BMC Psychology

RESEARCH

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Preventing postpartum depression in pregnant women using an app-based health-promoting behaviors program (Pender's health promotion model): a randomized Controlled Trial

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Abstract

Background Depression is a prevalent mood disorder. Women face a heightened risk of depression during pregnancy and after childbirth, which can have negative consequences for both the mother and her family. It is essential to explore preventive strategies.

Objective To assess the impact of education focused on health-promoting behaviors in preventing postpartum depression (PPD) through social messaging among pregnant women.

Methods This randomized controlled trial study involved 108 non-depressed eligible pregnant women with a gestational age of 28–30 weeks during 2022–2023. Participants were randomly assigned to intervention and control groups using a block randomization method. The intervention group received virtual education based on health-promoting behaviors weekly over six sessions. The Edinburgh Postnatal Depression Scale (EPDS), Patient Health Questionnaire-9 (PHQ-9), and Health Promoting Lifestyle Profile II (HPLP II) questionnaires were utilized to evaluate outcomes. Data analysis was performed using SPSS software version 23, with a significance level set at $P < 0.05$.

Results The mean differences between the scores of EPDS, PHQ-9 and HPLP II before and after the intervention in two groups were −4.85 (CI95%= -3.22, -6.48), -6.22 (CI95%= -4.43, -8.00) and 28.22 (CI95%= 23.41, 33.03), respectively, which were statistically significant ($P < 0.001$). The findings regarding the dimensions of health-promoting behaviors also indicated that all dimensions increased significantly in the intervention group. The greatest and least amount of change was observed in the physical activity dimension at 5.50 (CI95%= 4.31, 6.68) and in interpersonal relations at 3.48 (CI95%= 2.24, 4.72), respectively. The number needed to treat (NNT) for depression, based on the Edinburgh questionnaire six weeks postpartum was approximately 2.571, indicating that nearly one in two mothers who received education benefited.

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Conclusion The app-based health-promoting behaviors intervention-benefiting from not requiring in-person referrals and providing a common platform for communication-is effective in enhancing health-promoting behaviors, reducing depression scores and decreasing the frequency of PPD. In other words, this type of intervention led to the prevention of postpartum depression and the promotion of health-promoting behaviors among pregnant women.

Registration The study was retrospectively registered with the IRCT Registry on 31/05/2024 (registration number: IRCT20221109056451N2).

Keywords Education, Electronic health, Health behavior, Health promotion, Postpartum depression

Introduction

In recent years, there has been growing concern about depression in various populations, including pregnant women. The significant changes experienced by women during pregnancy can lead to a range of psychological problems [1]. During the postpartum period, mothers are more vulnerable to emotional and mood disorders, including depression, due to factors such as hormonal fluctuations (a decrease in estrogen and progesterone levels), lifestyle changes, psychosocial influences, sleep disturbances and stress related to baby care [2]. Despite the numerous concerns for mothers during this time, postpartum depression and its clinical management strategies remain unresolved issues [3].

Postpartum depression is the most common mental health problem associated with childbirth, typically beginning four to six weeks after delivery [3, 4]. The global prevalence of postpartum depression in mothers is reported to be 17.22%, with rates of 25% in developing countries and 25.3% in Iran. Within specific subgroups, such as unintended pregnancy, illiteracy, housewives, and a history of depression, the prevalence rates are reported to be 43.4%, 31.6%, 30.7%, and 45.2%, respectively [5–8]. Postpartum depression can have various negative effects on both the mother and her infant, including an increased risk of serious health and social problems, growth disorders, difficulties with breastfeeding, strained mother-child relationships [9], and long-term impacts on emotional, cognitive, and behavioral child development [10]. Additionally, it can reduce the quality of life for mothers [11] and delay language and personal-social skills in children [12, 13]. The results of a systematic review study showed that postpartum depression increases the likelihood of malnutrition (stunting and underweight), common infant diseases, and non-exclusive breastfeeding [14].

Given the prevalence and negative consequences of postpartum depression, it is essential to consider preventive strategies from a public health perspective [15]. Numerous studies have been conducted aimed at developing preventive strategies for postpartum depression. Beydokhti et al. (2021) reported that the prevalence of depression was significantly lower in the group that received an educational-counseling intervention [16]. However, the results of another study by McCarter-Spaulding et al. suggest that education provided by nurses at the time of hospital discharge did not reduce depression scores [17]. A systematic review conducted in 2022 indicated that psychological interventions have very limited effectiveness in preventing postpartum depression in non-depressed women. More clinical trials with low bias risk and more effective interventions are needed [18].

Mental health and lifestyle share a reciprocal relationship, where mental health is fostered through a healthy lifestyle, and conversely, a healthy lifestyle is supported by mental health [19, 20]. Lifestyles encompass the awareness, attitudes, and behaviors related to health in individuals or groups [21]. A health-promoting lifestyle consists of six dimensions: nutrition, physical activity, spiritual growth, stress management, interpersonal relationships, and health responsibility [22]. Theorists assert that a health-promoting lifestyle positively impacts an individual's quality of life and can even prevent and treat various physical and mental issues [22, 23]. The Pender Health Promotion Model is one of the oldest comprehensive frameworks used to predict health-promoting behaviors [24].

Pender's Health Promotion Model, a widely used framework in nursing research, organizes health promotion into three key areas: individual characteristics and experiences (including past behaviors and personal attributes); behavior-specific cognitions and affect (such as perceived benefits, self-efficacy, perceived barriers, feelings, and interpersonal/situational influences); and behavioral outcomes (the commitment and execution of health behaviors, influenced by competing demands and preferences) [24]. This model, suitable for intervention, ultimately seeks to encourage healthy behaviors [25]. Given that the Pender Health Promotion Model has been applied in various populations and has proven effective in addressing certain psychological issues [26], this study selected this model as an intervention method to evaluate its efficacy in preventing postpartum depression.

On the other hand, smartphone technology is regarded as a valuable tool for disseminating health information, offering psychological education, and facilitating interactions through text messages or mutual communication

between patients and healthcare professionals. There is also evidence indicating that remote communication between patients and healthcare providers in mobile health programs is flexible, cost-effective, and particularly advantageous for individuals who encounter barriers in accessing health services due to time and location constraints [27]. Therefore, recognizing the significance of preventing postpartum depression and selecting the most effective intervention or approach, this study aimed to assess the impact of health-promoting behaviors education (Pender's health promotion model) on preventing postpartum depression in pregnant women using social messaging platforms.

Materials and methods

Study design and setting

This randomized controlled trial study was conducted between August 2022 and April 2023 on 108 eligible pregnant women who referred to prenatal clinics related the teaching hospitals in Babol (North of Iran). The Research Ethics Committee of Babol University of Medical Sciences approved this study (code: IR.MUBABOL.HRI.REC.1401.094). The current study was registered retrospectively (IRCT20221109056451N2). Necessary permissions were obtained from the clinics' management prior the data collection. Women participated voluntary and were assured that their data would remain anonymous. The purpose of the study was explained to the women and written informed consent was obtained from them after the interview. All methods were conducted in accordance with the relevant guideline and the ethical standards of the declaration of Helsinki.

The sample size was determined based on the study by Sanaati et al. [28], considering the comparison of means, standard deviation differences, a 95% confidence interval, a study power of 80%, an effect size of 0.42 from a similar study, and a correlation coefficient of 0.59 using G-power software version 3. The calculated sample size was 94 participants. Considering a 10% dropout rate, the final sample size was determined to be 108 participants (54 women in each group).

Study participants and sampling

Participants were recruited using convenience sampling based on the inclusion criteria. Written informed consent was obtained after participants were informed about the study objectives. They were then assigned to either the intervention or control groups according to a random block allocation protocol with a 1:1 ratio (generated by random allocation software). The study's dropout rate was 2.8% (1 woman in the intervention group and 2 women in the control group; Fig. 1).

The inclusion criteria for participation in the study were as follows: gestational age of 28–30 weeks, low-risk pregnancy (no chronic diseases, no pregnancy complications such as gestational diabetes or preeclampsia), ability to read and write, no history of infertility or use of assisted reproductive technologies, no history of abnormal fetus or child, no addiction or habitual use of alcohol and drugs (according to the mother's personal statements), no history of depression or psychiatric hospitalization (according to the mother's personal statements), an Edinburgh score of less than 12, possession of a smartphone, and at least one social messenger such as WhatsApp or Eitaa, along with a willingness to participate in the study. The exclusion criteria included preterm birth, loss of close relatives during the study, divorce or other severe emotional problems during the study, unwillingness to participate at any stage of the study, and incomplete questionnaires in the follow-up stages of the study.

Data collection tool and measurement

The data was collected using four questionnaires: demographic and fertility information questionnaire, Edinburgh postnatal depression scale (EPDS), patient health questionnaire-9 (PHQ-9) and health-promoting lifestyle profile II (HPLP II). Prior to the intervention, the questionnaires were completed through face-to-face interviews at prenatal clinics by the researcher. Following the intervention, due to limited in-person access to participants, the questionnaires were completed by the researcher via telephone calls.

The demographic and fertility information questionnaire includes questions such as age, education level, spouse's education level, occupation, spouse's occupation, family income status, height, weight, pre-pregnancy body mass index (BMI), number of gravidity and parity, history of abortion, gestational age, planning status of pregnancy, sources of health information, number of received prenatal cares, type of delivery, gestational age at childbirth, received postpartum cares and its number, participation in childbirth preparation classes and the number of sessions attended until the end of pregnancy.

The Edinburgh Postnatal Depression Scale was developed by Cox and colleagues in 1978 and revised in 1994 [29]. This tool consists of 10 multiple-choice questions, that options arranged from low to high intensity for some questions (questions 1, 2 and 4) and from high to low intensity for others (questions 3 and 5 to 10). Each question has a score ranging from 0 to 3, resulting in a total score that varies from 0 to 30. Individuals select the responses that reflect their feelings over the past week. Different cutoff points have been reported for various cultures and languages, with a cutoff point of 12 being considered for the Persian language version of this questionnaire [30]. The validity of this questionnaire has been assessed in Iran by Montazeri et al., who reported a Cronbach's alpha of 0.86 [31].

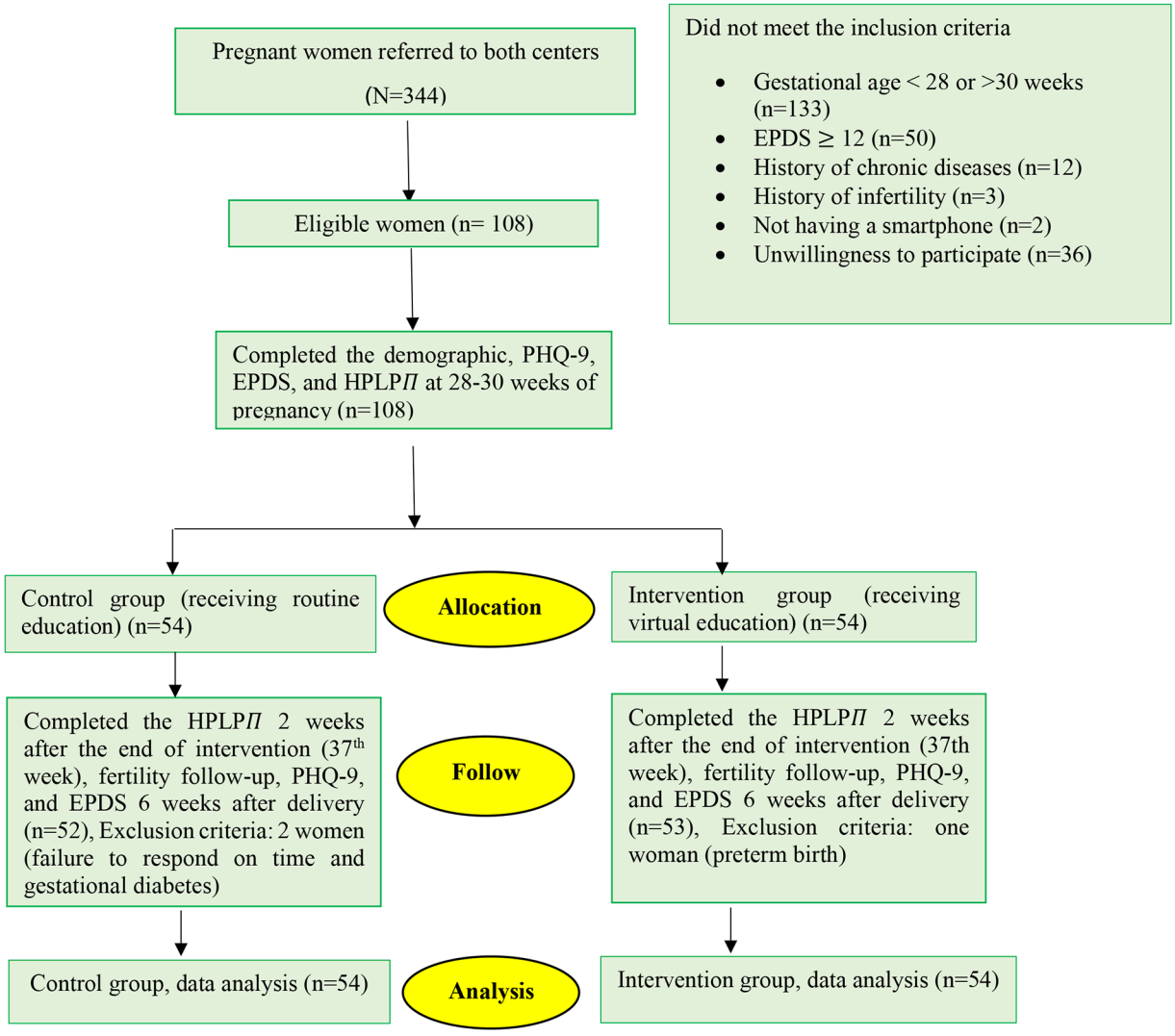

Fig. 1 Selection of the study sample Algorithm

The Patient Health Questionnaire is a survey consisting of 9 questions that individuals answer based on their condition over the past two weeks. The score range of this questionnaire varies from 0 to 27. Each item's score can be zero (not at all), one (some days), two (more than half of the days), or three (nearly every day). Dadfar et al. reported a Cronbach's alpha of 0.88 and a test-retest reliability of 0.79 for this questionnaire [32].

The Health-Promoting Lifestyle Profile *Π* comprises 52 questions across six dimensions. The score range for this questionnaire varies from 52 to 208. It employs a Likert-type response scale with scores from 1 to 4, representing the options of never, sometimes, often, and always [33]. The total scores from this questionnaire are categorized into four levels: poor for the range of 52–90, moderate for 91–129, good for 130–168, and excellent for 169–208 [34]. Mohammad Zeidi et al. confirmed the validity of this questionnaire with a Cronbach's alpha of 0.82 [35].

Intervention

In the intervention group, in addition to receiving routine prenatal and postpartum education based on national guidelines [36], educational content based on the six dimensions of health-promoting behaviors was provided to the pregnant women as PDF and audio files on a specific day and time chosen by the mothers. The educational content was sent starting from the 30th week of pregnancy and continued for six weeks. Two days after each educational session was sent, the researcher confirmed receipt and review of the educational material by checking the seen status on WhatsApp and Eitaa (√√) and sending a follow-up text message. Participants were also encouraged to ask questions and receive answers.

The educational content based on the six dimensions of health-promoting behaviors include nutrition, physical activity, stress management, health responsibility, spiritual growth, and interpersonal relations (Table 1). The educational content was developed in accordance with the guidelines set forth by the Ministry of Health and Medicine of Iran, the World Health Organization (WHO), the Centers for Disease Control and Prevention, authoritative texts, and relevant articles. The credibility of the content was validated by the research team members, which included faculty members from Babol University of Medical Sciences holding PhDs in reproductive health and women's health, as well as a master's student in midwifery counseling.

The control group received only the standard prenatal and postpartum education based on national guidelines. The HPLP questionnaire was administered two weeks after the intervention concluded. The EPDS, PHQ-9, and follow-up fertility variables were assessed six weeks after childbirth (Fig. 1).

Statistical analysis

Descriptive statistical analysis of participants' data was reported using measures of mean, standard deviation, or number and percentage. Analytical statistical analysis included paired t-tests, t-tests, chi-square tests, and Fisher's exact tests. An ANCOVA test was also conducted to compare the questionnaire scores after the intervention in both groups, considering the scores before the intervention and baseline variables. The analyses were performed using SPSS version 23, with a significance level of $P < 0.05$ considered. All data were analyzed with an intention-to-treat approach.

Results

The mean age and standard deviation of the pregnant women participating in the study were 28.71 ± 5.70 years. The two groups were relatively similar in terms of demographic variables and did not exhibit statistically significant differences (Table 2). Among the fertility variables assessed in both groups, significant differences were observed only in the variables of parity, postpartum care, and the number of received postpartum care, which were included in the ANCOVA model (Table 3). The scores of EPDS, PHQ-9, HPLP II, and its dimensions did not show a statistically significant difference between the two groups before the intervention. The findings after the intervention, based on effect size, indicate that the educational intervention focused on health-promoting behaviors resulted in a decrease of 4.85 points in PHQ-9, a decrease of 6.22 points in EPDS and an increase of 28.22 points in the total score of HPLP*II* (Table 4).

The prevalence of postpartum depression, as measured by the EPDS and PHQ-9, was 7.4% and 3.7% in the intervention group, compared to 46.3% and 27.8% in the control group. These differences were statistically significant between the two groups. The index of number needed to treat (NNT) — the most applicable index for assessing intervention effectiveness — for depression was calculated using the website https://www.medcalc.org/calc/relative_risk.php. The NNT for depression, according to the Edinburgh questionnaire six weeks after delivery, was approximately 2.571, indicating that nearly one in two mothers who received education benefited.

Finally, after adjusting for baseline variables through an analysis of covariance and comparing the post-intervention scores between the two groups, while considering the partial differences in pre-intervention scores and other baseline factors, the findings indicate that there were statistically significant differences between the two groups in terms of PHQ-9, EPDS, total HPLP II score, and each dimension of health-promoting behaviors (Table 5).

Discussion

The present study aimed to investigate the effect of an educational intervention based on health-promoting behaviors in preventing postpartum depression using a social messenger. The results indicated that this virtual education intervention, grounded in Pender's model and conducted between 30 and 35 weeks of pregnancy, significantly reduced the mean score of the Edinburgh Postnatal Depression Scale (EPDS), which was the primary outcome of the study. A study closely resembling ours

Table 1 The outline of the educational sessions in the intervention group

Educational sessions	Titles of sessions (Based on health-promoting behaviors' dimensions)
First session	**Introduction**, **nutrition** (the importance of nutrition during pregnancy, main food groups, recommended consumption amount)
Second session	**Physical activity** (definition and importance of physical activity, appropriate exercises and danger signs during physical activity)
Third session	**Stress management** (stress and its complications, strategies for managing stress)
Fourth session	**Health responsibility** (individual responsibilities to maintain and promote health)
Fifth session	**Spiritual growth** (orientation with the spiritual growth concept and exercises for spiritual growth)
Sixth session	**Interpersonal relations** (the importance of establishing correct interpersonal relationships, strengthening interpersonal relationships, self-expression skills)

Table 2 Demographic characteristics of participants in the intervention and control group

Demographic characteristics	Frequency (%)		*P*-value
	Intervention ($n=54$)	Control ($n=54$)	
Age (years)			
≥19	3 (5.6)	1 (1.9)	0.708
20–35	45 (83.3)	46 (85.2)	
>35	6 (11.1)	7 (13.0)	
Level of education			
Elementary/middle school	6 (11.1)	9 (16.7)	0.092
High school/diploma	26 (48.1)	15 (27.8)	
Academic	22 (40.7)	30 (55.6)	
Spouse's level of education			
Elementary/middle school	12 (22.2)	9 (16.7)	0.764
High school/diploma	23 (42.6)	25 (46.3)	
Academic	19 (35.2)	20 (37.0)	
Job			
Employed	6 (11.1)	5 (9.3)	0.750
housewife	48 (88.9)	49 (90.7)	
Spouse's job			
Employee	8 (14.8)	6 (11.1)	0.794
Self-employed	37 (68.5)	40 (74.1)	
Worker	9 (16.7)	8 (14.9)	
Family income			
Sufficient	7 (13.0)	12 (22.2)	0.260
Relatively sufficient	34 (63.0)	26 (48.1)	
Insufficient	13 (24.1)	16 (29.6)	
Body Mass Index (kg/m^2)			
Underweight (< 18.5)	2 (3.7)	1 (1.9)	0.823
Normal (18.5–24.9)	21 (38.9)	25 (46.3)	
Overweight (25-29.9)	21 (38.9)	18 (33.3)	
Obesity≤) 30)	10 (18.5)	10 (18.5)	

was conducted by Sanaati et al., focusing on the effects of lifestyle-based education on depression and anxiety during pregnancy and the postpartum period in three groups of 63 pregnant women and their spouses. The results of this study demonstrated a significant decrease in the EPDS score and anxiety levels in both the couple education and women education groups compared to the control group. Furthermore, the reduction in these scores was also significant in the couple education group compared to the women education group [28]. These findings were consistent with our study. However, the differences between the two studies were that the present study assessed all six main dimensions of health-promoting behaviors. Additionally, the education in the study by Sanaati et al. was conducted through face-to-face sessions, while our study provided virtual education without time and place restrictions, allowing for easier access for mothers and greater flexibility. Other interventional studies have focused on specific dimensions such as physical activity or nutritional interventions, and their results were also consistent with our findings [37–39].

In line with the findings of the present study, which utilized a virtual intervention approach, Zhou et al. reported in their systematic review and meta-analysis that mobile health interventions are effective for preventing and treating postpartum depression [40]. In another study conducted by Seo et al. in South Korea, the effectiveness of a mobile phone program (an eight-week intervention) did not show a difference in postpartum depression between the intervention and control groups [41]. Considering that all the mothers in Seo et al.'s study were depressed, it appears that such interventions alone cannot reduce depression scores in these women.

Given that this study also assessed depression in women using the PHQ-9, data analysis revealed that the mean PHQ-9 scores in the intervention group were significantly lower than those in the control group. Despite searching for articles, no study was found that examined the impact of educational interventions on postpartum depression scores using the PHQ questionnaire. However, Barros et al. conducted a cross-sectional study to investigate the relationship between health behaviors and depression in 65,803 adults aged 18–59 years using the PHQ-9 questionnaire. Their findings indicated a significant relationship between lifestyle factors and depression in Brazilian adults. They recommended the adoption of comprehensive and integrated strategies, considering the association between depression and health behaviors, to reduce early deaths from non-communicable chronic diseases [42].

Table 3 Fertility characteristics of pregnant women in intervention and control groups

Fertility characteristics	Frequency (%)		*P*-value
	Intervention (*n* = 54)	Control (*n* = 54)	
Gravidity			
1	27 (50.0)	16 (29.6)	0.095
2	17 (31.5)	23 (42.6)	
3 and more	10 (18.5)	15 (27.8)	
Parity			
0	32 (59.3)	19 (35.2)	0.033
1	15 (27.8)	27 (50.0)	
2	7 (13.0)	8 (14.8)	
History of abortion			
Yes	8 (14.8)	11 (20.4)	0.448
No	46 (85.2)	43 (79.6)	
Planned pregnancy			
Yes	47 (87.0)	40 (74.1)	0.089
No	7 (13.0)	14 (25.9)	
Number of received prenatal care			
4–8	18 (33.3)	21 (38.9)	0.548
More than 8	36 (66.7)	33 (61.1)	
Participation in childbirth preparation classes			
Yes	21 (38.9)	14 (25.9)	0.150
No	33 (61.1)	40 (74.1)	
Number of sessions for childbirth preparation classes			
≥ 4	9 (42.9)	6 (42.9)	1.000
> 4	12 (57.1)	8 (57.1)	
The most common source of health information			
Ask from doctor and healthcare providers	29 (53.7)	31 (57.4)	0.489
Book, Internet, and social media	24 (44.4)	20 (37.0)	
Experiences of family and friends	1 (1.9)	3 (5.6)	
Gestational age at childbirth (week)*			
Early term (37–38)	26 (48.1)	21 (38.9)	0.549
Full term (39–40)	23 (42.6)	29 (53.7)	
Late term (41–42)	4 (7.4)	4 (7.4)	
Type of delivery			
Vaginal birth	17 (31.5)	23 (42.6)	0.232
Cesarean delivery	37 (68.5)	31 (57.4)	
Received postpartum cares			
Yes	53 (98.1)	46 (85.2)	0.015
No	1 (1.9)	8 (14.8)	
Number of received postpartum cares			
0	1 (1.9)	8 (14.8)	0.027
1	24 (44.4)	26 (48.1)	
2 and more	29 (53.7)	20 (37.0)	

*A case of preterm birth in intervention group

Table 4 Comparison of outcomes' mean differences (net and standardized effect size) between the intervention and control groups before and after intervention

Variables	Mean Difference	Confidence Interval %95	*P*-value	Standardized effect size (CI %95)
PHQ-9[a]	-4.85	-6.48 to -3.22	< 0.001	-1.13 (-1.53 to -0.72)
EPDS[b]	-6.22	-8.00 to -4.43	< 0.001	-1.33 (-1.74 to -0.94)
Total HPLP*II*[c]	28.22	23.41 to 33.03	< 0.001	2.23 (1.75 to 2.71)

[a]PHQ-9: Patient Health Questionnaire-9; [b]EPDS: Edinburgh Postnatal Depression Scale; [c]HPLP: Health-promoting Lifestyle Profile Π

According to the findings of the present study, the prevalence of postpartum depression using the EPDS was 7.4% in the intervention group and 46.3% in the control group. The prevalence using the PHQ-9 (at approximately major and severe levels) was 3.7% in the intervention group and 27.8% in the control group. The difference in the prevalence of postpartum depression can vary depending on the questionnaire used. A study

Table 5 Analysis of covariance of study outcomes by adjusting to baseline variables (scores before the intervention and other variables)

Variables	*P* value* (Effect of intervention)	Adjusted *R* Squared	Effect size	Observed power
PHQ-9[a]	< 0.001	0.43	0.28	1.00
EPDS[b]	< 0.001	0.43	0.36	1.00
Total HPLP*II*[c]	< 0.001	0.78	0.69	1.00
Nutrition	< 0.001	0.66	0.47	1.00
Physical activity	< 0.001	0.71	0.61	1.00
Stress management	< 0.001	0.65	0.53	1.00
Health responsibility	< 0.001	0.65	0.54	1.00
Spiritual growth	< 0.001	0.62	0.48	1.00
Interpersonal relationships	< 0.001	0.57	0.40	1.00

Note: *Based on ANCOVA model (the included variables were: basic value of dependent variable and group type)

[a]PHQ-9: Patient Health Questionnaire-9; [b]EPDS: Edinburgh Postnatal Depression Scale; [c]HPLPΠ: Health-promoting Lifestyle Profile Π

conducted in 2023 reported that the prevalence of postpartum depression before, during, and after the early stages of the COVID-19 epidemic was 36%, 60%, and 42%, respectively [43]. Considering that our study was conducted towards the end of this epidemic, the prevalence of postpartum depression in our study aligns with these findings.

The results of the present study also showed that the virtual educational intervention based on Pender's Health Promotion Model had a significant effect on increasing the mean score of health-promoting behaviors in the intervention group, which is consistent with previous studies conducted [44–46].

Furthermore, the results of this study demonstrated a positive effect across all dimensions of health-promoting behaviors, with physical activity having the greatest impact and interpersonal relationships the least. Several studies have indicated that a healthy lifestyle can provide a protective effect against depression [47]. A study conducted by Zhao et al. revealed a strong link between lifestyle choices and immune and metabolic functions. In other words, an unhealthy lifestyle adversely affects our immune system and metabolism, thereby increasing the likelihood of depression [48]. Therefore, lifestyle factors are recognized as modifiable targets that play a crucial role in addressing the rising prevalence of depression.

The present study has some limitations. Given the nature of the research and the type of intervention, blinding was not feasible. To minimize bias, the statistical analyst was unaware of the group codes. Additionally, the contact numbers of all participants were recorded in a code on a separate SIM card in another phone, ensuring that the researcher would not know the participant group type when completing the follow-up questionnaires. Furthermore, to mitigate the possibility of communication between participants in the two groups, women were instructed not to share educational content with anyone until the study concluded (to prevent information contamination). Moreover, the intervention in this study commenced at the third trimester; it is advisable that future studies initiate earlier and compare the outcomes. Given the effectiveness of this individual educational intervention in preventing postpartum depression, it is recommended to conduct a study comparing individual-based health-promoting behavior education with its group-based approach for time management and optimal educational use.

The strength of this study lies in its comprehensive approach to all dimensions of health-promoting behaviors and the use of two questionnaires to assess depression.

Conclusion

The findings of the current study demonstrated that the educational intervention, which focused on health-promoting behaviors based on Pender's Health Promotion Model using social messenger, had a significant impact on "reducing the mean score of postpartum depression based on EPDS," "reducing the mean score of postpartum depression based on PHQ-9" and "increasing the mean score of HPLPΠ." In other words, this type of intervention led to the prevention of postpartum depression and the promotion of health-promoting behaviors among pregnant women.

Abbreviations

PPD	Postpartum Depression
PHQ-9	Patient Health Questionnaire 9
EPDS	Edinburgh Postnatal Depression Scale
HPLPΠ	Health-promoting Lifestyle ProfileΠ
NNT	Number needed to treat
BMI	Body Mass Index

Acknowledgements

This work has extracted from the thesis related to Master's Degree of midwifery counseling was supported by Babol University of Medical Sciences. The authors hereby thank the honorable Research Vice-Chancellor of Babol University of Medical Sciences, the staff of the prenatal clinics and the pregnant women who participated in the study.

Author contributions

NR and FB conceptualized the study. NR, FB, MA and HN contributed to the design of the research. Data collection was carried out by NR. HN and NR analyzed the data. All authors read and approved the final manuscript to publish.

Funding

This study was supported by Babol University of Medical Sciences. This research did not receive external funding.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethical approval and consent to participate

This study was conducted after obtaining the ethical code (IR.MUBABOL.HRI.REC.1401.094) from the Ethics Committee of Babol University of Medical Sciences. We also adhered to ethical considerations, such as obtaining written informed consent, explaining the study objectives to participants before their involvement, maintaining the confidentiality of research information and allowing participants to withdraw from the study at any time.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 4 December 2023 / Accepted: 26 February 2025
Published online: 13 March 2025

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