and Rui Gao have contributed equally to this work.

Acknowledgments

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