

The Effect of Health Education Based on the PRECEDE-PROCEED Model on the Psychological State of the Spouses of Primiparous Women During the Puerperium and on Maternal Breastfeeding

Jingrui Duan, Liyan Zhu

Department of Gynecology and Obstetrics, The Affiliated Wuxi People's Hospital of Nanjing Medical University; Wuxi Medical Center, Nanjing Medical University; Wuxi People's Hospital, Wuxi, People's Republic of China

Correspondence: Liyan Zhu, Department of Gynecology and Obstetrics, The Affiliated Wuxi People's Hospital of Nanjing Medical University; Wuxi Medical Center, Nanjing Medical University; Wuxi People's Hospital, No. 299, Qingyang Road, Liangxi District, Wuxi, 214000, People's Republic of China, Email H963182024@163.com

Background: Based on the PRECEDE-PROCEED (Predisposing, Reinforcing, and Enabling Causes in Educational Diagnosis and Evaluation-Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development) model (PPM), we investigated the psychological status of the spouses of primiparous women to implement a health education program.

Methods: The study retrospectively analyzed 310 spouses of primigravid women who gave birth from March 2022 to March 2024. 154 spouses received regular education, and 156 spouses also received health education of PPM. Binary logistic regression analysis was performed to analyze the independent risk factors for negative emotions of the spouses of primigravid women during puerperium. Analysis of variance was performed to determine the differences in the effect of maternal breastfeeding on the growth and development of infants between the two models of health education.

Results: The health education group based on the PPM was defined as Group A, while the regular health education group was defined as Group B. The SAS (Anxiety self-assessment scale) and SDS (Depression self-assessment scale) of the spouses in Group A were significantly lower than those of the spouses in Group B three days postpartum. Health education intervention (OR = 0.239, P = 0.001), maternal psychological state (OR = 0.458, P = 0.004), and the education level of the spouses (OR = 0.480, P = 0.006) independently influenced the emergence of negative emotions in spouses. The SCL-90 (symptom checklist 90) scores of Group A were significantly lower than those of Group B but significantly higher than the national norm (P < 0.05).

Conclusion: The content of the program not only helps increase the adaptability and participation of the spouses in their role as fathers but also helps increase the effect of maternal breastfeeding on the growth and development of infants.

Keywords: the PRECEDE-PROCEED model, health education, primigravida spouses, psychology, breastfeeding

Introduction

Modern life and environmental pressure have increased the incidence of postpartum depression.¹ Especially in the case of puerperal primipara, due to the lack of reproductive experience and high stress, women are under high physical and mental pressure, which might cause a series of emotional reactions.^{2,3} A cross-sectional study found that the postpartum social support and life satisfaction of spouses influenced postpartum depression.⁴ This indicated that the maternal psychological state is affected by the behavior and psychology of the spouse. Although the stress level of the spouse is lower than that of the new mother, their psychological history is similar to that of the mother and child. They undertake the task of taking care of the mother and child and bear the burden related to physical, psychological, and social aspects.⁵

Therefore, managing the mental health of the spouse is crucial.⁶ A study found that about 10% of the spouses of first-time mothers showed significant prenatal and postnatal depression.⁷ About two decades ago, the International Conference on Population and Development (ICPD) and the Fourth World Conference on Women discussed the role of spouses in the reproductive health of women.^{8,9} However, although spouses strongly influence the reproductive health of women, they have received less attention from researchers, which has led to many direct and indirect negative effects.¹⁰ In addition, other studies have found that the loss of paternal role function during breastfeeding will affect the growth of children.¹¹ Therefore, more attention should be paid to the role of fathers in breastfeeding, and questions need to be asked about the extent to which health professionals can support fathers in adapting to different roles and facing challenges.

The PRECEDE-PROCEED (Predisposing, Reinforcing, and Enabling Causes in Educational Diagnosis and Evaluation-Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development) model (PPM) was developed by the American epidemiologists Kreuter and Lawrence Cew. In the 1980s, PRECEDE-PROCEED integrated multiple theories and perspectives on changes in health-related behaviors. A planned intervention mode that promotes behavioral changes through knowledge acquisition, proposed by combining external environmental factors and psychological factors, is often used in health promotion programs.¹² PPM consists of the PRECEDE phase and the PROCEED stage.^{13,14} This model is widely used in many aspects, such as recommending healthcare techniques,^{15,16} chronic disease management,^{17,18} and teaching nursing skills.¹⁹ The application of this model in maternal health management, infant feeding, and other aspects of maternal and child health has become a popular area of research;²⁰ however, studies on the application of this model in the mental health management of husbands are limited. Using the PPM, in this study, we investigated the psychological state of paramaternal spouses and the effect of maternal breastfeeding, based on multiple disciplines and perspectives. Intervention strategies can be adjusted at any time by evaluating the process of implementing the intervention and assessing the impact and result to help in the construction of health programs based on evidence.

Materials and Methods

Research Participants

In total, 310 spouses of primigravid women who gave birth at The Affiliated Wuxi People's Hospital of Nanjing Medical University from March 2022 to March 2024 were included in this study.

The inclusion criteria were as follows: (1) the mothers had full-term singleton pregnancies and were giving birth for the first time; (2) the mothers and their spouses were married; (3) the mothers and their spouses were conscious, had no cognitive impairment, and agreed to complete the survey and participate in the health education program; (4) they provided informed consent to voluntarily participate in this study.

The exclusion criteria were as follows: (1) mothers with serious obstetric complications or comorbidities; (2) newborns with serious birth injuries or congenital diseases (Figure 1).

We conducted a retrospective study, and according to the group's previous research and relevant literature, approximately 70% of spouses in the conventional education group and 50% of spouses in the health education group based on Grimm's model experienced negative emotions. Assuming a specified alpha of 5% and a confidence level of 0.90, the sample size to be surveyed was calculated using the PASS 15 software and was found to be $N_1 = N_2 = 124$ cases. Assuming a non-response rate of the study population of 10%, the required sample size was $N = 124 \div 0.9 = 137$ cases. Therefore, the planned sample size for this study was 330 cases, with 165 cases in each group. The total number of attrition and lost cases was 20, and the final count was 310 cases. Among them, 154 cases were in the conventional education group and 156 cases were in the health education group based on the Grimm model.

General Information Questionnaire

The general information questionnaire included demographic data (eg, maternal age, mode of delivery, age of spouse, education level of spouse, family income, residence, whether planning pregnancy, whether participating in prenatal health education, degree of understanding of infant care (determined by the infant care questionnaire developed by the research

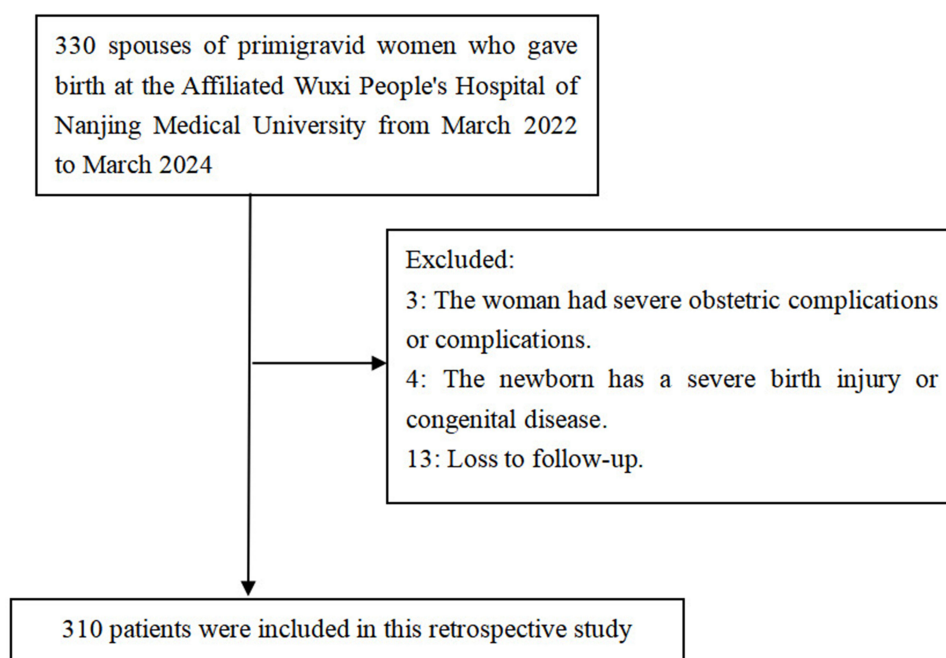


Figure 1 Flow chart of patient selection.

group; a total of 20 questions are defined as Proficiency and Mastery level at a correct rate of 60%), whether the spouse received a paternity leave, and maternal combined postpartum complications).

Construction of the Health Education Intervention Program

Formation of the Research Team

The research team consisted of six members, including one deputy chief physician from the obstetrics ward, one head nurse from the obstetrics ward, two outpatient nurses, and two ward nurses. Six healthcare workers had a work experience of >5 years. The main tasks of the research team members were to prepare the first draft of the program, identify the selected experts, organize the expert group meeting, revise and improve the program according to the opinions and suggestions of the experts, and form the final draft of the program.

Health Education Implementation Program

The health education intervention program for spouses was developed based on the literature review and preliminary investigation, along with the suggestions provided by the experts. While developing the program, the PPM was used as the theoretical framework (Figure 2), and the theory of knowing, believing, and acting was considered. The main content of the program included three aspects: predisposing factors, contributing factors, and reinforcing factors affecting the psychological state of the spouses. The subject content and measures of the intervention program are listed in Table 1.

Assessment Methodology

Negative Emotion Assessment

The anxiety self-assessment scale (SAS) and depression self-assessment scale (SDS) were used to evaluate the negative mood of the participants at different time points before and after the intervention. SAS consists of 20 items, with four points for each item, and a cut-off value of 50 points; ≤ 50 points indicates no anxiety, whereas > 50 points indicates anxiety, and the higher the score, the more severe the anxiety. SDS consists of 20 items, with a cut-off value of 53 points; ≤ 53 points indicate no depression, whereas > 53 points indicate depression, and the higher the score, the more severe the depression. The spouses were assessed using the SAS and SDS in the 28th week of gestation and three days after delivery,

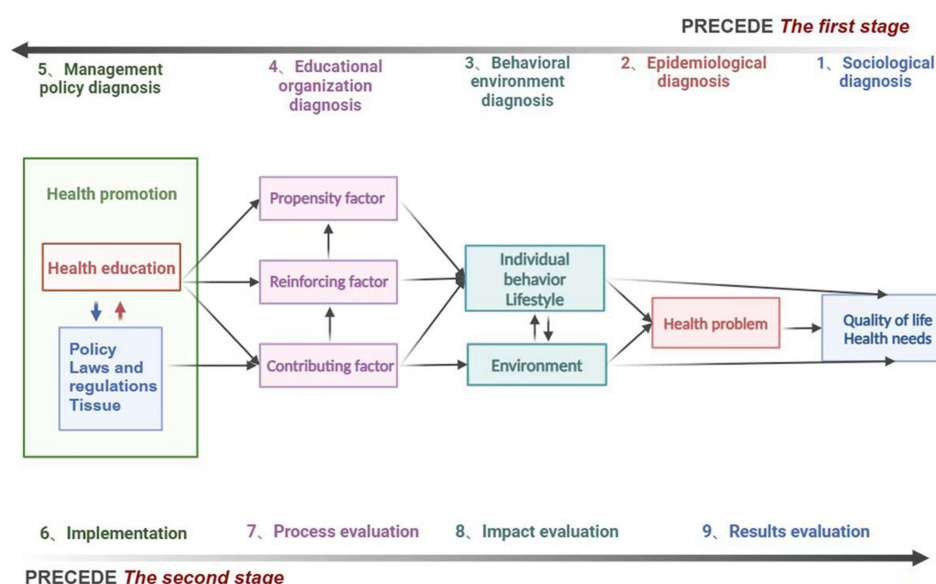


Figure 2 PRECEDE-PROCEED model frame diagram. Color coding: (RGB 134,134,134; 101,21,10; 72,99,146; 136,71,77; 76,101,98; 130,79,132; 48,60,48; 250,252,247; 227,242,239; 111,134,90; 255,247,248; 237,244,252; 254,239,244; 252, 238,238; 237,245,253).

respectively. The health education group based on the PRECEDE-PROCEED model was defined as Group A, while the regular health education group was defined as Group B.

Based on the SAS and SDS scores, patients were considered to be in the negative mood group if they had anxiety and/or depressive symptoms.

Symptom Check List 90 (SCL-90 Score)

This scale was developed by Derogatis L.R. in 1975 based on the Hopkins Symptom Inventory developed by himself.²¹ The scale contains 90 items divided into nine factors; each factor reflects some aspect of symptom distress among the participants of the survey, and the factor scores provide insights into the characteristics of the distribution of symptoms. The score is based on a 1–5 scale and indicates 1: no, 2: mild, 3: moderate, 4: severe, and 5: very severe problems. A higher score indicates a lower level of mental health. The subgrouping of all items in the scale was as follows: somatization (12 items), obsessive-compulsive issues (10 items), interpersonal sensitivity (nine items), depression (13 items), anxiety (10 items), anger-hostility (six items), phobic-anxiety (seven items), paranoid ideation (six items), and psychoticism (10 items). Additionally, seven items were not grouped into any factor and could be treated as a 10th factor, which was not analyzed in this study.

The SCL-90 is a widely used self-assessment scale in the field of mental health around the world and contains several psychiatric symptomatology components, such as thinking, emotion, behavior, interpersonal relationships, and life habits. It is a highly standardized scale and widely used in China. It has good reliability and validity. In this study, the spouses were scored three days after delivery.

Data Collection Related to the Feeding Situation

In this study, the time of first lactation and the lactation volume were measured in the postpartum period, and the feeding mode was recorded. The height, weight, BMI, head circumference, and other data of the infants were collected when they were six months old to assess the relationship of their growth and development with different education modes and feeding modes.

Statistical Analysis

The results and scores for each scale were entered into a computer for score conversion and statistically analyzed using SPSS 26 (IBM SPSS, USA). Continuous data were expressed as the mean \pm standard deviation, and count data were

Table 1 Program of Educational Interventions on the Mental Health of Spouses

Intervention Factor	Intervention Theme	Intervention Content	Interventions
Predisposing factors	Psychological adjustment method guidance	Theoretical teaching	<p>Frequency:</p> <ol style="list-style-type: none"> From the 28th week to the 36th week of gestation, every two weeks, four times; From the 38th week of gestation to the delivery date, once a week. <p>Methods:</p> <p>Theoretical teaching: The research team may prerecord the video to be shown to the participants; each video can be 30–45 min long.</p> <p>Contents:</p> <p>① First lesson:</p> <ul style="list-style-type: none"> Significance of the participation of the father in prenatal education; Importance of the father in parenting; Responsibility and satisfaction that the father can gain in the process of parenting. <p>② Second lesson:</p> <ul style="list-style-type: none"> Changes in the hormones of the parturient during pregnancy and possible emotional changes caused thereby; Importance of the emotional support of the husband for pregnant women. <p>③ Third lesson:</p> <ul style="list-style-type: none"> Affective fluctuations and emotional changes experienced by the father in the process of perceiving fetal growth; Ways to actively cope with the mood swings of the wife during pregnancy; Several common methods of psychological adjustment. <p>④ Fourth lesson:</p> <ul style="list-style-type: none"> Special physiological status of infants; Handling of abnormal conditions in infants; Meaning of breastfeeding and methods of assisting feeding.
		Personalized Guide	<p>Frequency:</p> <ol style="list-style-type: none"> From the 28th week to the 36th week of gestation, every two weeks, four times; From the 38th week of gestation to the delivery date, once a week. <p>Methods:</p> <ol style="list-style-type: none"> Online group meeting and offline practical operation; Online guidance. <p>Content:</p> <ol style="list-style-type: none"> After the course, question and answer sessions may be conducted at any time in the group; A small test may be conducted to give personalized guidance to those with poor test results in terms of their mastery and existing problems. <p>Offline guidance:</p> <p>Questions may be answered offline after each maternal prenatal examination or each lecture (organized about once every two weeks), and psychological adjustment can be performed on the spot for the actual operation. Personalized guidance may be provided according to the different psychological states and emotional distress of each individual.</p>
	Self-Role Cognition	Correct cognitive biases and promote role shifts	<p>Frequency: 37 weeks of gestation, once.</p> <p>Methods:</p> <ol style="list-style-type: none"> Theoretical lecture: (45–60 min)/session; lecture can be conducted on the content of father role self-definition, role adaptation, and role significance; Sharing relevant articles and forums to induce substitution role conversion.

(Continued)

Table I (Continued).

Intervention Factor	Intervention Theme	Intervention Content	Interventions
Contributing Factors	Harnessing social resources	Multidimensional path	<p>(1) Spouses can be asked to pay attention to public organizations, such as “Maternal and Child Health Care Association of China”, “Jianxin has me” and “National Defense Mind”, to facilitate them to obtain authoritative maternal health care information and information on emotional changes and regulation methods;</p> <p>(2) A WeChat group may be established known as “Novice Bao Dad Classroom”, a public number may be obtained for the WeChat group, and the content of each lecture can be released to the group and public number. The public number may have a message board for spouses to leave messages at any time, which can help novice fathers learn from each other and discuss various issues. For questions and feedback, team members may add knowledge to push regularly;</p> <p>(3) The curriculum may be uploaded to the public platform of the hospital network;</p> <p>(4) The curriculum can be played irregularly on the electronic transmission screen of the department;</p> <p>(5) The curriculum can be converted into a QR code and placed on the health education publicity bar of the outpatient clinic and ward;</p> <p>(6) Spouses having any questions while studying or parenting may text or call team members on WeChat during working hours, and team members can provide help or answers on time.</p>
Reinforcing factors	Continued behavioral surveillance	Discharge Follow-up	<p>Frequency: Once every two weeks, three times in total.</p> <p>Methods: WeChat or telephone follow-up or email: (10–20 min)/session.</p> <p>Content: 1. The spouses may be asked about their mental health during the childbearing stage; if necessary, their SAS and SDS scores can be measured again, and the existing problems of the spouse can be recorded; 2. The spouses can be followed up every week for emerging problems, and they can be given mental health education again to provide personalized solutions.</p>
	Peer support	Peer support	<p>Frequency: Any time</p> <p>Methods: WeChat or group talk</p> <p>Content: Communicate with each other within the group to determine psychological and parenting problems.</p>

expressed as frequencies and percentages. The differences between groups were determined by performing *t*-tests and chi-square tests, and the factors influencing the negative emotions of the spouses of primiparous women during puerperium were evaluated by binary logistic regression analysis. All differences were considered to be statistically significant at $p < 0.05$ (two-sided).

Results

Baseline Data

In total, 310 spouses of primiparous women were included in this study. Among them, 87 (55.8%) spouses in Group A showed negative emotions three days after delivery, while 113 (73.4%) spouses in Group B showed negative emotions. The differences between the two groups were not significant in terms of age and negative emotions of the mother, sex of the newborn, mode of delivery, age of the spouse, education level of the spouse, family income, place of residence, whether the pregnancy was planned, whether they participated in prenatal health education, the level of knowledge about infant care, and whether the spouse had paternity leave ($P > 0.05$) (Table 2).

Table 2 Baseline Data of Two Groups

Item	Group A	Group B	χ^2	P
Maternal age				
≥35 years	27(17.3)	21(13.6)	0.798	0.372
<35 years	129(82.7)	133(86.4)		
Maternal complicated with negative emotion				
Yes	91(58.3)	89(57.8)	0.009	0.923
No	65(41.7)	65(42.2)		
Newborn sex				
Male	78(50.0)	76(49.4)	0.013	0.909
Female	78(50.0)	78(50.6)		
Method of delivery				
Vaginal birth	106(67.9)	94(61.0)	1.616	0.204
Cesarean section	50(32.1)	60(39.0)		
Spouse age				
≥35 years	35(22.4)	35(22.7)	0.004	0.951
<35 years	121(77.6)	119(77.3)		
Spouse education level				
Below high school	79(50.6)	76(49.4)	0.052	0.820
High school and above	77(49.4)	78(50.6)		
Household income				
≥7000 yuan	91(58.3)	100(64.9)	1.428	0.232
<7000 yuan	65(41.7)	54(35.1)		
Address				
Countryside	76(48.7)	77(50.0)	0.051	0.821
City	80(51.3)	77(50.0)		
Planned pregnancy				
Yes	79(50.6)	76(49.4)	0.052	0.820
No	77(49.4)	78(50.6)		
Attend prenatal health education				
Yes	75(48.1)	70(45.5)	0.214	0.644
No	81(51.9)	84(54.5)		
Infant care information Mastery level				
Proficiency	58(37.2)	61(39.6)	0.194	0.660
Average	98(62.8)	93(60.4)		

(Continued)

Table 2 (Continued).

Item	Group A	Group B	X ²	P
Paternity leave				
Yes	92(59.0)	95(61.7)	0.238	0.625
No	64(41.0)	59(38.3)		
Postpartum complications				
Yes	46(29.5)	45(29.2)	0.003	0.959
No	110(70.5)	109(70.8)		

Notes: Maternal complicated with negative emotion: SDS (Self-Rating Depression Scale) ≥ 53 scores and (or) SAS (Self-Rating Anxiety Scale) > 50 scores.

Table 3 SAS and SDS Score of Two Groups

Item	SAS of 28 weeks Gestation	SAS of 3 Days Postpartum	SDS of 28 weeks Gestation	SDS of 3 Days Postpartum
Group B	51.16 \pm 7.24	54.31 \pm 7.89	52.01 \pm 10.31	56.30 \pm 6.22
Group A	51.03 \pm 7.51	51.94 \pm 7.84	51.08 \pm 10.64	53.34 \pm 7.36
t	0.156	2.652	0.781	3.821
P	0.876	0.008	0.435	0.000

Abbreviations: SAS: Self-Rating Anxiety Scale; SDS: Self-Rating Depression Scale.

Comparison of the SAS and SDS Scores of the Spouses of Primiparous Women in the 28th Week of Gestation and Three Days Postpartum

The results of independent *t*-tests showed no significant difference in SAS and SDS scores between the two groups in the 28th week of pregnancy ($P > 0.05$), but the differences between the groups were significant on the third day after delivery ($P < 0.05$). Spouses in Group A had significantly lower SAS and SDS scores than those in Group B (Table 3).

Binary Logistic Regression Analysis of the Negative Emotions of the Spouses

The results of the binary logistic regression analysis showed that several factors, including whether health education was provided, the maternal psychological status, the education level of the spouse, monthly family income, expertise in infant care, and whether there was paternity leave, acted as independent factors for negative emotions among the spouses of puerperal primiparous women (Table 4 and Figure 3).

Table 4 Binary Logistic Regression Analysis of Maternal Spouse' Negative Emotion

Related factor	B	SE	Wald	P	OR	95% CI	
						Upper	Lower
Nursing pattern	0.871	0.628	10.506	0.001	2.390	4.055	1.409
Maternal age(year)	0.040	0.499	0.006	0.936	1.041	2.768	0.391
Maternal complicated with negative emotion	-0.780	0.269	8.411	0.004	0.458	0.777	0.271
Newborn sex	0.112	0.273	0.169	0.681	1.119	1.910	0.655
Method of delivery	0.233	0.281	0.630	0.427	1.250	2.170	0.720
Spouse age	-0.060	0.429	0.020	0.889	0.942	2.185	0.406
Spouse education level	-0.734	0.269	7.472	0.006	0.480	0.812	0.283
Household income (yuan)	-0.602	0.273	4.879	0.027	0.548	0.934	0.321
Address	0.211	0.278	0.631	0.427	1.247	2.150	0.723
Planned pregnancy	0.397	0.297	1.789	0.181	1.488	2.660	0.831
Attend prenatal health education	-0.359	0.275	1.703	0.192	0.698	1.197	0.407
Infant care information mastery level	-0.653	0.306	4.574	0.032	0.520	0.947	0.286
Paternity leave	-0.795	0.276	8.316	0.004	0.452	0.775	0.263
Postpartum complications	-0.563	0.318	3.124	0.077	0.570	1.063	0.305

Notes: Negative emotion: SDS (Self-Rating Depression Scale) ≥ 53 scores and (or) SAS (Self-Rating Anxiety Scale) > 50 scores.

Abbreviations: SE, standard error; OR, odds ratio; CI, confidence interval.

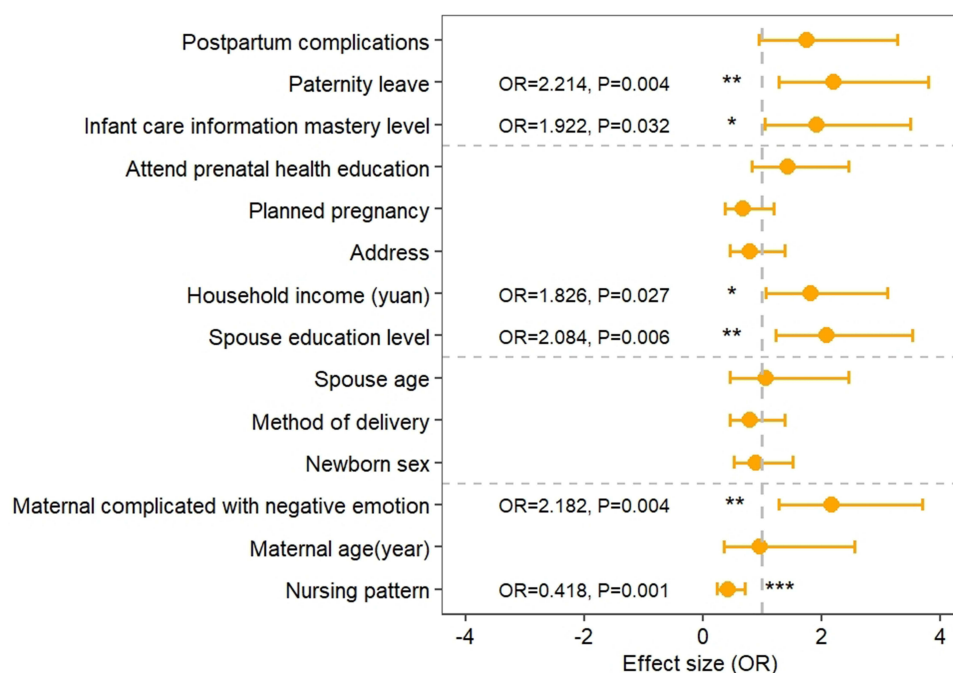


Figure 3 Binary logistic regression analysis of maternal spouse' negative emotion. Color coding: (Orange: RGB 255,153,0; black: RGB 0,0,0).

Comparison of SCL-90 of Spouses with Domestic Norms

The results of independent *t*-tests showed that somatization, interpersonal sensitivity, depression, anxiety, and total points in the SCL-90 (symptom checklist 90) scale of the spouses of primiparous women in Group A were significantly lower than those of the spouses of primiparous women in Group B ($P < 0.05$). However, the scores of somatization, depression, anxiety, phobic anxiety, and total points in Groups A and B were significantly higher than those of the domestic norm ($P < 0.05$). Additionally, the scores in terms of interpersonal sensitivity in Group A were also significantly higher than the domestic norm ($P < 0.05$) (Table 5).

Table 5 Comparison of SCL-90 of Spouses with Domestic Norms

Item	Group B (n=154)	Group A (n=156)	Domestic Norms (n=1388)	t1	t2	t3	P ₁	P ₂	P ₃
Somatization	1.74±0.73	1.41±0.63	1.37±0.48	4.258	8.536	8.580	0.000	0.000	0.000
Obsessive-compulsive	1.69±0.68	1.63±0.66	1.62±0.58	0.703	1.395	0.182	0.483	0.163	0.856
Interpersonal sensitivity	1.84±0.79	1.63±0.80	1.65±0.61	2.334	3.550	-0.303	0.020	0.000	0.763
Depression	2.03±0.85	1.80±0.84	1.50±0.59	2.347	10.053	0.598	0.020	0.000	0.000
Anxiety	2.11±0.86	1.76±0.76	1.39±0.43	3.849	17.303	9.250	0.000	0.000	0.000
Anger-hostility	1.52±0.55	1.49±0.56	1.46±0.55	0.511	1.284	0.636	0.610	0.199	0.526
Phobic-anxiety	1.41±0.60	1.44±0.59	1.23±0.41	-0.490	4.899	0.576	0.625	0.000	0.000
Paranoid ideation	1.49±0.56	1.46±0.57	1.43±0.57	0.495	1.241	0.623	0.621	0.215	0.534
Psychoticism	1.32±0.57	1.31±0.54	1.29±0.42	0.167	0.634	0.448	0.867	0.527	0.655
Total points	1.68±0.23	1.55±0.21	1.44±0.49	5.442	6.004	2.775	0.000	0.000	0.006

Notes: SCL-90: Symptom Check List 90; P₁: Compare with Group A and Group B; P₂: Compare with Group A and domestic norms; P₃: Compare with Group B and domestic norms.

Comparison of Breastfeeding and Growth of Children Between the Two Groups

The results of the chi-square test showed that 98 children (62.8%) in Group A and 87 children (56.5%) in Group B were exclusively breastfed. The difference in the feeding methods between the two groups was not significant ($P > 0.05$). The results of independent t -tests showed that the onset time of lactation in Group A was significantly shorter than that in Group B, and the three-day lactation volume in Group A was significantly higher than that in Group B ($P < 0.05$). After six months, infants in Group A were also significantly taller and heavier than those in Group B ($P < 0.05$) (Table 6).

The Growth of Children Under Different Feeding Regimens

The results of independent t -tests showed that among exclusively breastfed infants, infants in Group A were significantly heavier than those in Group B ($P < 0.05$); among mixed-fed infants, infants in Group A were significantly heavier than those in Group B ($P < 0.05$). In the exclusively breastfed group, the difference in growth between the two groups of infants was not significant ($P > 0.05$) (Table 7).

Table 6 Comparison of Breast-Feeding and Growth of Children Between the Two Groups

Item	Group A	Group B	t/X ²	P
Breastfeeding situation				
Exclusive breast milk	98(62.8)	87(56.5)	1.385	0.500
Artificial	48(30.8)	54(35.1)		
Mixed	10(6.4)	13(8.4)		
Lactation start time (days)	3.03±1.61	3.47±1.76	2.337	0.020
3 days postpartum milk production (mL)	155.27±20.85	149.53±18.91	-2.537	0.012
BMI (kg/m ²)	16.62±1.66	16.77±1.88	0.747	0.455
Weight (kg)	7.59±0.57	7.37±0.57	-3.440	0.001
Height (m)	0.68±0.03	0.66±0.03	-3.759	0.000
Head circumference (cm)	43.54±1.33	43.26±1.54	-1.716	0.087

Abbreviation: BMI: Body Mass Index.

Table 7 Comparison of Growth of Children Between the Two Groups Under Different Feeding Patterns

Item		Group A	Group B	t	P
Exclusive breast milk	BMI (kg/m ²)	16.88±1.64	16.75±1.90	-0.374	0.709
	Weight (kg)	7.73±0.54	7.44±0.54	-3.671	0.000
	Height (m)	0.68±0.03	0.67±0.03	-2.231	0.027
	Head circumference (cm)	43.71±1.18	43.49±1.57	-1.091	0.277
Mixed	BMI (kg/m ²)	16.27±1.63	16.86±1.84	1.729	0.087
	Weight (kg)	7.36±0.54	7.26±0.54	-0.909	0.366
	Height (m)	0.67±0.03	0.66±0.03	-3.126	0.002
	Head circumference (cm)	43.27±1.52	43.02±1.48	-0.855	0.394
Artificial	BMI (kg/m ²)	16.09±1.74	16.52±2.06	0.525	0.605
	Weight (kg)	7.28±0.59	7.29±0.82	0.040	0.968
	Height (m)	0.67±0.03	0.67±0.03	-0.738	0.469
	Head circumference (cm)	43.11±1.68	42.72±1.33	-0.629	0.536

Abbreviation: BMI, Body Mass Index.

Discussion

Childbirth causes severe stress among women, especially first-time mothers, who are more likely to have adverse emotional reactions, along with their spouses.²² The mood of the spouse also affects the mother, forming a cycle of negative emotions. Therefore, ways to manage the mental health of the spouses also need to be developed.

In this study, we found that health education based on PRECEDE-PROCEED model can significantly reduce anxiety and depression in spouses and can prevent the development of negative emotions in spouses of puerperal primiparous women. We also found significant differences in somatization symptoms, interpersonal sensitivity, depression, and anxiety factor scores, and total mean scores between the two groups of spouses. These results indicated that health education greatly improved the psychological status of spouses, which occurred probably because of the following reasons: (1) Traditionally, mothers play the dominant role in parenting, which decreases the importance of the father's role. Thus, their parenting participation is low, and their responsibilities and alienation give rise to anxiety and depression.²³ In this study, we implemented a health education intervention program based on the PRECEDE-PROCEED model to provide parenting knowledge and skills to the spouses of primiparous women through multiple paths. We also introduced them to the methods and significance of participating in parenting, used various means to motivate spouses to adapt and assume their role as a father at the earliest, make adequate practical and ideological preparations to take care of postpartum infants, overcome their perception of being "outsiders", improve their participation in parenting, reduce their fear and anxiety of unknown situations, and allow them to better cope with upcoming changes and challenges, which can greatly decrease the sense of anxiety and powerlessness of first-time fathers. (2) Health education based on PRECEDE-PROCEED model usually includes training the spouses of primiparous women on the corresponding psychological support and coping strategies and allows them to deal more effectively with stress and mood swings. This helps reduce the risk of developing anxiety and depression. (3) Through health education, spouses of primigravid women can learn how to better communicate and support their partners. This effective communication can improve the understanding and support between husband and wife and reduce emotional burden. Additionally, this health education system can establish a strong social support network, which can provide emotional support and practical guidance to parturients and their spouses, and also reduce their anxiety and depression. We also found that maternal negative emotions, high education level of the spouse, low family income, low understanding of how to care for infants, lack of paternity leave, and maternal postpartum complications are risk factors for the development of negative emotions in the spouses of primiparous women. This finding matched those of another study,²⁴ in which it was reported that people with high educational levels are more likely to have negative emotions. Highly demanding jobs and those with a lot of responsibilities may be accompanied by status quo, such as prolonged work, stressful work environment, and major occupational decision-making pressures, as well as, no paternity leave. Additionally, people with a high educational level pay special attention to the education problems of children and it has an important impact on the growth of children.²⁵ Fostering a good educational environment often requires a lot of effort and resources, which can greatly challenge the economic condition of the parents. Such an economic burden can also lead to negative emotions in people with a low income.²⁶

In this study, we also found that the somatization symptoms, interpersonal sensitivity, depression, and anxiety factor scores of the spouses who did not receive training and education were significantly higher than the domestic norm. Although the scores of some factors of the spouses who received health education were lower, some of the scores were higher than the domestic norm, and some of them were similar to the domestic norm. This showed that the mental health status of the spouses of primiparous women is generally poor, and their psychological problems are scattered. These problems mainly manifest as somatization symptoms, interpersonal sensitivity, depression, and anxiety, indicating that the spouses are more likely to have physical and psychological problems than the general population. This might be related to an increase in the level of postpartum stress in these men, a decrease in their social activities, lesser social support, introversion of their personality, an increase in sensitivity, emotional instability, and unmet psychological needs; they may also fail to adapt to their roles on time. A recent study suggests that some spouses may not even be aware of the changes in their own psychological status, and have the same perceptual difficulties as pregnant women.²⁷ Nursing staff should pay full attention to the mental health status of primiparous women after delivery, monitor the mental health status of their spouses, implement effective psychological nursing

intervention based on the factors affecting their mental health status, assist them in establishing a healthy and effective coping style, reduce or eliminate their negative emotions, such as anxiety and depression, and promote the health of the mother and child.

The effect of maternal breastfeeding can also strongly affect the growth and development of children, mainly their height and weight. This might occur because there is more protein and less fatty lactose in breast milk, which can be easily absorbed and digested by premature infants, facilitate newborns to obtain more adequate nutrition from breast milk, supplement the nutrients required by the body, and facilitate their growth and development.²⁸ In the breastfeeding period, infants in the health education group also had better growth status than those in the usual care group. This occurred probably because health education allows individuals to understand the importance of breastfeeding, allows parturients to learn how to perform healthy breastfeeding, and improves cooperation. Additionally, the physical health and emotional stability of parturients strongly affect the quantity and quality of breast milk.²⁹ Health education can provide parturients and their spouses with information on physical and mental health problems, and give corresponding measures and psychological counseling on time so that parturients can maintain a better state of physical and mental health, which can help them produce high-quality breast milk.

Limitations

The main shortcoming of this study is that the number of patients included was limited due to the shortage of time and manpower. Additionally, this was a single-center study, and only the short-term effects of breastfeeding on infants were recorded. Thus, multicenter studies need to be conducted and the long-term effects on the growth and development of children need to be monitored.

Conclusion

In this study, we investigated the effect of health education based on PRECEDE-PROCEED model on the psychological status of spouses of puerperal primiparous women, as well as, the risk factors affecting the psychological status of the spouses. Our findings might provide valuable information for the nursing staff to provide postpartum care and reduce stress in the family of primiparous women. This study showed that breastfeeding can contribute to better growth and development of infants.

Ethical Statement

The study was conducted in accordance with the Declaration of Helsinki. The study was approved by Ethics Committee of The Affiliated Wuxi People's Hospital of Nanjing Medical University. Informed consent was obtained from all patients.

Disclosure

The authors have no conflicts of interest to declare.

References

1. Lim G. Perinatal depression. *Curr Opin Anaesthesiol*. 2021;34(3):233–237. doi:10.1097/ACO.0000000000000998
2. Gopalan P, Spada ML, Shenai N, et al. Postpartum Depression-Identifying Risk and Access to Intervention. *Current Psychiat Rep*. 2022;24(12):889–896. doi:10.1007/s11920-022-01392-7
3. Ceriani Cernadas JM. Postpartum depression: risks and early detection. *Archivos Argentinos Pediat*. 2020;118(3):154–155. doi:10.5546/aap.2020.eng.154
4. Eslahi Z, Bahrami N, Allen KA, et al. Spouse's social support in the postpartum period, predictors and its relationship with postpartum depression in a sample of Iranian primiparous women. *Int J Gynaecol Obstet off Organ Int Fed Gynaecol Obstet*. 2021;154(1):24–30. doi:10.1002/ijgo.13488
5. Pérez CF, Brahm MP. Paternal postpartum depression: why is it also important? *Revista Chilena Pediatría*. 2017;88(5):582–585. doi:10.4067/S0370-41062017000500002
6. Ramchandani P, Stein A, Evans J, et al. Paternal depression in the postnatal period and child development: a prospective population study. *Lancet*. 2005;365(9478):2201–2205. doi:10.1016/S0140-6736(05)66778-5
7. Paulson JF, Bazemore SD. Prenatal and postpartum depression in fathers and its association with maternal depression: a meta-analysis. *JAMA*. 2010;303(19):1961–1969. doi:10.1001/jama.2010.605

8. Haile Selassie A International Conference on Population and Development, Cairo 5–13 September 1994 – IAC presence. Newsletter (Inter-African Committee on Traditional Practices Affecting the Health of Women and Children) **1995**;1995(17):19.
9. Greene ME, Singh S, Mehta M, et al. Involving men in reproductive health: contributions to development. *Microscopy Research and Technique*. **2004**;64(5–6):415–434. doi:10.1002/jemt.20100
10. Sapkota S, Kobayashi T, Takase MJM. Husbands' experiences of supporting their wives during childbirth in Nepal. *Midwifery*. **2012**;28(1):45–51. doi:10.1016/j.midw.2010.10.010
11. Francine D, Christine G, Danaë L-B, et al. The role of fathers during breastfeeding. *Midwifery*. **2017**;58:6–12. doi:10.1016/j.midw.2017.12.001
12. Gielen AC, McDonald EM, Gary TL, et al. Using the PRECEDE-PROCEED model to apply health behavior theories. *Health Behav Health Educ*. **2008**;4:407–429.
13. Green LW, Kreuter MW, Green LW, Kreuter MW. *Health Program Planning: An Educational and Ecological Approach*. 4th Edition ed. New York: McGraw-Hill; **2005**.
14. Crosby R, Noar SM. What is a planning model? An introduction to PRECEDE-PROCEED. *J Publ Halth Dentist*. **2011**;71(Suppl 1):S7–15. doi:10.1111/j.1752-7325.2011.00235.x
15. Lübs L, Peplies J, Drell C, et al. Cross-sectional and longitudinal factors influencing physical activity of 65 to 75-year-olds: a pan European cohort study based on the survey of health, ageing and retirement in Europe (SHARE). *BMC Geriatr*. **2018**;18(1):94. doi:10.1186/s12877-018-0781-8
16. Yu L, Tang X, Zhang B, et al. PRECEDE-PROCEED Model Nursing Intervention in Health Education for Parents of Obese Children. *Alternative Therap Health Med*. **2024**;2024:8889.
17. Calano BJD, Cacal MJB, Cal CB, et al. Effectiveness of a community-based health programme on the blood pressure control, adherence and knowledge of adults with hypertension: a PRECEDE-PROCEED model approach. *J Clin Nurs*. **2019**;28(9–10):1879–1888. doi:10.1111/jocn.14787
18. Moshki M, Dehnoalian A, Alami A. Effect of Precede-Proceed Model on Preventive Behaviors for Type 2 Diabetes Mellitus in High-Risk Individuals. *Clin Nurs Res*. **2017**;26(2):241–253. doi:10.1177/1054773815621026
19. Zhu X, Song C, Lu T, Jin M. Proposal and Efficacy of a Nurse-Led Pain Management Model for Neurointensive Care Based on the Precede-Proceed Model. *Comput Math Methods Med*. **2022**;2022:5686433. doi:10.1155/2022/5686433
20. de Jersey SJ, Mallan K, Callaway L, et al. A Cross Sectional Comparison of Predisposing, Reinforcing and Enabling Factors for Lifestyle Health Behaviours and Weight Gain in Healthy and Overweight Pregnant Women. *Maternal Child Health J*. **2017**;21(3):626–635. doi:10.1007/s10995-016-2148-0
21. Derogatis LR, Lipman RS, LJPb C. The SCL-90: an outpatient psychiatric rating scale. *Psychopharmacology Bulletin*. **1973**;9(1):13–28.
22. Huang HH, Lee TY, Lin XT, Duan HY. Maternal Confidence and Parenting Stress of First-Time Mothers in Taiwan: the Impact of Sources and Types of Social Support. *Healthcare*. **2022**;10(5):878. doi:10.3390/healthcare10050878
23. Johansson M, Benderix Y, Svensson I. Mothers' and fathers' lived experiences of postpartum depression and parental stress after childbirth: a qualitative study. *Int J Qualitat Stud Health Well-Being*. **2020**;15(1):1722564. doi:10.1080/17482631.2020.1722564
24. Nguyen AW, Walton QL, Thomas C, et al. Social support from friends and depression among African Americans: the moderating influence of education. *J Affective Disorders*. **2019**;253:1–7. doi:10.1016/j.jad.2019.04.013
25. Andreea S, Andreea S, Georgeta P. The emotional intelligence of today's parents - influences on parenting style and parental competence. *Front Public Health*. **2023**;11:1120994.
26. Heinrich Carolyn J. Parents' employment and children's wellbeing. *Future Child*. **2014**;24(1):121–146. doi:10.1353/foc.2014.0000
27. Kusumawati Y, Widyawati W, Dewi FST. Vulnerable to mental health problems: pregnant women and husband's perception in Surakarta, Indonesia. *Enfermeria Clin*. **2022**;32(5):334–343. doi:10.1016/j.enfcli.2021.12.004
28. Yi DY, Kim SY. Human Breast Milk Composition and Function in Human Health: from Nutritional Components to Microbiome and MicroRNAs. *Nutrients*. **2021**;13(9):3094. doi:10.3390/nu13093094
29. Baumgartel K, Caplan E, Glover C, et al. A Feasibility Study to Assess Sleep and Subsequent Breast Milk Volume Among Mothers With Hospitalized Preterm Infants. *J Perinatal Neonatal Nurs*. **2023**;37(4):295–302. doi:10.1097/JPN.0000000000000657