

Original Article

Exploring Link Between Erectile Dysfunction and COVID-19: A Comparative Analysis Across Two Distinct Regions

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HIGHLIGHTS

- Individuals who had a previous record of being infected with COVID-19 experienced the repercussions of ED.
- The various climate conditions encountered in two different cities did not impact the severity of ED observed among patients.

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ABSTRACT

Introduction

There is speculation that erectile dysfunction (ED) may be a possible manifestation of COVID-19 symptoms. Our research aimed to assess the frequency of ED and explore potential contributing factors including different climates, etc. among male patients with COVID-19 infection history.

Methods

In this study, a sample size of 383 cases were examined from two cities Tabriz and Ahvaz with completely different climates. We had a control group of 148 patients with a negative COVID-19 infection history and 245 patients with a positive COVID-19 infection history. The cases were analyzed by utilizing the IIEF-5 questionnaires. Data regarding demographics and the history of COVID-19 infections was gathered.

Results

The study included 383 male patients with ages ranging from 21 to 63. Of these patients, 48.4% were from Tabriz and 51.7% were from Ahvaz. The average erectile function for males with a positive history of COVID-19 infection in Tabriz was 47.9 whereas for those with a negative history, it was 50.51. In Ahvaz, the average erectile function for males with a positive COVID-19 infection history was 38/68 while for those with a negative history, it was 57.37.

Conclusions

Recent research indicates that a person's history of COVID-19 infection has considerable effects on male sexual function; with psychological factors playing a role in this impact; nevertheless, the effect of the cities with different climates was not proved. These findings highlight the potential connection between COVID-19 infections and sexual health in men, suggesting that various factors contribute to the observed effects

Keywords: COVID-19; Erectile Dysfunction; Infection; Sexual Health

Introduction

The COVID-19 breakout, attributable to the SARS-CoV-2 virus, occurred in Wuhan, China, in December 2019, and affected all of humanity. This virus spread out extremely fast due to its contagious nature, and it was announced a pandemic on March 11, 2022 (1). By the end of December 2022, it was declared that the number of people who had been infected by SARS-CoV-2 was

approximately 645 million and 6.6 million deaths were reported until that day (2).

As a result of the lack of accessible, solid, and effective treatment methods and vaccines that were later proposed (3, 4) and in order to prevent and reduce the spread of the disease of COVID-19, WHO decided to apply non-pharmacological interventions (NPIs), which include increasing the capacity of tests Polymerase chain

reaction (PCR) and public health improvement (5, 6). Self-isolation and social distancing were used in most countries as a prevention method to minimize the speed of COVID-19 spread (7, 8).

It had been known that COVID-19 only damages the respiratory system, but it was proven that the infection involves other tissues and organs (9). Excluding the main and deadly symptoms of COVID-19 infection, which relates to the respiratory system, the extra-pulmonary manifestations cannot be omitted.

Symptoms in the reproductive system are obvious specimens of this fact. The negative fallout on male reproductive system health is a matter of concern because the virus can injure the testicular tissues directly by entering the cells by connecting with angiotensin-converting enzyme 2 (ACE2) receptors in the host via the spike proteins on the cell membrane (10), which are exceedingly produced and expressed in reproductive organs (11).

31% of males have been reported to be facing sexual dysfunctions (12). Erectile dysfunction (ED) is a condition in which the patient cannot get erected or keep the erection long enough to participate in a successful sexual intercourse. ED has been known to be affecting 13-28% of males worldwide and it mainly occurs between ages 40-80. A wide variety of factors are involved in ED's occurrence, such as physical and psychogenic etiologies, or both of them. Physical etiologies mainly originate from hormonal and neuronal reasons alongside vasculogenic causes.

Subclinical hypogonadism, endothelial dysfunction, and pulmonary hemodynamic impairment are clear illustrations of physical etiologies (13, 14). On the other hand, psychogenic etiologies include intense anxiety and major depression disorders (15). A great part of psychogenic sexual problems among couples, who live together during the pandemic is considered to be the fear of infecting each other (15). Although these factors are playing a significant role in the occurrence of ED, few data and limited studies are proving the connection between the increasing risk of developing ED and COVID-19. In addition, the occurrence of premature ejaculation (PE) seems to differ among different socio-cultural and geographical populations, suggesting that its prevalence is influenced by various factors (22). Unlike PE, the link between geographical populations and ED has not been proved yet. It is widely believed that men are sexually more at risk, and even at greater risk in case of having a history of suffering from ED or any other possible sexual disease (16, 17).

Due to cultural differences, especially in Asian countries, including Iran, and conservative religious beliefs, sexual dysfunctions are mostly undiagnosed and untreated (14). Few studies have been done aiming at ED and its relation with infection history of COVID-19.

The possible differences of this research in an Asian-Islamic country and former studies in non-Asian countries are arguable. This study aims to evaluate the rampancy of ED by means of the International Index of Erectile Function 5 (IIEF-5) amongst patients with history of COVID-19 infections.

Methods

In this brief report study, 383 male participants from two different cities, Ahvaz and Tabriz, were examined. It is essential to notice that these two cities are completely different in climate; Tabriz has a mountain climate with relatively cold weather, whereas Ahvaz has a tropical and warm climate. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1396.2732). 400 IIEF-5 questionnaires were provided. 17 patients refused to answer, or their answers needed to be clarified. The questionnaires were filled out in Imam Reza Hospital of Tabriz, Amir Al Momenin Hospital of Ahvaz, and urology-specialized clinics. Some patients were interviewed due to problems such as illiteracy. 235 cases were recovered patients with a COVID-19 infection history, and 148 had never been infected. 138 patients with a history of COVID-19 infection were from Tabriz, and 97 were from Ahvaz. On the other hand, 47 patients in the control group were from Tabriz, and the remaining 101 were from Ahvaz. None of the patients with a COVID-19 infection history had been hospitalized in the intensive care unit due to the low intensity of their disease. After being treated for COVID-19, these patients were referred to the urology clinic on an outpatient basis due to sexual dysfunction. The subjects were between 21 and 63 years old. Eligibility criteria not having sexual problems before contracting COVID-19: It has been 5 to 9 months since being infected with COVID-19. Exclusion criteria include people's unwillingness to participate in the study and having sexual problems.

Viral transmission was prevented by obtaining informed consent before the assessment. A verbal interview was done with illiterate and disabled participants. Obtained demographic data includes age, education level, and employment years. Needed data, including questionnaires and interviews, was claimed in 3 months from 22/12/21 to 20/03/22.

Statistical analysis

COVID-19 treatment, mental health status, and demographic data were reported using descriptive statistics. A Two-Way ANOVA test has been used. Clinically essential covariates were adjusted for the multivariable model, which includes theoretically associating factors of ED, including climate status and infection history of COVID-19. A p -value > 0.05 was considered statistically significant.

Table 1. Demographic Characteristics of Cases Studied

| Variable | Category | Total | | Tabriz (185) | | Ahvaz (198) | |
|----------------------------|---------------------------|--------|---------|--------------|---------|-------------|---------|
| | | Number | Percent | Number | Percent | Number | Percent |
| COVID-19 infection history | Positive | 235 | 61.4 | 138 | 74.6 | 97 | 49.0 |
| | Negative | 148 | 38.6 | 47 | 25.4 | 101 | 51.0 |
| Age(Years) | 20 to 25 | 53 | 13.8 | 11 | 5.9 | 42 | 21.2 |
| | 26 to 30 | 54 | 14.1 | 28 | 15.1 | 26 | 13.1 |
| | 31 to 35 | 110 | 28.7 | 78 | 42.2 | 32 | 16.2 |
| | +35 | 166 | 43.3 | 68 | 36.8 | 98 | 49.5 |
| Education | High school graduate | 113 | 29.5 | 14 | 7.6 | 99 | 50.0 |
| | Associate degree | 93 | 24.3 | 35 | 18.9 | 58 | 29.3 |
| | Bachelor's degree | 127 | 33.2 | 89 | 48.1 | 38 | 19.2 |
| | Master's degree and Ph.D. | 50 | 13.1 | 47 | 25.4 | 3 | 1.5 |
| Service record | -5 years | 79 | 20.6 | 19 | 10.3 | 60 | 30.3 |
| | 6 to 10 years | 93 | 24.3 | 53 | 28.6 | 40 | 20.2 |
| | 11 to 15 years | 84 | 21.9 | 56 | 30.3 | 28 | 14.1 |
| | +15 years | 127 | 33.2 | 57 | 30.8 | 70 | 35.4 |

Results

383 male participants from two different cities, Ahvaz and Tabriz, were examined. 17 patients refused to answer, or their answers needed to be clarified. 235 cases were recovered patients with a COVID-19 infection history, and 148 had never been infected. 138 patients with a history of COVID-19 infection were from Tabriz, and 97 were from Ahvaz. On the other hand, 47 patients in the control group were from Tabriz, and the remaining 101 were from Ahvaz. None of the patients with a COVID-19 infection history had been hospitalized in the intensive care unit due to the low intensity of their disease. After being treated for COVID-19, these patients were referred to the urology clinic on an outpatient basis due to sexual dysfunction. The subjects were between 21 and 63 years old. As mentioned previously, all the data was gathered in 3 months period from 22/12/21 to 20/03/22 in Imam Reza Hospital of Tabriz, Amir Al Momenin Hospital of Ahvaz, and urology-specialized clinics.

Of all examined cases, 48.3% were from Tabriz, and 51.7% were from Ahvaz. 61.4% of the cases mentioned had a positive COVID-19 infection history. 13.8% were between 20 and 25, 14.1% were between 26 and 30, 28.7% were between 31 and 35, and 43.3% were older than 35. 29.5% of the cases were high school graduates, 24.3% had an associate degree, 33.2% had a bachelor's degree, and 13.1% had a master's degree or Ph.D. 20.6% of the cases had a service record of less than 5 years. 24.3% worked between 6 to 10 years, 21.9% had a service record of 11 to 15 years, and 33.2% had worked more than 15 years (Table 1).

Demographic characteristics of male erectile function are provided in Table 2. Among cases from Tabriz, average

erectile function in males with a positive COVID-19 infection history was 47.91 and the cases with a negative COVID-19 infection history was 50.51; on the other hand, examined cases from Ahvaz with a positive COVID-19 infection record, erectile function average was 38.68 and among males with a negative COVID-19 infection record, the number was equal to 57.37. According to Table 3 Male Erectile Function has a normal distribution (P -value>0.05).

The results of the Two-Way ANOVA test have been provided in Table 4. According to Table, it is clear that the main effect of the cities in Male Erectile Function in a confidence interval of 95% was not meaningful ($F(1,379) = 0.68$, P -value= 0.412, Eta Squared P -value=0.002). In other words, there is no meaningful difference in Male Erectile Function between the cases in two cities of Tabriz and Ahvaz.

The main effect of COVID-19 infection history in Male Erectile Function was statistically meaningful ($F(1,379) = 54.50$, P -value=0.001, Eta Squared=0.126). In men with COVID-19 infection history, mean Male Erectile Function was less than men without COVID-19 infection record (Figure 1).

In addition, the interaction effect of the cities and COVID-19 infection history in Male Erectile Function was meaningful ($F(1,379) = 31.09$, P -value=0.001, Eta Squared=0.076). In conclusion, mean Male Erectile Function in men with negative COVID-19 infection history in Ahvaz was the highest, and men with positive infection history in Ahvaz performed the lowest.

Discussion

Erectile dysfunction (ED), is one of the most distressing

Table 2. Demographic Characteristics of Male Erectile Function

| City | COVID-19 infection history | Number | Mean | Standard Deviation | Min. | Max. |
|--------|----------------------------|--------|-------|--------------------|------|------|
| Tabriz | Positive | 138 | 47.91 | 10.88 | 20 | 65 |
| | Negative | 47 | 50.51 | 13.69 | 8 | 68 |
| | Total | 185 | 48.57 | 11.67 | 8 | 68 |
| Ahvaz | Positive | 97 | 38.68 | 16.41 | 6 | 63 |
| | Negative | 101 | 57.37 | 11.85 | 17 | 71 |
| | Total | 198 | 48.21 | 17.03 | 6 | 71 |
| Total | Positive | 235 | 44.10 | 14.16 | 6 | 65 |
| | Negative | 148 | 55.19 | 12.82 | 8 | 71 |
| | Total | 383 | 48.38 | 14.67 | 6 | 71 |

Table 3. K-S Test Results for Checking Normalness in Distribution of Male Erectile Function Variable

| Variable | Number | Kolmogorov-Smirnov Z Statistic | P-value |
|------------------------|--------|--------------------------------|---------|
| Male erectile function | 383 | 1.277 | 0.139 |

Table 4. Two-Way ANOVA Analysis Results for Comparing Effects of Cities and COVID-19 Infection History in Male Erectile Function

| Source | Sum of Squares | Degree of Freedom | Mean Squared Error | F-Distribution | P-value | Eta Squared |
|---|----------------|-------------------|--------------------|----------------|---------|-------------|
| Main Effect of Cities | 115.228 | 1 | 115.228 | 0.675 | 0.412 | 0.002 |
| Main Effect of COVID-19 | 9301.59 | 1 | 9301.59 | 54.495 | 0.001 | 0.126 |
| Interaction effect of COVID-19 and Cities | 5306.47 | 1 | 5306.47 | 31.089 | 0.001 | 0.076 |
| Error | 64690.1 | 379 | 170.686 | | | |
| Total | 978817 | 383 | | | | |

and prevalent sexual dysfunctions (16), and research on ED in Asian and Islamic countries is limited. During the pandemic, numerous research studies had been conducted to investigate the various effects of COVID-19 on different aspects of health. However, there has been relatively limited research conducted specifically on how the virus affects sexual function and related aspects including significant geographical differences.

The impact of COVID-19 infection on male erectile function showed important statistical significance ($F(1,379) = 54.50$, $P\text{-value} = 0.001$). The results of this study indicate higher outcomes compared to previous research findings (14, 16, 18, 19).

In addition, an Italian study found that there was a noticeably higher prevalence of erectile dysfunction among individuals who had contracted COVID-19 compared to the general population. This discovery was made even after accounting for factors such as age, BMI, and psychological well-being (13).

Surprisingly, BMI and co-occurring medical conditions were not found to be significantly associated with the risk of ED (14).

In terms of climate and geographical differences, in contrary to PE, the results indicate that there was no significant impact of the areas on male erectile function within a 95% confidence interval ($F(1,379) = 0.68$, $P\text{-value} = 0.412$). There is no previously existing research available that directly compares the effects of different climates on erectile function. Inspired by the investigations about PE and lack of enough researches in this field led us to investigate how varying climates may influence or cause ED.

This study aims to investigate the population of individuals who have contracted a mild form of COVID-19 infection in a time period of 5 to 9 months from two different cities with significantly different climates.

Due to the risk of COVID-19 transmission, hormonal levels, conducting nocturnal penile tumescence testing, or Duplex Doppler ultrasound could not be carried out. Recall bias has the potential to influence the responses in any questionnaire as individuals tend to rely more on their recent experiences when answering questions. This means that their recollection of events or information may be biased towards what has happened recently, leading to

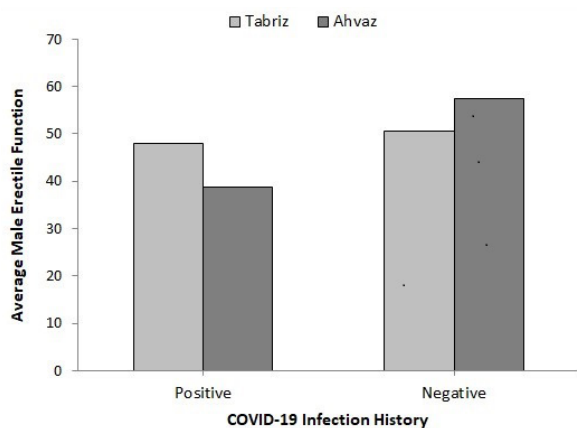


Figure 1. Bar Chart of Male Erectile Function in Different Groups

an inaccurate representation of their overall experiences or beliefs. Therefore, when interpreting questionnaire responses, it is essential to consider the potential impact of recall bias and take it into account when analyzing the data (20). Although, there was some limitations to the study methodology such as the inability to follow up with participants after their acute COVID-19 infection; it proved to be advantageous in terms of providing more accurate results about each individual's condition during that specific period. Future prospective studies will focus on identifying the causal relationship between ED and COVID-19 as well as investigating any potential long-term effects associated with the viral infection. Further research is necessary to explore and improve the strategies and availability of healthcare services for men in order to address the effects of the COVID-19 pandemic on their overall well-being (21).

Conclusions

In conclusion, the study found that there was no significant difference in male erectile function between the cities of Tabriz and Ahvaz. However; there was a significant effect of COVID-19 infection history on male erectile function with men who had a history of COVID-19 infection, reporting lower function. Furthermore, there was an interaction effect between the cities and COVID-19 infection history indicating that the impact of infection history on male erectile function varied between the two cities. Specifically, men with a negative infection history in Ahvaz had the highest function; while men with a positive history in Ahvaz had the lowest function. These findings suggest that COVID-19 infection history plays a role in male sexual function and that the impact may be influenced by regional and psychological factors.

Research conducted in Islamic countries has been limited in terms of focusing on female participants due to various challenges posed by religious beliefs. However, investigating the female perspective would be

particularly compelling since there is a notable dearth of research in that domain. Therefore, it is strongly suggested that more studies be conducted on the female version of the research with the aim of addressing this gap.

Authors' contributions

All authors contributed equally.

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Conflict of interest

All authors declare that there is no conflict of interest.

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Ethics statement

This study was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1396.2732).

Data availability

Data will be provided on request.

Abbreviations

| | |
|--------|--|
| ACE2 | Angiotensin-converting enzyme 2 |
| BMI | Body mass index |
| ED | Erectile dysfunction |
| IIEF-5 | International index of erectile function 5 |
| NPIs | Non-pharmaceutical interventions |
| PCR | Polymerase chain reaction |

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Author (s) biosketches

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