

The Sexual and Psychological Health of Azoospermic couples in the context of the COVID-19 Pandemic (#60583)

1

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The Sexual and Psychological Health of Azoospermic couples in the context of the COVID-19 Pandemic

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Background: The interruption of fertility treatments due to COVID-19, an uncontrollable and stressful event, has caused increased anxiety and depression in infertile patients. A special group of infertile patients, azoospermic couples, may be the most vulnerable. To date, there have been no reports on the changes in sexuality and psychological wellbeing of azoospermic patients in the context of the COVID-19 pandemic, and previous studies on sexual satisfaction and sexual health of azoospermic couples (especially the wife of azoospermic men) are limited. This study aimed to determine whether the diagnosis of azoospermia has an impact on the sexual and psychological health of patients and to investigate whether the COVID-19 pandemic increased changes in sexuality and psychological distress in azoospermic couples. **Methods:** We performed a case-control study between June 1, 2020 and December 20, 2020. A total of 100 azoospermic couples comprised the experimental group; 100 normozoospermic couples comprised the control group. General Anxiety Disorder-7; Patient Health Questionnaire-9; Quality of Marriage Index; International Index of Erectile Function-15, Premature Ejaculation Diagnostic Tool, and Female Sexual Function Index questionnaires were administered to assess psychological health, couple relationship quality, and sexual health of the participants. Structural equation modelling was performed to measure the influence and mediation effects of changes in sexuality, psychological health, couple relationship quality, and sexual health in the context of COVID-19. **Results:** For changes in sexuality due to COVID-19, the frequency of masturbation and the use of pornography were higher among azoospermic couples than among normozoospermic couples ($p < 0.05$). The incidence of psychological distress, sexual dysfunction and lower relationship quality was higher among azoospermic couples than among normozoospermic couples ($p < 0.05$). Structural equation modelling evidenced that the frequency of masturbation directly mediated levels

of psychological distress and relationship quality in both genders, and negatively mediated the sexual health in men ($\beta = -0.21, p < 0.001$), but not in women ($\beta = -0.02, p = 0.587$).

Conclusions: The COVID-19 pandemic has had a significant impact on the sexual and psychological health of azoospermic patients. Changes in sexuality due to COVID-19 pandemic are associated with sexual health and are mediated by psychological distress and relationship quality.

The Sexual and Psychological Health of Azoospermic couples in the context of the COVID-19 Pandemic

Running title: Azoospermic couples' sexual health during COVID-19

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Abstract

Background: The interruption of fertility treatments due to COVID-19, an uncontrollable and stressful event, has caused increased anxiety and depression in infertile patients. A special group of infertile patients, azoospermic couples, may be the most vulnerable. To date, there have been

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Methods: We performed a case-control study between June 1, 2020 and December 20, 2020. A total of 100 azoospermic couples comprised the experimental group; 100 normozoospermic couples comprised the control group. General Anxiety Disorder-7; Patient Health Questionnaire-9; Quality of Marriage Index; International Index of Erectile Function-15, Premature Ejaculation Diagnostic Tool, and Female Sexual Function Index questionnaires were administered to assess psychological health, couple relationship quality, and sexual health of the participants. Structural equation modelling was performed to measure the influence and mediation effects of changes in sexuality, psychological health, couple relationship quality, and sexual health in the context of COVID-19.

Results: For changes in sexuality due to COVID-19, the frequency of masturbation and the use of pornography were higher among azoospermic couples than among normozoospermic couples ($p < 0.05$). The incidence of psychological distress, sexual dysfunction and lower relationship quality was higher among azoospermic couples than among normozoospermic couples ($p < 0.05$). Structural equation modelling evidenced that the frequency of masturbation directly mediated

levels of psychological distress and relationship quality in both genders, and negatively mediated the sexual health in men ($\beta = -0.21, p < 0.001$), but not in women ($\beta = -0.02, p = 0.587$).

Conclusions: The COVID-19 pandemic has had a significant impact on the sexual and psychological health of azoospermic patients. Changes in sexuality due to COVID-19 pandemic are associated with sexual health and are mediated by psychological distress and relationship quality.

Key words: COVID-19; azoospermia; masturbation; sexual health; psychological health

Introduction

Since the outbreak in December 2019, coronavirus disease (COVID-19) has lasted for more than a year. The COVID-19 pandemic has brought about unprecedented challenges to global healthcare. It has had an unprecedented **impact individual** psychological and relationship health (Brooks et al., 2020; Huang et al., 2020).

The COVID-19 pandemic may have increased the rates of depression, anxiety, and post-traumatic stress disorder in the general population and in COVID-19 survivors (Dutheil et al., 2020; Shuja et al., 2020; Liu et al., 2020; González et al., 2020). The interruption of fertility treatments due to COVID-19, an uncontrollable and stressful event, has caused increased anxiety and depression in infertile patients (Ferrero et al., 2020; Boivin et al., 2020; Ben-Kimhy et al., 2020). A special group of infertile patients, azoospermic men, may be the most vulnerable (Bechoua et al., 2016). Being diagnosed with azoospermia can be a devastating experience for

infertile couples (Johansson et al., 2011). Men believe they have lost their masculinity and virility; therefore, they experience low self-esteem and depression (Reder et al., 2009). To conceive a child, azoospermic men must undergo surgical sperm retrieval (Song et al., 2020). If the surgical retrieval fails or if repeated intracytoplasmic sperm injections are unsuccessful, couples usually choose artificial insemination with donor semen (Viloria et al., 2011). The unfulfilled, strong desire to have children causes significant anxiety in infertile couples; this may have worsened during the COVID-19 pandemic.

Sexual life is an essential part of life (Davison et al., 2009), and sexual health is directly related to people's mental health and quality of life (World Health Organization [WHO], 2002; World Association for Sexual Health, 2006). New investigations of the impact of COVID-19 on sexual health have shown reduced quality of sexual life and changes in sexual intercourse frequency (Yuksel and Ozgor, 2020; Fuchs et al., 2020; Li W et al., 2020; Li G et al., 2020;). To date, there have been no reports on the changes in sexuality and psychological wellbeing of azoospermic patients due to the COVID-19 pandemic, and previous studies on sexual satisfaction and sexual health of azoospermic couples are limited (especially the wife of azoospermic men) (Kızılay et al., 2018). Therefore, this study aimed to determine whether the diagnosis of azoospermia has had an impact on the sexual and psychological health of patients and to investigate whether the COVID-19 pandemic increased changes in sexuality and psychological distress in azoospermic couples?

Materials and methods

Participant selection

A case–control field survey was conducted at the Center of Reproductive Medicine from July 1, 2020 to December 20, 2020. The experimental group consisted of azoospermic men and their wives, and the control group consisted of normozoospermic men (according to WHO semen examination standards, 2010) and their wives. Azoospermia is defined as having at least two microscopic analyses confirming the absence of spermatozoa after centrifugation of the complete semen sample (American Society for Reproductive Medicine [ASRM], 2018). The control group comprises healthy men who have undergone a fertility examination and consultation in our centre. Men who take drugs that may affect their ejaculation and erectile function and/or mental state were excluded (e.g., selective serotonin reuptake inhibitor, tricycle antidepressants, and phosphodiesterase type 5 inhibitors) (Gao et al., 2013). All subjects knew their semen status before filling out the questionnaire. Before participating, all patients informed that the study was voluntary, anonymous, and did not involve any privacy. None of the subjects had any biological children.

Self-reported questionnaires

Our questionnaire contained three parts. The first part comprised the patient’s baseline information including age, height, weight, occupation, education level, work or life stress level, and lifestyle habits (such as frequency of physical exercise, smoking status, and drinking alcohol status). The

second part was related to the impact of the COVID-19 pandemic and comprised questions on changes in sexuality (sexual desire; sexual satisfaction; and the frequency of intercourse, masturbation, and pornography use), relationship with spouse, and psychological wellbeing.

Psychological wellbeing during the COVID-19 pandemic was evaluated using the Generalized Anxiety Disorder scale (GAD-7) (Lowe et al., 2008), the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001), and a question about COVID-19-related anxiety (“Does the novel coronavirus pneumonia pandemic make you anxious”; respondents rated their anxiety as either severe, slight, or none). The cut-off score for the GAD-7 was ≥ 10 , which was used to assess for the presence of anxiety (Lowe et al., 2008); a PHQ-9 cut-off score of ≥ 10 was used to assess for the presence of depression (Kroenke et al., 2001). Relationship quality with spouse was evaluated using the Quality of Marriage Index (QMI) (Zimmermann et al., 2019). We set up two questions to assess the sexual satisfaction of the responder couples: 1. How satisfied are you with intimacy and sexual activity with your wife (husband)? 2. Are you satisfied with your sexual life? The subjects chose from the following answers: very satisfied (5 points), relatively satisfied (4 points), neutral (3 points), dissatisfied (2 points), very dissatisfied (1 point), and no sexual activity (0 points).

The third part considered the sexual health and function of the responders in the context of COVID-19 and comprised standardised, sex-specific, sexual health -based questionnaires. The sexual health of men was assessed using the International Index of Erectile Dysfunction (IIEF-15) and Premature Ejaculation Diagnostic Tool (PEDT) and was based on the sexual status in the

preceding 4 weeks. The IIEF-15 includes 15 items covering 5 domains of male sexual function (erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction) with Cronbach's alpha values ≥ 0.91 (Rosen et al., 1997; Corona et al., 2006). The presence and severity of erectile dysfunction (ED) was based on the IIEF-15–Erectile Function score with the severity of ED represented as follows: 26–30 none, 22–25 mild, 17–21 mild to moderate, 11–16 moderate, and <11 severe (Cappelleri et al., 1999). A PEDT score ≤ 8 indicated no premature ejaculation (PE), while scores of 9 and 10 indicated probable PE and those ≥ 11 implied PE; Cronbach's alpha values were 0.78 (Symonds et al., 2007). Female sexual health was assessed using the Female Sexual Function Index (FSFI), which includes 19 items and 6 domains of sexual function (desire, arousal, lubrication, orgasm, satisfaction, and coital pain) based on the sexual status in the preceding 4 weeks (Rosen et al., 2000). An FSFI total score of ≤ 23.45 (Chinese cut-off) indicated that the woman may have sexual dysfunction (Ma et al., 2014; Lo et al., 2018); Cronbach's alpha values were ≥ 0.82 (Rosen et al., 2000). We also set up one question to assess the sexual health of both genders: Do you have difficulty with or pain during sexual intercourse (dyspareunia)? The subjects chose from the following answers: almost always (0 points), usually (1 points), sometimes (2 points), rarely (3 points), very rarely (4 points), never (5 points).

The questionnaires were completed in a private room, no spouse present. The subjects were informed that the research was voluntary, anonymous, and confidential. The responders were not compensated in any form.

Statistical analyses

Data analyses were performed using the statistical software SPSS (version 22.0; SPSS Inc., Chicago, IL, USA). Results are presented in a tabular format. Categorical variables are summarised as counts and percentages, in addition to continuous measures with counts, means, and standard deviations (SDs). The chi-square test was used to compare categorical data, and the independent t-test and one-way analysis of variance (ANOVA) were used to compare numerical data.

We performed a structural equation model (SEM) (Mollaioli et al.,2021) to assess the relationship between changes in sexuality (the frequency of masturbation) due to COVID-19 and sexual function for both genders. We used the R package “lavaan” for calculating the mediation effects. The final path models (one for each gender) were constructed in accordance with the modification indices. Standardised regression weights were used to represent path coefficients among variables with $p < 0.05$. The overall fitting model and goodness-of-fit were evaluated with the following indices: ratio of χ^2 values and degrees of freedom values (χ^2/df) < 3 , root mean square error of approximation ($RMSEA$) < 0.10 , standardised root mean square residual ($SRMR$) < 0.10 , normed fit index (NFI) > 0.90 , comparative fit index (CFI) > 0.90 (Ryu et al., 2014).

A two-tailed p value < 0.05 indicated statistical significance for all tests.

Ethical approval

The study protocol was approved by the Institutional Review Board for Research on Human Subjects at the Center of Reproductive Medicine (2020PS009F).

160

161 **Results**

162 **Participant response and demographic characteristics**

163 A total of 128 couples (men diagnosed with azoospermia and their wives), belonging to the
 164 experimental group, participated in the study, while 28 couples were excluded owing to either or
 165 both providing inconsistent answers and/or failure to complete all the questions (18 failed to
 166 complete all the questions and 10 had inconsistent answers). A total of 135 couples (men diagnosed
 167 with normozoospermia and their wives), belonging to the control group, and 35 couples were
 168 excluded (23 failed to complete all the questions and 12 had inconsistent answers). Ultimately, the
 169 responses of 200 couples (100 azoospermic men ,100 azoospermic men's wives; 100
 170 normozoospermic men ,100 normozoospermic men's wives) were included in the analysis
 171 (response rate = 76%).

172 There were no significant differences in the age, body mass index (BMI), income, lifestyle
 173 habits (smoking, frequency of physical exercise), or stress level among the groups ($p > 0.05$).
 174 (Table 1).

175

176 **Comparison of sexual health and sexuality between azoospermic and** 177 **normozoospermic couples**

178 The total scores of IIEF-15 and ratings of four domains of male sexual function (erectile function,
 179 orgasmic function, intercourse satisfaction, and overall satisfaction) were lower for azoospermic

men than for normozoospermic men ($p < 0.05$). The PEDT score and PE incidence were higher for azoospermic men than for normozoospermic men ($p < 0.05$). Sexual satisfaction and frequency of sexual activity were lower in azoospermic men than in normozoospermic men ($p < 0.05$). Intimacy, dyspareunia, sexual desire, and incidence of ED were not different between the two groups ($p > 0.05$) (Table 2).

For their wives, the total FSFI scores and ratings from three of the six domains of female sexual function (orgasm, satisfaction, coital pain) were lower in the azoospermic group than in normozoospermic group ($p < 0.05$). Sexual satisfaction and satisfaction with sexual intimacy were lower in the azoospermic group than in the normozoospermic group ($p < 0.05$). Dyspareunia, sexual desire, sexual arousal ability, and vaginal lubricity were not different between the two groups ($p > 0.05$) (Table 3).

Changes in sexuality and psychological health of azoospermic and normozoospermic couples in the context of COVID-19

Regarding changes in sexuality, the frequency of masturbation and the use of pornography were higher among azoospermic couples than among normozoospermic couples ($p < 0.05$); however, there were no significant differences in the changes in sexual satisfaction, sexual desire, or frequency of sexual activity among the groups ($p > 0.05$). During the COVID-19 pandemic, the proportion of azoospermic couples that experienced relationship deterioration was significantly higher than that of normozoospermic couples ($p < 0.05$). The QMI scores of the azoospermic

couples were significantly lower than those of normozoospermic couples ($p < 0.05$). GAD-7 and PHQ-9 scores were significantly higher for azoospermic couples than for normozoospermic couples ($p < 0.05$). The incidence of anxiety, depression, and COVID-19-related anxiety was higher among azoospermic couples than among normozoospermic couples ($p < 0.05$) (Table 4).

Effects of changes in the frequency of masturbation on mental health, relationship quality, and sexual health

Among the responders with an increased frequency of masturbation, 82% (36/44) were from azoospermic couples. Compared with the other three groups, the increased masturbation group had the highest stress levels, the least amount of sexual activity per month, the highest incidence of anxiety and depression, the lowest QMI scores, and the highest ratio of spousal relationship deterioration. This group also comprised the largest proportion in the decreased sexual desire, frequency of sex, and sexual satisfaction categories, and had the highest incidence of sexual dysfunction, and the lowest levels of sexual and intimacy satisfaction ($p < 0.05$) (Table 5).

Relationship of frequency of masturbation with psychological distress, relationship satisfaction, and sexual health

To assess the relationship between the frequency of masturbation during the COVID-19 pandemic and psychological distress, relationship satisfaction, and sexual function, we performed a SEM, separately, for both genders (Fig. 1, 2). We used frequency of masturbation (0 = increased, 1 =

unchanged, 2 = decreased, 3 = none) as an exogenous variable, with psychological distress (based on GAD-7 scores, PHQ-9 scores, and self-reported COVID-19-related anxiety) and relationship satisfaction (QMI score, sexual satisfaction, and sexual intimacy) as mediator variables and sexual health as a latent dependent (outcome) variable. Male sexual health was based on the incidence of PE and ED and on the responses to the sexual desire, orgasm, intercourse satisfaction, and dyspareunia questions. Female sexual health was based on 5 domains of the FSFI (desire, arousal, vaginal lubricity, orgasm, and coital pain) and the incidence of dysfunction and dyspareunia. The frequency of masturbation directly mediated levels of psychological distress ($\beta = -0.11, p < .001$ in men; $\beta = -0.17, p < .001$ in women) and relationship satisfaction ($\beta = 0.37, p < .001$ in men; $\beta = 0.16, p = .006$ in women). Moreover, the frequency of masturbation significantly and negatively mediated sexual health in men ($\beta = -0.21, p < 0.001$), but not in women ($\beta = -0.02, p = 0.587$). In contrast, psychological distress had no significant mediating effect on sexual health ($p = 0.282$ in men; $p = 0.624$ in women) but did have a direct negative effect on relationship satisfaction, irrespective of gender ($\beta = -0.57, p < .001$ in men; $\beta = -0.61, p < .001$ in women). Relationship satisfaction had a direct positive effect on sexual health ($\beta = 1.01, p < .001$ in men; $\beta = 0.71, p < .001$ in women). Goodness-of-fit indexes of SEMs were good (males: $\chi^2/df = 2.430$; $RMSEA = 0.085$; $SRMR = 0.054$; $NFI = 0.939$; $CFI = 0.963$; and females: $\chi^2/df = 2.621$; $RMSEA = 0.090$; $SRMR = 0.056$; $NFI = 0.926$; $CFI = 0.953$) (Fig. 1, 2).

The association between frequency of masturbation and sexual health was mediated by psychological distress and relationship satisfaction in men (total indirect effect: 0.21 [95% CI:

0.08–0.35]) and women (total indirect effect: 0.17 [95% *CI*: 0.09–0.28]). Thus, the relationship between frequency of masturbation and sexual function was partially mediated by psychological distress and relationship satisfaction in men and fully mediated in women. (Table 6).

Discussion

This is the first study to evaluate the sexual and psychological health of azoospermic couples in the context of the COVID-19 pandemic. Our research found that the COVID-19 pandemic has had a significant impact on the sexual and psychological health of azoospermic couples. Changes in sexuality (the increased frequency of masturbation) due to COVID-19 were associated with sexual health and mediated by psychological distress and couple relationship quality. Our research found that among responders with an increased frequency of masturbation, 82% (36/44) were azoospermia couples. Owing to COVID-19, the incidence of anxiety and depression in the responders had generally increased, but the incidence in azoospermic couples was significantly higher than that in normozoospermic couples. Our research further confirmed that the incidence of sexual dysfunction in azoospermic couples was significantly higher than that of normozoospermic couples.

Patients with infertility are a special group in society, and the diagnosis and treatment of infertility can cause extreme psychological distress, including anxiety, emotional pain, and depression, as well as decreased sexual satisfaction (Cocchiaro et al., 2020; Greil et al., 1997; Eugster and Vingerhoets, 1999). Azoospermia is a very serious and troublesome condition, and if

sperm extraction fails, patients cannot conceive biologically (ASRM, 2018). Therefore, couples with azoospermia may experience tremendous mental and psychological stress before their desire to have children is fulfilled (Bechoua, et al., 2016; Moura et al., 2012). Therefore, it was very important to explore the sexual and mental health of azoospermic couples during the COVID-19 pandemic.

Our research found that during the COVID-19 pandemic, the frequency of masturbation and the use of pornography were higher among azoospermic couples than among normozoospermic couples. With the outbreak of COVID-19, Pornhub (one of the largest pornography websites) has reported increased pornography use in multiple countries (Mestre-Bach et al., 2020). Pornography use and masturbation play a role either in reducing natural sexual arousal or in the mechanism for coping with negative moods, stress, and anxiety (Wordecha et al., 2018). Increased use of pornography is related to the need for distraction from loneliness, distress, boredom, or pandemic-related emotions (Grubbs, 2020).

Azoospermic couples, who are aware that sexual intercourse cannot lead to pregnancy ('firing blanks'), experience both depressive symptoms and somatic anxiety (Lotti et al., 2016). This leads to masturbation to fulfil one's sexual desire or to relieve stress sexually. A previous study reported that preference for pornography with masturbation was found to be significantly associated with ED (Berger et al., 2019). The diagnosis of infertility may lead to ED in azoospermic men (Lotti et al., 2016; Bechoua et al., 2016; Kızılay, et al., 2018) and to the couples' unwillingness to have sexual intercourse. The frequency of sexual activity in azoospermic couples in our study was

significantly lower than that in normozoospermic couples, which further supports the abovementioned point.

Previous study has evaluated the moderating effects of sexual activity on mental health, relationship quality, and sexual health through SEM, and the relationship between them (Mollaioli et al., 2016). Inspired by this, we explored the impact of increasing frequency of masturbation on sexual health through SEM. In our SEM model, our research also found that frequency of masturbation significantly mediates relationship satisfaction in a negative way. This is consistent with research that found that increased masturbation frequency and frequent pornography use are related to a decline in the quality of sexual life and sexual satisfaction (Brody and Costa, 2009; Bőthe et al., 2020). In our study, we also observed that azoospermic couples have lower sexual satisfaction than normozoospermic couples. This can be concluded from the two self-reported satisfaction questions and the satisfaction-domain scores of the IIEF-15 and FSFI. This may be because the diagnosis of azoospermia can be regarded as loss of masculinity (Bechoua et al., 2016), and couples feel that it is hopeless to conceive naturally, thus reducing their sexual satisfaction and intimacy; infertility itself can also reduce sexual satisfaction and intimacy between couples (Jumayev et al., 2012) and azoospermia may exacerbate this dissatisfaction.

We discovered that azoospermic men had the highest levels of psychological distress, as proven by both GAD-7 and PHQ-9 scores, when compared with other groups. Moreover, the same results were revealed when we assessed responses to the question we set up to verify whether anxiety was related to COVID-19. Most surveys of the general public show increased symptoms

of depression, anxiety, and stress related to COVID-19 (Moreno, et al., 2020; Li J et al., 2020; Qiu et al., 2020; González et al., 2020). Our research found that increased frequency of masturbation and decreased relationship satisfaction are both risk factors for anxiety and depression. Research suggests that people with pre-existing mental health disorders are more likely to be directly or indirectly affected by the pandemic (Moreno, et al., 2020). Therefore, it is reasonable to believe that the COVID-19 pandemic has aggravated the anxiety and depression of patients with azoospermia. Therefore, improved mental health services are urgently needed.

Our study further systematically compared the sexual health of azoospermic couples because few studies have focused on the sexual health and sexual health of azoospermic men's wives (Kızılay, et al., 2018). In azoospermic couples, the incidence of sexual dysfunction was significantly higher than that in the control group. The ED, orgasmic function, intercourse satisfaction, and overall satisfaction scores were significantly lower for azoospermic men than for normozoospermic men. This is consistent with previous research, which found a relationship between the severity of semen quality impairment and sexual dysfunction (Lotti et al., 2016). In their study, infertile men showed more ejaculatory latency and reduced sexual health, sexual desire, and orgasmic function than fertile men (Lotti et al., 2016). In our study, the incidence of PE in azoospermic men was higher than that in normozoospermic men, which is consistent with findings of previous studies (Lotti, et al. 2016; Gao et al., 2013). Research indicates that anxiety (Lotti et al., 2012; Zhang et al., 2013a; Gao et al., 2014) and depression (Son et al., 2011; Gao et al., 2013; Zhang et al., 2013a,b; Gao et al., 2014) are related to the occurrence of PE. Through

SEM, we also observed that, although psychological health cannot directly affect sexual health, psychological health can affect sexual health by mediating relationship satisfaction.

Notably, there are very few existing studies on the sexual health of wives of azoospermic men. Our study found that the FSFI scores (orgasm, sexual satisfaction, coital pain) of these wives were significantly lower than the wives of normozoospermic men. The incidence of sexual dysfunction was insignificantly higher in wives of azoospermic men than in those of normozoospermic men ($p = 0.056$), which may be owing to the cut-off value (Wiegel et al., 2005) and relatively small sample size. Despite this, we believe that the diagnosis of azoospermia does have an impact on the sexual health of women, as evidenced by the FSFI scores for orgasm function and intercourse pain ($p < 0.05$), and with a p value of incidence of sexual dysfunction close to 0.05. Our study is consistent with the study of Kızılay et al., in which they believe that the FSFI scores of wives of azoospermic men are significantly lower and that there is a positive correlation between sperm count and IIEF and FSFI scores (Kızılay, et al., 2018). Previous studies have also reported that female sexual function is significantly related to male sexual function (Jiann, et al., 2013). Female sexual health can be influenced by various factors, such as biologic (hormonal and pelvic floor disorders), psychosexual (emotional and affective), and contextual (relationship discord, partner's health problems, and sexual dysfunction) (Graziottin et al., 2006). Therefore, the diagnosis of azoospermia with perceived loss of masculinity and virility (Reder et al., 2009), as well as the unfulfilled desire to conceive and psychological distress in the context of COVID-19, may negatively impact women's sexual health. Our SEM model also confirmed this

conclusion.

The above conclusions will also provide a reference for patients with other causes of infertility. During the treatment of infertility, it is very important to consider not only the couple's reproductive health, but also their sexual and psychological health. It is vital to detect these issues early and treat them appropriately with sexological and psychological therapy.

This article has some limitations. First of all, the impossibility of having quantitative data about mental and sexual health prior to the COVID-19 pandemic. Our study can only be assessed through changes in sexuality by **compare** the situation before and during the COVID-19 pandemic. Secondly, because this questionnaire is anonymous, we cannot obtain patient clinical data such as azoospermia classification and serum hormone levels. These indicators may affect the sexual health of azoospermic patients. If the real-name questionnaire is used, azoospermic patients will be reluctant to conduct this research or be unwilling to answer truthfully. Finally, our study selected local samples, which need to be further confirmed by multi-center clinical trials.

The COVID-19 pandemic dramatically impacted the psychological and sexual health of the azoospermic couples in our study. Increased frequency of masturbation due to the pandemic had a potentially deleterious effect, on both genders, with regard to psychological wellbeing, relationship satisfaction, and sexual health. In contrast, when compared with normozoospermic men, azoospermic men had significantly reduced sexual health, and the decline in sexual health could also be seen in their partners. Therefore, azoospermic couples had a lower quality of sexual life with higher levels of psychological distress, which has been exacerbated by the COVID-19

360 pandemic. This finding will also provide a reference for patients with other causes of infertility. It
 361 is essential to provide sexual and mental health counselling to infertile patients, especially during
 362 the pandemic.

363

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511

512 Fig. 1 Association between frequency of masturbation and sexual health mediated by
513 psychological distress and relationship satisfaction in men.

514

515 Fig. 2 Association between frequency of masturbation and sexual health mediated by
516 psychological distress and relationship satisfaction in women.

517

518

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Table 1(on next page)

Table 1. Participants' demographic characteristics

1 Table 1. Participants' demographic characteristics (n=400)

Characteristics	Male (n=200)		P1 value	Female (n=200)		P2 value
	Azoospermia (n =100)	Normozoospermia (n = 100)		Azoospermia (n =100)	Normozoospermia (n = 100)	
	Mean ± SD/n (%)	Mean ± SD/n (%)		Mean ± SD/n (%)	Mean ± SD/n (%)	
Age (years)	34.52 ± 4.71	34.95 ± 4.00	0.487	32.76 ± 4.32	33.51 ± 4.42	0.226
BMI (kg/m ²)	25.48 ± 3.49	25.47 ± 3.72	0.980	22.86 ± 3.33	23.33 ± 3.35	0.320
Income (%)			0.542			0.397
Low	23 (23.0)	26 (26.0)		45 (45.0)	43 (43.0)	
Middle	59 (59.0)	61 (61.0)		44 (44.0)	48 (48.0)	
High	18 (18.0)	13 (13.0)		11 (11.0)	9 (9.0)	
Education			0.298			0.001**
High school and below	34 (34.0)	23 (23.0)		27 (27.0)	30 (30.0)	
College for professional training	19 (19.0)	22 (22.0)		30 (30.0)	19 (19.0)	
Undergraduate	37 (37.0)	47 (47.0)		24 (24.0)	45 (45.0)	
Postgraduate and above	10 (10.0)	8 (8.0)		19 (19.0)	6 (6.0)	
Smoking status			0.885			0.748
Yes	41 (41.0)	39 (39.0)		6 (6.0)	4 (4.0)	
No	59 (59.0)	61 (61.0)		94 (94.0)	96 (96.0)	
Drinking alcohol			0.494			0.034*
Almost every day	2 (2.0)	1 (1.0)		0	0	
Often	7 (7.0)	4 (4.0)		2 (2.0)	1 (1.0)	
Sometimes	23 (23.0)	27 (27.0)		15 (15.0)	4 (4.0)	
Rarely	47 (47.0)	39 (39.0)		38 (38.0)	38 (38.0)	
Never	21 (21.0)	29 (29.0)		45 (45.0)	57 (57.0)	
Frequency of physical exercise			0.758			0.166
None	23 (23.0)	24 (24.0)		40 (40.0)	31 (31.0)	

≤ 2 times a month	29 (29.0)	33 (33.0)		29 (29.0)	31 (31.0)
≥ 3 times a month	48 (48.0)	43 (43.0)		31 (31.0)	38 (38.0)
Stress level			0.304		0.295
High	42 (42.0)	32 (32.0)		30 (30.0)	27 (27.0)
General	48 (48.0)	58 (58.0)		44 (44.0)	54 (54.0)
Low	10 (10.0)	10 (10.0)		26 (26.0)	19 (19.0)

BMI: body mass index

* $p < 0.05$ ** $p < 0.01$

Table 2(on next page)

Table 2. Comparison of sexuality and sexual health between azoospermic men and normozoospermic men

1 Table 2. Comparison of sexuality and sexual function between azoospermic men and
2 normozoospermic men

Items	Azoospermic men (n = 100) n (%) / Mean ± SD	Normozoospermic men (n = 100) n (%) / Mean ± SD	P value
Sexual satisfaction			0.024*
Satisfied	56 (56.0)	70 (70.0)	
Neutral	20 (20.0)	20 (20.0)	
Dissatisfied	24 (24.0)	10 (10.0)	
Intimacy during sex life			0.327
Very satisfied	18 (18.0)	25 (25.0)	
Satisfied	44 (44.0)	49 (49.0)	
Neutral	17 (17.0)	15 (15.0)	
Dissatisfied	16 (16.0)	8 (8.0)	
Very dissatisfied	5 (5.0)	3 (3.0)	
Dyspareunia			0.313
Never	33 (33.0)	38 (38.0)	
Very rarely	18 (18.0)	21 (21.0)	
Rarely	14 (14.0)	17 (17.0)	
Sometimes	32 (32.0)	18 (18.0)	
Usually + Almost always	3 (3.0)	6 (6.0)	
Sexual life frequency (per month)	4.14 ± 2.72	5.04 ± 2.25	0.012*
IIEF-15 Score	53.07 ± 11.11	57.52 ± 8.57	0.002**
Erectile function score	23.25 ± 5.13	24.82 ± 4.18	0.019*
Orgasmic function score	7.34 ± 1.82	8.04 ± 1.48	0.003**
Sexual desire score	6.07 ± 1.37	6.24 ± 1.29	0.366
Intercourse satisfaction score	9.45 ± 2.71	10.55 ± 2.18	0.002**
Overall satisfaction score	6.96 ± 2.24	7.67 ± 1.86	0.016*
Incidence of ED			0.095
No ED (26–30)	44 (44.0)	54 (54.0)	
Mild ED (22–25)	22 (22.0)	25 (25.0)	
Mild to moderate ED (17–21)	21 (21.0)	17 (17.0)	
Moderate ED (11–16)	13 (13.0)	4 (4.0)	
Severe ED (<11)	0	0	
PEDT score	6.58 ± 3.13	5.17 ± 2.22	0.000**
Incidence of PE			0.000**
No PE (≤8)	65 (65.0)	85 (85.0)	
Probable PE (9–10)	22 (22.0)	14 (14.0)	
PE (≥11)	13 (13.0)	1 (1.0)	

3 IIEF-15: International Index of Erectile Dysfunction; ED: Erectile dysfunction; PEDT:
 4 Premature Ejaculation Diagnostic Tool; PE: Premature ejaculation
 5 * $p < 0.05$ ** $p < 0.01$

6

Table 3(on next page)

Table 3. Comparison of sexuality and sexual health between azoospermic and normozoospermic men's wife

1 Table 3. Comparison of sexuality and sexual health between azoospermic and normozoospermic
2 men's wife
3

Items	Azoospermic men's wife (n =100) n (%) / Mean $\pm$ SD	Normozoospermic men's wife (n = 100) n (%) / Mean $\pm$ SD	<i>P</i> value
Sexual satisfaction			0.001**
Satisfied	57 (57.0)	72 (72.0)	
Neutral	13 (13.0)	19 (19.0)	
Dissatisfied	30 (30.0)	9 (9.0)	
Intimacy during sex life			0.011*
Very satisfied	20 (20.0)	29 (29.0)	
Satisfied	38 (38.0)	45 (45.0)	
Neutral	17 (17.0)	19 (19.0)	
Dissatisfied	19 (19.0)	6 (6.0)	
Very dissatisfied	6 (6.0)	1 (1.0)	
Dyspareunia			0.490
Never	31 (31.0)	34 (34.0)	
Very rarely	23 (23.0)	19 (19.0)	
Rarely	20 (20.0)	22 (22.0)	
Sometimes	19 (19.0)	23 (23.0)	
Usually + Almost always	7 (7.0)	2 (2.0)	
FSFI score	25.12 $\pm$ 5.56	26.75 $\pm$ 4.82	0.028*
Sexual desire score	3.39 $\pm$ 0.85	3.31 $\pm$ 0.86	0.490
Sexual arousal ability score	3.84 $\pm$ 1.15	3.96 $\pm$ 1.13	0.457
Vaginal lubricity score	4.85 $\pm$ 1.02	5.12 $\pm$ 0.93	0.052
Orgasm score	4.22 $\pm$ 1.26	4.60 $\pm$ 1.03	0.019*
Sexual satisfaction score	4.10 $\pm$ 1.39	4.72 $\pm$ 1.09	0.001**
Coital pain score	4.72 $\pm$ 1.06	6.04 $\pm$ 0.92	0.024*
Incidence of sexual dysfunction	33 (33.0)	21 (21.0)	0.056

4 FSFI: Female Sexual Function Index

5 * $p < 0.05$ ** $p < 0.01$

6

Table 4(on next page)

Table 4. Changes in sexuality, couple relationship, and psychological distress of azoospermic and normozoospermic couples in the context of COVID -19.

1 Table 4. Changes in sexuality, couple relationship, and psychological distress of azoospermic
2 and normozoospermic couples in the context of COVID -19.
3

Items	Azoospermia		Normozoospermia		P value
	Men	Women	Men	women	
	(n =100)	(n =100)	(n = 100)	(n = 100)	
	n (%) /Mean ± SD	n (%) /Mean ± SD	n (%) /Mean ± SD	n (%) /Mean ± SD	
Sexual satisfaction					0.149
Increased	2 (2.0)	5 (5.0)	2 (2.0)	3 (3.0)	
Unchanged	83 (83.0)	76 (76.0)	87 (87.0)	90 (90.0)	
Decreased	15 (15.0)	19 (19.0)	11 (11.0)	7 (7.0)	
Sexual desire					0.679
Increased	4 (4.0)	7 (7.0)	4 (4.0)	4 (4.0)	
Unchanged	83 (83.0)	77 (77.0)	83 (83.0)	87 (87.0)	
Decreased	13 (13.0)	16 (16.0)	13 (13.0)	9 (9.0)	
Sexual frequency					0.680
Increased	4 (4.0)	7 (7.0)	5 (5.0)	4 (4.0)	
Unchanged	77 (77.0)	78 (78.0)	78 (78.0)	85 (85.0)	
Decreased	19 (19.0)	15 (15.0)	17 (17.0)	11 (11.0)	
Frequency of masturbation					0.000**
Increased	12 (12.0)	24 (24.0)	6 (6.0)	2 (2.0)	
Unchanged	45 (45.0)	31 (31.0)	46 (46.0)	41 (41.0)	
Decreased	23 (23.0)	6 (6.0)	18 (18.0)	11 (11.0)	
None	20 (20.0)	39 (39.0)	30 (30.0)	46 (46.0)	
Frequency of pornography use					0.000**
Increased	12 (12.0)	17 (17.0)	6 (6.0)	3 (3.0)	
Unchanged	43 (43.0)	23 (23.0)	41 (41.0)	27 (27.0)	
Decreased	7 (7.0)	4 (4.0)	8 (8.0)	5 (5.0)	
None	38 (38.0)	56 (56.0)	45 (45.0)	65 (65.0)	
QMI-score	27.66 ± 8.99	28.71 ± 9.05	32.16 ± 7.28	32.41 ± 8.61	0.000**
Couple relationship					0.001**
Fine	81 (81.0)	70 (70.0)	91 (91.0)	88 (88.0)	
General	9 (9.0)	17 (17.0)	7 (7.0)	10 (10.0)	
Deteriorate	10 (10.0)	13 (13.0)	2 (2.0)	2 (2.0)	
COVID-19 related anxiety					0.001**
Severe	9 (9.0)	13 (13.0)	3 (3.0)	1 (1.0)	
Slight	30 (30.0)	15 (15.0)	27 (27.0)	19 (19.0)	

No	61 (61.0)	72 (72.0)	70 (70.0)	80 (80.0)	
GAD-7 score	7.18 ± 5.56	6.65 ± 5.09	5.68 ± 4.58	5.10 ± 3.29	0.008**
Prevalence (%)	39 (39.0)	28 (28.0)	28 (28.0)	16 (16.0)	0.004**
PHQ-9 score	10.21 ± 6.37	9.07 ± 6.74	7.49 ± 6.10	7.18 ± 4.70	0.001**
Prevalence (%)	43 (43.0)	28 (28.0)	30 (30.0)	20 (20.0)	0.005**

4 QMI: Quality of Marriage Index; GAD-7: Generalized Anxiety Disorder-7; PHQ-9: Patient

5 Health Questionnaire-9

6 *P<0.05, **P<0.01

7

Table 5(on next page)

Table 5. The effect of changed in frequency of masturbation on mental health, couple relationship and sexual health of the participants

Table 5. The effect of changed in frequency of masturbation on mental health, couple relationship and sexual health of the participants

	Increased(n=44) n (%) / Mean $\pm$ SD	Unchanged(n=164) n (%) / Mean $\pm$ SD	Decreased(n=58) n (%) / Mean $\pm$ SD	None(n=134) n (%) / Mean $\pm$ SD	P value
Age	34.09 $\pm$ 5.77	34.16 $\pm$ 4.15	34.67 $\pm$ 3.54	33.28 $\pm$ 4.59	0.173
Group					0.000**
Azoospermia	36 (81.8)	77 (46.9)	29 (50.0)	58 (43.3)	
Control	8 (18.2)	87 (53.1)	29 (50.0)	76 (56.7)	
Gender					0.000**
Male	18 (40.9)	91 (55.5)	41 (70.7)	50 (37.3)	
Female	26 (59.1)	73 (44.5)	17 (29.3)	84 (62.7)	
Sexual life frequency (per month)	3.16 $\pm$ 2.47	4.18 $\pm$ 2.52	3.90 $\pm$ 2.41	4.77 $\pm$ 2.65	0.002**
Stress level					0.017*
Very high	9 (20.5)	12 (7.3)	5 (8.6)	6 (4.5)	
High	16 (36.4)	37 (22.6)	17 (29.3)	30 (22.4)	
General	10 (22.7)	90 (54.8)	30 (51.7)	74 (55.2)	
Low	7 (15.9)	18 (10.9)	5 (8.6)	17 (12.7)	
None	2 (4.5)	7 (4.3)	1 (1.7)	7 (5.2)	
GAD-7 score	11.75 $\pm$ 5.53	5.40 $\pm$ 4.27	6.76 $\pm$ 4.26	4.97 $\pm$ 3.88	0.000**
Anxiety					0.000**
Prevalence (%)	30 (68.2)	37 (22.6)	20 (34.5)	24 (17.9)	
PHQ-9 score	15.48 $\pm$ 7.24	7.48 $\pm$ 5.26	9.60 $\pm$ 5.93	6.60 $\pm$ 4.61	0.000**
Depression					0.000**
Prevalence (%)	31 (70.5)	41 (25.0)	24 (41.4)	25 (18.7)	
QMI score	22.34 $\pm$ 8.27	28.32 $\pm$ 7.88	30.57 $\pm$ 4.95	35.02 $\pm$ 8.48	0.000**
Conjugal relations					0.000**
Deteriorated	22 (50.0)	2 (1.2)	0 (0.0)	3 (2.2)	
General	7 (15.9)	23 (14.0)	7 (12.1)	7 (5.2)	
Fine	15 (34.1)	139 (84.8)	51 (87.9)	124 (92.5)	
Changed in sexual desire					0.000**
Decreased	21 (47.7)	9 (5.5)	13 (22.4)	8 (5.9)	
Unchanged	15 (34.1)	151 (92.1)	44 (75.9)	120 (89.6)	
Increased	8 (18.2)	4 (2.4)	1 (1.7)	6 (4.5)	
Changed in sex frequency					0.000**
Decreased	22 (50.0)	12 (7.3)	15 (25.9)	13 (9.7)	

Unchanged	13 (29.6)	148 (90.2)	41 (70.7)	116 (86.6)	
Increased	9 (20.4)	4 (2.4)	2 (3.4)	5 (3.7)	
Changed in satisfaction					
Decreased	30 (68.2)	6 (3.7)	11 (19.0)	5 (3.7)	
Unchanged	9 (20.5)	154 (93.9)	46 (79.3)	127 (94.8)	
Increased	5 (11.3)	4 (2.4)	1 (1.7)	2 (1.5)	
Dyspareunia					0.000**
Almost always	0 (0.0)	3 (1.8)	2 (3.5)	0 (0.0)	
Usually	2 (4.6)	9 (5.5)	0 (0.0)	2 (1.5)	
Sometimes	20 (45.5)	30 (18.3)	26 (44.8)	16 (11.)	
Rarely	2 (4.6)	36 (22.0)	11 (19.0)	24 (17.91)	
Very rarely	12 (27.3)	24 (14.6)	11 (19.0)	34 (25.4)	
Never	8 (18.2)	62 (37.8)	8 (13.8)	58 (43.3)	
Sexual dysfunction					0.000**
Prevalence (%)	26 (59.1)	34 (20.7)	17 (29.3)	19 (14.2)	
Sexual satisfaction					0.000**
Very dissatisfied	6 (13.6)	9 (5.5)	2 (3.4)	3 (2.2)	
Dissatisfied	26 (59.1)	17 (10.4)	8 (13.8)	2 (1.5)	
Neutral	0 (0.0)	33 (20.1)	14 (24.1)	25 (18.7)	
Satisfied	7 (15.9)	66 (40.2)	26 (44.8)	63 (47.0)	
Very satisfied	5 (11.4)	39 (23.8)	8 (13.8)	41 (30.6)	
Intimacy during sex life					0.000**
Very dissatisfied	5 (11.4)	7 (4.3)	0 (0.0)	3 (2.2)	
Dissatisfied	24 (54.6)	17 (10.4)	5 (8.6)	3 (2.2)	
Neutral	3 (6.8)	30 (18.3)	16 (27.6)	19 (14.2)	
Satisfied	7 (15.9)	74 (45.1)	26 (44.8)	69 (51.5)	
Very satisfied	5 (11.4)	36 (21.9)	11 (19.0)	40 (29.9)	

4 QMI: Quality of Marriage Index; GAD-7: Generalized Anxiety Disorder-7; PHQ-9: Patient

5 Health Questionnaire-9

6 *P<0.05, **P <0.01

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Table 6(on next page)

Table 6. Direct, indirect, and total effects on sexual health.

1 Table 6. Direct, indirect, and total effects on sexual health.

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	<i>Path</i>	<i>Direct Effect</i>	<i>Indirect Effect</i>	<i>Total Effect</i>	<i>SE</i>	<i>95% CI</i>	<i>P</i>
Male Sexual Health	F>S	-0.21			0.06	[-0.32, -0.10]	0.001
	F>P>S		-0.008		0.01	[-0.02, 0.01]	0.311
	F>R>S		0.37		0.07	[0.23, 0.51]	< .001
	F>P>R>S		0.06		0.02	[0.02, 0.11]	0.008
				0.21	0.07	[0.08, 0.35]	< .001
Female Sexual Health	F>S	-0.02			0.03	[-0.08, 0.04]	0.587
	F>P>S		-0.006		0.01	[-0.03, 0.02]	0.626
	F>R>S		0.12		0.04	[0.03, 0.20]	0.009
	F>P>R>S		0.08		0.02	[0.03, 0.12]	< .001
				0.17	0.05	[0.09, 0.28]	< .001

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4 F: frequency of masturbation;P: psychological distress; R: relationship satisfaction;

5 S: sexual health

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Figure 1

Fig. 1 Association between frequency of masturbation and sexual health mediated by psychological distress and relationship satisfaction in men.

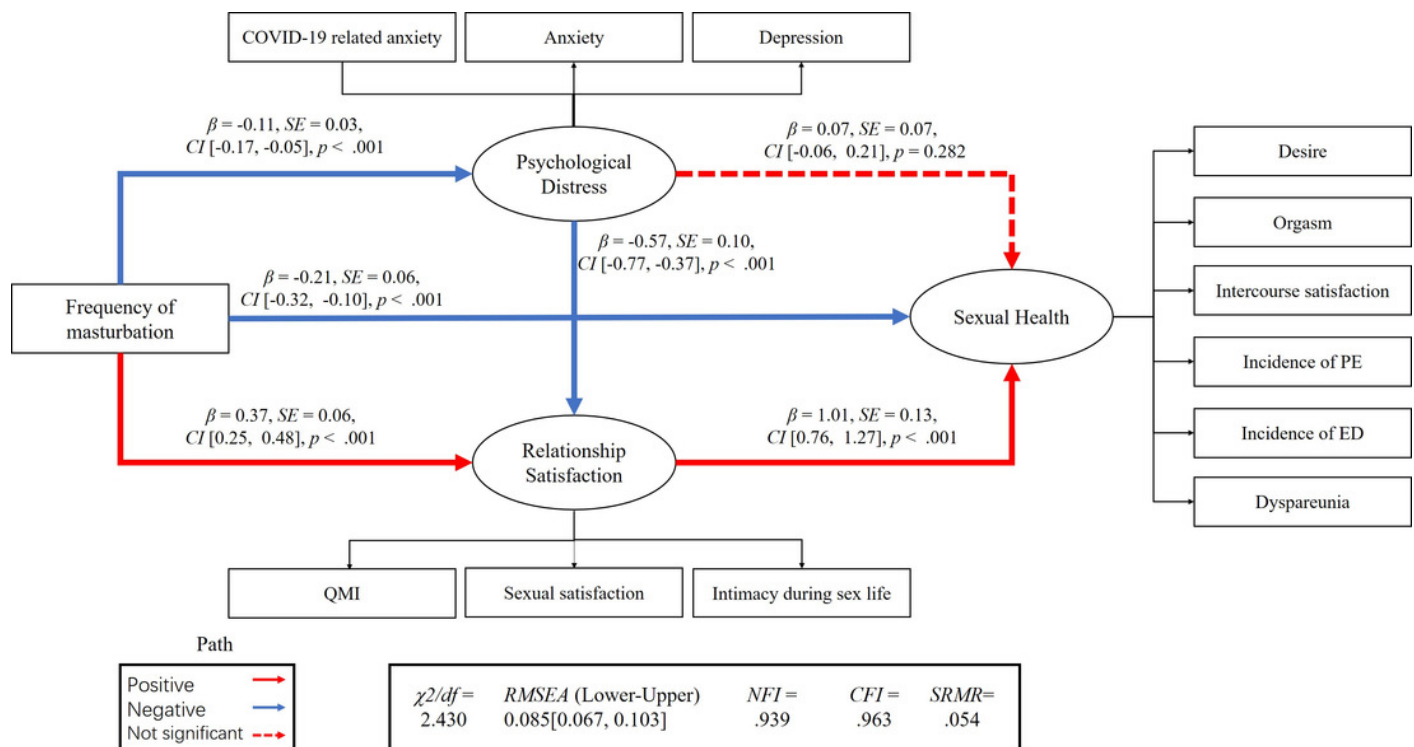


Figure 2

Fig. 2 Association between frequency of masturbation and sexual health mediated by psychological distress and relationship satisfaction in women.

