

Psychological Symptoms, Stress Trajectories, and Pregnancy Outcomes in Women Undergoing In Vitro Fertilization–Embryo Transfer: A Prospective Longitudinal Study

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Abstract

Background

Women undergoing in vitro fertilization–embryo transfer (IVF-ET) are at high risk of psychological distress. However, most existing studies use cross-sectional designs, limiting understanding of how psychological symptoms and stress evolve across treatment phases, as well as the factors influencing these changes and their potential effects on pregnancy outcomes.

Objective

To characterize the longitudinal trajectories of psychological symptoms and perceived stress across three key stages of IVF-ET treatment—baseline (T1), oocyte retrieval (T2), and embryo transfer (T3)—and to identify factors associated with these trajectories and their relationship with clinical pregnancy outcomes.

Methods

This prospective longitudinal observational study was conducted at the Reproductive Medicine Center of Peking University Shenzhen Hospital between May 2023 and May 2024. A total of 183 women diagnosed with infertility completed assessments at T1, T2, and T3. Psychological distress, coping styles, marital quality, and social support were evaluated using validated instruments.. Linear mixed-effects models were used to examine within-person changes in psychological symptoms and stress over time and to explore the effects of coping strategies and social support. Multivariable logistic regression was performed to evaluate the associations of baseline psychological symptoms and stress with clinical pregnancy outcomes.

Results

A total of 183 women completed the study, 111 (60.7%) achieved clinical pregnancy. At baseline, women who subsequently achieved pregnancy had significantly lower distress scores than those who did not achieve pregnancy (60.00 vs. 67.50, $p = 0.005$); however, no significant between-group differences were observed at later time points. Trajectory analyses revealed significant heterogeneity: maladaptive coping (particularly submission and avoidance) was associated with increasing distress over time, whereas high marital quality, family care, and social support significantly buffered distress. Multivariable logistic regression indicated that higher baseline distress was independently associated with reduced odds of pregnancy (OR = 0.98, 95% CI: 0.97–0.99, $p = 0.014$). Furthermore, being unemployed (OR = 0.49, 95% CI: 0.25–0.96, $p = 0.039$) was associated with lower odds of pregnancy, whereas being a non-only child was

associated with significantly higher odds of pregnancy compared to being an only child (OR = 2.50, 95% CI: 1.06–6.05, $p = 0.038$).

Conclusions

Psychological distress in women undergoing IVF-ET shows dynamic changes across treatment stages and is influenced by multiple psychosocial factors. Early assessment of perceived stress may help identify women at risk of poorer reproductive outcomes. These findings support the integration of longitudinal psychological monitoring into fertility care and highlight the value of nurse-led psychosocial interventions tailored to individuals, couples, and families.

Background

Infertility is recognized as one of the top three global health challenges of the 21st century, alongside cancer and cardiovascular disease, reflecting its substantial public health impact (World Health Organization, 2023). In China, infertility affects 17.6% of individuals of reproductive age, and the burden has grown further with fertility policy changes, including the full implementation of the two-child and three-child policies, which have increased demand for childbirth among older couples (Wang et al., 2022; Si & Pu, 2023). Against this background, in vitro fertilization–embryo transfer (IVF-ET) has become a cornerstone of infertility treatment (Garg et al., 2024). Since the birth of the first IVF infant in 1978 and China's first test-tube baby in 1988, assisted reproductive technologies have resulted in more than 12 million births worldwide, with over 300,000 IVF cycles performed annually in China alone (Qiao et al., 2021).

Despite its clinical importance, IVF-ET is associated with substantial economic, physical, and psychological burden. Treatment is costly, with each cycle estimated at 30,000–50,000 RMB, while cumulative live birth rates remain around 30%–40%, creating considerable pressure for families and healthcare systems (Wang et al., 2024; Teede et al., 2023). Women undergoing IVF-ET also experience high rates of anxiety and depression, with prevalence estimates ranging from 36% to 43.6%, far exceeding those in the general population of reproductive-age women (Wu et al., 2024; Wu et al., 2023). These symptoms often intensify across treatment stages and may reduce adherence, increase cycle discontinuation, and adversely affect reproductive outcomes (Liu et al., 2022; Li et al., 2021; Wu et al., 2023; Gameiro et al., 2012; Zhou et al., 2023). Chronic stress may impair endometrial receptivity and embryo implantation through hypothalamic–pituitary–adrenal axis activation and elevated cortisol levels, and higher pre-treatment stress has been associated with an 18%–25% reduction in clinical pregnancy rates (Son et al., 2022; Wang et al., 2023). Psychological stress has also been implicated in ovarian dysfunction, including diminished ovarian reserve, premature ovarian insufficiency, functional hypothalamic amenorrhea, and polycystic ovary syndrome (Zhou et al., 2023).

The psychological burden of IVF-ET arises from a combination of biomedical, psychosocial, and cultural influences. In addition to the uncertainty and complexity of treatment, women may face infertility-related

stigma, diminished self-worth, and limited emotional or practical support from family and social networks (Yan et al., 2025; Ye et al., 2025; Zou et al., 2024). Importantly, psychological symptoms and perceived stress are not static but fluctuate across key treatment phases, suggesting that longitudinal trajectories may be more informative than single-point assessments (Li et al., 2021). Social support is a key protective factor that can alleviate anxiety and depression, strengthen coping, and improve fertility-related quality of life through enhanced emotional regulation, cognitive reappraisal, self-efficacy, and resilience (Yan et al., 2025; Wang et al., 2024). Among these interpersonal resources, marital quality is particularly important. Supportive couple relationships may buffer treatment-related distress and promote engagement in care, whereas marital conflict or perceived partner withdrawal may worsen stress and undermine reproductive outcomes (Jiang et al., 2025; Wang, 2024).

Although previous studies have linked psychological factors with assisted reproductive outcomes, few have used prospective longitudinal designs to examine how psychological symptoms and stress evolve across the IVF-ET cycle and what factors shape these trajectories. This study therefore aimed to: (1) characterize patterns of psychological symptoms and perceived stress across treatment baseline (T1), oocyte retrieval (T2), and embryo transfer (T3); (2) identify individual and interpersonal predictors, particularly social support and marital quality, of distinct psychological trajectories; and (3) examine the associations between these trajectories and assisted reproductive outcomes, including clinical pregnancy and live birth. By clarifying the longitudinal evolution and determinants of psychological distress during IVF-ET, this study seeks to inform more precise, timely, and patient-centered nursing interventions and to support the integration of mental health surveillance into routine fertility care.

Methods

Study design and setting

This prospective longitudinal observational study examined changes in psychological distress across key stages of the in vitro fertilization–embryo transfer (IVF-ET) cycle, identified relevant individual and interpersonal correlates, and explored their associations with reproductive outcomes. The study was conducted at the Reproductive Center of Peking University Shenzhen Hospital, China, from May 2023 to May 2024. This study was approved by the Ethics Review Committee of Peking University Shenzhen Hospital (Approval No. PKUSZ-IRB-2022-048). All study procedures were conducted in accordance with relevant ethical guidelines and regulations, including the principles of the Declaration of Helsinki. All participants provided written informed consent before enrolment.

Participants

Women undergoing IVF-ET were eligible if they: (1) had a clinical indication for IVF-ET; (2) had experienced no major stressful life events in the previous 6 months; (3) provided informed consent and

agreed to follow-up; and (4) had at least a junior high school education and were able to complete self-report questionnaires independently.

Women were excluded if they had: (1) known genetic disorders; (2) acute urogenital infection or sexually transmitted disease; (3) severe reproductive or endocrine disease; or (4) cognitive impairment, current or past psychiatric disorders, or a history of psychological therapy.

Participants were withdrawn if they discontinued treatment, did not undergo oocyte retrieval or embryo transfer, or were lost to follow-up.

Measures

Baseline data included age, ethnicity, education, occupation, family monthly income, body mass index, years of marriage, reproductive history, religion, cause and duration of infertility, infertility type, IVF-ET treatment status, and history of gynecological surgery.

Psychological symptoms and distress were assessed using the Psychological Symptoms and Distress Scale for Female Infertile Women with Assisted Reproduction (Zhou et al., 2017), a 52-item instrument comprising two symptom dimensions and six distress dimensions, with established reliability and validity in Chinese women undergoing assisted reproduction.

Coping style was measured using the Medical Coping Modes Questionnaire, originally developed by Feifel et al. and translated into Chinese (Feifel et al., 1987). The scale contains 20 items across three dimensions, with higher scores indicating greater use of the corresponding coping style.

Marital quality was assessed using the Quality Marriage Index (QMI) (Cheng et al., 2023), a 6-item unidimensional measure of overall marital satisfaction.

Family functioning was measured using the Family Caringness Index Questionnaire (Lü et al., 1999), which includes five items assessing adaptation, partnership, growth, affection, and intimacy. Higher scores indicate better family functioning.

Social support was assessed using the Social Support Rating Scale (SSRS) developed by Xiao (Xiao, 2006). This 10-item scale measures objective support, subjective support, and support utilization, with higher scores indicating greater perceived social support.

Data collection

Data were collected by trained investigators at three time points during the IVF-ET cycle: baseline (T1), oocyte retrieval day (T2), and embryo transfer day (T3). After providing written informed consent, participants completed the baseline questionnaires independently, with standardized clarification provided when necessary.

At T2 and T3, participants were contacted by telephone or WeChat to complete follow-up assessments. The same questionnaires were re-administered, excluding baseline demographic items. Completed questionnaires were checked for completeness and consistency, and participants were contacted to clarify missing or unclear responses when necessary.

With institutional approval, clinical data, including anti-Müllerian hormone, follicle-stimulating hormone, oocyte yield, embryo quality, and pregnancy outcomes, were extracted from the electronic medical record system and cross-checked against self-reported data. The study was registered with the Chinese Clinical Trial Registry (ChiCTR2200063540).

Sample size

Sample size was estimated based on a previous cross-sectional study conducted by our research group among women undergoing IVF-ET ($n = 424$), in which the median psychological symptom and distress score was 61.0 and the estimated standard deviation was 16.48. Assuming a two-sided significance level of 0.05, 80% power, and an allowable error of 0.15 times the standard deviation, the minimum required sample size was 168. After allowing for 10% attrition, the target sample size was 186. The final analytical sample comprised 183 participants.

Statistical analysis

Psychological symptom and distress scores at T1, T2, and T3 were analysed as continuous variables. Continuous variables were summarised as means and standard deviations or medians and interquartile ranges, as appropriate, and categorical variables as frequencies and percentages.

Baseline differences by pregnancy outcome were compared using independent-samples t tests, Mann-Whitney U tests, chi-square tests, or Fisher's exact tests, as appropriate.

Temporal changes in psychological symptoms and distress, and their psychosocial correlates, were examined using linear mixed-effects models, with time entered as a fixed effect and participant as a random intercept. Continuous covariates were standardised before modelling. Psychosocial variables and their interactions with time were entered to assess associations with symptom trajectories. Significant interactions were further explored using estimated marginal means to evaluate simple effects at specific time points and longitudinal trends within groups. Multivariable logistic regression was used to examine associations between baseline psychological symptoms and distress and clinical pregnancy. Results are presented as odds ratios with 95% confidence intervals. All tests were two-sided, and statistical significance was set at $P < 0.05$. All analyses were performed using R version 4.4.0.

Data Availability Statement:

The datasets generated and/or analysed during the current study are not publicly available due to patient privacy and confidentiality restrictions, but are available from the corresponding author on reasonable request.

Results

Participant characteristics

A total of 214 women scheduled for in vitro fertilization–embryo transfer (IVF-ET) at the Reproductive Medicine Center of Peking University Shenzhen Hospital between May 2023 and May 2024 were initially enrolled. Of these, 21 withdrew after baseline assessment (T1), leaving 193 participants who proceeded to oocyte retrieval (T2). At T2, 6 women had no oocytes retrieved and 4 declined fresh embryo transfer. Consequently, 183 women completed the full follow-up at embryo transfer (T3), contributing 549 observations across the three assessment points. Based on clinical pregnancy outcome, participants were classified into a pregnancy group ($n = 111$, 60.7%) and a non-pregnancy group ($n = 72$, 39.3%) (Fig. 1). The median follow-up intervals were 25 (13–43) days from T1 to T2, 38 (3–106.5) days from T2 to T3, and 14 (14–14) days from T3 to T4.

As shown in Table 1, no significant between-group differences were observed in demographic and clinical baseline characteristics, including age, body mass index, monthly family income, duration of treatment, education level, employment status, only-child status, family structure, marital status, history of dysmenorrhea, cause of infertility, and infertility type (all $P > 0.05$). At baseline (T1), psychological symptom and stress scores were significantly lower in the pregnancy group than in the non-pregnancy group [60.00 (52.50, 73.50) vs. 67.50 (57.75, 88.50), $P = 0.005$]. Furthermore, baseline submission score were significantly higher in the pregnancy group [10.00 (8.00, 11.00) vs. 8.00 (8.00, 10.00), $P = 0.013$]. No other baseline psychosocial variables, including confrontation, avoidance, marital quality, family care, and social support, differed significantly between the two groups (all $P > 0.05$). Similarly, at T2 and T3, no significant between-group differences were found for psychosocial indicators.

Table 1

Comparison of Baseline Demographic, Clinical, and Psychosocial Characteristics Between Pregnant and Non-Pregnant Groups in Vitro Fertilization-Embryo Transfer Women

Items	Level	Non-Pregnant (n = 72)	Pregnant (n = 111)	P- value
Age (years)		32.00 (29.00, 36.00)	33.00 (31.00, 36.00)	0.110
Body Mass Index (kg/m ²)		23.47 (20.08, 26.26)	22.27 (20.51, 24.46)	0.338
Monthly Family Income (¥10,000)		3.00 (2.00, 4.25)	3.00 (2.00, 5.00)	0.629
Duration of Treatment (years)		2.00 (1.00, 2.25)	1.00 (0.25, 3.00)	0.192
Symptoms and Stress (T1)		67.50 (57.75, 88.50)	60.00 (52.50, 73.50)	0.005
Submission(T1)		8.00 (8.00, 10.00)	10.00 (8.00, 11.00)	0.013
Confrontation (T1)		19.00 (17.00, 21.00)	19.00 (17.00, 21.00)	0.922
Avoidance(T1)		13.00 (11.00, 16.00)	13.00 (11.00, 14.00)	0.302
Marital Quality (T1)		42.00 (33.00, 42.00)	42.00 (30.00, 42.00)	0.423
Family Care (T1)		8.00 (5.00, 10.00)	8.00 (5.00, 10.00)	0.663
Social Support (T1)		39.00 (32.75, 45.00)	39.00 (33.50, 45.00)	0.906
Symptoms and Stress (T2)		57.00 (52.00, 78.25)	57.00 (52.00, 76.50)	0.901
Submission(T2)		9.00 (8.00, 11.00)	9.00 (8.00, 11.00)	0.150
Confrontation(T2)		19.50 (18.00, 21.00)	19.00 (18.00, 21.00)	0.900
Avoidance(T2)		13.00 (11.75, 14.25)	14.00 (12.00, 15.00)	0.100

Note. Continuous variables are presented as mean $\pm$ SD or median (IQR). Categorical variables are presented as n (%). Group comparisons were conducted using independent-samples t tests or Mann-Whitney U tests for continuous variables and chi-square or Fisher's exact tests for categorical variables.

Items	Level	Non-Pregnant (n = 72)	Pregnant (n = 111)	P- value
Marital Quality(T2)		42.00 (31.75, 42.00)	42.00 (31.00, 42.00)	0.837
Family Care (T2)		9.50 (5.00, 10.00)	8.00 (5.00, 10.00)	0.427
Social Support (T2)		40.00 (35.00, 44.25)	41.00 (36.00, 44.00)	0.689
Symptoms and Stress (T3)		56.00 (52.00, 93.00)	56.00 (52.00, 76.00)	0.520
Submission(T3)		9.00 (8.00, 11.00)	9.00 (8.00, 10.00)	0.062
Confrontation(T3)		19.00 (17.00, 21.00)	19.00 (18.00, 22.00)	0.170
Avoidance(T3)		14.00 (12.75, 15.00)	14.00 (13.00, 15.00)	0.800
Marital Quality(T3)		42.00 (30.00, 42.00)	42.00 (36.00, 42.00)	0.962
Family Care (T3)		5.50 (5.00, 10.00)	8.00 (5.00, 10.00)	0.271
Social Support (T3)		39.15 ± 7.64	39.25 ± 8.15	0.933
Education Level	High school or below	30 (41.7%)	44 (39.6%)	0.801
	Associate degree	16 (22.2%)	23 (20.7%)	
	Bachelor's degree	23 (31.9%)	35 (31.5%)	
	Master's degree or above	3 (4.2%)	9 (8.1%)	
Employment Status	Employed	44 (61.1%)	82 (73.9%)	0.069
	Unemployed	28 (38.9%)	29 (26.1%)	
only-child status	Yes	15 (20.8%)	12 (10.8%)	0.062
	No	57 (79.2%)	99 (89.2%)	
Family Structure	Living with spouse only	51 (70.8%)	77 (69.4%)	0.404
	Living with parents-in-law	7 (9.7%)	19 (17.1%)	
Note. Continuous variables are presented as mean ± SD or median (IQR). Categorical variables are presented as n (%).Group comparisons were conducted using independent-samples t tests or Mann–Whitney U tests for continuous variables and chi-square or Fisher’s exact tests for categorical variables.				

Items	Level	Non-Pregnant (n = 72)	Pregnant (n = 111)	P- value
	Living with own parents	5 (6.9%)	4 (3.6%)	
	Living with spouse, parents-in-law, and spouse's siblings	9 (12.5%)	11 (9.9%)	
Marital Status	First marriage	65 (90.3%)	94 (84.7%)	0.274
	Remarriage	7 (9.7%)	17 (15.3%)	
Dysmenorrhea	Yes	31 (43.1%)	43 (38.7%)	0.561
	No	41 (56.9%)	68 (61.3%)	
Infertility Type	Primary	32 (44.4%)	48 (43.2%)	1.000
	Secondary	40 (55.6%)	62 (55.9%)	
	Other	0 (0.0%)	1 (0.9%)	
Cause of Infertility	Male factor	3 (4.2%)	6 (5.4%)	0.948
	Female factor	16 (22.5%)	28 (25.2%)	
	Combined factors	51 (71.8%)	76 (68.5%)	
	Unexplained	1 (1.4%)	1 (0.9%)	
Note. Continuous variables are presented as mean ± SD or median (IQR). Categorical variables are presented as n (%).Group comparisons were conducted using independent-samples t tests or Mann–Whitney U tests for continuous variables and chi-square or Fisher’s exact tests for categorical variables.				

Longitudinal changes in psychological symptoms and stress

Linear mixed-effects models were utilized to examine longitudinal changes in psychological symptoms and stress (Table 2). Including a random slope for time did not improve model fit ($P = 0.920$) and led to singular fit, therefore, models with subject-specific random intercepts were retained. After backward selection of baseline covariates, no sociodemographic or clinical variable was significantly associated with symptom and stress levels. Time was retained as the only fixed effect, but no significant overall change in mean psychological symptom and stress scores was observed across T1–T3 ($P = 0.466$ for T2, $P = 0.565$ for T3).

Table 2
Linear Mixed Effects Model Analysis of Symptom and Stress Changes over Time and
Baseline Covariates

Term	β	SE	95% CI	t	P-value
Model 1: Time only					
Intercept	70.31	1.65	67.07, 73.55	42.59	< 0.001
TimeT2	-1.70	2.33	-6.29, 2.88	-0.73	0.466
TimeT3	-1.34	2.33	-5.93, 3.24	-0.58	0.565
Model 2: time $\times$ Submission					
Intercept	78.55	8.51	61.84, 95.26	9.23	< 0.001
TimeT2	-64.91	11.91	-88.31, -41.50	-5.45	< 0.001
TimeT3	-87.44	12.43	-111.86, -63.01	-7.03	< 0.001
Submission	-0.87	0.88	-2.61, 0.87	-0.98	0.326
TimeT2:Submission	6.72	1.24	4.27, 9.16	5.40	< 0.001
TimeT3:Submission	9.20	1.30	6.64, 11.76	7.06	< 0.001
Model 3: time $\times$ Avoidance					
Intercept	78.07	8.06	62.25, 93.90	9.69	< 0.001
TimeT2	-39.02	12.66	-63.89, -14.14	-3.08	0.002
TimeT3	-46.34	13.06	-71.98, -20.69	-3.55	< 0.001
Avoidance	-0.59	0.60	-1.78, 0.59	-0.98	0.326
TimeT2:Avoidance	2.81	0.94	0.96, 4.66	2.99	0.003
TimeT3:Avoidance	3.27	0.95	1.41, 5.13	3.46	< 0.001
Model 4: time $\times$ Confrontation					
Intercept	59.00	10.22	38.92, 79.07	5.77	< 0.001
TimeT2	17.90	15.29	-12.12, 47.93	1.17	0.242
TimeT3	10.76	14.81	-18.32, 39.85	0.73	0.468
Confrontation	0.59	0.53	-0.44, 1.62	1.12	0.262
TimeT2:Confrontation	-1.02	0.79	-2.56, 0.52	-1.30	0.195
TimeT3:Confrontation	-0.63	0.76	-2.12, 0.85	-0.83	0.404
Model 5: time $\times$ Marital Quality					

Term	β	SE	95% CI	t	P-value
Intercept	57.41	6.30	45.04, 69.79	9.11	< 0.001
TimeT2	26.29	8.65	9.30, 43.27	3.04	0.002
TimeT3	33.85	9.13	15.92, 51.79	3.71	< 0.001
Marital Quality	0.37	0.17	0.03, 0.70	2.12	0.035
TimeT2:Marital Quality	-0.79	0.24	-1.25, -0.33	-3.36	< 0.001
TimeT3:Marital Quality	-0.98	0.25	-1.46, -0.49	-3.97	< 0.001
Model 6: time $\times$ Family Care					
Intercept	67.03	3.75	59.66, 74.40	17.86	< 0.001
TimeT2	14.00	5.52	3.15, 24.84	2.53	0.012
TimeT3	23.50	5.55	12.61, 34.40	4.24	< 0.001
Family Care	0.48	0.49	-0.49, 1.45	0.97	0.335
TimeT2:Family Care	-2.19	0.71	-3.59, -0.79	-3.07	0.002
TimeT3:Family Care	-3.48	0.72	-4.90, -2.07	-4.83	< 0.001
Model 7: time $\times$ Social Support					
Intercept	69.26	7.40	54.72, 83.80	9.36	< 0.001
TimeT2	38.92	10.95	17.42, 60.43	3.56	< 0.001
TimeT3	53.73	10.79	32.54, 74.93	4.98	< 0.001
Social Support	0.03	0.19	-0.34, 0.40	0.15	0.885
TimeT2:Social Support	-1.03	0.27	-1.57, -0.49	-3.75	< 0.001
TimeT3:Social Support	-1.40	0.27	-1.94, -0.87	-5.18	< 0.001

In time-adjusted mixed-effects models (Table 2), significant time-by-variable interactions were observed for submission ($P < 0.001$ at T2 and T3), avoidance ($P = 0.003$ at T2, $P < 0.001$ at T3), marital quality, family care, and social support (all $P < 0.001$). This indicates indicating that psychological trajectories were highly heterogeneous and dependent on individual psychosocial profiles. Table 3 and Table 4, alongside Fig. 2, detail these differential trajectories through simple effects analyses comparing individuals at the 25th percentile (low group) and 75th percentile (high group) for each psychosocial factor:

Table 3
Type III Analysis of Variance for Main and Time-Interaction Effects
of Psychosocial Factors on Symptoms and Stress

Variable / Time Point	Difference	SE	t-value	p-value
P75 vs P25				
Submission				
T1	-2.61	2.66	-0.98	0.328
T2	17.54	2.63	6.67	< 0.001
T3	25	2.88	8.67	< 0.001
Avoidance				
T1	-1.78	1.81	-0.98	0.327
T2	6.66	2.18	3.06	0.002
T3	8.03	2.2	3.66	< 0.001
Confrontation				
T1	2.36	2.11	1.12	0.264
T2	-1.72	2.34	-0.73	0.463
T3	-0.16	2.18	-0.07	0.941
Marital Quality				
T1	3.66	1.73	2.11	0.035
T2	-4.25	1.61	-2.64	0.009
T3	-6.14	1.77	-3.47	< 0.001
Family Care				
T1	2.39	2.48	0.96	0.336
T2	-8.56	2.58	-3.32	< 0.001
T3	-15.02	2.63	-5.71	< 0.001
Social Support				
T1	0.27	1.88	0.14	0.885
T2	-10.03	2.01	-4.98	< 0.001
T3	-13.78	1.97	-6.99	< 0.001

Table 4

Simple Effects Analysis of Symptom and Stress Trajectories Stratified by Psychosocial Characteristics

Variable / Group	Comparison	Change (T3-T1)	SE	t-value	p-value	Trend Direction
Submission						
Low group (P25)	T3 - T1	-13.82	2.8	-4.94	< 0.001	Decrease
High group (P75)	T3 - T1	13.79	2.98	4.63	< 0.001	Increase
Avoidance						
Low group (P25)	T3 - T1	-7.09	2.76	-2.57	0.029	Decrease
High group (P75)	T3 - T1	2.72	2.69	1.01	0.569	Increase
Confrontation						
Low group (P25)	T3 - T1	0.04	2.94	0.01	> 0.999	Increase
High group (P75)	T3 - T1	-2.48	2.66	-0.93	0.619	Decrease
Marital Quality						
Low group (P25)	T3 - T1	2.51	2.48	1.01	0.571	Increase
High group (P75)	T3 - T1	-7.29	2.76	-2.64	0.023	Decrease
Family Care						
Low group (P25)	T3 - T1	6.1	2.69	2.27	0.062	Increase
High group (P75)	T3 - T1	-11.31	3.11	-3.64	< 0.001	Decrease
Social Support						
Low group (P25)	T3 - T1	5.96	2.58	2.32	0.055	Increase
High group (P75)	T3 - T1	-8.09	2.59	-3.12	0.006	Decrease

Coping Styles

For submission coping, participants in the high group experienced a significant increase in distress from T1 to T3 (change = 13.79, $P < 0.001$), while those in the low group showed a significant decrease (change=-13.82, $P < 0.001$). Although the two groups did not differ significantly at baseline ($P = 0.328$), the high submission group exhibited significantly greater distress at T2 ($t = 6.67$, $P < 0.001$) and T3 ($t = 8.67$, $P < 0.001$). A similar but less pronounced pattern was observed for avoidance coping; the high avoidance group maintained higher distress levels that slightly increased over time, while the low avoidance group experienced a significant reduction in symptoms by T3 (change=-7.09, $P = 0.029$). Confrontation coping showed no significant interaction with time ($P > 0.05$).

Interpersonal and Social Resources

Higher baseline interpersonal resources were initially associated with slightly higher or equivalent stress, but proved highly protective over time. For marital quality, the high group reported higher stress at T1 ($P = 0.035$) but experienced a significant decline in symptoms by T3 (change=-7.29, $P = 0.023$), resulting in significantly lower stress than the low group at both T2 and T3. Similarly, individuals with high family care and high social support experienced significant and substantial reductions in their psychological symptoms from T1 to T3 (change=-11.31, $P < 0.001$; and change=-8.09, $P = 0.006$, respectively). In contrast, those with low family care and social support demonstrated a trend of escalating distress throughout the IVF-ET cycle.

Association between baseline psychological symptoms and pregnancy outcome

The logistic regression analysis included participants with complete baseline data and defined pregnancy outcomes, comprising 111 pregnancies (61.0%) and 71 non-pregnancies (39.0%). In multivariable logistic regression, baseline psychological symptom and stress scores (T1) were retained as the primary exposure. After backward stepwise selection, the final model included baseline symptoms and stress, employment status, and only-child status (Table 5). No other baseline variables were retained.

Table 5
Multivariate Logistic Regression Analysis of Factors Associated with Pregnancy Outcome

Variable	OR	95% CI	<i>p-value</i>
Intercept	3.56	0.95–13.98	0.063
Symptoms and Stress (T1)	0.98	0.97–0.99	0.014
Employment Status (Unemployed vs Employed)	0.49	0.25–0.96	0.039
Only Child (No vs Yes)	2.50	1.06–6.05	0.038

After adjustment, higher baseline psychological symptom and stress scores were associated with a reduced likelihood of achieving clinical pregnancy (OR = 0.98, 95% CI 0.97–0.99, $P = 0.014$). This indicates that every 1-point increase in the baseline distress score corresponds to an approximately 2% decrease in the odds of pregnancy. Furthermore, employment status and family background independently predicted pregnancy outcome. Unemployed participants had lower odds of pregnancy compared to employed participants (OR = 0.49, 95% CI 0.25–0.96, $P = 0.039$). In contrast, being a non-only child was associated with higher odds of pregnancy (OR = 2.50, 95% CI 1.06–6.05, $P = 0.038$). These progressive relationships are visibly illustrated by forest plots and predicted probability curves (Figs. 3 and 4)

Discussion

This study provides longitudinal evidence that psychological symptoms and stress during the in vitro fertilization–embryo transfer (IVF-ET) cycle are shaped not only by time, but also by coping style, marital quality, family care, and social support. Although average psychological symptom and stress levels did not change significantly across treatment stages, important heterogeneity was observed in symptom trajectories according to psychosocial characteristics. In addition, higher baseline psychological symptom and stress scores were associated with a lower likelihood of pregnancy, highlighting the potential clinical relevance of early psychosocial risk identification.

Women with higher levels of submission and avoidance coping experienced greater psychological burden and showed less favorable symptom trajectories over time. These findings suggest that maladaptive coping styles are not merely static correlates of distress, but dynamic factors that may amplify responses to evolving treatment-related stressors, including hormonal fluctuations, invasive procedures, and uncertainty regarding treatment outcomes. This interpretation is consistent with previous evidence showing that negative coping strategies are closely associated with poorer psychological outcomes in women undergoing IVF-ET (Bai et al., 2024). Likewise, avoidant coping has been shown to mediate the association between infertility-related stigma and fertility-related quality of life, with detrimental effects on overall well-being (Jing et al., 2021). Because coping strategies are potentially modifiable, they represent important targets for nursing intervention. Early screening for maladaptive coping at the start of treatment may help identify women at increased psychological risk. These patients may benefit from structured interventions, such as cognitive-behavioral strategies, problem-solving training, cognitive restructuring, and emotion regulation support. Given the significant interaction between coping style and time, psychosocial care may need to be phased across the IVF-ET cycle, with particular attention to high-stress stages such as oocyte retrieval and embryo transfer. Nurses, as the professionals with the most sustained contact with patients during treatment, are well positioned to deliver such tailored support.

Marital quality also showed a time-varying association with psychological symptoms and stress. At treatment initiation, women reporting higher marital quality appeared to have greater stress, which may reflect stronger mutual emotional investment, higher expectations, or greater communication demands within the couple. Over time, however, higher marital quality was associated with improving psychological trajectories, whereas poorer marital relationships were associated with increasing distress. These findings suggest that marital quality may function as a dynamic protective resource, buffering the accumulation of treatment-related stress. From a clinical perspective, this supports a couple-centered approach to fertility care. Assessment should extend beyond the individual woman to include dyadic functioning, especially early in treatment, when expectations are high and coping patterns are still forming. Interventions aimed at strengthening marital resilience, improving communication, fostering realistic expectations, and enhancing shared emotion regulation may be beneficial. The finding that women with high marital quality may still experience substantial early stress suggests that strong relationships do not eliminate distress, but may instead shape recovery over time. This may identify a subgroup with short-term psychological overload but greater longer-term adaptive potential, who could benefit from proactive follow-up and timely psychological support. These findings are also consistent

with prior evidence that dyadic coping interventions can improve joint coping capacity, marital quality, intimacy, and relationship satisfaction among patients undergoing assisted reproductive treatment and their partners (Sun et al., 2023; Chen and Bo, 2023).

Family care and social support also influenced symptom trajectories across the treatment cycle. Although baseline differences were not evident, women with stronger family support or higher perceived social support showed declining stress levels over time, whereas those with lower support experienced progressively worsening distress. This suggests that supportive interpersonal environments may not only buffer initial distress, but also shape how psychological burden evolves throughout treatment. Conversely, low support may exert a cumulative adverse effect, as women facing repeated procedural stressors and uncertainty may lack sufficient emotional and practical resources to cope effectively. These findings highlight the importance of longitudinal psychosocial monitoring during IVF-ET rather than relying solely on one-time assessments. They also point to modifiable intervention targets. Nurses may help strengthen support systems by involving partners and family members more actively, facilitating referral to counseling services, or connecting women with peer-support resources (Alzahrani et al., 2026; Rajan et al., 2026). Future studies should develop and test interventions designed to enhance perceived support, including partner counseling, family-based psychoeducation, and peer-support models embedded within routine assisted reproductive care. Qualitative research may also be useful in identifying which specific supportive behaviors from partners, family members, or healthcare professionals are perceived as most meaningful at different treatment stages, thereby informing the development of culturally sensitive and patient-centered care models.

This study also found that higher baseline psychological symptom and stress scores were associated with lower odds of pregnancy. Specifically, each 1-point increase in baseline symptom and stress score was associated with an approximately 2% reduction in the odds of pregnancy. This finding supports growing evidence that psychological stress may adversely affect assisted reproductive outcomes (Ha et al., 2023; Koochaksaraei et al., 2023; Martínez-Borba et al., 2025). Potential mechanisms include disruption of hypothalamic-pituitary-adrenal axis activity, altered immune regulation, and autonomic dysregulation, all of which may influence implantation and early embryonic development. These findings underscore the value of incorporating psychosocial assessment into fertility care pathways, particularly at treatment initiation, to identify women who may benefit from early intervention.

In addition, employment status was associated with pregnancy outcome. Women in one employment category had lower odds of pregnancy than the reference group, suggesting that occupational and socioeconomic factors may influence treatment success. Unemployment or unstable work status may be linked to financial strain, reduced daily structure, or poorer mental well-being, all of which could indirectly affect treatment experiences and health behaviors. However, employment status may also act as a proxy for other unmeasured factors, such as treatment history, duration of infertility, or access to resources. Future studies should examine these mechanisms in greater detail using more granular indicators, including job security, work stress, income, and insurance coverage.

Only-child status was also associated with pregnancy outcome, with women who were only children showing higher odds of pregnancy. Although this finding has rarely been reported, it may reflect differences in family structure, emotional support, treatment persistence, or culturally shaped expectations and coping resources. Given its exploratory nature, this association should be interpreted cautiously and requires replication in more diverse populations. Qualitative inquiry may further clarify how sibling structure relates to psychosocial resources and treatment experience. More broadly, these findings are consistent with a biopsychosocial understanding of fertility treatment, in which psychological distress, interpersonal context, and sociodemographic factors interact with biological processes to influence reproductive outcomes.

Limitations

Several limitations should be acknowledged. First, psychological symptoms, stress, coping strategies, and perceived support were assessed using self-report measures and may therefore be subject to recall bias and social desirability bias. Second, this was a single-center study, which may limit the generalizability of the findings. Third, although significant associations and longitudinal patterns were observed, the observational design precludes causal inference. Finally, the outcome assessment focused on biochemical or clinical pregnancy; future studies should include longer-term reproductive outcomes, particularly live birth. Additionally, biological markers, such as cortisol and inflammatory cytokines, were not assessed, limiting our ability to elucidate the biological mechanisms underlying the association between psychological stress and reproductive outcomes. Although the sample size was sufficient for the primary analyses, statistical power may have been limited for detecting higher-order interactions within subgroup analyses. Finally, given the observational nature of the study, the observed associations should not be interpreted as causal.

Conclusion

This longitudinal study shows that modifiable psychosocial factors shape psychological symptom and stress trajectories in women undergoing in vitro fertilization–embryo transfer (IVF-ET) and are also associated with pregnancy outcomes. Maladaptive coping strategies, particularly submission and avoidance, were linked to less favorable psychological trajectories, whereas marital quality and perceived family and social support appeared to play protective roles over time. Higher baseline psychological symptom and stress levels were independently associated with a lower likelihood of pregnancy. These findings support a shift toward a more proactive biopsychosocial model of fertility care, with routine longitudinal psychosocial assessment and early targeted support throughout the IVF-ET cycle. Nurse-led interventions focused on coping, couple communication, and social support may help improve psychological well-being and potentially enhance reproductive outcomes. Integrating psychosocial care into routine fertility practice may therefore promote more patient-centered and holistic assisted reproduction services.

Declarations

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Author Contribution

R.J. (Rongxiu Jin) contributed to data collection, investigation, and drafting of the original manuscript. P.W. (Panpan Wang) performed the statistical analysis and data interpretation. D.Y. (Duxia Yu) contributed to data curation, project administration, and validation of the results. Q.S. (Qiru Su) conceptualized and designed the study, provided methodological guidance, and critically revised the manuscript. W.L. (Wenjuan Lai) supervised the overall research, secured funding, administered the project, and reviewed and edited the final manuscript. All authors reviewed and approved the final manuscript.

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Data Availability

Data Availability Statement:The datasets generated and/or analysed during the current study are not publicly available due to patient privacy and confidentiality restrictions, but are available from the corresponding author on reasonable request.

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Figures

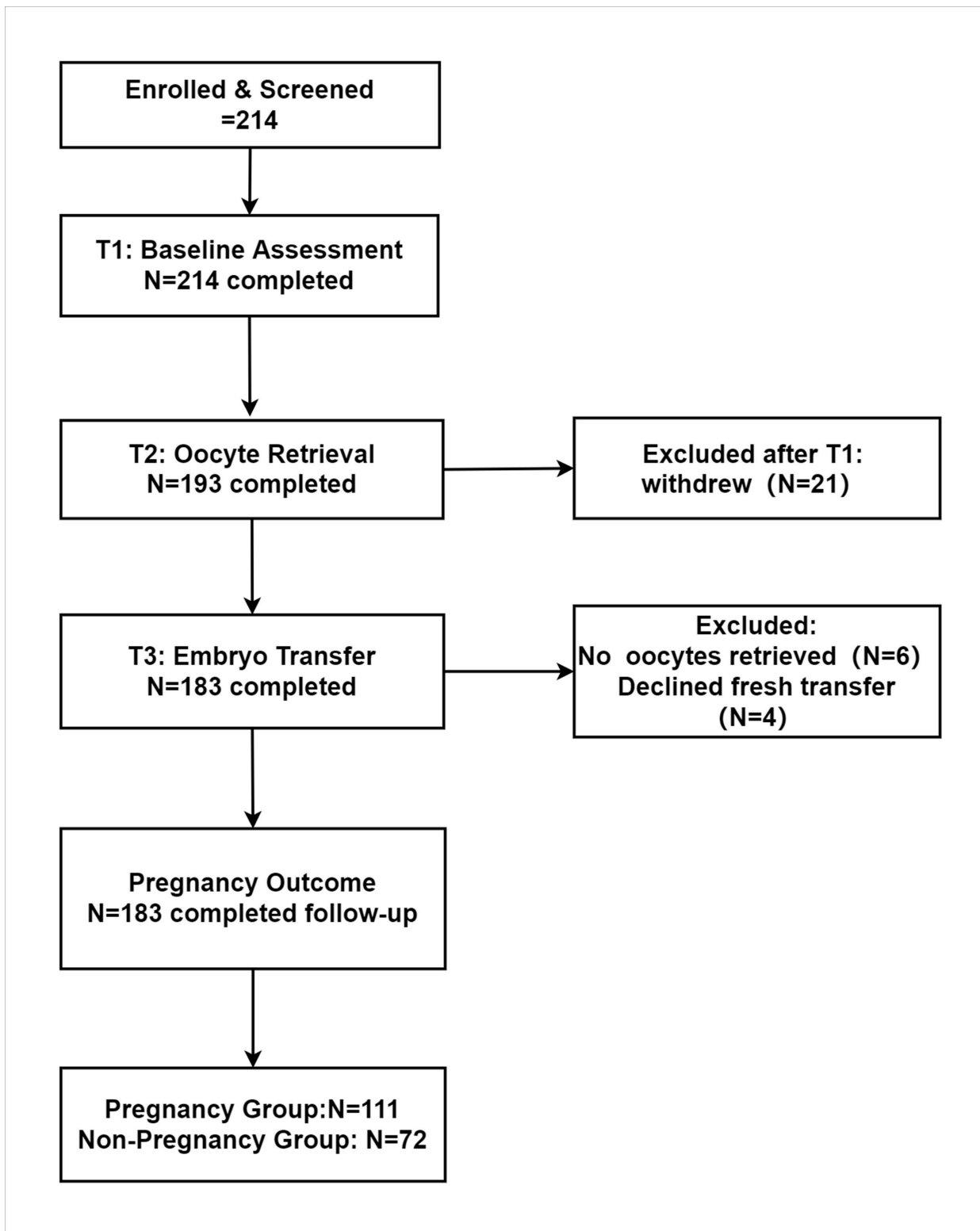


Figure 1

Flowchart of Follow-up During the Female Treatment Cycle In vitro Fertilization-Embryo Transfer

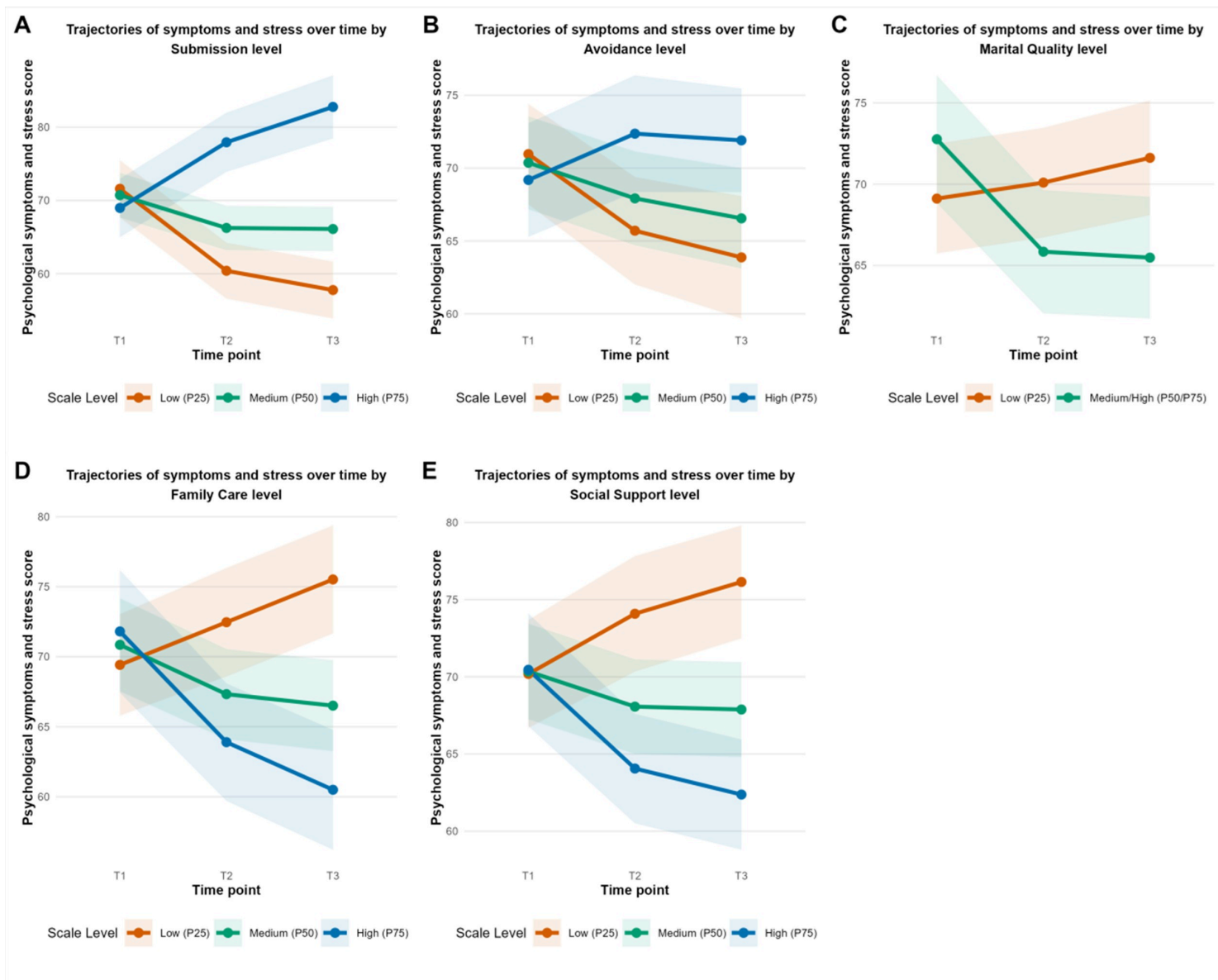


Figure 2

Longitudinal trajectories of psychological symptoms and stress across IVF-ET treatment phases, stratified by psychosocial factors

Note. Points represent odds ratios, and horizontal lines indicate 95% confidence intervals. The dashed vertical line indicates OR = 1.0.

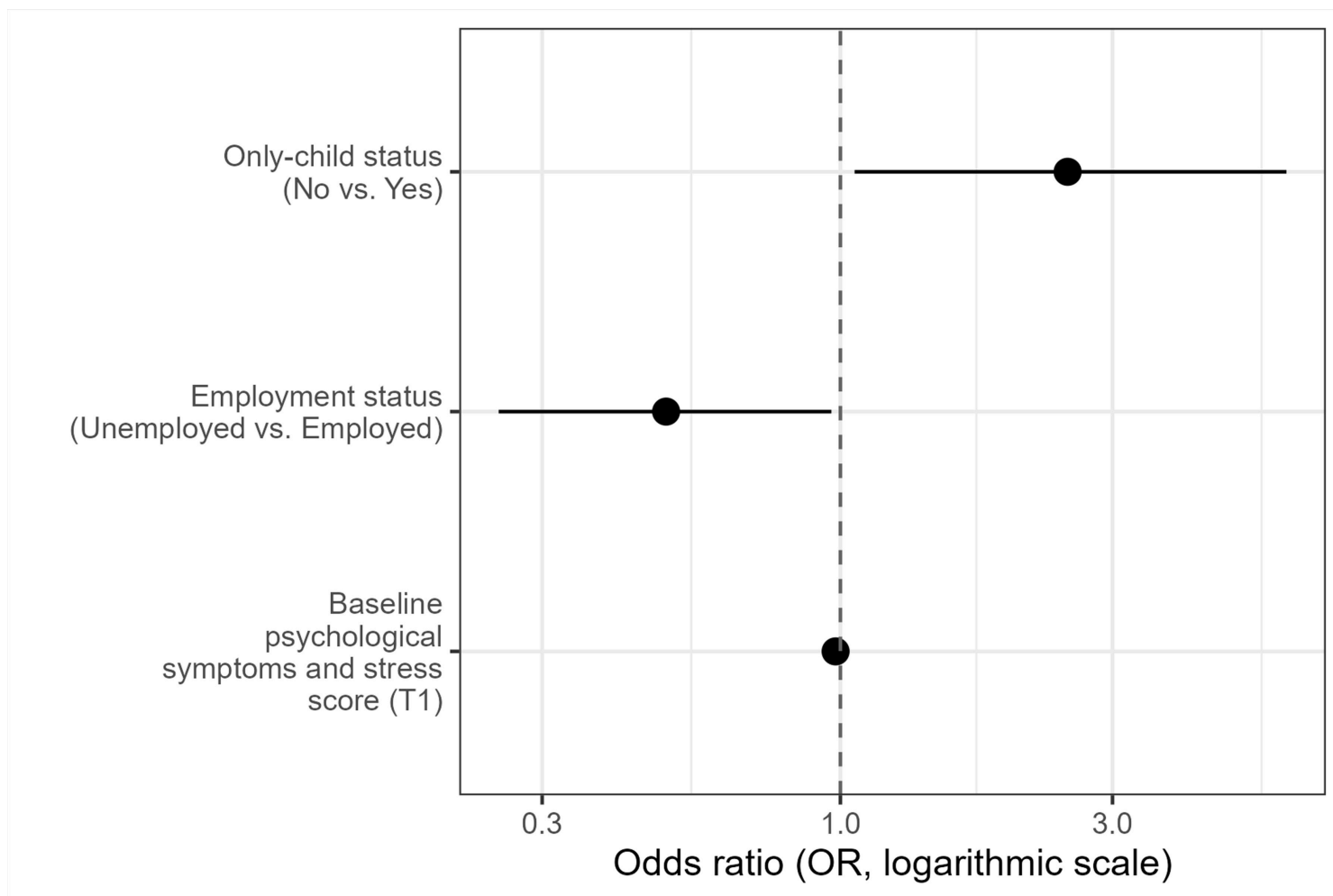


Figure 3

Forest plot of odds ratios for factors associated with clinical pregnancy based on multivariable logistic regression

Note. The solid line represents predicted probabilities derived from the final multivariable logistic regression model. The shaded area indicates the 95% confidence interval. Higher scores indicate greater severity of psychological symptoms and stress.

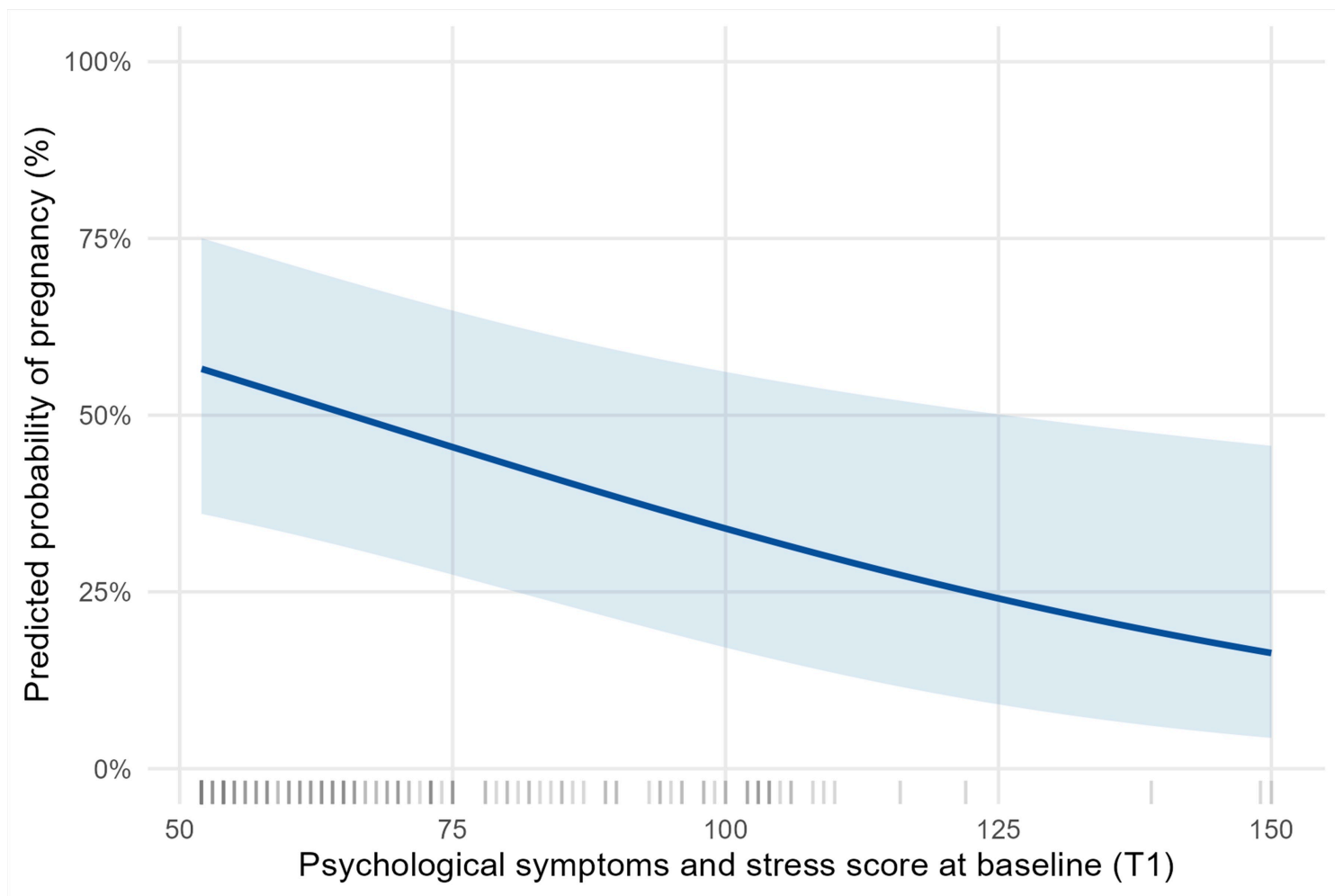


Figure 4

Predicted probability of clinical pregnancy across levels of baseline psychological symptoms and stress