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Profiles and associated factors of prenatal psychological symptoms and their association with health-related quality of life among pregnant women: a cross-sectional study

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ABSTRACT

Objectives To cluster prenatal psychological symptoms into different profiles and investigate prenatal psychological symptoms' sociodemographic, health-related and pregnancy-related factors. Furthermore, health-related quality of life was compared across prenatal psychological symptom profiles.

Design Cross-sectional study.

Setting Obstetrics clinics of two university-affiliated, governmental, tertiary hospitals in Xi'an City, Northwestern China.

Participants Between June and August 2020, 1020 pregnant women who maintained their health assessment appointments at the two research sites participated in this study.

Primary and secondary outcome measures This study's primary outcome was the creation of latent profiles of prenatal psychological symptoms. These were represented by the coexisting symptoms of three common psychological disorders: depression measured using the eight-item Patient Health Questionnaire, anxiety measured using the Generalised Anxiety Disorder-7 and stress measured using the Pregnancy Stress Rating Scale. Secondary outcomes included potential sociodemographic, health-related and pregnancy-related factors associated with prenatal psychological symptoms, which were measured using a researcher-designed information sheet, and health-related quality of life, measured using the 5-Level EuroQol 5-Dimension questionnaire.

Results Prenatal psychological symptoms were classified into three latent profiles using latent profile analysis: low (62.9%), moderate (31.3%) and severe (5.8%). Factors associated with the severity of prenatal psychological symptoms included age, relationship with partner, relationship with mother-in-law, history of gynaecological diseases, history of dysmenorrhoea, stage of pregnancy, unplanned pregnancy, severity of vomiting symptoms and abnormal pregnancy indicators. Moreover, an inverse association was identified between the severity of prenatal psychological symptoms and health-related quality of life.

Conclusions Considering the high prevalence of prenatal psychological symptoms and their adverse effects on health-related quality of life, the assessment of prenatal psychological symptoms should be integrated into prenatal healthcare and made routine practice. Investigating the relevant associated factors would be beneficial for identifying vulnerable individuals.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study regarded coexisting prenatal psychological symptoms as an integral entity that could facilitate the early detection of psychological problems in pregnant women and the implementation of comprehensive, timely interventions.
⇒ Latent profile analysis was used to cluster prenatal psychological symptoms into different profiles.
⇒ Health-related quality of life was compared based on the severity of prenatal psychological symptoms, the results of which provided evidence for the internal validity of the proposed latent profiles of prenatal psychological symptoms.
⇒ Due to the nature of the cross-sectional design, a causal relationship between the associated factors and prenatal psychological symptoms cannot be established.

INTRODUCTION

Gestation is a stressful event during which women experience substantial physiological, psychological and social changes to adapt to motherhood,[1] during which depression, anxiety and stress are common psychological symptoms.[2] Evidence suggests that around a quarter of women are impacted by at least one psychological problem during pregnancy,[3] and depression, anxiety and stress could be present in up to 25% of pregnant women.[4 5] Psychological problems pose a large spectrum of adverse outcomes on maternal and fetal health, such as pre-eclampsia, gestational diabetes, prolonged length of hospital stay in mothers, and preterm birth, low birth weight, miscarriage, and stillbirth in infants.[6 7] Impaired mother–baby bonding, long-lasting mental problems in mothers, and poor cognitive, emotional, and motor development in

offspring are also common long-term consequences of prenatal psychological disorders.[8 9]

Ample evidence exists regarding the epidemiological characteristics of psychological disorders among pregnant women. However, existing studies have consistently investigated different psychological disorders separately. It is worth noting that the coexistence of multiple psychological problems is common in pregnant women and could result in a variety of undesirable health outcomes.[7 10] As a result, a paradigm examining depression, anxiety and stress as independent entities could lead to the fragmentation of care. The patterns of coexisting psychological symptoms are complicated as different mental disorders may present heterogeneously with regard to onset, longitudinal trajectory and symptom configuration.[11] In this sense, an examination of prenatal psychological well-being, which includes a comprehensive evaluation of coexisting psychological problems would add to the literature on this subject. Unfortunately, relevant evidence is still lacking, making further investigations of prenatal psychological symptoms necessary.

Identifying the factors associated with prenatal psychological problems could facilitate the recognition of vulnerable individuals and the implementation of early preventive strategies. Frequently reported factors related to prenatal psychological disorders can be grouped into sociodemographic characteristics, including age, age at gestation, educational level, occupation, socioeconomic status and social support[12 13]; antecedent history of physiological and psychological illness[14] and pregnancy-related factors, including antenatal follow-up, unplanned pregnancy, gestational week, the number of gestations, pregnancy complications and prior history of adverse pregnancy outcomes.[15 16] Although the factors associated with prenatal psychological disorders such as depression, anxiety and distress have been well documented in relevant studies, evidence regarding the protective and risk factors for coexisting prenatal psychological problems is lacking.

Health-related quality of life (HRQoL), defined as the subjective perception of an individual's general well-being and the extent of role fulfilment across multiple physical, psychological and social domains,[17] is a multidimensional variable and is deemed a vital health indicator. Growing evidence indicates that multiple prenatal psychological disorders can lead to compromised HRQoL.[18 19] A recent systematic review of 73 studies suggested that anxiety and depression were closely related to poor HRQoL during pregnancy.[18] Despite the established correlation between having a single psychological disorder and HRQoL, empirical studies examining the association between coexisting prenatal psychological symptoms and HRQoL are valuable.

To address the above-mentioned research gaps, the current study was conceptualised with the objectives of clustering prenatal psychological symptoms into different profiles and evaluating the differences in sociodemographic, health-related and pregnancy-related factors among each profile. Furthermore, HRQoL was compared across different profiles, which could serve as internal validation for the newly constructed profiles of prenatal psychological symptoms.

METHODS

This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology statement.[20]

Study design, setting and participants

This cross-sectional study was conducted in the obstetrics clinics of two university-affiliated, governmental and tertiary hospitals in Xi'an City, Northwestern China, from July to August 2020. Pregnant women in China generally build a health record in a governmental hospital and regularly visit the hospital for prenatal health assessment.

The target population for this study was pregnant women who had maintained their health assessment appointments at the two research sites. The inclusion criteria were as follows: (1) age 18 years or above, (2) no cognitive impairment or communication difficulties and (3) consent to participate in the study. Pregnant women were excluded if they had a clinical diagnosis of any psychological disease or were participating in other studies. On a convenience basis, all eligible pregnant women were invited to participate during the study period.

Measures

Sociodemographic, health-related and pregnancy-related characteristics

Based on a comprehensive review of evidence regarding the factors associated with common prenatal psychological disorders, a researcher-designed sociodemographic, health-related and pregnancy-related information sheet was developed to collect data from the research participants. The variables investigated included age, education level, employment status, monthly household income, residence, relationship with partner, relationship with mother-in-law, prepregnancy body mass index (BMI), history of gynaecological diseases and dysmenorrhoea, stage of pregnancy, gravidity, unplanned pregnancy, severity of vomiting symptoms, abnormal pregnancy indicators and monocytosis.

Prenatal psychological symptoms

Three predominant psychological disorders—depression, anxiety and stress—were selected and assessed in combination to represent prenatal psychological symptoms.

Prenatal depression was assessed using the eight-item Patient Health Questionnaire (PHQ-8), encompassing eight of the nine diagnostic criteria for major depression, as mentioned in the Diagnostic and Statistical Manual of Mental Disorders-fifth Edition, with the question on suicidal ideation omitted.[21 22] The PHQ-8 assesses participants' depressive symptoms during the past 2 weeks. Each item was scored from 0 ('not at all') to 3 ('nearly every

day') and the possible range for the total score is 0–24, with higher scores indicating more severe depressive symptoms. The PHQ-8 has good reliability and validity in pregnant women.[23]

Prenatal anxiety was assessed using the Generalised Anxiety Disorder-7 (GAD-7) scale, developed by Spitzer *et al* in 2006.[24] Each item of the GAD-7 investigates one symptom of typical anxiety disorders experienced during the past 2 weeks and was rated on a 4-point Likert scale from 0 ('not at all') to 3 ('nearly every day'). Thus, the total score ranges from 0 to 21, with higher scores indicating a worse condition. The GAD-7 has exhibited satisfactory psychometric properties in pregnant women.[25]

Prenatal stress was assessed using the 30-item Pregnancy Stress Rating Scale (PSRS) initially developed by Chen *et al* in 1983.[26] It consists of three dimensions: stress regarding maternal and infant health and safety, stress regarding maternal role identification, and stress regarding altered physical appearance and function. Items were rated on a 4-point Likert scale ranging from 0 ('definitely no') to 3 ('very severe'), with a total score range of 0–90. Higher scores indicated higher levels of perceived stress. The original Chinese version of the PSRS has demonstrated good reliability and validity.[27]

Health-related quality of life

The 5-Level EuroQol 5-Dimension questionnaire (EQ-5D-5L) was used to assess HRQoL. The instrument comprises a short descriptive questionnaire (five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression) and a Visual Analogue Scale (VAS).[28] The questionnaire provides a simple descriptive profile of a respondent's health status; scores for the five items can be converted into a utility index score by referring to the values of preference weights calculated for the Chinese general population.[29] The VAS provides an alternative way to elicit an individual's rating of their overall health status. The EQ-5D-5L has demonstrated good psychometric properties in pregnant women.[30]

Procedures and ethical considerations

On identifying an eligible participant, the principal investigator briefed them on the study and invited the pregnant women to participate. Interested participants were asked to provide written informed consent, after which they participated in the study. Data were collected through face-to-face interviews. The principal investigator asked the questions individually, following the protocol, and recorded the participants' responses to the printed survey questionnaires. All data collection was conducted by the principal investigator, ensuring consistency in the collected data.

Statistical analysis plan

IBM SPSS V.22.0, Stata V.16.1 and Mplus V.8.3 were used for the data analysis. Continuous data are presented as means and SD if normally distributed, while categorical data are presented as counts and percentages. Latent profile analysis (LPA) was used to categorise participants into distinct heterogeneous subgroups of prenatal psychological profiles based on three psychological disorders (depression, anxiety and stress). Per guidelines from Nylund *et al*,[29] our research team specified two potential profiles and increased the number of profiles until the model fit reached an optimal level. Several coefficients were selected to examine model fitness, including log-likelihood (LL), Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size-adjusted BIC, Entropy, Lo-Mendell-Rubin likelihood ratio test, bootstrap likelihood ratio test and the relative frequency of the smallest class.[31] In addition, the theoretical and practical significance of the models was considered when selecting the preferred profile structure.

A two-step procedure was employed to examine the factors associated with prenatal psychological symptoms by subgroup (profiles). Analysis of variance, the χ^2 test and Fisher's exact test were employed as univariate analytical strategies to explore differences in sociodemographic, health-related and pregnancy-related characteristics across subgroups. Multivariate multinomial logistic regression (MLR) modelling was performed to identify factors associated with prenatal psychological symptoms. The level of statistical significance for univariate and multivariate analyses was set to α=0.1 and α=0.05, respectively. To control for potential biases related to the profiles and guarantee the criterion validity of the LPA, propensity-weighted regression modelling and pairwise comparison tests were used to analyse the indicators characterising the latent profiles and evaluate the output variable measures across the profiles. Multiple imputation was used to impute the missing data.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, interpretation or dissemination of this study.

RESULTS

Sociodemographic, health-related and pregnancy-related characteristics of the research participants

A total of 1465 pregnant women were approached for participation, of which 1020 (69.62%) agreed and completed the survey questionnaires. The average age of the participants was 30.09 (SD: 3.48), and the majority were 23–35 years old. Nearly one-third of the participants were underweight, overweight or obese prior to pregnancy based on their BMI. 90% of participants had a college degree or higher. A large proportion of the participants were employed (77.65%) and had a monthly household income of more than CN¥5000 (58.04%). Most participants reported good or close relationships with their partners (97.27%) and mothers-in-law (85.60%). Approximately 20% and 50% of the participants had a history of gynaecological diseases and dysmenorrhoea, respectively. Regarding pregnancy-related characteristics, slightly

more than half of the participants were in the third trimester, and two-thirds were primiparous. Participants with unplanned pregnancies accounted for 42.84% of the total sample. More than two-fifths of participants reported moderate or severe vomiting. 24 (2.42%) participants had abnormal pregnancy indicators. The sociodemographic, health-related and pregnancy-related characteristics of the participants are presented in table 1.

With regard to independent prenatal psychological problems, 55.7% and 2.8% of the participants exhibited mild/moderate and major depressive symptoms (with a PHQ-8 total score of 5–14 and ≥15, respectively). A total of 264 (25.9%) participants had mild/moderate anxiety symptoms (with a GAD-7 total score of 6–15) and 12 (1.2%) had major anxiety symptoms (with a GAD-7 total score of ≥16). Mild/moderate stress levels were observed in 88.2% of the sample.

LPA of prenatal psychological symptoms

The LPA generated five models of latent profiles, with the number of latent profiles in the models ranging from 2 to 6 (table 2). As the relative frequency of the smallest class was lower than 5% in models III, IV and V, these three models were inferior to models I and II. With lower coefficients in LL, AIC, BIC, and SSA-BIC, and a higher entropy value, model II, which suggested three latent profiles of prenatal psychological symptoms, was considered superior to model I and was selected.

Based on the mean scores across the subconstructs (depression, anxiety and stress) of the prenatal psychological symptoms in each profile (figure 1), the three latent profiles were categorised as 'low prenatal psychological symptoms' group (642 participants, 62.9%), 'moderate prenatal psychological symptoms' group (319 participants, 31.3%) and 'severe prenatal psychological symptoms' group (59 participants, 5.8%).

Propensity-weighting adjusted interprofile comparisons

Weighted adjustments for covariates were performed to control for potential confounding factors across profiles. The propensity-weighted adjusted means and SEs for the latent profile indicators and pairwise comparisons are presented in table 3. The three subconstructs of prenatal psychological symptoms—depression, anxiety and stress—were significantly heterogeneous across the profiles. Specifically, participants with severe prenatal psychological symptoms had the highest total scores for depression (mean: 1.57; SD: 0.467), anxiety (mean: 2.04, SD: 0.417) and stress (mean: 1.22, SD: 0.570), while those with low prenatal psychological symptoms had the lowest total scores for depression (mean: 0.48, SD: 0.303), anxiety (mean: 0.23, SD: 0.228) and stress (mean: 0.36, SD: 0.266).

Factors associated with prenatal psychological symptoms

Univariate analyses demonstrated that age, relationship with partner, relationship with mother-in-law, history of gynaecological diseases, history of dysmenorrhoea, stage of pregnancy, unplanned pregnancy, severity of vomiting and abnormal pregnancy indicators were associated with the severity (different latent profiles) of prenatal psychological symptoms (table 1).

All associated factors identified in the univariate analyses were entered into a multivariate MLR model (table 4). Younger participants were more vulnerable to moderate and high levels of prenatal psychological symptoms. An increase of 1 year in age could reduce the risk of moderate prenatal psychological symptoms by 2% and severe prenatal psychological symptoms by 10%. Participants who reported a 'good' or 'close' relationship with their partner were less likely to have severe prenatal psychological symptoms compared with those reporting a 'general' relationship, with the relative risk being (indicated by OR) 19% (good relationship) and 14% (close relationship). Other factors associated with an increased vulnerability to moderate prenatal psychological symptoms included a poorer relationship with one's mother-in-law (OR: 'close' vs 'general', 0.71); having a history of gynaecological diseases (OR: 1.53), having a history of dysmenorrhoea (OR: 1.79); at an earlier stage of pregnancy (OR: 1.20 for '3–6 months' vs '>6 months', 1.53 for '<3 month' vs '>6 months'); unplanned pregnancy (OR: 1.29); more severe vomiting (OR: 0.72 for 'moderate' vs 'severe', 0.57 for 'mild' vs 'severe', 0.41 for 'no' vs 'severe') and having abnormal pregnancy indicators (OR: 3.82). Factors that contributed to an increased vulnerability to severe prenatal psychological symptoms included worse relationship with mother-in-law (OR: 0.35 for 'good' vs 'general', 0.31 for 'close' vs 'general'); having a history of dysmenorrhoea (OR: 2.20); being at an earlier stage of pregnancy (OR: '<3 months' vs '>6 months', 2.57); unplanned pregnancy (OR: 1.86) and having abnormal pregnancy indicators (OR: 5.76).

Comparison of HRQoL by prenatal psychological symptoms profiles

Propensity weighting-adjusted comparisons showed that both EQ-Utility Index (UI) and EQ-VAS scores were the highest in participants with low prenatal psychological symptoms, followed by those with moderate prenatal psychological symptoms and those with severe prenatal psychological symptoms (table 5 and online supplemental figure S1). All intergroup differences in the EQ-UI and EQ-VAS scores were statistically significant, suggesting a substantial decrease in HRQoL with an increase in prenatal psychological symptoms. Regarding the five dimensions of the EQ-5D, participants with moderate and severe prenatal psychological symptoms had significantly higher scores, indicating worse HRQoL than those with mild prenatal psychological symptoms.

DISCUSSION

Because the symptoms of various prenatal psychological disorders are usually present simultaneously, it is realistic to view them as an integral entity. In the current study, prenatal

Table 1 Sociodemographic, health-related and pregnancy-related characteristics and the comparison across latent profiles (N=1020)

Variables	Total samples (N=1020)	Latent profiles			Test statistics P value
		Profile 1* (n=642)	Profile 2† (n=319)	Profile 3‡ (n=59)	
Age (in years, mean±SD)	30.09±3.48	30.25±3.45	29.93±3.53	29.29±3.46	F=2.59 0.08
<23	4 (0.39)	1 (0.16)	2 (0.63)	1 (1.70)	0.141§
23–29	466 (45.78)	281 (43.84)	152 (47.80)	33 (55.93)	
30–35	468 (45.97)	305 (47.58)	140 (44.02)	23 (38.98)	
≥35	80 (7.86)	54 (8.42)	24 (7.556)	2 (3.39)	
Marital duration (in years, mean±SD)	3.60±3.06	3.73±3.07	3.42±3.10	3.07±2.77	F=1.99 0.138
Prepregnancy BMI					x^2=4.47, 0.614
<18.5	165 (16.32)	111 (17.40)	47 (14.97)	7 (11.86)	
18.5–23.9	689 (68.15)	429 (67.24)	218 (69.42)	42 (71.19)	
24.0–27.9	130 (12.86)	79 (12.38)	41 (13.06)	10 (16.95)	
≥28	27 (2.67)	19 (2.98)	8 (2.55)	0 (0.00)	
Educational level					x^2=2.50, 0.645
High school degree or lower	117 (11.55)	71 (11.13)	39 (12.34)	7 (11.86)	
College degree	288 (28.43)	175 (27.43)	92 (29.11)	21 (35.60)	
Undergraduate degree or above	608 (60.02)	392 (61.44)	185 (58.55)	31 (52.54)	
Employment status					x^2=1.78, 0.410
Housewife	200 (22.35)	128 (22.38)	58 (21.01)	14 (29.79)	
Employed	695 (77.65)	444 (77.62)	218 (78.99)	33 (70.21)	
Monthly household income (in CNY)					x^2=4.73, 0.316
<3000	39 (4.24)	24 (4.12)	13 (4.58)	2 (3.77)	
3000–5000	347 (37.72)	208 (35.68)	121 (42.60)	18 (33.96)	
>5000	534 (58.04)	351 (60.20)	150 (52.82)	33 (62.27)	
Residence					x^2=3.66, 0.160
Urban	814 (87.15)	523 (88.05)	250 (86.81)	41 (78.85)	
Rural	120 (12.85)	71 (11.95)	38 (13.19)	11 (21.15)	
Relationship with partner					x^2=55.33, <0.001
Close	749 (78.51)	502 (82.84)	213 (72.45)	34 (62.96)	
Good	179 (18.76)	95 (15.68)	73 (24.83)	11 (20.37)	
General	26 (2.73)	9 (1.48)	8 (2.72)	9 (16.67)	
Relationship with mother-in-law					x^2=32.88, <0.001
Close	494 (53.29)	341 (58.09⟩	133 (46.34⟩	20 (37.74⟩	
Good	281 (30.31)	167 (28.45)	102 (35.54)	12 (22.64)	
General	152 (16.40)	79 (13.46)	52 (18.12)	21 (39.62)	
History of gynaecological diseases					x^2=6.14, 0.046
Yes	178 (19.22)	101 (17.24)	69 (23.96)	8 (15.38)	
No	748 (80.78)	485 (82.76)	219 (76.04)	44 (84.62)	
Dysmenorrhoea					x^2=22.91, <0.001
Yes	446 (47.75)	244 (41.71)	170 (57.82)	32 (58.18)	
No	488 (52.25)	341 (58.29)	124 (42.18)	23 (41.82)	
Trimester (stage of pregnancy)					x^2=10.04, 0.040

Continued

Table 1 Continued

Variables	Total samples (N=1020)	Latent profiles			Test statistics P value
		Profile 1* (n=642)	Profile 2† (n=319)	Profile 3‡ (n=59)	
First (<3 months)	154 (15.42)	86 (13.59)	53 (17.10)	15 (26.79)	
Second (3–6 months)	300 (30.03)	188 (29.70)	100 (32.26)	12 (21.43)	
Third (>6 months)	545 (54.55)	359 (56.71)	157 (50.64)	29 (51.78)	
Gravidity					x^2=2.89, 0.236
Primigravida	609 (66.20)	373 (64.20)	200 (69.93)	36 (67.92)	
Multigravida	311 (33.80)	208 (35.80)	86 (30.07)	17 (32.08)	
Unplanned pregnancy					x^2=13.68, 0.001
Yes	428 (42.84)	247 (39.14)	146 (46.95)	35 (61.40)	
No	571 (57.16)	384 (60.86)	165 (53.05)	22 (38.60)	
Severity of vomiting					x^2=20.59, 0.002
No or minimal	237 (23.65)	173 (27.33)	52 (16.67)	12 (21.05)	
Mild	349 (34.83)	226 (35.70)	106 (33.97)	17 (29.83)	
Moderate	345 (34.43)	198 (31.28)	124 (39.74)	23 (40.35)	
Severe	71 (7.09)	36 (5.69)	30 (9.62)	5 (8.77)	
Abnormal pregnancy indicators					x^2=11.452, 0.003
Yes	24 (2.42)	8 (1.27)	12 (3.90)	4 (7.02)	
No	969 (97.58)	620 (98.73)	296 (96.10)	53 (92.98)	
Baby sex expectation					x^2=4.54, 0.338
Boy	123 (12.25)	70 (11.02)	44 (14.10)	9 (15.79)	
Girl	258 (25.70)	157 (24.73)	84 (26.92)	17 (29.82)	
No expectation	623 (62.05)	408 (64.25)	184 (58.98)	31 (54.39)	
Monocytosis					x^2=2.45, 0.293
Yes	951 (97.14)	603 (96.63)	295 (97.68)	53 (100.00)	
No	28 (2.86)	21 (3.37)	7 (2.32)	0 (0.00)	

*Low psychological symptoms profile.
†Moderate psychological symptoms profile.
‡Severe psychological symptoms profile.
§Fisher's exact test.
BMI, body mass index.

psychological symptoms were classified into three latent profiles using LPA, representing low (62.9%), moderate (31.3%) and severe (5.8%) levels of prenatal psychological symptoms. Multiple sociodemographic, health-related and pregnancy-related factors were found to be associated with the severity of prenatal psychological symptoms. Moreover, an inverse association was found between the severity of prenatal psychological symptoms and HRQoL.

Table 2 Fitness indicators for latent profile analysis (N=1020)

Model	No. of profiles	LL	AIC	BIC	SSA-BIC	Entropy	LMRT	BLRT	Relative frequency of smallest class (%)
I	2	−1642.497	3304.994	3354.269	3322.508	0.841	<0.001	<0.001	20.88
II	3	−1452.981	2933.962	3002.948	2958.482	0.863	<0.001	<0.001	5.78
III	4	−1404.006	2844.013	2932.709	2875.539	0.883	0.102	<0.001	3.12
IV	5	−1360.498	2764.996	2873.403	2803.529	0.857	0.065	<0.001	2.75
V	6	−1339.971	2731.941	2860.058	2777.479	0.858	0.639	<0.001	1.37

AIC, Akaike information criterion; BIC, Bayesian information criterion; BLRT, bootstrapped likelihood ratio test; LL, log-likelihood; LMRT, Lo-Mendell-Rubin test; SSA-BIC, sample-size adjusted BIC.

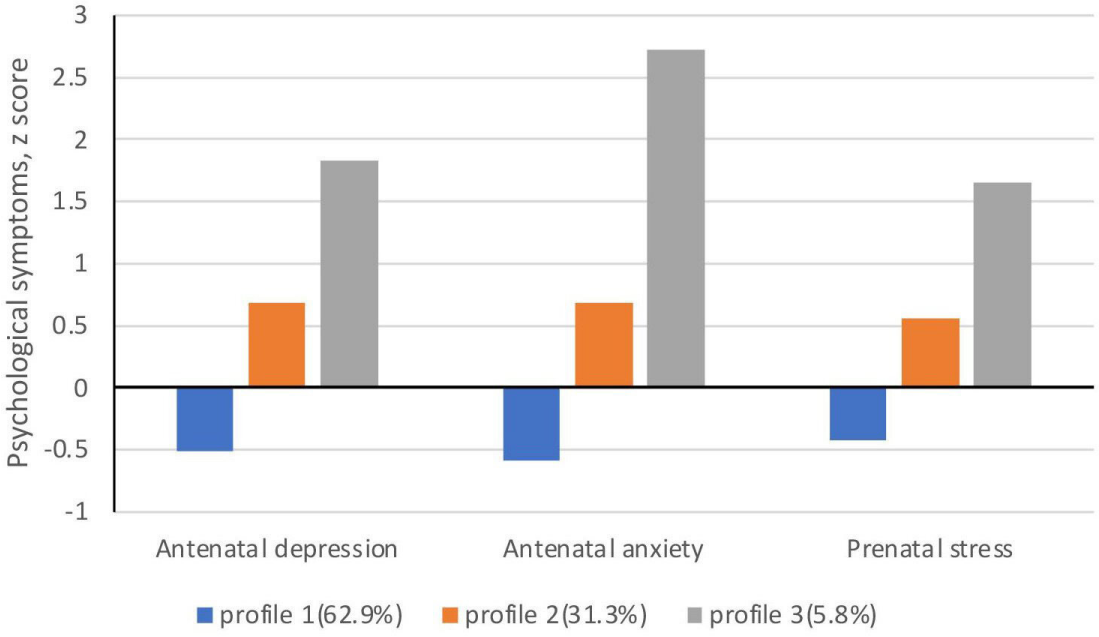

Figure 1 Mean standardised factor score on each psychological subconstruct, stratified by latent profiles.

Profiles of prenatal psychological symptoms

Classifying prenatal psychological symptoms according to severity is important as it facilitates the identification of pregnant women with poor mental well-being. In this study, three latent profiles were observed: low, moderate and severe prenatal psychological symptoms, which is consistent with the results of a recent similar study.[32] It was also observed that substructural prenatal psychological disorders tended to occur in clusters, rather than independently, with the group with more severe symptoms scoring higher in all the subconstructs (figure 1). Such a pattern might be explained by the shared pathophysiological mechanisms, symptoms and risk factors of depression, anxiety and stress.[33 34]

Among the participants, 37.1% had moderate or severe prenatal psychological symptoms. The alarming prevalence of prenatal psychological symptoms can be attributed to the high prevalence of depression, anxiety and stress among pregnant women.[4 35] Another explanation for the high prevalence of prenatal psychological symptoms could be the COVID-19 pandemic that was ongoing during the study period. The COVID-19 pandemic had a detrimental impact on individuals' psychological well-being both directly and indirectly through consequences like social isolation.[36–38]

Notably, the prevalence of moderate or severe prenatal psychological symptoms was significantly higher than the prevalence of moderate or severe prenatal depression, anxiety and stress when these mental health issues were considered separately.[4 35] This finding highlights the value of assessing coexisting prenatal psychological symptoms as a single unit, as individual symptoms may not have accumulated enough to inform a diagnosis of a specific independent psychological disorder, but said symptoms

Table 3 Propensity-weighting adjusted means (SE) for latent profile variables and paired comparison (N=1020)

		Prenatal depression		Prenatal anxiety		Prenatal stress		Cohen's d					
								vs profile 1			vs profile 2		
Profiles	% of sample	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	PD	PA	PS	PD	PA	PS
1*	62.9	0.48 (0.01)	0.46, 0.51	0.23 (0.01)	0.21, 0.25	0.36 (0.01)	0.34, 0.39						
2†	31.3	1.03 (0.02)	0.99, 1.06	0.92 (0.01)	0.89, 0.95	0.78 (0.02)	0.74, 0.81	−1.96	−1.19	−0.84			
3‡	5.8	1.57 (0.04)	1.48, 1.65	2.04 (0.03)	1.97, 2.11	1.22 (0.05)	1.14, 1.31	−3.89	−1.95	−1.41	−2.32	−0.93	−0.65

*Low psychological symptoms profile.
†Moderate psychological symptoms profile.
‡High psychological symptoms profile.
PA, prenatal anxiety; PD, prenatal depression; PS, prenatal stress.

Table 4 Multivariate multinomial logistic regression analysis of factors associated with prenatal psychological symptoms (N=1020)

	(Profile 2*; n=319) vs (Profile 1†; n=642)		(Profile 3‡; n=59) vs (Profile 1†; n=642)	
Variables	OR (95% CI)	P value	OR (95% CI)	P value
Age	0.98 (0.96, 0.99)	**0.009**	0.90 (0.87, 0.94)	**<0.001**
Relationship with partner				
Close	0.89 (0.55, 1.43)	0.630	0.14 (0.09, 0.24)	**<0.001**
Good	1.37 (0.85, 2.21)	0.202	0.19 (0.11, 0.32)	**<0.001**
General§	1	–	1	–
Relationship with mother-in-law				
Close	0.71 (0.58, 0.86)	**0.001**	0.31 (0.22, 0.44)	**<0.001**
Good	1.00 (0.83, 1.21)	0.975	0.35 (0.25, 0.50)	**<0.001**
General§	1	–	1	–
History of gynaecological diseases				
Yes	1.53 (1.32, 1.78)	**<0.001**	0.85 (0.59, 1.21)	0.364
No§	1	–	1	–
History of dysmenorrhoea				
Yes	1.79 (1.58, 2.03)	**<0.001**	2.20 (1.70, 2.85)	**<0.001**
No§	1	–	1	–
Trimester (stage of pregnancy)				
First (<3 months)	1.53 (1.29, 1.83)	**<0.001**	2.57 (1.88, 3.53)	**<0.001**
Second (3–6 months)	1.20 (1.04, 1.38)	**0.010**	0.91 (0.67, 1.25)	0.568
Third (>6 months)§	1	–	1	–
Unplanned pregnancy				
Yes	1.29 (1.14, 1.46)	**<0.001**	1.86 (1.44, 2.41)	**<0.001**
No§	1	–	1	–
Severity of vomiting				
No	0.41 (0.32, 0.53)	**<0.001**	0.82 (0.49, 1.40)	0.470
Mild	0.57 (0.45, 0.72)	**<0.001**	0.77 (0.46, 1.28)	0.311
Moderate	0.72 (0.56, 0.91)	**0.006**	1.18 (0.72, 1.95)	0.513
Severe§	1	–	1	–
Abnormal pregnancy indicators				
Yes	3.82 (2.52, 5.79)	**<0.001**	5.75 (3.23, 10.23)	**<0.001**
No§	1		1	–

Bold values signifies P<0.05.
*Moderate psychological symptom profile.
†Low psychological symptom profile.
‡High psychological symptom profile.
§Reference group.

may have produced substantial detrimental impacts on individuals' mental well-being when considered together.

Multiple sociodemographic, health-related and pregnancy-related factors were associated with the severity of prenatal psychological symptoms

Sociodemographic and health-related factors

Younger pregnant women were more vulnerable to moderate or severe prenatal psychological symptoms in this study, which is consistent with a recent synthesis of relevant evidence.[12 13] This tendency could be due to individuals' gradually increasing adaptive responses to stressful events as they age. Even though this study's results suggest a constant decreasing risk with increased age, a predominant amount of evidence has indicated an increased risk of prenatal psychological problems in the age group ≥35 years old.[12 39] The current study found that pregnant women who maintained good relationships with their husbands and mothers-in-law were less likely to experience moderate or severe psychological symptoms. Husbands are the most important source of affective

Table 5 Propensity-weighting adjusted means (SE) for EQ-5D, EQ-UI and EQ-VAS scores, and comparison across profiles (N=1020)

EQ-5D constructs	Profile 1* (n=642)	Profile 2† (n=319)	Profile 3‡ (n=59)	Profile 2† vs Profile 1* MD (95% CI)	Profile 3‡ vs Profile 1* MD (95% CI)	Profile 3‡ vs Profile 2† MD (95% CI)
Mobility	1.21 (0.02)	1.44 (0.03)	1.38 (0.08)	**0.23 (0.16, 0.31)**	**0.18 (0.02, 0.33)**	−0.06 (−0.22, 0.10)
Self-care	1.04 (0.01)	1.09 (0.01)	1.11 (0.03)	**0.05 (0.02, 0.08)**	**0.07 (0.004, 0.14)**	0.02 (−0.05, 0.09)
Usual activities	1.13 (0.02)	1.33 (0.03)	1.39 (0.06)	**0.20 (0.14, 0.26)**	**0.26 (0.13, 0.38)**	0.06 (−0.07, 0.19)
Pain/discomfort	1.58 (0.02)	1.77 (0.03)	1.88 (0.07)	**0.19 (0.01, 0.26)**	**0.30 (0.16, 0.44)**	0.11 (−0.03, 0.26)
Anxiety/depression	1.39 (0.02)	1.94 (0.03)	2.37 (0.07)	**0.55 (0.48, 0.63)**	**0.98 (0.83, 1.13)**	**0.43 (0.27, 0.59)**
EQ-UI	0.92 (0.00)	0.85 (0.01)	0.82 (0.01)	**−0.07 (−0.08, 0.06)**	**−0.11 (−0.13, 0.08)**	**−0.04 (−0.06, 0.01)**
EQ-VAS	90.23 (0.37)	84.27 (0.51)	76.79 (1.24)	**−5.96 (−7.20, 4.73)**	**−13.44 (−15.97, 10.91)**	**−7.47 (−10.10, 4.85)**

Bold values signifies P<0.05.
*Low psychological symptom profile.
†Moderate psychological symptom profile.
‡High psychological symptom profile.
EQ-5D, EuroQol 5-Dimension; EQ-UI, EQ-Utility Index; MD, mean differences; VAS, Visual Analogue Scale.

value and social support for married women, while a large proportion of mothers-in-law play an important role in the perinatal period of Chinese women.[40] The findings of this study are consistent with existing evidence.[12 13 38 39]

This study indicates that an antecedent history of gynaecological diseases and dysmenorrhoea could increase the risk of pregnant women experiencing moderate and severe prenatal psychological symptoms. As a contributor to spontaneous preterm delivery and premature rupture of membranes, a history of dysmenorrhoea can have a profound influence on the psychological well-being of pregnant women.[14 41] Despite the lack of direct evidence, pregnant women may worry that antecedent gynaecological diseases could cause adverse pregnancy outcomes, which could negatively impact their psychological health. Considering the lack of evidence regarding the effects of an antecedent history of gynaecological diseases and dysmenorrhoea on prenatal psychological symptoms, further investigations are necessary before we can draw firm conclusions.

Pregnancy-related factors

This study found that pregnant women in the first and second trimesters were more prone to experiencing moderate and severe psychological symptoms than those in the third trimester. These results agree with the findings of a previous study which indicated a gradual decrease in both depressive symptoms and anxiety during pregnancy.[42] This could be a result of gradual adaptation to stressful pregnancy events. Unplanned pregnancy was identified as another risk factor for more severe prenatal psychological symptoms, which is consistent with existing evidence.[39 43] Some researchers have suggested that human beings find it more difficult to cope with unexpected and undesired events and are therefore more likely to experience psychological problems when confronted with such events.[15] In the current study, participants' experience of moderate or severe prenatal psychological symptoms increased with the severity of vomiting, which is common during the early stages of pregnancy. Given the bidirectional mechanism between gastrointestinal and psychological symptoms, it is reasonable to observe such an association.[44] In the current study, diagnoses of abnormal pregnancy indicators increased the likelihood of participants experiencing prenatal psychological symptoms, which is consistent with the synthesised evidence.[12 39] There is no doubt that pregnant women face significant challenges when encountering obstetric complications, considering the adverse influences on themselves and their offspring.[16]

HRQoL was associated with the severity of prenatal psychological symptoms

HRQoL is a multidimensional concept that reflects the overall well-being of human beings. This study's results suggest an inverse association between the severity of prenatal psychological symptoms and HRQoL. A similar association between various psychological disorders and

HRQoL has been well established in pregnant women and other populations.[45 46] To some extent, the association between prenatal psychological symptoms and HRQoL could serve as evidence supporting the internal validity of the originally proposed latent profiles.

Strengths and limitations

This study has several strengths. Foremost, to the best of our knowledge, it is among few studies that have explored coexisting prenatal psychological symptoms as a single unit. An examination of coexisting symptoms rather than individual symptoms (depression, anxiety and stress) could facilitate the early detection of psychological problems in pregnant women and the implementation of comprehensive, timely interventions. Moreover, several sociodemographic, health-related and pregnancy-related factors were identified, which would be meaningful for the quick screening of high-risk individuals and provide targets for preventive and management strategies. Finally, HRQoL was compared based on the severity of prenatal psychological symptoms. The results provided evidence for the internal validity of the proposed latent profiles of prenatal psychological symptoms.

Despite these strengths, the findings of this study should be interpreted with caution due to its limitations. First, although the sample size was relatively large, the participants were recruited using a convenience sampling approach, which could introduce selection bias. Second, latent profiles were proposed based on an analysis of three psychological disorders: depression, anxiety and distress. Consequently, some important symptoms were neglected. Third, the classification of latent profiles was based on subjective ratings of symptom severity, which could have led to reporting bias. In addition, owing to the nature of the cross-sectional design, a causal relationship between the associated factors and prenatal psychological symptoms could not be established.

Implications

Healthcare professionals should shift their focus from independent psychological disorders to coexisting psychological symptoms when assessing the mental well-being of pregnant women. Pregnant women may experience substantial psychological symptoms in the absence of a distinct psychological disorder. The associated factors could be used for the early detection of pregnant women who are highly vulnerable to psychological symptoms, ideally using an autogenerated approach based on health data from hospital information systems.

Large multisite studies with strict methodological standards that minimise bias are necessary to further contribute high-quality research evidence to the body of knowledge on coexisting prenatal psychological symptoms. Additional substructural psychological disorders should be included in future LPAs of prenatal psychological symptoms. Longitudinal studies are needed to clarify the causal relationships among potential factors, prenatal psychological symptoms and HRQoL. Longitudinal studies are valuable for examining the trajectory of prenatal psychological symptoms.

CONCLUSIONS

Considering the high prevalence of prenatal psychological symptoms and their adverse effects on HRQoL, the assessment of prenatal psychological symptoms should be integrated into prenatal healthcare and made routine practice. Investigating the relevant associated factors would be beneficial for identifying vulnerable individuals.

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