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# Analysis of the Correlation between Semen Quality and Mental Psychological Stress in Infertile Men and Potential Cofactors

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**Key words**
**Infertile men, Anxiety, Semen quality, Stress, Depression, Mental health**

## ABSTRACT

The objective of this study was to investigate the factors influencing stress and mental health in infertile men, and correlations of these factors with semen quality, to provide a basis for developing targeted psychological interventions. A total of 204 male patients were recruited and allocated into dysspermia (n=110) or normospermia (n=94) groups on the basis of semen parameters. Personal profiles and mental states were assessed by a general questionnaire and self-assessment scales. Correlations among various dimensional factors were analyzed, including infertility-related stress, anxiety and depression. Multivariate analysis revealed that chronic diseases, absence of reproductive history, and longer infertility duration were significant risk factors for male infertility. Patients with lower levels of family income showed relatively higher scores for anxiety and depression. Patients with a lower family income level had a higher likelihood of experiencing anxiety and depression ($P<0.05$). Correlation analysis indicated that anxiety and depression levels in infertile men were positively correlated with each other and with social and sexual stress. Depression levels were positively associated with the need for parenthood. Sexual and relationship concerns were negatively correlated with semen quality. Overall infertility-related stress and social concerns were negatively correlated with the rate of normal sperm morphology ($P<0.05$). To conclude there was a significant correlation between semen parameters and mental stress in infertile men. These findings highlight the impact of financial situation, chronic diseases, and semen parameters on mental health. Addressing these factors will be important to improve the psychological well-being and reproductive quality of life of patients.

## INTRODUCTION

Male infertility is defined as the inability of a couple to conceive within one year of trying because of factors affecting the male partner, and is often accompanied by psychosocial impacts and marital discord (Eisenberg *et al*., 2023). Recent estimates indicate that the age-standardized prevalence rate of male infertility is projected to continue rising by 1.25% from 2022 to 2040 annually (Liang *et al*., 2025). Semen parameters provide the most common diagnostic basis to assess male fertility, and are affected by many factors, including testicular function, endocrinopathies, genetics, environment, lifestyle, and aging. Psychosocial stress and negative emotion have also been reported as potential risk factors for reduced semen quality (Band, 2011; Hall and Burt, 2012; Nargund, 2015). The correlation between psychological factors and physiological indicators, such as sperm concentration, sperm cell DNA fragmentation rate, and reproductive hormone levels, may provide new insights into the diagnosis and treatment of male infertility. A recent large-scale cohort study showed that increased perceived stress was negatively associated with semen parameters, including sperm concentration, total motility, and morphology (Reddy *et al*., 2025).

Recent studies have demonstrated the relationships between semen quality and multiple factors, including nutritional status, dietary habits, physical activity, and

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sleep duration (Kumar *et al*., 2024; Zańko *et al*., 2022; Zhang *et al*., 2024). These factors can be predicted by broader socioeconomic profiles, such as family income and region of residence. Additionally, men with higher levels of education tend to have a more comprehensive knowledge regarding drug use, healthy diet, and lifestyle choices, which in turn may contribute to improved semen quality (Zhong, 2024). Characteristics of modern life, such as family role expectations and a fast-paced lifestyle, induce common stressors and contribute to an increasing number of adults facing significant psychological challenges. These challenges can disrupt the homeostasis of a spermatogenic microenvironment through various mechanisms (Hall and Burt, 2012; Shi *et al*., 2024). Long-term psychological stress suppresses the hypothalamic–pituitary–gonadal axis by activating the hypothalamic–pituitary–adrenal axis, resulting in reduced testosterone levels and gonadotropin-inhibitory hormone-induced testicular cell degeneration, involving the disruption of spermatogenesis and sperm motility (Nargund, 2015; Odetayo *et al*., 2023). Stress or anxiety can affect DNA damage and increase sperm DNA fragmentation, possibly resulting from chromatin packing abnormalities, reactive oxygen species, or apoptosis (Khalid *et al*., 2023; Radwan *et al*., 2016; Vellani *et al*., 2013).

Psychological stress and distress frequently co-occur (Zurlo *et al*., 2020). Many studies have shown that outpatients in andrology, particularly those with poor semen quality and infertility, exhibit relatively high levels of depression and anxiety symptoms (Biggs *et al*., 2024; Braverman *et al*., 2024; Čegar *et al*., 2023; Mehmet Şahin, 2025; Yang *et al*., 2017; Yuan, 2016). However, few studies have simultaneously considered the impact of infertility-related stress and negative emotions on the subjects. The scales related to anxiety or depression are generally not designed with infertile individuals in mind, therefore, the real stress levels of infertile men are more likely to be concealed (Hanna and Gough, 2021; Newton *et al*., 1999). To date, the psychological aspects of male infertility have often been overlooked and undertreated (Braverman *et al*., 2024; Wischmann and Thorn, 2013). In China, influenced by the traditional "family line" concept, men undertake relatively heavier reproductive expectations than their partners, especially men as the only child (Logan *et al*., 2019). Generally, sons represent the continuous family lineage in China, and fatherhood is an affirming experience to the respected male identity. Thus, male infertility seems to be more stigmatized than other infertility diagnoses, and infertile individuals experience more prejudice and pressure from society (Joja *et al*., 2015; Wischmann and Thorn, 2013). Some reports present negative or partial associations between semen quality and physical health (Coward *et al*., 2019; Holter *et al*., 2007; Zhang *et al*., 2024). One of the limitations of this area of research is the limited range of participants selected, typically either diagnosed infertile males or couples intending to undergo IVF treatment, with no control fertile participants.

This study recruited men attending andrology clinics for fertility/infertility counseling to explore the correlations between psychological status and semen parameters including sperm concentration, motility, and morphology. We also profiled factors such as underlying diseases, infertility duration, and family income, to provide empirical evidence for the future development of individualized psychological and biological intervention schemes. This comprehensive and multi-dimensional research methodology will facilitate a thorough understanding of the multiple etiologies of male infertility, and promote a transition from single clinical indicators to a holistic assessment of overall and psychophysiological states. Consequently, this investigation aims to enhance the psychological well-being and life quality of infertile men and target the personalization of infertility treatment.

## MATERIALS AND METHODS

### *Study design and participants*

A cross-sectional survey was performed among outpatient men referred to the Reproductive Medicine Center of Huzhou Maternity and Child Health Care Hospital by convenience sampling. Voluntary participants, 20 and 45 years old, having ability to complete the questionnaire independently were included in the study. The exclusion criteria were: (1) infertility attributed to female partner or both; (2) primary erectile dysfunction, epididymitis, varicocele, urogenital tract inflammation and other urogenital system disorders, tumors or severe chronic diseases; (3) history of serious mental illness, regular alcohol consumption and smoking. The subjects with normal semen parameters were allocated to the normospermia group.

### *Semen analysis*

Semen samples were collected via masturbation after 2–7 days of sexual abstinence, and allowed to liquefy at 37 °C. They were then evaluated for sperm concentration, motility and morphology by computer-assisted semen analysis (CASA) system. According to the World Health Organization (WHO) guideline (World Health Organization, 2021), normal semen parameters should m*eet al*l the following criteria: sperm count $\geq 15\times10^6$/mL; total motile spermatozoa$\geq 39\times10^6$/an entire ejaculate; sperms of grade (A+B)$\geq$32%; proportion of sperms with normal morphology$\geq$4%.

*Demographic features*

A self-designed general information questionnaire was adopted, encompassing two major sections: The sociodemographic part comprised age, residence, education, residence, and only child; the disease-related part pertained to reproductive background (fatherhood history), infertility duration, and chronic diseases (e.g., hypertension, diabetes, coronary heart disease, hyperlipidemia, and others).

*Measures*

Scales were distributed via online survey website for respondents to fulfill self-evaluation. Prior to submitting, all subjects notified to comprehend meanings of each question in the scales and complete questionnaires independently. The assessment range pertained to subjects conditions within the most recent week.

The fertility problem inventory (FPI) is a representative scale to assess infertility-related stress in individuals. Forty-six items were categorized into five dimensions (social concern, sexual concern, relationship concern, need for parenthood, and rejection of childfree lifestyle) (Newton *et al*., 1999). Each item was rated on a 6-point Likert scale, from strongly disagree = 1 to strongly agree = 6. The final score ranged from 46 to 276. In general, higher scores indicated higher fertility stress for both overall score and each dimension. M-FPI, the Mandarin edition adopted in this study was adequately tested to have good reliability and validity (Peng *et al*., 2011). Cronbach's α coefficient was 0.80 in the present study.

Depressive and anxious symptoms were assessed with Zung's self-rating depression scale (SDS) and self-rating anxiety scale (SAS), respectively (Zung, 1965, 1971). Both instruments contain 20 items rated on a 4-point Likert scale to measure the degree of the symptoms. By the end of questionnaire, negative items score were complemented, sum together with positive items score, and multiplied by 1.25 to obtain a weighted value ranging from 20 to 80. These scales were designed to serve as screening tools, which do not provide a clinical diagnosis of depression but rather indicate levels of depressive symptoms that may be clinically significant. Typically, non-depressed or non-anxious individuals score below 40, while a score between 40 and 60 suggested the presence of depressive or anxious symptoms. A score of 60 or higher indicates clinically significant depressive or anxiety symptoms.

*Statistical analysis*

Data were aggregated and preprocessed with Excel, and imported into SPSS 27.0 for subsequent analysis. Categorical data were expressed as the frequency and constituent ratio (%) and performed $x^2$ test between groups. Normally distributed continuous data were expressed as mean ± standard deviation ($\bar{x}$±s), and analyzed using Student t-test or ANOVA for two independent or multiple groups, respectively. For nonnormally distributed continuous data, we used median and inter-quartile range (IQR) to express, and analyzed using Wilcoxon signed ranks test. Risk variables with significance difference ($P < 0.05$) during univariate analysis were incorporated into the multivariate regression analysis. Pearson correlation analysis was used to explore relationship between semen parameters, anxiety, depression and M-FPI scores. A two-sided $P < 0.05$ was considered statistically significant.

**Table I. Characteristics of respondents with two types of semen quality.**

| Variable | Dyssper-mia | Normo-spermia | $\chi^2$ | P |
|---|---|---|---|---|
| **Age (years)** | | | 4.398 | 0.036 * |
| ≤32 | 71(34.8) | 47(23.0) | | |
| >32 | 39(19.1) | 47(23.0) | | |
| **Education** | | | 0.807 | 0.668 |
| Middle school or below | 24(11.8) | 21(10.3) | | |
| High school | 52(25.5) | 39(19.1) | | |
| Bachelor or above | 34(16.7) | 34(16.7) | | |
| **Only child** | | | 2.102 | 0.147 |
| Yes | 58(28.4) | 40(19.6) | | |
| No | 52(25.5) | 54(26.5) | | |
| **Chronic diseases** | | | 5.281 | 0.022 * |
| Yes | 15(7.4) | 4(2.0) | | |
| No | 95(46.6) | 90(44.1) | | |
| **Family income per year** | | | 0.374 | 0.066 |
| ≤50,000 | 21(9.8) | 19(8.9) | | |
| 50,000~100,000 | 37(17.3) | 30(14.0) | | |
| ≥100,000 | 54(25.2) | 53(24.8) | | |
| **Residence** | | | 3.217 | 0.073 |
| City | 47(23.0) | 52(25.5) | | |
| Village | 63(30.9) | 42(20.6) | | |
| **Reproduction history** | | | 16.496 | <0.001 ** |
| Yes | 27(13.2) | 49(24.0) | | |
| No | 83(40.7) | 45(22.1) | | |
| **Infertility duration (years)** | | | 18.028 | <0.001 ** |
| ≤1 | 39(19.1) | 61(29.9) | | |
| 1~3 | 44(21.6) | 18(8.8) | | |
| ≥3 | 27(13.2) | 15(7.4) | | |

Note: * $P < 0.05$ ** $P < 0.001$

## RESULTS

*Participating subjects*

A total of 216 questionnaires were distributed in this study, of which 204 were deemed valid. The average age of all respondents was 31.91 years (± 4.38). Specifically, the mean ages were 31.37 years (± 4.20) for the dysspermia group (n = 110) and 32.53 years (± 4.52) for the normospermia group (n = 94). $x^2$ test indicated significant differences in age, chronic diseases, fatherhood history, and infertility duration between the two groups (P < 0.05). In contrast, no statistically significant differences were observed in only child, education level, family income level, or place of residence. The detailed characteristics are shown in Table I.

The average values of all aspect of semen indicators of dysspermia group were relatively lower, and these differences were statistically significant (P<0.001) (Table II).

*M-FPI, depression and anxiety scores of the two groups*

Among the dysspermia group, the prevalence of mild anxiety was 45.5%, and severe anxiety was 1.8%. For depression, the corresponding figures were 58.2% for mild and 12.7% for severe. In contrast, in the normospermia group, the prevalence of mild anxiety was 47.9%, with no cases of severe anxiety, while for depression, the rates were 54.3% for mild and 12.8% for severe. Such distribution was in accordance with previous report (Yuan *et al*., 2016). There were no significant differences between two groups in terms of infertility-related stress, as well as anxiety and depression. For the subscales, both sexual concern (P = 0.035) and relationship concern (P = 0.048) showed significantly higher scores in the dysspermia group. The scores of each group are detailed in Table III.

*Multifactor linear regression analysis of correlation between groups*

Select statistically significant sociodemographic and psychological factors as independent variables for assignment, including chronic diseases (yes = 1, no = 0), fatherhood history (yes = 1, no = 0), infertility duration (≤1 year = 1, 1 - 3 years = 2, >3 years = 3), and scores of sexual concern and relationship concern. Given that the normospermia group primarily comprised patients undergoing preconception health check-ups, age was not included as an independent variable. Binary logistic regression analysis was conducted with the groups defined by semen parameters (dysspermia = 1, normospermia = 0) as the dependent variable. The results indicated that neither sexual concern (P = 0.237) nor relationship concern (P = 0.958) were statistically significant predictors of semen quality and were therefore excluded from the regression model.

**Table II. Semen parameters of dysspermia and normospermia groups of participants.**

| Semen parameters | Dysspermia | Normospermia | Z | P |
|---|---|---|---|---|
| Total motility (%) | 18.75(0.00~51.30) | 65.80(52.75~82.00) | -8.971 | <0.001 ** |
| Progressive motility (%) | 13.90(0.00~41.35) | 56.50(46.90~74.00) | -9.050 | <0.001 ** |
| Sperm concentration ($10^6$/mL) | 24.80(0.00~66.00) | 116.20(60.35~236.53) | -8.080 | <0.001 ** |
| Total sperm count ($10^6$) | 70.75(0.00~226.23) | 411.85(188.98~654.38) | -8.203 | <0.001 ** |
| Sperm morphology (%) | 1,00(0.00~2.00) | 5.00(4.00~7.00) | -11.203 | <0.001 ** |

Note: ** $P < 0.001$

**Table III. M-FPI (Mandrin-fertility problem inventory), depression and anxiety scores of dysspermia and normospermia groups.**

| | Dysspermia | Normospermia | OR (95% CI) | P |
|---|---|---|---|---|
| Fertility stress | 176.85±30.10 | 170.66±24.41 | 6.20(-1.46~13.85) | 0.112 |
| Social concern | 34.64±8.40 | 33.34±6.81 | 1.30(-0.84~3.43) | 0.233 |
| Sexual concern | 28.54±6.47 | 26.62±6.41 | 1.92(0.14~3.70) | 0.035 * |
| The need for parenthood | 43.78±7.89 | 44.56±6.60 | -0.78(-2.78~1.22) | 0.442 |
| Rejection of a child-free lifestyle | 31.05±7.15 | 29.35±6.82 | 1.69(-0.25~3.63) | 0.086 |
| Relationship concern | 38.85±7.63 | 36.79±7.09 | 2.07(0.02~4.11) | 0.048 * |
| Anxiety | 40.84±8.07 | 40.41±6.33 | 0.43(-1.60~2.46) | 0.677 |
| Depression | 48.49±10.23 | 46.75±10.11 | 1.73(-1.08~4.55) | 0.226 |

Note: * $P < 0.05$

**Table IV. Multifactor linear regression analysis of factors associated with semen quality.**

| Predictors | B | SE | Wald $\chi^2$ | P | OR (95% CI) |
|---|---|---|---|---|---|
| Chronic diseases | 1.275 | 0.617 | 3.949 | 0.047 | 3.405 (1.017~11.399) |
| Infertility duration | 0.595 | 0.200 | 8.806 | 0.003 | 1.812 (1.224~2.685) |
| Reproduction history | 1.275 | 0.320 | 15.880 | <0.001 | 3.579 (1.912~6.700) |

**Table V. Univariate analysis of mental health of the dysspermia group.**

| Variable | M-FPI | t/F | P | anxiety | t/F | P | depression | t/F | P |
|---|---|---|---|---|---|---|---|---|---|
| **Age (years)** | | -1.984 | 0.050 | | 1.246 | 0.215 | | -0.611 | 0.542 |
| ≤32 | 172.69±29.03 | | | 41.55±8.09 | | | 48.05±9.67 | | |
| >32 | 184.44±30.92 | | | 39.55±7.96 | | | 49.29±11.26 | | |
| **Education** | | 0.620 | 0.540 | | 6.101 | 0.003* | | 1.572 | 0.212 |
| Middle school or below | 178.46±38.86 | | | 45.68±7.76 | | | 51.56±9.98 | | |
| High school | 173.58±29.42 | | | 39.74±7.43 | | | 48.15±10.17 | | |
| Bachelor or above | 180.74±23.85 | | | 39.12±8.10 | | | 46.84±10.31 | | |
| **Only child** | | 0.566 | 0.573 | | -0.502 | 0.617 | | -0.579 | 0.564 |
| Yes | 47.95±10.47 | | | 40.47±8.98 | | | 47.95±10.47 | | |
| No | 49.09±10.02 | | | 41.25±6.97 | | | 49.09±10.02 | | |
| **Chronic diseases** | | 1.563 | 0.121 | | 1.292 | 0.199 | | 1.161 | 0.248 |
| Yes | 188.07±33.44 | | | 43.33±7.67 | | | 51.33±8.43 | | |
| No | 175.08±29.34 | | | 40.45±8.09 | | | 48.04±10.45 | | |
| **Family income per year** | | 0.266 | 0.767 | | 5.892 | 0.004* | | 4.740 | 0.011* |
| ≤50,000 | 179.10±27.15 | | | 45.83±8.09 | | | 54.23±8.28 | | |
| 50,000~100,000 | 173.95±35.75 | | | 40.61±6.49 | | | 48.21±9.70 | | |
| ≥100,000 | 178.02±27.12 | | | 38.99±8.35 | | | 46.37±10.58 | | |
| **Residence** | | -1.013 | 0.313 | | -2.757 | 0.007* | | -2.488 | 0.014* |
| Urban | 173.49±30.23 | | | 38.46±7.62 | | | 45.74±9.72 | | |
| Village | 179.37±30.00 | | | 42.62±7.99 | | | 50.54±10.19 | | |
| **Reproduction history** | | -0.132 | 0.895 | | -0.177 | 0.860 | | 0.693 | 0.490 |
| Yes | 176.19±25.92 | | | 40.60±8.31 | | | 49.68±9.91 | | |
| No | 177.07±31.48 | | | 40.92±8.03 | | | 48.10±10.35 | | |
| **s** | | 0.994 | 0.373 | | 0.134 | 0.875 | | 0.199 | 0.820 |
| ≤1 | 176.03±30.53 | | | 40.38±9.36 | | | 47.66±10.60 | | |
| 1~3 | 173.41±23.02 | | | 40.88±7.40 | | | 48.86±10.72 | | |
| ≥3 | 183.67±38.61 | | | 41.44±7.30 | | | 49.07±9.08 | | |

Note: * $P < 0.05$

The final model incorporated chronic diseases, fatherhood history, and infertility duration as factors. In the results, concurrence of chronic diseases (OR = 3.405, 95% CI 1.017 - 11.399, P = 0.047), longer duration of infertility (OR = 1.812, 95% CI 1.224 - 2.685, P = 0.003), or without a history of fatherhood (OR = 3.579, 95% CI 1.912 - 6.700, P < 0.001) were significantly associated with semen abnormality, which indicates an increased risk of male infertility (Table IV).

*Univariate and multivariate analyses of mental health of the dysspermia group*

In the dysspermia group, elder subgroups exhibited higher M-FPI scores (P = 0.050). Significant differences were observed in anxiety levels based on residence, education, and income levels, as well as in depression levels based on residence and income levels. LSD post-hoc test revealed that anxiety levels were significantly higher among individuals with low educational attainment (high school or below) (P = 0.002), while both anxiety and

**Table VI. Multivariate analyses of depression and anxiety of the dysspermia group.**

| Variable | Group | B | SD | β | t | P |
|---|---|---|---|---|---|---|
| Anxiety | Family income | -0.905 | 0.727 | -0.096 | -1.244 | 0.215 |
| | Residence | 2.559 | 1.068 | 0.176 | 2.395 | 0.018 * |
| | Education | -1.373 | 0.744 | -0.139 | -1.844 | 0.067 |
| Depression | Family income | -1.872 | 0.962 | -0.142 | -1.945 | 0.053 |
| | Residence | 3.717 | 1.481 | 0.183 | 2.509 | 0.013 * |

**Table VII. Associations of semen quality and mental health of the dysspermia group.**

| | | Total motility | Progressive motility | Sperm concentration | Total sperm count | Sperm morphology | Anxiety | Depression |
|---|---|---|---|---|---|---|---|---|
| Fertility stress | P | 0.079 | 0.111 | 0.194 | 0.236 | 0.029* | <0.001 ** | <0.001 ** |
| | r | -0.123 | -0.112 | -0.091 | -0.083 | -0.152 | 0.361 ** | 0.366 ** |
| Social concern | P | 0.153 | 0.167 | 0.287 | 0.273 | 0.026* | <0.001 ** | <0.001 ** |
| | r | -0.100 | -0.097 | -0.075 | -0.077 | -0.156 | 0.350 ** | 0.351 ** |
| Sexual concern | P | 0.059* | 0.091* | 0.359* | 0.327* | 0.046* | <0.001 ** | <0.001 ** |
| | r | -0.132 | -0.119 | -0.065 | -0.069 | -0.140 | 0.409 ** | 0.413 ** |
| The need for parenthood | P | 0.869 | 0.965 | 0.632 | 0.531 | 0.661 | 0.068 | 0.021 * |
| | r | 0.012 | 0.003 | 0.034 | 0.044 | -0.031 | 0.175 | 0.220 * |
| Rejection of a child-free lifestyle | P | 0.248 | 0.289 | 0.563 | 0.552 | 0.326 | 0.228 | 0.324 |
| | r | -0.081 | -0.075 | -0.041 | -0.042 | -0.069 | 0.116 | 0.095 |
| Relationship concern | P | 0.003* | 0.010* | 0.003* | 0.003* | 0.007* | <0.001 ** | <0.001 ** |
| | r | -0.207 | -0.179 | -0.207 | -0.208 | -0.187 | 0.401 ** | 0.390 ** |
| Anxiety | P | 0.854 | 0.962 | 0.375 | 0.810 | 0.785 | | <0.001 ** |
| | r | -0.013 | 0.003 | -0.062 | -0.017 | -0.019 | | 0.691 ** |
| Depression | P | 0.337 | 0.552 | 0.201 | 0.300 | 0.706 | <0.001 ** | |
| | r | -0.068 | -0.042 | -0.090 | -0.073 | -0.027 | 0.691 ** | |

Note: * $P < 0.05$ ** $P < 0.001$

depression levels were significantly higher among those with a family income less than ¥ 50,000 compared to those with a family income exceeding ¥100,000, with P values of < 0.001 and 0.003, respectively. Detailed results are presented in Table V.

Among dimensions of M-FPI, stress of the need for parenthood presented a statistically significant difference in age subgroups (t = -2.942, P = 0.004) and infertility duration subgroups (F = 3.672, P = 0.029).

Select statistically significant factors from the univariate analysis as independent variables for the multiple linear regression model, including family income (≤ ¥50,000 = 1, ¥50,000 - 100,000 = 2, ≥ ¥100,000 = 3), education (middle school or below = 1, high school = 2, bachelor or above = 3), and residence (urban = 1, non-urban = 2). The attributive variables were the levels of anxiety and depression. As shown in Table VI, there were significant differences in anxiety (B = 2.559, t = 2.395, P = 0.018) and depression (B = 3.717, t = 2.509, P = 0.013) levels between residence groups, but not between family income groups, Additionally, no significant differences were found in anxiety levels across education groups.

*Associations of semen quality and mental health of the dysspermia group*

Pearson's correlation analysis revealed that anxiety, depression and infertility-related stress were substantially and positively correlated among individuals with dysspermia ($P < 0.001$) (Table VII). Subscales of infertility-related stress including social concern, sexual concern, and relationship concern were significantly correlated with both anxiety and depression ($P < 0.001$). Additionally, the need for parenthood was also positively correlated with depression ($P = 0.021$).

In semen parameters, a negatively association were observed between sperm morphology and social concern, sexual concern, as well as overall infertility-related stress. All semen parameters showed a negative correlation with relationship concern and sexual concern.

## DISCUSSION

The deterioration of male semen quality has emerged as a crucial factor leading to the widespread increase in the infertility rate among couples of reproductive ages (Liang *et al*., 2025). Different levels of infertility-related stress, as well as depression and anxiety symptoms, may also impact fertility outcomes and life quality of both patients and their spouses (Biggs *et al*., 2024; Klemetti *et al*., 2010; Shi *et al*., 2024). The present investigation included 204 men who underwent consultation for fertility issues, and a cross-sectional study was conducted in the form of multiple questionnaires. To the best of our knowledge, this is the first study to comprehensively consider semen quality alongside stress, anxiety, and depression while specifically focusing on infertility caused solely by male factors.

The variance analysis indicated that the scores of sexual concern and relationship concern differed significantly between the dysspermia and normospermia groups, consistent with previous studies (You, 2020; Zhong *et al*., 2024). No differences were observed in other psychological factors, including depression, anxiety, and overall infertility-related stress. Earlier studies also showed no significant differences in anxiety and psychological stress symptoms in male patients exhibiting dysspermia compared with those exhibiting normospermia (Bräuner *et al*., 2020; Vellani *et al*., 2013). These findings may be attributed to self-regulation, a psychological compensation mechanism aimed at relieving mental stresses and improving fertility quality of life, although this possibility needs further investigation (Abulizi *et al*., 2023). Additionally, factors such as lifestyle and personal characteristics can influence mental and psychological conditions (Fisher and Hammarberg, 2012). Moreover, the levels of psychological well-being were significantly affected by the stage of diagnosis and treatment at the time of the investigation (Warchol-Biedermann, 2021). As reported, the average delay between a diagnosis of infertility and the onset of mental illness was 1.67 years (Wang *et al*., 2018). Thus, the stage of disease management during the investigation may significantly influence the conclusions. Interestingly, patients with varying durations of male infertility did not show differences in scores of infertility-related stress or other emotional measures (Band *et al*., 2011), indicating that mental health does not necessarily deteriorate linearly with the length of infertility. This finding is consistent with the conclusion of a recent study focused on the correlation between duration of infertility and mental health (Dong *et al*., 2022).

Multivariate regression analysis revealed that the duration of infertility, the absence of reproductive history, and the presence of chronic diseases were significant predictors of dysspermia. Past evidence suggests a robust association between long-term chronic diseases in men and decreased fertility, independent of potential mediating factors, such as obesity (Glazer *et al*., 2017). It is widely acknowledged that age is a confounding factor for infertility (Ying *et al*., 2023). Therefore, in the current study, age was excluded from the final model (multivariate analysis) despite its significance in univariate analysis.

The current analysis of the dysspermia group alone showed that increasing age was significantly associated with higher levels of infertility-related stress. Subscale analysis revealed that the need for parenthood was the primary influencing factor. As age increases, more peers transition from childlessness to parenthood, leading to a growing sense of social isolation and related stress in infertile men (Fisher and Hammarberg, 2012). Besides age, the need for parenthood also intensified with the duration of infertility. A study found that this dimension was the most significant concern for both infertile men and infertile women (Shayesteh-Parto *et al*., 2023). Family income and place of residence were also significant factors affecting anxiety and depression levels. Multivariate analysis suggested that residence may act as an intermediary factor, with post hoc tests indicating that this association was significant only when there was a relatively large income disparity.

Pearson correlation analysis revealed positive correlations among anxiety, depression, overall infertility-related stress, and social and sexual concerns. These findings confirmed that psychological stress and distress were likely to co-occur (Newton *et al*., 1999). Furthermore, only depression was significantly associated with the need for parenthood. Given its positive correlations with age and duration of infertility, the need for parenthood may serve as a confounding factor, as suggested by other studies (Alosaimi *et al*., 2015).

Correlation analyses of semen parameters and mental health revealed that all parameters were significantly correlated with sexual and relationship concerns, while the rate of normal sperm morphology was negatively correlated with overall and social stress. The association between negative emotions and semen parameters remains debatable (Coward *et al*., 2019; Zhang *et al*., 2024). Therefore, for patients with dysspermia seeking medical consultation, greater attention should be paid to

specific stressors. For patients with a high rate of sperm deformities, overall infertility-related stress should be carefully evaluated. However, a recent study showed that the stress level quantified by salivary cortisol was positively correlated with total sperm counts in men with male-factor infertility, although the mechanism was not clear (Spitzer *et al*., 2022). Infertility-related stress may be independent of general stress, and the assessment by Spetizer *et al*. (2022) did not include men exhibiting normospermia. In the current study, there were no correlations between infertility-related stress and any semen parameters in the controls. Based on these findings, it is possible that distinct semen parameters can be influenced by different stress factors, and physiological stress may potentially damage, not harm, or even improve semen parameters.

In general, the association between semen quality and mental health is multifaceted. From a diagnostic perspective, in addition to routine etiological screening, particular attention should be paid to underlying diseases. From a therapeutic perspective, special emphasis can be placed on addressing anxiety and depression that may arise from patients' family economic circumstances, while monitoring overall ongoing stress from long-term infertility, particularly potential depression. The processes of diagnosis and treatment, compounded by economic, physical, social, and psychological effects, can also be stressful, which in turn influences disease prognosis (Warchoł-Biedermann and Mojs, 2021). In conclusion, psychological interventions may play a positive role in treating infertility itself, thereby forming a "virtuous cycle" and further enhancing the fertility-related quality of life in men.

The limitations of this study include the relatively limited dimensions of the basic situation questionnaire, the potential presence of unincorporated mediating factors, and the non-random selection of the control group from a healthy male population, all of which may introduce biases into the results. Future studies may consider recruiting a larger sample size and collecting additional data dimensions, such as therapy phase and sleep status, and using a fertility quality of life (FertiQoL) tool.

## DECLARATIONS

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*IRB approval*

The study was approved by the Ethics Committee of Huzhou Maternal and Child Health Care Hospital(2021-R-007).

*Ethical statement*

All samples were collected after the patients had signed the informed consent, and the study was approved by the Ethics Committee of Huzhou Maternal and Child Health Care Hospital.

*Generative AI and AI-assisted technology statement*

The authors declare that no generative artificial intelligence (AI) tools or AI assisted technologies were used in the preparation, writing, data analysis or editing of this manuscript.

*Statement of conflict of interest*

The authors have declared no conflict of interest.

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