

A factor not to be ignored in post-COVID-19 erectile dysfunction; psychological effect, a prospective study

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Abstract

It was aimed to show the effect of anxiety and depression on erectile dysfunction seen after coronavirus disease-2019 (COVID-19). Between March and July 2021, the participants completed the International Index of Erectile Function, Beck Depression Inventory and Generalised Anxiety Disorder 7 forms at the beginning and after the 1st month of the disease. We investigated the psychological impact of COVID-19 on the development of erectile dysfunction. The mean age of 156 male patients in the study was 54.74 ± 8.01 years. It was determined that the mean International Index of Erectile Function scores of the patients before COVID-19 were 73.42 ± 3.43 and decreased to 68.28 ± 12.86 after COVID-19 ($p < .01$). The patients' erectile function scores were significantly lower after COVID-19 (29.45 ± 1.23 , 27.69 ± 4.33 , $p < .01$, respectively). Their Beck Depression Inventory scores were statistically significantly higher after COVID-19 (1.69 ± 2.56 , 2.22 ± 2.79 , $p < .01$, respectively). Their Generalised Anxiety Disorder 7 scores were also statistically significantly higher after COVID-19 (4.69 ± 1.63 , 6.56 ± 2.40 , $p < .01$, respectively). A negative correlation was found between the increase in the Beck Depression Inventory score during the pandemic process and the decrease in the International Index of Erectile Function score ($r = -0.356$, $p = <.001$). A negative correlation was also found between the increase in the Generalised Anxiety Disorder 7 score and the decrease in the International Index of Erectile Function score ($r = -0.200$, $p = .012$). One of the main factors post-COVID-19 erectile dysfunction is anxiety and depression due to the disease.

KEYWORDS

anxiety, COVID-19, depression, erectile dysfunction

1 | INTRODUCTION

Erectile dysfunction (ED) is one of the most common male sexual dysfunctions. It is defined as the inability to achieve or maintain an erection for satisfactory sexual intercourse ("NIH Consensus Conference. Impotence. NIH Consensus Development Panel on Impotence," 1993). Penile erection is a haemodynamic event characterised by increased penile arterial blood flow, relaxation of sinusoidal smooth muscles and decreased venous return, resulting from the nervous system's

interaction and local factors. Neurological, psychogenic, vascular, urogenital and hormonal integrity is required. The most common aetiology of organic ED is vasculogenic ED, which develops due to decreased blood flow, arterial insufficiency and arterial stenosis resulting from vascular diseases and endothelial dysfunction. Stress, anxiety and depression can also cause ED. The underlying mechanism is the contraction of penile smooth muscle, which needs to be relaxed due to increased peripheral catecholamines due to psychogenic factors and excessive sympathetic discharge (Pyke, 2020).

The global coronavirus disease-2019 (COVID-19) epidemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) presents different cases ranging from mild upper respiratory tract symptoms to progressive pneumonia. Still, it may also cause non-respiratory symptoms and dysfunction in many body parts. (Bernard et al., 2020; Libby & Luscher, 2020). In the pathophysiology of COVID-19, there is a cytokine storm caused by hyperinflammation and immunosuppression and the resulting microthrombosis and disseminated intravascular coagulation (DIC) development (Jose & Manuel, 2020; Tay et al., 2020). Although the lungs are the first and most affected organs by this cytokine storm, studies have shown that the whole body, especially the cardiovascular system, is affected due to bleeding and coagulation at multiple levels such as endothelial damage, microangiopathy and vasculitis (Aydn Yoldemir et al., 2021; Menter et al., 2020). Studies have shown that endothelial dysfunction, subclinical hypogonadism, anxiety and impaired cardiac and pulmonary haemodynamics may develop with COVID-19, which may contribute to the emergence of ED (Kresch et al., 2021; Sansone et al., 2020).

In this study, depression and anxiety states were evaluated by hypothesising that not only endothelial damage but also anxiety may have a primary contribution to the erectile functions of patients who had COVID-19 and were hospitalised in pandemic services. We aimed to investigate the effects of anxiety and depression after COVID-19 on the development of ED.

2 | MATERIAL-METHOD

This study was designed after being approved by the Republic of Turkey Ministry of Health and the local ethics committee. The participants were 156 men aged 18–65 years without any comorbidities who had positive COVID-19 polymerase chain reaction (PCR) test and were treated for COVID-19 disease not in the intensive care unit but in the pandemic wards of Kütahya Health Sciences University Evliya Çelebi Training and Research Hospital between March and July 2021. We recorded the patients' demographic data and the number of days treated for COVID-19. The study did not include patients with a history of the previous prostate or urethral surgery or who had previously received surgical or medical treatment for ED. Patients who needed to be followed up in the intensive care unit during the disease were excluded from the study.

The Turkish-validated International Index of Erectile Function (IIEF) evaluated the sexual function status of the patients for the last 4 weeks and therefore showed the erectile function before hospitalisation and the Turkish-validated Beck Depression Inventory (BDI), which measures the severity of depression in these patients due to COVID-19, was filled in the 1st day of hospitalisation (Akkus et al., 2002; Beck et al., 1961; Hisli, 1989; Rosen et al., 1997). We also filled in the Turkish-validated Generalised Anxiety Disorder 7 (GAD-7) forms to measure the anxiety level of the patients due to COVID-19 on the 1st day of hospitalisation (Konkan et al., 2013; Spitzer et al., 2006).

TABLE 1 Patients' characteristics

	n = 156
Age (mean + SD)	54.74 ± 8.01
BMI (mean + SD)	26.03 ± 4.09
Marital status n %	Married 131 (84%) Single 25 (16%)
Cigarette n %	Yes 86 (55.1%) No 70 (44.9%)
Alcohol n %	Often 19 (12.1%) Rarely 20 (12.8%) Never 117 (75%)
Hospital stay (day) (mean ± SD)	10.64 ± 3.43

According to IIEF, erectile dysfunction (questions 1–5 and 15); 0–10 was severe, 11–16 was moderate, 17–21 was mild–moderate, 22–25 was mild and 26–30 was no ED. Sexual desire (questions 11 and 12) was scored between 2 and 10. Orgasmic function (questions 9 and 10) was scored between 0 and 10. Intercourse satisfaction (questions 6–8) was scored between 0 and 15. Overall satisfaction (questions 13 and 14) was scored between 2 and 10 (Akkus et al., 2002). According to BDI, a score of 0–9 was considered minimal depression, 10–16 as mild depression, 17–29 as moderate depression and 30–63 as severe depression (Hisli, 1989). A GAD-7 score of 10 or more was considered a generalised anxiety disorder (Konkan et al., 2013). The patients were contacted by phone in the 1st month after PCR test positivity, and the IIEF, BDI and GAD-7 forms were filled in again. Patients who could not be reached were excluded from the study. IIEF, BDI and GAD-7 scores change at the onset and after the COVID-19 disease were compared. Correlation analyses were performed to evaluate the relationship between the development of depression and anxiety and the development of ED.

2.1 | Statistical analysis

Statistical Package for Social Sciences for Windows 22.0 (SPSS Inc, Chicago, IL, USA) program was used for statistical analysis. The normal distribution of the data was tested with the Kolmogorov–Smirnov/Shapiro–Wilk test. Numbers, percentages, mean and standard deviation expressions were used for descriptive statistics. Mann–Whitney U-test was used for data that did not show a normal distribution in comparing the mean between two independent groups. Chi-square/Fisher's exact test was used to compare categorised data. Paired sample *t*-test and the Wilcoxon signed-rank test were used for dependent variables. Chi-square/Fisher's exact test, Student's *t*-test and Mann–Whitney U-test were used to analyse univariate analyses. For statistical significance, $p < .05$ was accepted. Pearson correlation coefficient was used to evaluate the correlation between BID, GAD-7 and IIEF score alteration. The quality of reporting outcomes was performed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Gallo et al., 2012).

TABLE 2 Pre- and post-COVID-19 sexual function status

	Pre-COVID	Post-COVID	<i>p</i> value
IIEF score (mean ± SD)	73.42 ± 3.43	68.28 ± 12.86	<.01*
Erectile function (mean ± SD)	29.45 ± 1.23	27.69 ± 4.33	<.01*
Sexual desire (mean ± SD)	9.81 ± 0.55	9.15 ± 1.75	<.01*
Orgasmic function (mean ± SD)	9.92 ± 0.36	9.30 ± 1.61	<.01*
Intercourse satisfaction (mean ± SD)	14.50 ± 1.24	13.28 ± 3.31	<.01*
Overall satisfaction (mean ± SD)	9.74 ± 0.62	8.87 ± 2.32	<.01*
Frequency of sexual intercourse (mean ± SD)	6.24 ± 2.46	5.16 ± 2.96	<.01*
BDI score (mean ± SD)	1.69 ± 2.56	2.22 ± 2.79	<.01*
GAD-7 score (mean ± SD)	4.69 ± 1.63	6.56 ± 2.40	<.01*

*Paired sample *t*-test.

Abbreviations: BDI, beck depression inventory; COVID-19; coronavirus disease-2019; GAD-7, generalised anxiety disorder-7; IIEF, international index of erectile function.

TABLE 3 Pre- and post-COVID-19 depression and anxiety status

	Pre-COVID	Post-COVID	<i>p</i> value
BDI score (mean ± SD)	1.69 ± 2.56	2.22 ± 2.79	.002*
GAD-7 score (mean ± SD)	4.69 ± 1.63	6.56 ± 2.40	.01*
Minimal depression (<i>n</i> %)	62 (39.7%)	75 (48.1%)	.01**
Mild depression (<i>n</i> %)	1 (0.6%)	4 (2.5%)	.180**
Generalised anxiety disorder (<i>n</i> %)	2 (1.3%)	18 (11.5%)	.01**

*Paired sample *t*-test.

**Wilcoxon signed-rank test.

Abbreviations: BDI, beck depression inventory; GAD-7, generalised anxiety disorder-7.

3 | RESULTS

The mean age of 156 male patients included in the study was 54.74 ± 8.01 years. Their mean BMI was found to be 26.03 ± 4.09 kg/m². Their mean number of days of hospitalisation in the pandemic service was determined as 10.64 ± 3.43 (Table 1).

It was determined that the mean IIEF scores of the patients before COVID-19 were 73.42 ± 3.43 and decreased to 68.28 ± 12.86 after COVID-19 (*p* < .01). Erectile function scores of the patients before COVID-19 were 29.45 ± 1.23 and decreased to 27.69 ± 4.33 after COVID-19 (*p* < .01). We found that ED occurred in 29 (18.6%) patients in total after COVID-19. Of these patients with ED, 11 (7.1%) had mild, 13 (8.3%) had mild-moderate, 2 (1.3%) had moderate and 3 (1.9%) had severe ED. It was determined that sexual desire decreased from 9.81 ± 0.55 to 9.15 ± 1.75 after COVID-19 (*p* < .01). The IIEF questionnaire data showed that orgasmic satisfaction was 9.92 ± 0.36 before COVID-19 and 9.30 ± 1.61 after COVID-19 (*p* < .01). Also, in the sexual satisfaction questioning, the mean satisfaction scores of the patients were 14.50 ± 1.24 before COVID-19 and 13.28 ± 3.31 after COVID-19 (*p* < .01). The mean general satisfaction scores decreased significantly from 9.74 ± 0.62 to 8.87 ± 2.32 after COVID-19 (*p* < .01). When the frequency of sexual intercourse was examined, the mean number of sexual intercourse per month before COVID-19 was 6.24 ± 2.46, whilst it became 5.16 ± 2.96 after COVID-19 (*p* < .01) (Table 2).

TABLE 4 Correlation analysis between IIEF score and BID score

Correlations	IIEF change	BDI change
IIEF change		
Pearson correlation	1	−0.356
<i>p</i> value		.000
<i>N</i>	156	156
BDI change		
Pearson correlation	−0.356	1
<i>p</i> value	.000	
<i>N</i>	156	156

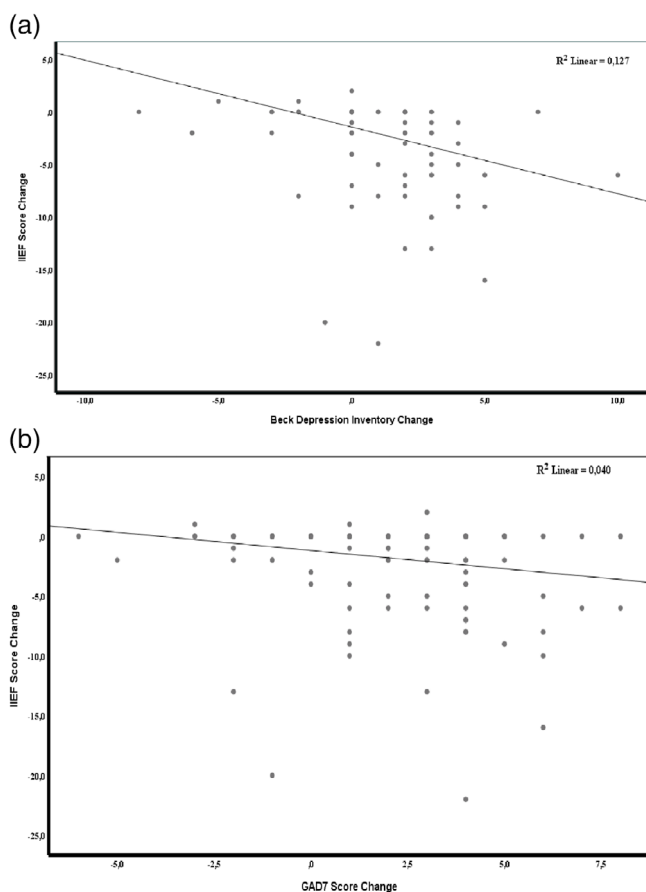
Abbreviations: BDI, beck depression inventory; IIEF, international index of erectile function.

The mean BDI scores used to measure the depression status of the patients were 1.69 ± 2.56 before COVID-19 and 2.22 ± 2.79 after COVID-19 (*p* < .01). According to BDI scores, depression was not observed in 93 (59.6%) patients before COVID-19, whilst minimal depression was found in 62 (39.7%) patients and mild depression in 1 (0.6%) patient. After COVID-19, the number of patients with no signs of depression decreased to 77 (49.3%), whilst the number of patients with minimal depression increased to 75 (48.1%), and mild depression was observed in 4 (2.5%) patients. Also, it was determined that the mean GAD-7 score increased from 4.69 ± 1.63 to 6.56 ± 2.40 after

TABLE 5 Correlation analysis between IIEF score and GAD-7 score

Correlations		
	IIEF change	GAD-7 change
IIEF change		
Pearson correlation	1	-0.200
<i>p</i> value		.012
<i>N</i>	156	156
GAD-7 change		
Pearson correlation	-0.200	1
<i>p</i> value	0.0012	
<i>N</i>	156	156

Abbreviations: GAD-7, generalised anxiety disorder-7; IIEF, international index of erectile function.

**FIGURE 1** (a and b) Correlation between IIEF score and Beck depression inventory (a) and GAD-7 score (b) during the pandemic process ($r = -0.356$, $p < .001$), ($r = -0.200$, $p < .012$)

COVID-19. When the GAD-7 scores were evaluated, generalised anxiety disorder was detected in 2 (1.3%) patients before COVID-19, whilst it was found in 18 (11.5%) patients after COVID-19 ($p < .01$) (Table 3).

The correlation analysis showed a negative correlation between the increase in the BDI score during the pandemic process and the decrease in the IIEF score ($r = -0.356$, $p < .001$). Also, a negative correlation was found between the increase in the GAD-7 score and the decrease in the IIEF score ($r = -0.200$, $p = .012$) (Tables 4 and 5; Figure 1).

4 | DISCUSSION

Every day, a new study reveals the widespread effects of COVID-19 on different organs throughout the body. Erectile dysfunction has also been shown to be one of these effects (Kaynar et al., 2022; Nassau et al., 2021). It has been suggested that the underlying pathophysiological mechanism of ED is endothelial damage. It has also been stated that such causes as the severity of the disease, fear of death and the length of the isolation period lead to anxiety and depression, and thus, ED may increase (Pennanen-lire et al., 2021). Similarly, our study revealed that ED increased in COVID-19 patients. We also found that anxiety and depression may be important factors as well. This study is the first to evaluate hospitalised patients with a prospective design and proven PCR positivity to the best of our knowledge.

Sexual function comprises desire, arousal, orgasm and resolution phases, and pathologies occurring in any of these phases are considered sexual dysfunctions (Ostfeld et al., 2021). We found a significant decrease in the sexual desire of the patients in our study compared with pre-COVID-19. However, studies have shown that there is also a decrease in sexual desire in healthy people during the COVID-19 period. In their online survey of 553 healthy individuals during the closure period, Li et al. found a decrease in sexual desire in 25% of the participants compared with the pre-pandemic period (Li et al., 2020). Similarly, Wignall et al., in their online questionnaire, which included 565 people, showed that sexual desire decreased significantly in healthy people during the COVID-19 pandemic, and this was a decrease in sexual desire attributed to the psychological stress of COVID-19 (Wignall et al., 2021). Also, in the study by Sansone et al. that included healthy and COVID-19 patients, the prevalence of ED was significantly higher in the COVID-19 group (Andrea Sansone et al., 2021). In parallel with other studies, the decrease in sexual desire in our study, which included patients with COVID-19, supports previous studies. We think it may be one of the main factors in the deterioration of sexual activities.

We showed that along with other sexual functions, orgasmic function, which is an essential phase of sexual function, also decreases in patients with COVID-19. Fuchs et al., in their study on only female sexual health during COVID-19, found a decrease in sexual desire, arousal, lubrication and orgasmic function (Fuchs et al., 2020). Anosmia and ageusia may occur in most patients affected by COVID-19, especially those with flu-like symptoms. It has been suggested that anosmia effectively decreases sexual functions, especially in sexual desire, orgasmic function and satisfaction (Bertolo et al., 2021). At the same time, testicular damage caused by microthrombus and intravascular haemorrhages has also been shown in studies (Flaifel

et al., 2021). Therefore, since the main organ of the testosterone production is the testicles, hypogonadism may also occur and contribute to sexual desire and erectile dysfunction. Thus, it will be helpful to investigate the development of hypogonadism in future studies on the subject.

Endothelial dysfunction may also occur by potentially affecting penile vessels due to cytokine storm and thrombi due to COVID-19. Therefore, it may lead to the emergence or progression of ED by impairing vascular function (Yafi et al., 2016). Such factors as hypoxia in the penile vascular bed, endothelial dysfunction, anosmia, hypogonadism, anxiety and depression can cause ED individually, or ED can occur when one or more of them are combined. Salonia et al. also showed an independent relationship between COVID-19 and secondary hypogonadism in their study (Salonia et al., 2021). On the other hand, all these potential factors may cause ED, which is actually sub-clinical, to occur with the effect of COVID-19. In addition, it can be said that just as COVID-19 is considered in the differential diagnosis of patients who typically complain of anosmia and ageusia during the pandemic period, it should also be considered at sudden-onset ED or if the existing ED worsens rapidly.

Depression is characterised by loss of interest, decreased energy, low self-esteem and inability to enjoy. It leads to loss of intimacy with irritability and social withdrawal. When these symptoms are evaluated as a whole, it is understood that depression causes difficulties in sexual intercourse. Depression can lead to erectile dysfunction in several ways. Erectile dysfunction may occur due to the vulnerability, sensitivity and loss of self-confidence caused by depression. Low sexual desire and erectile dysfunction secondary to it can occur due to loss of interest and desire in depression (Suija et al., 2014).

A few studies have shown that the frequency of sexual intercourse decreases during the quarantine period (Cito et al., 2021; Schiavi et al., 2020). Since spouses who do not live together have less chance of sexual life due to the restrictions on social activity and transportation during the epidemic, the frequency of sexual intercourse decreases. In addition, the increase in anxiety between individuals to maintain social distance may also contribute to this. Although the studies in the literature have mainly evaluated the sexual relations of healthy individuals, in our study, a statistically significant decrease was observed in the frequency of sexual intercourse in male COVID-19 patients, in line with the literature. We think this is related to anxiety and depression that occurs mostly in people who had COVID-19. In general, there is a bidirectional interaction between sexual activity and psychological well-being (Mollaioli et al., 2021). Our study revealed the negative correlation of ED with anxiety and depression. ED may occur due to anxiety and depression, or it may be possible that ED that occurs due to other organic causes may trigger anxiety and depression or exacerbate the current situation. However, it is a fact that the severity of ED is also higher in people with high anxiety and depression.

We think that the priority in treating ED in patients with COVID-19 should be the elimination of anxiety and depression. However, eliminating the possible impact of anxiety and depression alone may not be sufficient to treat ED. Therefore, it is necessary to consider other organic causes.

Although its Turkish validation has been provided, the use of the questionnaires and the inability to reveal such organic causes as endothelial dysfunction and hypogonadism as possible causes of ED are the limitations of our study. In addition, although IIEF is a form that questions the last 4 weeks, the fact that patients completed these questionnaires whilst they were symptomatic due to COVID-19 is an important limitation of the study. Another limitation of the study is that the duration of hospitalisation was included in the questionnaire conducted 1 month after the diagnosis of COVID-19.

5 | CONCLUSION

It should be considered that patients with symptomatic or non-symptomatic COVID-19 may apply to urology outpatient clinics with ED complaints. One of the main factors in the development of ED in patients with COVID-19 is anxiety and depression due to the disease. Treating anxiety and depression due to COVID-19 can accelerate the recovery of patients' erectile function. However, other organic causes related to COVID-19 also have an effect on the emergence of ED. Whilst our study did not include such data, more prospective studies are needed to provide conclusive evidence in patients with a history of COVID-19, including large numbers of patients with anxiety and depression, which will reveal organic causes such as hypogonadism, endothelial damage and penile ischaemia.

CONFLICT OF INTEREST

The authors declare no competing interests.

AUTHOR CONTRIBUTIONS

Mehmet Sevim set up the main idea and hypothesis of the study. Okan Alkış, Mehmet Sevim and Bekir Aras developed the theory and edited the material method section. Mehmet Sevim, Okan Alkış, İbrahim Güven Kartal and Serkan Telli made the evaluation of the data in the results section. The discussion part of the article was written by Mehmet Sevim, Okan Alkış, Bekir Aras, İbrahim Güven Kartal and Serkan Telli have reviewed and made the necessary corrections and approved. In addition, all authors discussed the entire study and approved its final version.

ETHICAL APPROVAL

This study was initiated by obtaining the permission of the Republic of Turkey Ministry of Health and Kutahya Health Science University Ethics Committee on 17 February 2021 with 2021-01/03 decision number.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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