ORIGINAL ARTICLE

Male Infertility

Psychological burden prediction based on demographic variables among infertile men with sexual dysfunction

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There has been increasing interest in the psycho-socio-relational and sexual disorders of infertility, as the risk of psychological burden among infertile men with sexual dysfunctions is significant. The purpose of this study was to develop and to validate a predictive model to estimate individual psychological burden among infertile men with sexual dysfunction and study the association between them. Comprehensive data were collected for infertile men ($n = 480$) who sought treatment for infertility in a reproductive medicine center between June 2012 and December 2013. Using independent predictors of psychological burden from the least absolute shrinkage and selection operator, univariable and multivariable analyses were developed into two models. Predictive accuracy was compared between the models. We explored the association between sexual dysfunction and psychological burden. A total of 480 patients were analyzed using 10-fold cross-validation. Independent predictors of psychological burden were incorporated into a model to measure anxiety (corrected-area under curve (AUC): 77.3%) and a model to measure depression (corrected-AUC: 70.2%). Anxiety and depression were both associated with erectile dysfunction ($P < 0.05$), with anxiety demonstrating the strongest association. Only anxiety was associated with premature ejaculation ($P < 0.05$). Premature ejaculation was not found to be associated with depression ($P > 0.05$). Predictive models for psychological burden among infertile men with sexual dysfunction are presented, and we found that there is an association between psychological burden and sexual dysfunction. According to the models, proper counseling and treatment of sexual dysfunction in infertile men may reduce the psychological burden, help attain natural pregnancy, and improve the quality of life.

INTRODUCTION

Over the past years, there has been increasing interest in the psycho-socio-relational and sexual disorders of infertility. The World Health Organization (WHO) defines infertility as the inability of a sexually active couple to achieve pregnancy despite unprotected intercourse for a period of greater than 12 months.[1] The etiology of male infertility is very complex and includes poor semen quality, varicocele, endocrine disorders, genetic factors, cancer treatment, sexual dysfunction, and other factors. Male sexual dysfunction involves premature ejaculatory (PE) and erectile dysfunction (ED) and may result in male infertility.[2,3] Infertile men may also experience negative emotions, which contribute to sexual dysfunction.[4]

Previous studies have shown that sexual dysfunction is significantly associated with mental health. Depression is a common disorder and affects approximately 18% of men in the United States.[5] A meta-analysis by Xia *et al.*[6] further suggests that depression is significantly associated with an increased risk of PE. Prevention and treatment of depression may substantially decrease the risk of PE. Anxiety specifically related to sexual dysfunction can be a significant contributor to both ED[7–9] and PE.[10]

Anxiety and depression are the most prevalent mental health problems. There are many factors that may lead to psychological burden among infertile men, such as worries around the cause of infertility, financial worries, and pressure from friends and family.[11–13] Yang *et al.*[14] found that clinical factors such as concomitant disorders (ED) may be associated with depression and anxiety symptoms among infertile men. Despite a large number of studies linking depression and anxiety to sexual dysfunction, the risk factors in infertile men remain unclear. Few studies have provided a quantitative evaluation of the risk factors of psychological burden and their possible associations in infertile men.

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Therefore, our primary objective was to develop a predictive model to better predict the effect of psychological burden on male infertility. Our secondary objective was to investigate the relationship between psychological burden and sexual dysfunction. To the best of our knowledge, this is the first study using models to predict psychological burden in infertile men. According to the models, proper counseling and treatment of male sexual dysfunction in infertile men may reduce psychological burden and help attain natural pregnancy.

PATIENTS AND METHODS

An observational, cross-sectional field survey was conducted in The First Affiliated Hospital of Sun Yat-sen University (Guangzhou, China). Infertile men ($n = 480$) were consecutively recruited from men seeking treatment for infertility at the Reproductive Medicine Center between June 2012 and December 2013. This study was approved by the Research and Ethics Committee of the First Affiliated Hospital of Sun Yat-sen University. Informed consent was obtained from all the study participants.

All infertile men in the study were required to meet the following criteria: (1) age >18 years, (2) in a heterosexual, stable relationship for at least 1 year, and (3) able to read and speak Chinese. Their medical history was carefully evaluated to rule out mental and/or other major medical conditions (*e.g.*, diabetes mellitus). Men on medication (*e.g.*, phosphodiesterase type 5 inhibitors) that could affect ejaculatory function, erectile function, and/or psychological status were excluded. After informed consent was obtained, all participants were required to complete a questionnaire designed specifically for this study. This study was designed as a four-stage protocol.

Demographic variables

The first stage involved data collection, including demographic variables (*e.g.*, age, body mass index [BMI], smoking, educational status, occupational status, pressure status, monthly income, alcohol consumption, exercise, marriage, and reproductive history). All variables were coded as categorical, with the exception of age, semen volume, and BMI.

Psychological burden measurement

The second stage involved assessing the degree of psychological disorder using the hospital anxiety and depression scale (HADS).[15,16] HADS is an appropriate and concise tool for evaluating these disorders. HADS is used for self-assessment, has been translated and validated in various studies, and has been shown to be acceptable to patients. After completing the questionnaires, we combined the total scores of the HADS-Depression (D) and HADS-Anxiety (A) questionnaires. Each item on the questionnaire is scored from 0-3, meaning that a person may score between 0 and 21 for either anxiety or depression. According to standard practice, a HADS-D or HADS-A score >7 is defined as either depression or anxiety, respectively. The severity of anxiety was further categorized as mild (score 8 to 10), moderate (score 11 to 14), or severe (score >15). The ratings for depression were the same as those for anxiety.

Assessment of the sexual dysfunction

The third stage involved the assessment of sexual dysfunction. All men were required to complete the Premature Ejaculation Diagnostic Tool (PEDT) and International Index of Erectile Function (IIEF-5) questionnaires. A PEDT score of 8 indicated no PE, scores of 9 and 10 indicated probable PE, and scores ≥11 implied PE. Classification of ED was divided into four severity grades using IIEF-5: no ED (score 22 to 25), mild (12 to 21), moderate (8 to 11), or severe ED (5 to 7).[17,18]

Assessment of semen quality

The fourth stage involved the assessment of semen quality. We collected patients' information using a routine semen test (Sperm Quality Analyzer, Olympus BX41, Shenzhen, China). According to the results of this test, we were able to identify seminal abnormality, semen volume, oligospermia, asthenospermia, and teratospermia.

Statistical analyses

Descriptive statistics focused on frequencies and proportions of categorical variables. Means, medians, and ranges were reported for continuous variables. The Chi-squared test and paired *t*-test were used to compare proportions and means, respectively. A logistic least absolute shrinkage and selection operator (LASSO) regression was used to select potential predictors of psychological burden among candidate variables to reduce multicollinearity. Univariate logistic regression was used to reselect psychological burden predictors from the LASSO regression. Multivariate logistic regression models were fitted to predict psychological burden. We applied and compared two regression methods as follows: stepwise logistic (SL) regression and LASSO regression. Before the models were built, multiple imputation was used to compensate for the loss of precision and potential bias resulting from incomplete data. Two models, SL and LASSO, were established. The models were subjected to 10 cross-fold validation to reduce overfitting bias and for internal validation.

The area under the curve (AUC) was used to quantify the tool's predictive accuracy. Advantages of the final model were confirmed by comparing the SL model and LASSO model using the Akaike information criterion (AIC) and AUC. The three parameters were calculated using a 200-resample bootstrap. The Mantel-Haenszel test was used to assess the statistical significance of the difference in predictive accuracy between the two models. In addition, the extent of overestimation or underestimation of anxiety/depression was explored graphically in logistic calibration plots for both models. A decision curve analysis (DCA) was performed to evaluate and compare the net benefit associated with the use of the two models. Finally, through the above comparison, the final model was constructed.

All statistical analyses were performed using the R program (version 3.4.0; https://www.r-project.org/). All tests were two-sided, with a significance level set at $P < 0.05$.

RESULTS

We summarize the association of clinical and semen characteristics with psychological burden using descriptive statistics (**Supplementary Table 1**). Predictive variables, including such as pressure status, sleep time, income status, marriage status, BMI, differed significantly between infertile men with anxiety and those without anxiety (all $P < 0.05$). Only three variables (education status, income status, and exercise frequency) differed significantly between infertile men with depression and those without depression (all $P < 0.05$). Conversely, semen quality was not significantly predictive of psychological burden (all $P \geq 0.05$).

Table 1 and **Figure 1** show the association between sexual disorder and psychological burden. Anxiety and depression were associated significantly with ED (anxiety: $P < 0.0001$; depression: $P = 0.014$), with anxiety found to be more strongly associated. Anxiety ($P = 0.015$), but not depression ($P = 0.61$), was found to be associated with PE.

Figure 2 illustrates the LASSO regression used to select potential predictors of psychological burden among candidate variables to reduce multicollinearity. When log(lambda.min) = −3.96 in the analysis of anxiety, the strongest predictors of anxiety were BMI group, pressure

Table 1: Association of erectile dysfunction/premature ejaculation and anxiety/depression

Characteristics (n=480)	ED		P	PE		P
	No	Yes		No	Yes	
Anxiety (*n*)			<0.0001			0.015
Normal	136	143		234	43	
Mild	31	75		80	27	
Moderate	6	40		34	11	
Severe	1	10		6	5	
Missing data	38			40		
Depression (*n*)			0.014			0.61
Normal	65	72		112	25	
Mild	86	130		167	47	
Moderate	22	62		71	13	
Severe	1	4		4	1	
Missing data	38			40		

P<0.05 was considered statistically significant. ED: erectile dysfunction; PE: premature ejaculation
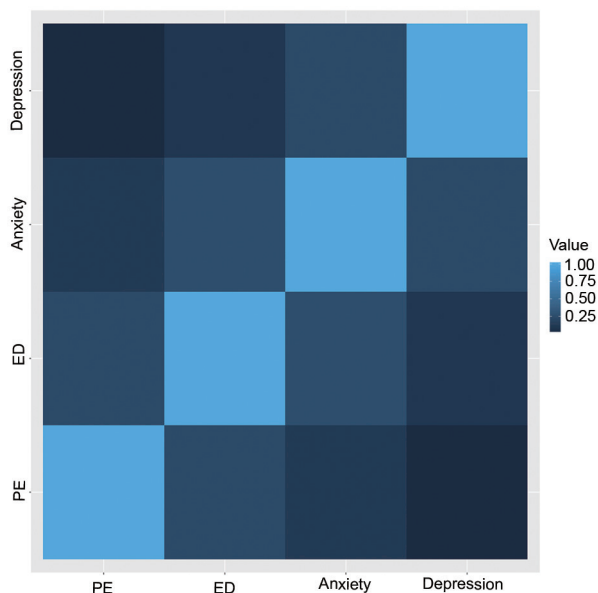
Figure 1: The association of sexual disease and psychological burden. PE: premature ejaculation; ED: erectile dysfunction.

status, smoking history, sleep quality, marital status, PE, intercourse satisfaction, ED, and depression. Similarly, the optimal predictors of depression (log[lambda.min] = −3.57) were age, alcohol intake, exercise frequency, education status, economic status, and anxiety. Based on the LASSO regressions of anxiety and depression, the LASSO models of anxiety and depression were established.

Table 2 illustrates the univariable analysis (UVA) and multivariable analysis (MVA) testing the association between predictors selected from LASSO of anxiety and depression. In the UVA of anxiety/depression, all variables were significantly associated with anxiety/depression (*P* < 0.05). UVA predictive accuracy analyses for anxiety showed that pressure status (63.9%) was the most accurate predictor of anxiety, followed by BMI group (51.6%), sleep quality (62.5%), marital status (52.8%), intercourse satisfaction (59.7%), PE (54.8%), ED (62.9%), and depression (61.1%). Analysis of depression demonstrated that exercise frequency (66.8%) was the most accurate predictor of depression, followed by age (50.7%), education status (50.9%),

economic status (57%), and anxiety (62%). In MVA of anxiety, pressure status, BMI group, sleep quality, marital status, ED, and depression were all independently predictive (all *P* < 0.05), whereas intercourse satisfaction and PE, were not (both *P* > 0.05). In MVA of depression, exercise frequency, economic status, and anxiety were all independently predictive (all *P* < 0.05), whereas age, education status were not (both *P* > 0.05). Based on these MVA results, the SL models for anxiety and depression were established.

After conducting a 200-resample bootstrap the AUC in the SL-anxiety-model versus the LASSO-anxiety-model was 77.3% versus 78.1% (gain 0.8%, *P* = 0.17), whereas the AIC was 573.6 versus 573.8, respectively. For depression, the AUC in SL-depression-model versus LASSO-depression-model was 70.2% versus 71.7% (gain 1.5%, *P* = 0.063), while the AIC was 531.1 versus 564.6, respectively.

The calibration plot of predicted probabilities against observed anxiety indicated a better concordance of the SL model over the LASSO model. There was good agreement between the two models from the calibration plot of depression (**Figure 3**). A decision curve analysis of depression showed that the LASSO model and SL model were similar in clinical net benefit. A DCA of anxiety indicated that two models had a similar clinical net benefit (**Figure 4**).

According to the results above, the models constructed for psychological burden were thought to be reliable. The model for anxiety was based on the SL model for anxiety (ln(P/[1−P]) = −2.9621 −0.5875 × BMI group + 0.9286 × pressure status + 0.4926 × sleep quality −0.5788 × marital status + 1.1727 × ED + 1.0692 × depression, P: probability of anxiety). Related parameters are marital status in four categories: 1 = unmarried, 2 = married, 3 = divorce, 4 = widowed; BMI group: 1 is equal to <18.5 kg m^{-2}, 2 is equal to 18.5–24.5 kg m^{-2}, 3 is equal to 24–28.5 kg m^{-2}, 4 is equal to ≥28.5 kg m^{-2}; Pressure and sleep quality were divided into four levels as follows: for pressure, 1 = too low or almost none, 2 = general, 3 = relative large but adaptable, 4 = very large; and for sleep quality, 1=well, 2= not bad, 3=poor, 4=very poor). The model to predict probability of depression among infertile men with sexual dysfunction was based on the SL model for depression (the model: ln(P/[1−P]) = −0.3213 + 0.4986 × exercise frequency −0.3536 × economic status + 1.103 × anxiety, P: probability of depression). Related parameters: exercise frequency, 1 is ≥3 times per week, 2 is 1−2 times per week, 3 is 1−2 times per month, and 4 is rarely or 1 time per month. Economic status was divided into four levels, with different values as follows: 1=not acceptable, 2=acceptable, 3=good, 4=very good.

DISCUSSION

This is the first study using models to graphically display the effect of predictor variables on the risk of psychological burden. We went on to further study their possible associations in infertile men in China. The results from our study demonstrated a possible association between sexual (ED and PE) and psychological (anxiety and depression) disorders in infertile men. Psychological factors play particularly important roles in men with infertility. They were found to affect many aspects of life, including personality, social behavior, intimacy, and sexual activities. It is critical to identify risk factors associated with the psychological burden for personalized therapy.

BMI has been associated with depressive and anxiety disorders.[19] Similarly, in our study, significant independent risk factors for anxiety were quality of sleep, BMI, ED, marital status, pressure status, and depression. We also found that significant independent risk factors for depression included exercise frequency, economic status, and anxiety. An association between anxiety and depression was also found. One of the risk factors for anxiety was depression, and one of the risk factors
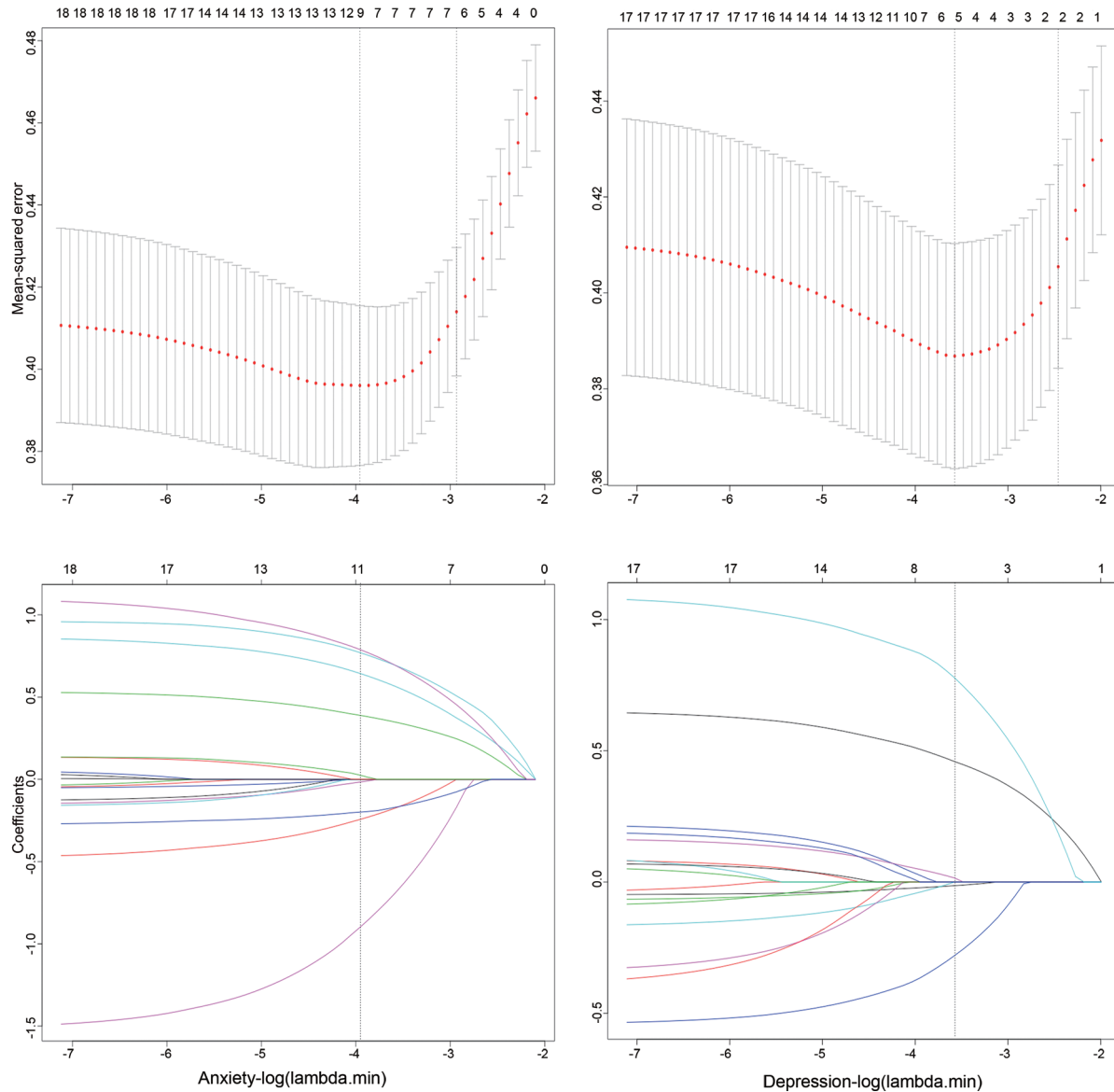
Figure 2: A logistic LASSO regression was used to select potential predictors of psychological burden among candidate variables. LASSO: least absolute shrinkage and selection operator.

for depression was anxiety. They influenced each other. The present findings indicated that a history of treatment failure could predict anxiety and depression.[20] However, impaired sexual potency was the only sexual symptom not significantly associated with psychological burden. Depression was associated with an interspousal age gap of ≥6 years.[21]

We found that neither the number of consulting doctors nor seminal abnormality was risk factors of psychological burden. Similarly, the quality of sperm was not a significant risk factor for psychological symptoms. However, Yang *et al.*[14] found that infertility lasting over 2 years was associated with a high risk of anxiety symptoms. Azoospermic men showed the worst erectile function and general health. In addition, azoospermic men reported higher PE prevalence, lower sexual desire and impaired orgasmic function, all of which were related to psychopathological symptoms.[22]

Age was correlated with more symptoms of the sexual disorder, and the psychological burden was associated with more pronounced symptoms of aging. Depression was associated with more symptoms of sexual disorder than anxiety.[21] In this study, age was significantly associated with depression in a univariable analysis but was excluded in the multivariable analysis.

The association between sexual and psychological problems has been reported by many studies. However, in China, this relationship in infertile men is rarely reported. Corona *et al.*[23] found that anxiety (assessed by Middlesex Hospital Question [MHQ]) is significantly correlated with ED and PE. Only PE maintained a significant correlation with MHQ scores. Using the Beck Depression Inventory (BDI) questionnaire, Son *et al.*[24] reported the most pronounced depression in patients with PE. Similarly, Fatt *et al.*[25] observed relationships between PE and psychological burden. The researchers
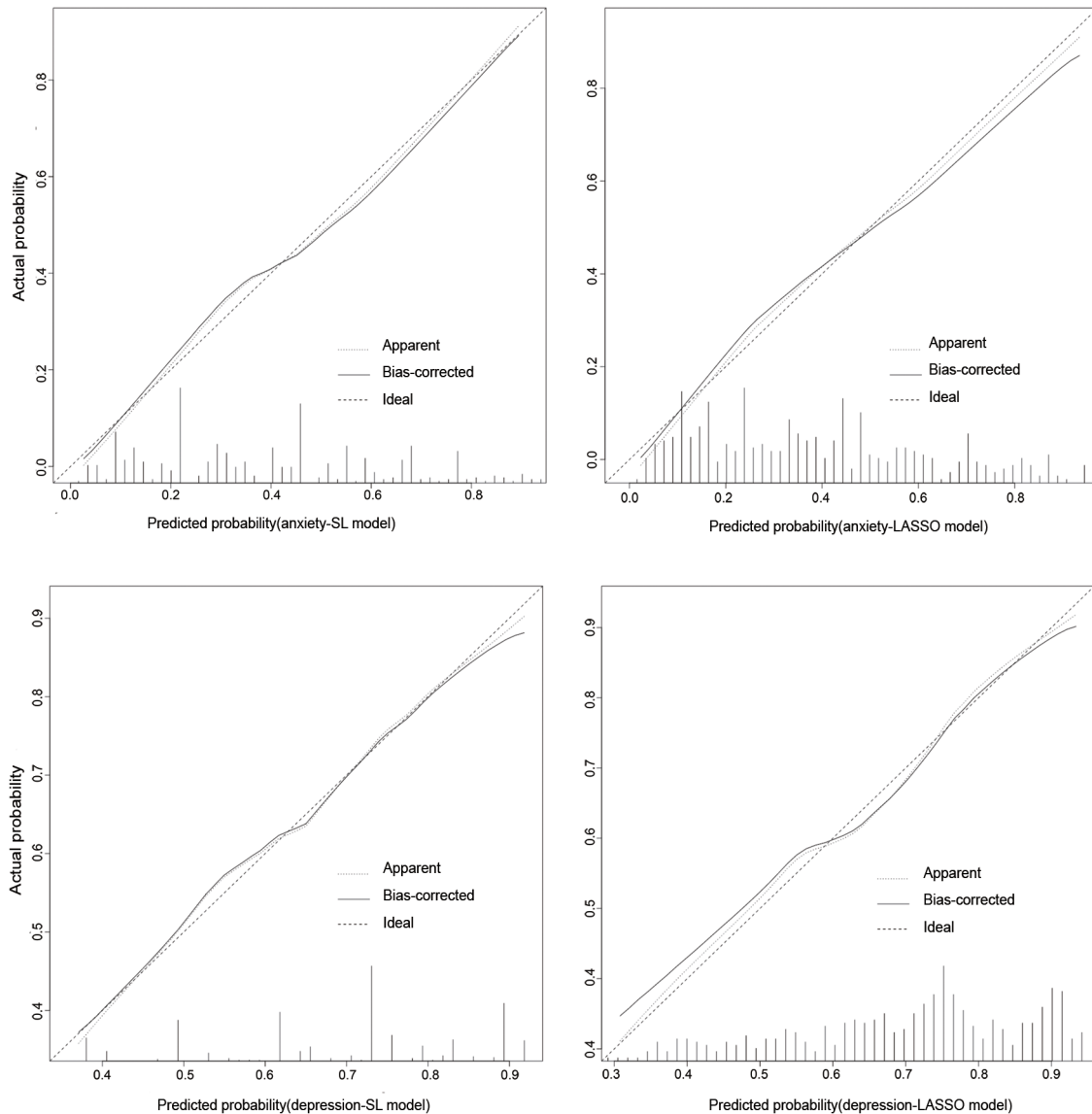
Figure 3: The calibration plot of predicted probabilities against observed anxiety indicated better concordance for the SL regression model versus the LASSO model. SL: stepwise logistic; LASSO: logistic least absolute shrinkage and selection operator.

reported a higher mean score of Hospital Anxiety and Depression Scale (HADS) in patients with PE than those without PE. Lotti *et al.*[26] argued that PEDT scores were positively associated with phobic anxiety, and IIEF scores were negatively associated with depression. Phobic anxiety, a prominent psychological disorder, was associated with PE while depression was associated with ED. Gao *et al.*[27] reported that both anxiety and depression were associated with PE and ED. The psychological burden was more prevalent in patients with higher PEDT scores and lower IELT and IIEF-5 scores.

Using the data from 480 assessed infertile men, we were able to perform a multivariate analysis to study the relationship between psychological burden and sexual disorders. Through this method, we found a significant association between ED and psychological burden (anxiety and depression). In contrast, PE was only associated with anxiety and not with depression. Similarly, research by Zhang *et al.*[6] did

not find a positive association between depression and PE. However, we should note that there are the different diagnostic criterion of sexual and psychological disorders in various research populations and andrology clinics. Moreover, cultural and religious differences should be taken into account. Hence, the varying conclusions may be explained by these factors, and further research is needed to confirm and expand these results.

There have been many studies around prevalence and risk factors of psychological burden among men with sexual problems. However, the possible mechanisms between sexual and psychological disorders have not been well studied. Rowland *et al.*[28] found that during psychosexual stimulation, a consistently higher heart rate strongly predicted a rapid ejaculatory response and weaker penile tumescence. Corona *et al.*[23] found that negative psychological factors (*e.g.*, reduced job satisfaction) might impair self-esteem and cause men to feel disgraced, weakened,

Table 2: Univariable and multivariable logistic regression analysis predicting anxiety/depression

Covariable	Univariable analysis		P	Multivariable analysis	P
	OR (95% CI)	AUC (%)		OR (95% CI)	
Anxiety					
Pressure status	2.26 (1.59–3.21)	63.9	<0.001	2.36 (1.58–3.54)	<0.001
BMI group	0.71 (0.52–0.99)	51.6	0.0432	0.65 (0.45–0.95)	0.0254
Sleep quality	2.16 (1.51–3.09)	62.5	<0.001	1.62 (1.09–2.4)	0.0071
Marital status	0.23 (0.07–0.77)	52.8	0.0163	0.23 (0.06–0.84)	0.0236
Intercourse satisfaction	0.57 (0.42–0.77)	59.7	<0.001	NS	NS
PE	1.83 (1.07–3.15)	54.8	0.0283	NS	NS
ED	3.18 (1.95–5.17)	62.9	<0.001	2.62 (1.46–4.68)	0.0017
Depression	3.13 (1.84–5.33)	61.1	<0.001	2.87 (1.61–5.11)	<0.001
AUC of multivariable models (%)	NA			77.3	
Depression					
Age	0.95 (0.91–0.99)	50.7	0.0275	NS	NS
Education status	0.76 (0.61–0.96)	50.9	0.0196	NS	NS
Exercise frequency	1.83 (1.46–2.29)	66.8	<0.001	1.81 (1.42–2.31)	<0.001
Economic status	0.5 (0.31–0.82)	57	0.00632	0.58 (0.34–0.99)	0.0473
Anxiety	3.13 (1.84–5.33)	62	<0.001	3.14 (1.79–5.51)	<0.001
AUC of multivariable models (%)	NA			70.2	

P<0.05 was considered statistically significant. BMI: body mass index; ED: erectile dysfunction; PE: premature ejaculation; AUC: area under curve; CI: confidence interval. NA: not available; NS: not significant; OR: Odds ratio
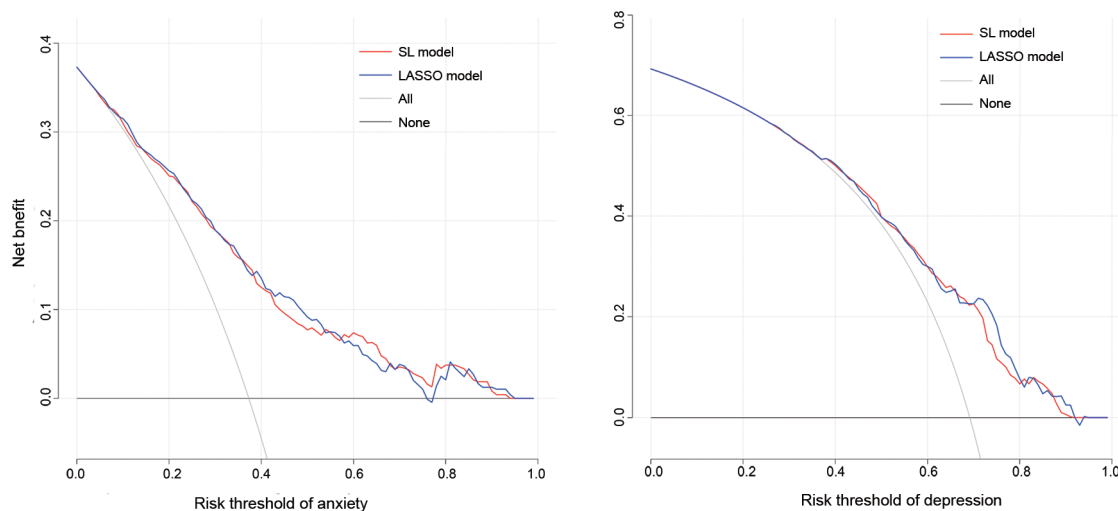
Figure 4: Decision curve analysis of the logistic LASSO model and the SL regression model about depression and anxiety. SL: stepwise logistic; LASSO: logistic least absolute shrinkage and selection operator.

and frightened, all of which are negative feelings that can be carried over to sexual life. However, further studies on these mechanisms are needed.

We developed the models composed of easily obtained clinical parameters. Our models, particularly the model for anxiety, are thought to be highly accurate tools for predicting psychological burden among infertile men. However, these models require further external validation before being applied for general use. Nevertheless, our study is an important first step in creating a predictive tool to estimate the psychological burden among infertile men.

Finally, our study is not devoid of limitations. A larger sample size is preferred and might have reflected the results of other studies more closely. Clinical variables used here might be incomplete. Because variations from the datasets can affect the accuracy of any prediction model, we are unable to improve the performance of the model using

more psychological features.[29,30] We hope that patients will seek timely fertility treatment and that physicians are aware of the association between sexual dysfunction and psychological burden in infertile men. According to our models, proper counseling and treatment of male sexual dysfunction in infertile men may reduce this burden, help attain natural pregnancy and improve quality of life.

CONCLUSIONS

We developed and internally validated two highly accurate models (corrected-AUC of anxiety-model: 77.3%; corrected-AUC of depression-model: 70.2%) in infertile men. This research was based on readily available clinical parameters including pressure status, BMI, sleep quality, marital status, ED, exercise frequency, and economic status. We found a significant association between ED and

psychological burden (anxiety and depression). However, we found that PE was associated only with anxiety and not with depression. According to the model, proper counseling and treatment of male sexual dysfunction in infertile men may reduce psychological burden, help attain natural pregnancy and improve quality of life.

AUTHOR CONTRIBUTIONS

HMC performed the statistical analysis and drafted and revised the manuscript. ZW and YG participated in the design of this study, the collection and interpretation of data, and the drafting of the manuscript. CHD was involved in revising the manuscript and coordinating tasks. YZ, JLZ, HPX, XAT, and XZS helped to collect data and do literature review. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declare no competing interests.

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Supplementary information is linked to the online version of the paper on the *Asian Journal of Andrology* website.

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Supplementary Table 1: Association of the studied characteristics and anxiety/depression

Characteristics (n=480)	Anxiety		P	Depression		P
	No	Yes		No	Yes	
Age (year), n (%)	284 (59.2)	167 (34.8)	0.286	140 (29.2)	311 (64.8)	
18–29, n	85	55		34	106	0.069
30–40, n	170	102		90	182	
41≤, n	29	10		16	23	
Missing data, n (%)			29 (6)			
Educational status, n (%)	282 (58.75)	168 (35)	0.545	139 (28.95)	311 (64.8)	
Middle school or below it, n	194	115		86	223	0.001
University degree, n	69	42		42	69	
Graduate degree or above it, n	19	11		11	19	
Missing data, n (%)			30 (6.25)			
Occupational status, n (%)	285 (59.37)	168 (35)	0.093	140 (29.2)	313 (65.17)	
Sedentary work, n	138	82		72	148	0.144
High temperature operation, n	12	6		7	11	
Mental labourer, n	27	17		19	25	
Manual workers, n	33	29		12	50	
Exposure to metal or chemistry, n	15	14		5	24	
Exposure to various radiation, n	7	6		3	10	
Other, n	53	14		22	45	
Missing data, n (%)			27 (5.63)			
Pressure status, n (%)	285 (59.37)	168 (35)	0.0001	140 (29.2)	313 (65.17)	
Small or almost no	14	4		9	9	0.335
General, n	172	66		71	167	
High but adaptive, n	92	86		55	123	
Very high, n	7	12		5	14	
Missing data, n (%)			27 (5.63)			
Smoking, n (%)	285 (59.37)	168 (35)	0.286	140 (29.2)	313 (65.17)	
Never, n	117	69		58	128	0.924
Ever, n	44	37		23	58	
Sometimes, n	53	28		27	54	
Often, n	71	34		32	73	
Missing data, n (%)			27 (5.63)			
Drinking wine, n (%)	283 (59)	168 (35)	0.449	140 (29.2)	311 (64.8)	
Everyday, n	3	4		1	6	0.126
3–4 per week, n	8	7		5	10	
1–2 per week, n	25	19		21	23	
1–3 per week, n	61	28		26	63	
Almost no, n	186	110		87	209	
Missing data, n (%)			29 (6)			
Exercise frequency, n (%)	283 (59)	168 (35)	0.224	139 (28.95)	312 (65.05)	
3 ≤per week, n	31	14		27	18	0.0001
1–2 per week, n	55	36		32	59	
1–2 per month, n	68	29		35	62	
Almost no, n	129	89		45	173	
Missing data, n (%)			29 (6)			
Sleep time, n (%)	269 (56.05)	155 (32.29)	0.001	134 (27.92)	290 (60.42)	
Normal sleep, n	187	82		92	177	0.13
Extreme sleep (short sleep time, very late to go to bed), n	82	73		42	113	
Missing data, n (%)			56 (11.66)			
Income status, n (%)	284 (59.2)	167 (34.8)	0.002	139 (28.95)	312 (65.05)	
No satisfactory, n	245	151		113	283	0.015
Satisfactory, n	39	16		26	29	
Missing data, n (%)			29 (6)			
Marriage status, n (%)	285 (59.37)	168 (35)	0.03	140 (29.2)	313 (65.17)	
Single, n	7	13		4	16	0.479
Married, n	275	153		135	293	

Contd...

Supplementary Table 1: Contd...

Characteristics (n=480)	Anxiety		P	Depression		P
	No	Yes		No	Yes	
Divorced, n	3	2		1	4	
Missing data, n (%)			27 (5.63)			
History of pregnancy, n (%)	261 (54.38)	153 (31.87)	0.356	128 (26.67)	286 (59.58)	
0, n	171	46		85	193	0.829
1≤, n	90	107		43	93	
Missing data, n (%)			66 (13.75)			
The number of consult doctors, n (%)	283 (59)	167 (34.8)	0.243	138 (28.7)	312 (65.05)	
Only one, n	69	29		33	65	0.819
2–5, n	130	76		63	143	
6≤, n	43	32		23	52	
Forget, n	41	30		19	52	
Missing data, n (%)			30 (6.25)			
BMI (mean±s.d.)	23.67±3.28	22.66±3.35	0.002	23.64±3.13	21.15±3.43	
Missing data, n (%)	30 (6.25)			38 (7.91)		0.152
Seminal abnormality, n (%)	136 (28.33)	71 (14.79)	0.304	71 (14.79)	136 (28.33)	
Normal, n	33	18		17	34	0.834
Abnormal, n	88	40		43	85	
Azoospermia, n	15	13		11	17	
Missing data, n (%)			273 (56.88)			
Semen volume (mean±s.d.)	3.29±1.38	3.48±1.5	0.37	3.46±1.46	3.31±1.4	
Missing data, n (%)	268 (55.83)					0.459
Oligospermia, n (%)	132 (27.5)	70 (14.8)	0.624	70 (14.8)	132 (27.5)	
No, n	96	48		48	96	0.624
Yes, n	36	22		22	36	
Missing data, n (%)			278 (57.92)			
Asthenospermia, n (%)	133 (27.5)	70 (14.8)	0.882	71 (14.79)	132 (27.51)	
No, n	60	33		31	62	0.661
Yes, n	73	37		40	70	
Missing data, n (%)			277 (57.7)			
Teratospermia, n (%)	86 (17.92)	33 (6.88)	0.381	41 (8.55)	78 (16.25)	
No, n	29	8		12	25	0.836
Yes, n	57	25		29	53	
Missing data, n (%)			361 (75.2)			

P<0.05 was considered statistically significant. BMI: body mass index, mean±s.d.; s.d.: standard deviation