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Investigating the relationship between anxiety and perceived stress with coping strategies adopted in pregnant women during the COVID-19 pandemic

Fatemeh Shabani [1], Seyedeh Hajar Sharami [1]*, Roya Faraji [1], Habib Eslami-Kenarsari [2], Asiyeh Namazi [3]

[1] Reproductive Health Research Center, Department of Obstetrics & Gynecology, Al-zahra Hospital, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran

[2] Vice-Chancellorship of Research and Technology, Guilan University of Medical Science, Rasht, Iran

[3] Midwifery Department, Rasht branch, Islamic Azad University, Rasht, Iran

Abstract

Introduction: The COVID-19 pandemic has led to mental problems, including stress and anxiety, for people, especially pregnant women. Identifying strategies to deal with stress is important and can help pregnant mothers to adapt to stressful life factors such as the conditions of the COVID-19 pandemic. The present study was designed and implemented with the aim of investigating the relationship between anxiety and perceived- stress with the coping strategies of pregnant women referring to Al-Zahra Hospital in Rasht.

Methods: The current study was conducted on 221 pregnant women using a cross-sectional analysis method. The required information was collected by the self-report method through demographic questionnaires, Corona disease anxiety (CDAS), Cohen's perceived stress, and Endler and Parker's coping strategies questionnaire. Data were analyzed using SPSS version 22 software using Spearman's correlation coefficient and linear regression tests. The significance level of the tests was considered as $P < 0.05$.

Results: 53.4% of women had moderate anxiety and 60.6% of pregnant women had high levels of perceived stress. There was a direct and significant correlation between anxiety-perceived stress and emotion-focused strategy ($P<0.001$).

Conclusion: The present study showed high perceived stress and moderate anxiety in pregnant women during the COVID-19 pandemic and their relationship with emotion-focused coping strategies.

Keywords: Coping strategies, Anxiety, Perceived stress, Self-care, Coronavirus

Corresponding Authors: Seyedeh Hajar Sharami

✉ Email: sharami@gums.ac.ir

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Introduction

COVID-19 is a new respiratory disease that is spreading rapidly worldwide the world and was declared a pandemic by the World Health Organization on March 11, 2020 (1). In addition to physical complications (2) and mortality, the COVID-19 pandemic also causes psychological disorders in members of society (3) and especially in pregnant women (4). The mental health of women, especially pregnant women, is crucial due to their role in the family. Studies have shown that during the COVID-19 pandemic, women are experiencing higher rates of anxiety, depression, and stress compared to men (5-7). Due to physiological and psychological changes during pregnancy, this period is one of the most sensitive stages of a woman's life. These changes in pregnant women lead to the induction of great changes, including physiological and psychological changes, which cause the emergence of psychopathological disorders, including stress and anxiety (8).

Mood and anxiety disorders are among the most common problems during pregnancy, which is why half of pregnant women experience pregnancy-specific anxiety (9). With the Prevalence of infectious diseases, such as the stressful conditions during the COVID-19 pandemic and the changes created due to the existing conditions, widespread anxiety disorders during pregnancy have intensified so that in pregnant women, symptoms of anxiety (57%) and depression (37%) compared to the period before Corona shows an increase (10, 11). Despite the prevalence of corona disease, fear and stress in pregnant women due to the fear of infection and transmission to the fetus have caused excessive and obvious anxiety with negative psychological effects in this vulnerable group (12). Due to physiological changes, these worries increase in the first and third trimester compared to the second trimester (13, 14). During the COVID-19 pandemic, pregnant women in the first trimester reported increased stress at work, increased stress from home, and greater feelings of anxiety than pregnant women in the second and third trimesters. In addition, pregnant women in the second trimester of pregnancy felt more helpless than pregnant women in the first and third trimesters of pregnancy (13). The stress hormone cortisol, along with the release of inflammatory markers like cytokines, can lead to negative consequences for both mother and fetus due to elevated levels of these chemicals (15).

The negative effects of maternal anxiety and stress during pregnancy lead to complications such as postpartum depression and mood disorders (16), preeclampsia, pregnancy-related nausea and vomiting, increased blood pressure, and increased number of unplanned cesarean section. Furthermore, due to the increase of glucocorticoids, their negative effects on the fetus include weight loss, increased fetal birth defects, infant mortality (17, 18), as well as fetal and neonatal complications such as premature delivery (19, 20), low birth weight, low Apgar score, neonatal abnormalities such as cleft palate, hospitalization, and developmental delay. These babies often have symptoms such as severe bloating and heart pain, insomnia at night, and constant crying (21-23). Although studies show that fear and anxiety caused by the illness can increase preventive behaviors in a person, fear and anxiety related to the disease are are directly related to psychological problems (9, 24). The World Health Organization announced in 2014 that mental disorders in women not only affect the individual, but also their children and other family members, and thus the society, as well as future generations in economic planning (25).

Coping is a person's first reaction to stressful events (26). Interestingly, some research suggests that coping can also moderate the effects of stress on mental health (27, 28). But many studies indicate the relationship of coping strategies with mental health consequences during the COVID-19 pandemic (9, 11, 23, 29, 30). Therefore, it is important to identify stress coping strategies and it can help pregnant mothers to adapt to the stressful factors of life, especially the existing conditions affecting the COVID-19 disease. There are three types of coping strategies: Problem-focused strategy, emotional-focused strategy, and avoidance coping strategy (31, 32). In Problem-focused strategy, the person tries to manage or modify the stressful situation, and this type of coping is useful when faced with a controllable stressor (33). People who use problem-based coping reduce their stress levels by gathering available information to deal with the stressor (18, 34). The more problem-focused coping strategies a person uses, the better their mental health

and the less anxiety and worry they display, and vice versa. Problem-focused coping strategies are associated with more coping, and emotion-focused coping strategies are associated with less coping (35, 36). Avoidant and emotion-focused coping strategies act as mediators through which experiences of COVID-19 is indirectly related to mental health during pregnancy (9, 23).

Prior to the COVID-19 pandemic, a study was conducted on a group of pregnant women which revealed that avoidant coping strategies such as refusal, non-involvement, and self-blame were associated with an increased risk of mental health issues. On the other hand, emotion-focused coping strategies were found to be less associated with mental health issues, while problem-focused coping strategies were not found to be related to mental wellbeing issues. In a recent study conducted on non-pregnant women prior to the outbreak, it was found that maladaptive coping strategies such as avoidance were associated with increased levels of stress and anxiety. During outbreaks, these maladaptive coping strategies were found to be associated with even higher levels of stress and anxiety (8, 9, 29). It seems that when faced with stressors that are beyond our control, utilizing emotion-focused coping strategies proves to be more effective. On the other hand, when dealing with situations that we have some level of control over, employing problem-focused coping strategies tends to yield better results (37). The mental health of pregnant women is a high-risk concern in society, especially during stressful conditions such as the coronavirus pandemic. Effective interventions can be taken to reduce stress by adopting coping strategies and eliminating inappropriate solutions. By understanding the coping strategies adopted by pregnant women in the face of perceived anxiety and stress, necessary interventions can be implemented to improve their mental health. Due to the scarcity of studies related to coping strategies during pregnancy, this study aims to investigate the relationship between perceived anxiety and stress and coping strategies adopted by pregnant women, highlighting the importance and necessity of this topic.

Methods

This cross-sectional analytical study was conducted after receiving the code of Guilan University of Medical Sciences from June to September 2022 and with a random sampling of 221 pregnant women referred to the educational-therapeutic center of Al-Zahra Hospital in Rasht. To be considered for the study, patients must have singleton pregnancies, have ultrasound confirmation at 8 weeks, basic literacy level or above, know the Persian language, consent to participate in the application process, and meet certain conditions such as substance abuse risk factors. Patients who have had physical illness, undergone medical consultations or had experienced significant stress in the last six months (such as a loved one's divorce or death), were not willing to cooperate with others, and completed the questionnaire unfinished..

Method of determining sample size

The sample size was obtained using the study of Basharpoor et al (38) and the study of Masjoudi et al (24) The initial sample size was obtained from the following formula, but the questionnaires were given to 256 pregnant women in this study.

$$N = \frac{\left(z_{1-\alpha} + z_{1-\beta}\right)^2}{\left(\frac{1}{2} Ln \frac{1+\rho}{1-\rho}\right)^2} + 3 = 98$$

$$\alpha = 0.05 \quad \beta = 0.05 \quad \rho = 0.25$$

Measures

1. **Demographic information questionnaire**: personal, social, midwifery profile questionnaire which is a questionnaire of 23 questions made by the researcher, 12 questions about age, education, occupation, level of education of spouse, occupation of a spouse, number of pregnancies, history of abortion, amount of income Household, residence status, covered by health insurance, current week of pregnancy and additionally, there are 11 questions addressing potential risk factors in the individual, including contact with a COVID-19 patient, smoking, and hookah usage, among others.

2. **COVID-19 Anxiety Scale (CDAS**): This questionnaire was prepared and validated to measure anxiety during the Corona era in Iran and has 18 items and 2 components (factors) regarding anxiety. Items 1 to 9 measure psychological symptoms and items 10 to 18 measure physical symptoms. The instrument is rated

on a 4-degree Likert scale (never = 0, sometimes = 1, most of the time = 2, and always = 3). Therefore, the highest and lowest scores that respondents get in this questionnaire are between 0 and 54. High scores indicate a high level of anxiety in individuals. The total CDAS score was divided into 0–16 (mild), 17–29 (moderate), and 30–54 (severe). The reliability of this tool was obtained using Cronbach's alpha method for the cause of psychological symptoms (0.879) and physical symptoms (0.861) of the total questionnaire (0.919) (39).

3. Cohen's Perceived Stress Scale (PSS): 14-item version was used in this research. This scale is a self-report tool consisting of 14 items that was developed by Cohen, Kamarck & and Mermelstein in 1983 in order to know how individuals evaluate their difficult and exhausting experiences. In this scale, individuals are asked to indicate on a five-point scale from 0 (never) to 4 (very much) how they often felt during the last 10 weeks. In this scale, after reverse scoring the items 4, 5, 6, 7, 9, 10, and 13, a total score is obtained by summing up the scores of all items for each person. On this scale, the minimum and maximum scores are 0 to 56. The higher the score, the higher the score. It means more perceived stress. In the study of Cohen et al. (1983), the internal consistency coefficients for each of the subscales and the overall score were between 0.84 and 0.86 (40). This questionnaire was developed in Iran by Safaei and Shokri. , with the translation and construct validity and convergent validity being confirmed. Furthermore, the reliability of the survey was assessed and found to be appropriate, with a value of 0.84 (41).

"4. "Endler" and "Parker" Coping Strategies Questionnaire: The Coping Strategies Questionnaire developed by Endler and Parker (1990) is comprised of 45 items that utilize the Likert method to determine responses ranging from never (1) to always (5). The questionnaire is divided into three main areas of coping behaviors, with each area containing 15 questions. These areas include problem-focused coping, emotion-focused coping, and avoidant coping. Problem-focused coping involves actively managing and solving the problem, while emotion-focused coping focuses on emotional responses to the problem, and avoidant coping involves running away from the problem. The scoring system for this questionnaire is based on a 5-point Likert scale, with a maximum score of 5 and a minimum score of 1 for each subject. The score for each of the three coping behaviors ranges from 15 to 75, with the behavior that receives the highest score being considered the person's primary coping strategy. The total score for the coping strategy ranges from 45 to 225 (42). Qureshi Rad et al. conducted the validation of this scale, yielding a correlation coefficient of 0.84 and Cronbach's alpha of 0.83 for the overall scale. Additionally, the subscales of problem-focused, emotion-focused, avoidance, and social orientation demonstrated correlation coefficients of 0.86, 0.81, 0.79, and 0.69, respectively. The coping strategy in this study was operationally defined as the total score obtained by individuals participating in the study, based on their responses to the Andler and Parker coping strategies questionnaire (43).

Data analysis

In this research, a total of 256 pregnant women were selected to participate by completing questionnaires. However, three individuals declined to continue their cooperation, resulting in a final sample size of 253 participants. Among the remaining participants, 23 reported having an underlying disease, and nine experienced significant stressful events within the past six months. These individuals were excluded from the study, leaving a final analysis sample of 221 pregnant women. For data analysis, the researchers utilized SPSS-22 software. Descriptive statistics methods were employed to analyze the data, including the use of frequency and percentage distribution tables for qualitative variables. Additionally, quantitative variables were analyzed using measures such as standard deviation, average, minimum, and maximum. To examine the relationship between variables, Spearman's correlation coefficient tests were conducted. Furthermore, to account for any confounding factors, the researchers employed the multivariable linear regression method. The significance level for all tests was set at 5%.

Results

Table 1 presents the demographic characteristics information of the participants. Based on the data provided, the average age of pregnant women was 30.96 years, with a standard deviation of 11.64. The age

range varied from 18 to 44 years. The gestational age ranged from 8 to 39 weeks. The number of pregnancies for women ranged from 1 to 5, and the average gestational age was 26.62 with a standard deviation of 8.87. A majority of the women (57.5%) held a diploma, while 86% were housewives. Additionally, 67.4% of the participants had an average household income between 2 and 5 million Tomans (Table 1).

Table 1. Participants' demographic and obstetrics characteristics (Frequency distribution of quantitative and qualitative variables).

variables	M±SD	Maximum-minimum
Age	30.96±11.64	18-14
Gravida	1.95±1.21	1-5
number of children	0.57±0.75	0-3
Number of abortions	0.35±0.75	0-5
Gestational age (weeks)	26.62±8.87	8-39
variables		**Frequency(%)**
Mother's Educational status		
Secondary school		33(14.9)
Diploma		127(57.5)
University		61(27.6)
Mother's Employment status		
Housewife		190(86)
Self-employed		12(5.4)
Employed		19(8.6)
Spouse's Educational status		
Secondary school		42(19)
Diploma		119(53.8)
University		60(27.2)
Spouse's Employment status		
Self-employed		147(66.5)
Worker		35(15.8)
Employed		30(13.6)
Farmer		9(4.1)
Income		
≥ 20000000 rail		36(16.3)
20000000-50000000 rail		149(67.4)
≥50000000 rail		36(16.3)

The mean (standard deviation) of the anxiety score and perceived stress score were (16.57±7.16) and (31.06±8.64), respectively. The mean (standard deviation) score of Problem-focused strategy, Emotional-focused strategy, and avoidant coping strategy were (49.95±9.32), (44.53±12.41) and (43.06±8.99) respectively. The minimum and maximum anxiety score was 5-44, and the minimum and maximum perceived stress score was 13-56. In addition, the minimum and maximum score of the total coping strategy was 59-192, the minimum and maximum score of the Problem-focused strategy was 21-70, the Emotional-focused strategy was 17-67, and the Avoidant coping strategy was 21-68 (Table 2).

Table 2. Mean and standard deviation of different dimensions of anxiety, perceived stress and adopted coping strategies.

Variable	kurtosis	Skewness	SD	mean	Min-max
Anxiety	1.222	1.009	7.16	16.57	5-44
Perceived Stress	-0.239	0.191	8.64	31.06	13-56
Coping strategy	0.111	-0.105	21.36	137.55	59-192
Problem-focused strategy	-0.375	-0.169	9.32	49.95	21-70
Emotional-focused strategy	-0.869	-0.142	12.41	44.53	17-67
Avoidant coping strategy	0.176	0.320	8.99	43.06	21-68

Initial findings additionally indicated that 118 individuals (60.6%) experienced mild anxiety, while 89 participants (40.3%) reported moderate anxiety, and 14 individuals (6.3%) suffered from severe anxiety as a result of the COVID-19 pandemic. Moreover, the assessment of perceived stress revealed that 134 pregnant women (60.6%) exhibited elevated levels of stress. In terms of coping strategies, 121 individuals (54.8%) employed problem-focused coping, 79 individuals (35.7%) utilized emotion-focused coping, and 21 individuals (9.5%) resorted to avoidance coping (Table 3).

Table 3. Frequency of anxiety, perceived stress and stress and adopted coping strategies.

Variable	Level	Frequency	%
Anxiety			
	mild	118	**53.4%**
	moderate	89	**40.3%**
	severe	14	**6.3%**
Perceived stress			
	low	87	**39.4%**
	high	134	**60.6%**
Coping strategy			
Problem-focused strategies		121	**54.8%**
emotional-focused strategies		79	**35.7%**
Avoidance strategies		21	**9.5%**

The results show that there is a direct and significant linear correlation between anxiety and the adopted coping strategies (r=0.263); also the perceived stress and the adopted coping strategies (r=0.309) (P-value=0.001>) in Meanwhile, there is a direct and significant linear correlation between anxiety and emotion-focused coping strategy (r=0.413) and between perceived stress and emotion-focused coping strategy (r=0.408) (P-value=0.001). However, there is a direct linear correlation between anxiety with avoidance coping strategy (r=0.183) (P-value=0.006) and between perceived stress with avoidance coping strategy (r=0.169) (P-value=0.012). Also, there is no direct and significant linear correlation between anxiety with problem-focused strategies (r=-0.119) (P-value=0.078) and There is no direct and significant linear correlation between perceived stress and problem-focused strategies (r=-0.008) (P-value=0.906) (Table 4).

Table 4. Correlation between anxiety and perceived stress with adopted coping strategies.

Statistical tests	coping strategy	Problem-focused strategies	emotional-focused strategies	Avoidance strategies
Anxiety				
Spearman correlation coefficient	0.263	-0.119	0.413	0.183
P-value	<0001	0.078	<0.001	0.006
Perceived stress				
Spearman correlation coefficient	0.309	-0.008	0.408	0.169
P-value	<0.001	0.906	<0.001	0.012

The results of linear regression show that with the increase of each unit in the emotion- focused strategy score, the anxiety score increases by 0.4 or 40%, provided that other factors are constant. In the variable of anxiety, the squared multiple correlation coefficient (R2 variable coefficient) equal to 0.167 shows that the predicting variables of triple strategies predict 16.7% of the variance of anxiety scores of pregnant women. Also, the results of multiple linear regression show that with the increase of each unit in the emotion-focused strategy score, the perceived stress score increases by 0.39 or 39%, provided that other factors are constant. In the stress variable, the squared multiple correlation coefficient (R2 variable coefficient) equal to 0.147 shows that the predicting variables of the triple strategies predict 14.7% of the variance of the stress scores of pregnant women (Table 5).

Table 5. Results of linear regression analysis of anxiety and perceived stress based on coping strategies.

Collinearity assumption		P-value	t	Beta	B	SE	Sig	F	R2	Predictor variables	Criterion variable
VIF	Tolerance										
1.108	0.903	0.164	-1.397	-0.091	-0.070	0.050	<0.001	14.514	0.167	Problem-focused strategies	**Anxiety**
1.241	0.806	<0.001	5.819	0.402	0.232	0.040				emotional-focused strategies	
1.341	0.745	0.840	0.202	-0.015	-0.012	0.057				Avoidance strategies	
1.108	0.903	0.752	0.317	0.021	0.019	0.061	<0.001	12.479	0.147	Problem-focused strategies	**Perceived stress**
1.241	0.806	<0.001	5.663	0.393	0.274	0.049				emotional-focused strategies	
1.341	0.745	0.736	-0.338	-0.025	-0.024	0.070				Avoidance strategies	

Discussion

The present study was conducted to investigate the relationship between perceived anxiety and stress and the coping strategies adopted by pregnant women. The results of our study show that there is a direct and significant linear correlation between perceived anxiety and stress caused by COVID-19 and the coping strategies adopted. In addition, there is a direct and significant linear correlation between perceived anxiety and stress with the emotion-oriented strategy subscale (P-value=0.001). The mean (standard deviation) of the anxiety score (7.16) was 16.57 and the level of moderate to high anxiety in our study was 46.6%, while in the study of Alipour et al., which was conducted on the general population consisting of men and women, the average The anxiety score (11.05) is reported to be 17.74, which is almost consistent with our study (39). but, the average score of the total anxiety of COVID-19 in Masjoudi et al.'s study (10/45) is 18.20 and the level of moderate to high anxiety is 49.3% slightly higher than our study. But the level of perceived stress was high in our study (60.6 %), which is higher than Masjoudi et al.'s study (49.3%) (24).

It seems that with the passage of time and the increase of sufficient information about COVID-19 and vaccination, the level of anxiety caused by COVID-19 in pregnant women has decreased. Because one of the factors causing anxiety can be not having enough information about this disease, as was done in the study of Rah Nejat et al. Anxiety and stress were not having enough information in this field (44). However, the results of Kazemi et al.'s study showed that the more pregnant women know about COVID-19, the more worried and stressed they are. There was a positive correlation between the amount of knowledge of the studied pregnant mothers about the coronavirus disease, with the perceived stress and worry of the pregnant mothers about the coronavirus disease

(r=0.126) and (r=0.141), respectively. Furthermore, Masjoudi's research revealed a significant association between the apprehension and unease caused by the COVID-19 pandemic and the level of perceived stress (r = 50; indicating a moderate effect; P < 0.001). Similarly, there was a noteworthy correlation between fear and anxiety related to COVID-19 and perceived stress (r = 0.48; indicating a moderate effect; P < 0.001). These findings highlight the meaningful impact of fear and anxiety on individuals' stress levels during the pandemic (45).

Considering the role of perceived anxiety and stress on coping strategies and considering that during the COVID-19 pandemic, no study has been conducted on anxiety and stress on coping strategies using the desired tool. Discussion, from the studies conducted on pregnant women under stressful conditions, less related articles, and articles before the outbreak of corona disease were also used. For example, in Berhl et al.'s 2021 study in a non-pregnant sample, the use of maladaptive coping strategies was associated with increased stress and anxiety during the COVID-19 pandemic (46). Wheeler et al.'s study conducted both before and during the COVID-19 pandemic showed that greater use of avoidant coping was associated with higher levels of perceived stress (47). In The study of Sarani et al. in 2015, to examin the relationship between coping strategies in pregnancy and the level of perceived stress of pregnant mothers, which was conducted before COVID-19, between perceived stress and planned preparation strategy (r=.69) and spiritual strategy. There was a positive (r=.68) inverse and significant linear correlation, and also there was a direct and significant linear correlation between perceived stress and avoidance strategy with pregnancy stress (r=.75) (18). Therefore, considering that pregnancy itself creates stressful conditions for pregnant women and despite the double stressful conditions during the COVID-19 pandemic, the results of our study showed that there is a significant relationship between anxiety and perceived stress and coping strategies. (P-value=0.001) because in our study there was a direct and significant linear correlation between perceived stress and emotion-focused strategy. The results of our study show that there is a direct and significant linear correlation between anxiety and the adopted coping strategies and also between the perceived stress and the adopted coping strategies (P-value=0.001).

Emotion-focused coping was associated with decreased mental health due to the uncontrollable nature of the COVID-19 pandemic. Ineffective (avoidant) coping and emotion-focused coping were related to mental health problems, while problem-focused coping was not related to mental health problems (9, 48, 49). In this case, it can be said that the mentioned studies are consistent with our study because the findings of Khoury and others show that coping strategies are directly related to mental health outcomes, and ineffective coping and emotion-focused coping (maladaptive and emotion-focused coping strategies) between the experiences of COVID-19. and related mental health outcomes in pregnancy.

Conclusion

Coping strategies play a crucial role in maintaining the mental well-being of pregnant women, particularly when faced with stressful situations. Therefore, it is imperative to identify effective strategies that can help pregnant women adapt to the various stressors in their lives. The findings of the study revealed that a significant proportion (45.2%) of the coping strategies employed during the COVID-19 pandemic were emotion-oriented. However, these strategies were found to be ineffective as they were associated with higher levels of pregnancy anxiety and inverse (50). Training Basharpoor pregnant mothers to use an efficient and appropriate coping strategy with the stress created during pregnancy, especially in special and critical situations, including the critical period of COVID-19, can improve their mental health. Interventions are suggested to improve coping strategies in pregnant women.

Limitation

In the present study, sampling was done in an educational-therapeutic center, which does not include a wider range of women referring to health centers and private clinics.

Suggestion

Based on the current research, it is recommended that midwives and healthcare providers who work with

pregnant women should assist in reducing anxiety levels by educating them on coping mechanisms that focus on problem-solving. By encouraging the use of effective coping strategies and minimizing the use of ineffective ones, it is possible to enhance the physical and mental well-being of expectant mothers and reduce the negative outcomes associated with anxiety and stress, such as prenatal and postpartum depression, as well as maternal and fetal complications.

Ethics approval and consent to participate

The study was approved by the ethics committee of Guilan University of Medical Sciences (IR.GUMS.REC.1401.115). The Helsinki Declaration was adhered to throughout all phases of this research. The participants, who met the necessary inclusion criteria, were provided with comprehensive explanations of all study procedures. Additionally, before their involvement in the study, all participants willingly completed a written informed consent form. They were given the freedom to make their own decisions regarding their participation and had the option to withdraw from the study at any point, for any reason, without any impact on their medical care.

Availability of data and materials

supporting data are available in the Reproductive Health Research Center, Department of Obstetrics & Gynecology, Al-Zahra Hospital, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran

Competing interests

The authors declare that they have no competing interests.

Authors contributions

FSH, **SHSh** and **RF** contributed to the concept and design of the study. **FSH** collected the data. H.E performed the data analysis and **AN** contributed to the interpretation of the data. **FSH** drafted the manuscript and prepared the final version, while **SHSh** and **RF** read and revised the manuscript critically for important intellectual content. Finally, all authors approved the final version of the manuscript for publication.

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