Review Article

Effect of maternal–fetal/Neonatal attachment interventions on perinatal anxiety and depression: A narrative review

Parastou Mahmoudi[1], Forouzan Elyasi[2], Ali Nadi[3], Marjan Ahmad Shirvani[4]

[1]Department of Midwifery, Student Research Committee, Mazandaran University of Medical Sciences, [2]Department of Psychiatry, Faculty of Medicine, Psychiatry and Behavioral Sciences Research Center, Addiction Institute, Mazandaran University of Medical Sciences, [3]Health Sciences Research Center, Mazandaran University of Medical Sciences, [4]Department of Midwifery, Sexual and Reproductive Health Research Center, Mazandaran University of Medical Sciences, Sari, Iran

ORCID:
Parastou Mahmoudi: https://orcid.org/0000-0002-8936-3849; Marjan Ahmad Shirvani: https://orcid.org/000-0002-1557-4563

Abstract

Pregnancy and postpartum period may be accompanied with maternal anxiety and depression, each of which causes unfavorable outcomes in the mother and the infant. The maternal–fetal/neonatal interaction called attachment may influence these mental states. The present research has been performed with the goal to review the effect of maternal–fetal/neonatal attachment on perinatal anxiety and depression. This narrative review study has been done on the interventional studies in Persian and English published in 2006–2018 through searching the databases such as Google Scholar, Science Direct, Magiran, PubMed, Scientific Information Database, and Scopus and the keywords, such as anxiety, depression, and maternal–fetal/neonatal attachment. At the end, 14 articles have been included in the study. The findings have been organized into two categories: maternal–fetal attachment (10 papers) including three categories such as (1) paying attention to the fetus made up of two subcategories as relationship with the fetus and mental imagery, (2) awareness raising, and (3) relaxation techniques covering three subcategories as relaxation, exercise, and music and maternal–neonatal attachment (4 papers) including two categories such as (1) physical touch with infant and (2) pregnancy period training. Maternal–fetal/neonatal attachment increase using various interventions can reduce pregnancy- and postpartum-induced anxiety and depression. Although regarding the mutual attachment and physiological health relationship, it is not possible to state which of these two variables get improved initially by the interventions and finally the expected result, i.e., the above factors' improvement is achieved. Thus, training attachment enhancement techniques to pregnant women's care providers are recommended.

Keywords: Anxiety, Attachment, Depression, Fetus, Infant, Mother

Address for correspondence: Mrs. Marjan Ahmad Shirvani, Faculty of Nursing and Midwifery, Vesal St., Sari, Iran.
E-mail: Mashirvani@mazums.ac.ir
Received: 28 May 2019; **Accepted:** 13 July 2019; **Published:** 06 April 2020

INTRODUCTION

Although one of the most appealing stages of a woman's life resulting in her development is motherhood process, in this period the changes in mother's body and mind may make her obsessed with some stress and worries. If these mental changes get abnormal, some mental pressures will

Access this article online	
Quick Response Code:	Website: www.jnmsjournal.org
	DOI: 10.4103/JNMS.JNMS_28_19

How to cite this article: Mahmoudi P, Elyasi F, Nadi A, Ahmad Shirvani M. Effect of maternal–fetal/Neonatal attachment interventions on perinatal anxiety and depression: A narrative review. J Nurs Midwifery Sci 2020;7:126-35.

pop up in the long term and will produce a very stressful period.[1] The WHO (2008) estimated that over 80% of the women with low-risk gestation have experienced some degrees of anxiety in their pregnancy. Of 3–5 pregnant women in developing countries, one undergoes anxiety problems. This is 1 of 10 pregnant women in developed countries.[2] In various parts of Iran, the prevalence of anxiety among pregnant women has been reported as ranging from 26.6% to 43%.[3] Anxiety causes increased muscle contraction and decreased oxygen to the brain and muscle. As a result, the mother feels more fatigue, sensitivity, and stress to pain and cannot adapt herself to pain.[4] The individual's performance and communication with others are negatively affected by anxiety. Furthermore, it leads to somatic and mental disorders,[5] delayed maturing of fetal heart rate and movement,[6] negative outcomes during birth and infancy,[7] and inappropriate responses of the mother to the fetus.[8] The depression symptoms' prevalence in pregnant women is around 25%–35%.[9] In Iran, pregnancy-induced depression outbreak has been reported as 30.6%.[10] Pregnancy-induced depression causes the mother to underperform in emotional communication with the newborn, resort to smoking, alcohol, and drug abuse, and also commit suicide, fetal distress, birth underweight, premature neonate, neonatal behavior change, and postpartum depression.[11] Postpartum depression causes the mother not to do her motherhood care properly, and there is a suicide risk of 5% and infanticide of 4%. The induced long-term effects are marriage conflicts, permanent depression, and impaired mother–infant communication.[12]

Since there are some limitations regarding drug prescriptions during gestation and lactation, nonpharmacological methods are on the focus to prevent and improve the perinatal period-induced anxiety and depression. One of these interventions is to train mother–fetus/infant attachment increase skills.[13] Attachment is a sustained mother–infant intimacy-based relationship which results in satisfaction and relief and facilitates the maternal–fetal/infant interaction.[14] This emotional relationship is strengthened after delivery.[15] Maternal attachment starts from the 10th week of gestation and rapidly promotes in the 16th week.[16] When the mother considers her health interrelated with the fetus, her interaction with the fetus will get boosted.[17] Mother–fetus interaction can cause lower maternal anxiety[18] and results in raised maternal sensitivity to the infant and effective and sufficient care.[7]

There is a wide variety of methods to enhance the maternal–fetal/neonatal attachment. Often, the review studies have addressed the methods to create maternal–fetal/neonatal attachment, while they have not dealt with related anxiety and depression. Besides, the Iranian studies on the subject have not been included in the research.[8,19,20] Regarding the adverse consequences of maternal anxiety and depression during pregnancy and postpartum period, finding safe, low-cost, and convenience technique to improve mothers' mental health is important. Although practitioners usually believe that mental health has a negative effect on mother–fetal/infant attachment, reviewing some clinical studies shows that attachment may have a positive effect on mother psychological condition. Hence, the current study has been performed to investigate the effect of maternal–fetal/infant attachment interventions on perinatal period anxiety and depression.

MATERIALS AND METHODS

This narrative review study has been conducted on the research cases focused on the interventions related to maternal–fetal/neonatal attachment and its effect on anxiety and depression in the mothers during pregnancy and postpartum period.

RESEARCH QUESTIONS

We have reviewed the published articles in order to answer the following questions:

1. Do maternal–fetal attachment interventions affect the mother's anxiety and depression in pregnancy?
2. Do maternal–fetal attachment interventions affect the mother's anxiety and depression in postpartum period?

SEARCH STRATEGY

The search has been done based on the study questions. The researchers have done the initial search in the electronic databases including Google Scholar, Science Direct, Magiran, PubMed, Scientific Information Database, and Scopus and with the keywords including anxiety, depression, maternal–fetal relationship, and maternal–neonatal attachment.

The interventional studies (clinical trial, field and semi-experimental studies) in Persian and English during 2006-2018, that used the effective techniques on maternal-fetal/neonatal attachment and reported perinatal induced anxiety and depression were included in the study.

EXCLUSION CRITERIA

The noninterventional studies (descriptive, case–control, and cohort) not dealing with the research questions and merely analyzing the maternal attachment or mental problems were excluded from the study.

DATA COLLECTION METHOD

In the first stage, the papers have been picked up by the researchers separately using the keywords and based on the topic. In the second stage, the repeated irrelevant topics have been crossed out. After that, the abstract and the full text of the papers have been examined, and the ones on the desired topic have been included in the research. At last, the researcher attempted to obtain the original form of the papers that abstract of which was only available through re-browsing other databases and communicating with the authors. Furthermore, surveying the papers' resources, other relevant papers have been searched. In this manner, totally 453 papers were gathered, of which 324 restated as irrelevant ones, 99 in the abstract screening, and 16 following text analysis were removed. At the end, 14 articles were included in this review [Chart 1].

REPORT OF FINDINGS

The findings have been reported in two main categories. Besides, based on an interventional procedure, each of the groups has been categorized in several subgroups.

ETHICAL CONSIDERATIONS

The ethical considerations have been followed on loyalty in translation, lack of plagiarism, and respecting intellectual property rights.

RESULTS

Overall, 14 papers have been included in this study – 10 ones reporting maternal–fetal attachment and 4 ones reporting maternal–infant attachment. The findings are organized into categories and subcategories [Table 1].

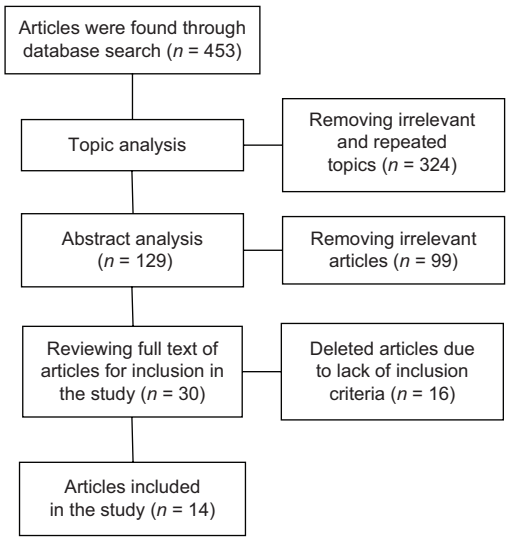

Chart 1: Study selection procedure

Maternal–fetal attachment and its effect on pregnancy-induced anxiety and depression

The findings' summary related to the pregestation intervention effect has been depicted in Table 2. These findings have been divided into three categories as it follows:

Paying attention to the fetus

Relationship with the fetus

It is done through speaking, touching the abdomen, paying attention to the movements and counting it, calling the fetus with a nickname, guessing the position of its organs, focusing on the fetus and recognizing it as an independent entity, and performing ultrasound in pregnancy. In reviewing the literature, four articles examined the above behaviors:

In a study, training how to touch the abdomen, recognizing the fetus, counting the movements and recording them, speaking with it, calling the fetus with a nickname, looking at the abdomen, focusing on the fetus and recognizing it as an independent identity, guessing the position of its organs, and calming it down by touching the abdomen were done. In addition, mental imagery has been applied. The mean anxiety score significantly decreased in the intervention group and increased in the control group. Depression and attachment variation has not been reported, and only maternal–fetal attachment has been addressed, showing a significant increase.[21] In another research, training to count and record the fetus' movements, speaking with the fetus, and touching the abdomen accompanied with mental imagery have been performed. The fetal attachment and the mental health level revealed a significant difference between the two groups.[22]

In a study, ultrasound counseling was performed consisting of four phases: (1) demonstrating the fetus physical features, gender, and position; (2) searching the fetus' physical movements, reflex, and orientation changes

Table 1: Categorize of maternal-fetal/neonatal attachment interventions

Maternal-fetal attachment
Paying attention to the fetus
Relationship with the fetus
Mental imagery
Awareness raising
Relaxation techniques
Relaxation
Exercise
Music
Maternal-neonatal attachment
Physical touch with infant
Pregnancy period training

Table 2: Studies on maternal-fetal attachment interventions' effect on anxiety and depression during pregnancy

Author	Participants	Design	Type of intervention	Instruments	Most important results
Toosi *et al*. (Iran, 2011)[21]	84 nulliparous women (35-32 weeks) were equally divided into two groups	Clinical trial	During 1 month, four sessions of 90 min training on attachment behaviors, fetal communication, and mental imagery were held. The control group received routine pregnancy care	Spielberger Anxiety Inventory	Anxiety decreased significantly in the intervention group (P=0.01) while it increased in the control group (P=0.002) immediately after intervention
Abasi *et al*. (Iran, 2013)[22]	83 women, 28-32 weeks (control=43, intervention=40)	Clinical trial	Four sessions of 2-h training on attachment behaviors including fetal communication and imagery were conducted once a week. The control group received routine care	Spielberger Anxiety, Cranley's Maternal-Fetal Attachment, and GHQ questionnaire	Mental health and maternal-fetal attachment improved in the intervention group compared to control after 4 weeks (P<0.001)
Boukydis *et al*. (USA, 2006)[23]	52 pregnant, 16-26 weeks (24 in control and 28 in intervention group)	Clinical trial	An ultrasound consultation on fetal development, maternal and familial responses, and maternal-fetal interaction was performed. The standard clinical ultrasound screen was done in the control group	MFAS, Beck depression, and Spielberger anxiety questionnaires	Positive change occurred in maternal-fetal attachment (P<0.05) and anxiety scores (P<0.04) after performing ultrasound, but depression did not differ between groups
Rafiee *et al*. (Iran, 2013)[24]	126 primigravid women, 28-34 weeks (42 mothers in each group, 1 control and 2 intervention)	Clinical trial	For each intervention, Group 4 sessions were held in groups of 14 mothers. One group received relaxation training. In another one, attachment behaviors and training attachment skills to fathers by mothers were explained. The control group received routine care	Spielberger Anxiety Scale	Both trainings were effective on reducing anxiety after 4 weeks (P<0.001), and there was no significant difference between them
Hosseinian *et al*. (Iran, 2016)[25]	30 pregnant women in the third trimester were equally divided into two groups	Semi-experimental	10 sessions, 90-min weekly training based on Cranley's viewpoint on maternal-fetal attachment, Bowlby's attachment, Beck overview, and Ellis's behavior therapy. The control group received routine care	Questionnaire of Cranley's Maternal-Fetal Attachment and DASS	Training resulted in improving of maternal-fetal attachment and mental health (P>0.05) after 10 weeks
Kordi *et al*. (Iran, 2016)[26]	67 nulliparous with 34 weeks unplanned pregnancy (35 in intervention and 32 in control group)	Clinical trial	A 20-min guided imagery on maternal role in small groups, guided CDs to performing imagery twice a week for 2 weeks. The control group received routine care	Cranley's Maternal-Fetal Attachment, London, and DASS21 questionnaires	Comparing with the control group, imagery technique was effective on enhancing attachment (P=0.04) and decreasing depression (P=0.004) and anxiety (P<0.001) after 2 weeks
Toosi *et al*. (Iran, 2017)[27]	80 women with the first-time IVF, 32-35 weeks (40 in each group)	Clinical trial	90-min relaxation classes in four sessions. The control group received routine care	Spielberger Anxiety, Cranley's Maternal-Fetal Attachment Inventory	Anxiety score reduced and attachment score raised after 4 weeks (P<0.001)
Ji and HR (South Korea, 2010)[28]	70 women over 18 weeks (33 in intervention and 37 in control group)	Semi-experimental	Qi exercise (tensile, breathing, and meditation) was performed for 90 min twice a week for 12 weeks. The control group received routine care	Questionnaires of intrapersonal communication, Zang's Self-Rating Depression and Attribute Anxiety	Maternal-fetal interaction increased (P=0.018) and depression decreased compared to the control group (P=0.001). There was no difference in anxiety
Akarsu and Rathfisch (India, 2018)[29]	63 primiparous, 14-26 weeks (31 in intervention and 32 in control group)	Randomized controlled trials	The intervention group received yoga exercises for 40 min twice a week for 8 weeks	Muller's Prenatal Attachment and Psychosocial Health Assessment Scale	Psychological well-being (P<0.001), anxiety and prenatal attachment (P<0.05) were better in intervention group
Shin and Kim (South Korea, 2011)[30]	233 women in the first trimester (116 in control and 117 in intervention group)	Nonequivalent control group nonsynchronized design	The intervention group received a 30-min session of music therapy in transvaginal ultrasonography room. The control group received routine care	Spielberger Anxiety Inventory, Pregnant women's stress scale of Ahn, Cranley's Maternal-Fetal Attachment	Maternal anxiety reduced compared to the control group (P=0.04), but no significant difference occurred in maternal-fetal attachment after sonography

MFAS: Maternal-Fetal Attachment Scale, IVF: *In vitro* fertilization, DASS: Depression anxiety stress scales, GHQ: General health questionnaire

in the uterus; (3) allowing the mother to explore the fetus' responses to actions such as laughing, pressing the abdomen, talking to the fetus, and singing for it, and (4) postcounseling session maternal questioning. The mean

fetal attachment has increased in the intervention group and the mean anxiety dropped. The changes were not significant in the control group. Depression level variation was not examined, and it has only been dealt with in one stage ahead of sonography between the two groups, which indicates no significant difference.[23]

A researcher compared the fetal communication techniques with relaxation training, in which the anxiety level of the training groups has been lower than that of the control group but not significantly different between two interventions. However, postpartum depression was lower in the relaxation group.[24]

Mental imagery

It includes imagining having the baby in one's arms, guided motherhood role imagery, visualizing herself when breastfeeding, and the fetus' appearance as positive. Four studies have investigated the mental imagery effect on anxiety and depression:

In a study, mothers were trained about the positive imagination of the fetus' appearance, visualizing hugging and breastfeeding the new born and communication skills with the fetus. As reported above, the anxiety level of the intervention group dropped significantly and that of the control group increased.[21]

In another study, the mental imagery of motherhood role has been trained accompanied with relaxation and rising awareness. A significant difference has popped up in depression, anxiety, and stress scales between the two groups. Furthermore, a significant difference was displayed in the mean of total score and subscales of maternal–fetal attachment.[25]

In a research, the guided imagery on maternal–fetal attachment had been trained. The fetal attachment, anxiety, and depression were significantly better in the intervention group.[26]

In another research, positive imagery about the appearance of the fetus and that of her own while breastfeeding along with fetal communication techniques resulted to a significant difference in terms of the psychological health and fetal attachment between the groups. In this research, anxiety and depression have not been measured independently.[22]

Awareness rising

It involves training about the pregnancy-induced anatomical, physiological, and hormonal changes and these changes' effect on the maternal body and mind; some strategies to adapt more with pregnancy changes; attachment concept and the benefits of higher attachment in pregnancy; embryo development; the effect of nutrition and care on maternal–fetal health; exercise; getting familiar with labor process;[21] familiarity with the husband's role as a supporter; and training attachment skills to the fathers by pregnant women.[24]

In a research, the general concept of attachment, fetal attachment and communication skills, psychological and physical changes during pregnancy, and general knowledge about labor manner and process were trained. Furthermore, in the second intervention group, only relaxation has been done. Both relaxation and training groups came up with a significant difference with the control group in terms of anxiety level. Fetal attachment was not reported.[24]

In another research, awareness rising including the description and analysis of the maternal expectations and changes physically and emotionally, the maternal and paternal emotional and physical health during and after pregnancy, and the embryo development were deal with. Besides, relaxation and mental imagery were employed. Attachment, depression, anxiety and stress were significantly different between the trained and control groups.[25]

Relaxation techniques

Relaxation

In a study, training relaxation was conducted. The fetal attachment and anxiety showed a significant difference. Depression was not measured in this study.[27]

A researcher focused on relaxation training including getting familiar with the general concept of anxiety and relaxation, the logic behind applying relaxation during pregnancy, familiarity with muscle relaxation technique and breathing exercises, and a thorough review of relaxation. The difference of anxiety level in the relaxation group was not significant with attachment training but was lower than the control groups.[24]

A study, as pointed out in the prior categories, worked on training relaxation accompanied with mental imagery and awareness rising. The two groups' depression, anxiety, stress, and attachment level have denoted a significant difference.[25]

Exercise

In a study, training exercises such as stretching, breathing, and meditation have been addressed. This exercise called Qi

is common in South Korea and it originates from yoga. This exercise elevates mental capacity and physical performance. Except of anxiety, the two groups' differences in fetal attachment and depression were significant.[28]

A research dealt with yoga exercise training. In the yoga group, the fetal attachment and psychological health have increased more.[29]

Music

One study surveyed the effect of music therapy during transvaginal sonography. A significant difference was observed regarding the anxiety but not with the attachment. Depression has not been addressed in this research.[30]

Maternal–neonatal attachment interventions and its effect on postpartum anxiety and depression

The findings related to the intervention-induced effect on postpartum maternal psychological condition have been listed in Table 3. These findings have been divided into two categories:

Physical touch with infant

This category includes mother–newborn skin contact or skin contiguity immediately after delivery, breast sucking, mother–newborn rooming-in, newborn touching and massaging, keeping the newborn close to the body, hugging, and kissing.

In a study, skin contact has been done at least 20–30 min daily. The two groups revealed a significant difference in terms of the attachment and anxiety in the 3rd and 10th days. This research has not reported depression.[31]

In another study, the maternal–neonatal skin contact immediately after delivery was done. The neonatal attachment and anxiety levels were significantly different.[32]

Pregnancy period training

Gestation and labor physiological training, being aware of the fetal feelings and perception, attachment concept, mental imagery, and attachment behavior (communicating with the fetus, anxiety control, negative thoughts, proper sleep patterns, exercise, and nutrition) during pregnancy have been surveyed in two studies.

In a research, relaxation training has been carried out in one group during pregnancy, and in another group, attachment behaviors, pregnancy-induced psychological and physical changes, general knowledge about labor manner and process, and familiarity with the paternal role as a supporter were trained. The mean scores of postpartum depression in the attachment and relaxation group were significantly lower than the control group but were not different between the two groups.[24]

In a study, training in the form of speech, discussion, film watching, and role playing were performed. The maternal anxiety level 3 months after delivery was lower in the intervention group.[33]

DISCUSSION

Maternal–fetal attachment intervention influencing pregnancy-induced anxiety and depression

The findings derived from the current study demonstrated that various fetal communication techniques have

Table 3: Studies about maternal-neonatal attachment enhancement interventions' effect on postpartum anxiety and depression

Author	Participants	Study design	Type of intervention	Instruments	Most important results
Nematbakhsh *et al*. (Iran, 2007)[31]	79 mothers after cesarean (40 in the intervention and 39 in the control group)	Randomized clinical trial	Skin-to-skin contact was performed daily for 20-30 min. The control group was given routine postpartum care	Nagata Maternal Attachment Scale	Skin contact was effective on increasing maternal attachment in the 3rd (P=0.03) and 10th days (P=0.04) and reducing anxiety in the 10th day (P=0.01)
Aqdas Karimi *et al*. (Iran, 2013)[32]	114 primipara women (57 in each group)	Randomized clinical trial	Maternal-neonatal skin contact was performed immediately after delivery. In the control group, the routine care was done	Maternal Attachment Scale	Intervention reduced anxiety (P=0.03) and increased maternal attachment (P=0.02) 28 days after birth
Rafiee *et al*. (Iran, 2013)[24]	126 primigravid women (28-34 weeks) in 1 control and 2 intervention groups (42 mothers in each one)	Clinical trial	For each intervention, Group 4 sessions were held in groups of 14 mothers. One group received relaxation training. In another one, attachment behaviors and training attachment skills to fathers by mothers were explained. The control group received routine care	Beck Depression Scale	Both relaxation and attachment training were effective in reducing postpartum depression (P<0.01) compared to control group
Akbarzadeh *et al*. (Iran, 2016)[33]	190 mothers, 34-28 weeks (96 in intervention and 94 in control group)	Clinical trial	60-90 min training in six sessions once a week on raising awareness about pregnancy and attachment behaviors to the fetus	Spielberger Anxiety Inventory	Reduction in maternal anxiety 3 months after delivery was significant (P=0.01)

influenced the maternal attachment increase and the maternal depression and anxiety drop during pregnancy. Attachment behavior learning exerts a positive effect on maternal–fetal attachment enhancement and maternal anxiety decrease.[4,34] In fact, the quality of attachment determines anxiety level.[35,36] Although a researcher reported the maternal–fetal attachment in surrogate mothers as lower than that of the normal mothers while their anxiety is not more,[37] regarding the confounders' effect, it is not possible to generalize lack of relationship between the attachment and anxiety among this group of mothers to the others. Besides, depression symptoms have shown a significant relationship with maternal–fetal attachment.[38]

Why training attachment reduces pregnant mothers' anxiety? When answering this question, we have to point out the major reasons behind pregnancy-induced anxiety. The most important reasons include fearing labor, fearing a disabled abnormal infant, and fearing facial and bodily changes. The peak of this anxiety is in mid-pregnancy. The three-dimensional model explaining the causes of pregnancy-induced anxiety indicates that the educational content of attachment can effectively cover the sides of this triangle. One of the attachment-related training contents is familiarity with the delivery process, fetus' development process, and explaining and making pregnancy-induced physiological changes perceived. Thus, making the mothers aware of these processes can cover the three sides of anxiety triangle, and it certainly has a positive effect on maternal anxiety. As seen in the two studies, raising maternal knowledge and awareness has accompanied with the mothers' psychological health getting boosted.[24,25] Of course, in these studies along with maternal information increase during pregnancy, training fetal attachment increase methods has been presented. Thus, it is not possible to definitely determine if raising awareness and knowledge alone can influence their psychological health.

Moreover, some studies have reported the training effect of fetal interaction techniques such as focusing on the movements, speaking with the fetus, guided imagery, and touching the abdomen on attachment increase and anxiety and depression decrease.[21,22,39] It can be stated that this training has an effect on the second side of the anxiety triangle, i.e., the mother fearing to deliver a disabled infant. Furthermore, fetal communication indirectly and through distracting the mother to avoid fearing facial and bodily changes influences the third side of the anxiety triangle. The results of a study revealed that presenting embryonic images through sonography during early pregnancy and before the mother understands pregnancy signs brings about reassuring importance for the mothers perceiving the true life in their womb and results in their intense attachment emotions to the unborn infant[40] and increases maternal health during gestation.[41] Behaviors such as counting the fetus' movements will stimulate the maternal feelings and boost the interactions with the fetus. Fetal movements may have a positive effect on prenatal attachment because fetus' life will turn as real for the mother after feeling its movements. The mothers with higher fetal attachment are more focused on the fetus' movements and detect them.[42]

In the studies, relaxation techniques as solely or integrated with other methods have been effective in boosting the maternal attachment, anxiety, and depression.[24,25,27,28] One of the renown conventional methods for lowering anxiety is relaxation which can cover all three sides of maternal fear.[24] Although in another study, relaxation alone has led to increased attachment and decreased anxiety,[27] it cannot be definitely concluded whether attachment increase brings about anxiety drop or vice versa, but the positive effect of this method on maternal–fetal attachment improvement cannot be overlooked. The findings suggest that pregnancy relaxation is a befitting and influencing opportunity for mental relaxation and concentration on the fetus and positive imagery about pregnancy and increased maternal–fetal attachment.[43] The individual's blood circulation gets boosted via doing the right relaxation and the maternal brain function improvement, and positive attitude will reduce her stress, anxiety, and depression.[44] One research suggested that Qi exercise as mind–body bonding intervention and similar to yoga as a more advanced form can decrease maternal depression and raise fetal attachment.[28] Although Qi decreased anxiety in the intervention group compared to the control group, no significant statistical difference was spotted. It seems that more studies are required to be done to prove the effectiveness of this technique. In another research in which yoga movements have been trained, maternal–fetal attachment and maternal psychological health have raised.[29] This way, it seems that these sorts of exercises as combined mental and physical relaxation techniques can affect the maternal–fetal attachment and pregnant women's mental health. One of the studies denoted that music lowered maternal anxiety, but it did not increase attachment.[30] Of course, in this research, the intervention was done at the time of sonography, so it has been short term. Therefore, it seems that the reduction of anxiety, especially short-term and intermittent, cannot improve fetal attachment. On the other hand, researchers reported that maternal attachment can get promoted through a combined plan based on music, exercise, and

reading educational books.[45] Thus, it seems that if music is accompanied with other attachment boosting strategies, it can exert a higher effect on this dimension. In the recent decade, music therapy effects on the body and mind have been identified.[46] Music removes negative feelings, uplifts stress threshold, coordinates internal processing, facilitates patients' recovery, accelerates the individual's relaxation and calmness, and reduces stress. Enjoying beauty by the right hemisphere releases endorphins from the pituitary gland; music alters the interaction of thalamus and the reticular activating system and influences emotions, muscular system, and bodily autonomic system's function, such as blood pressure, heart, and respiration.[47-49] According to the above effects, music can have effects on attachment and anxiety.

Apart from the effect inducing from the techniques of the maternal–fetal attachment formation and pregnant women's anxiety and depression decrease, group training of such techniques in most cases leads to the women's getting together that has a meaningful effect on the person's mental states and spirit. It has been reported that through the women entering a new social network and visiting other mothers, attachment training gives pregnant women the chance to receive emotional and social supports and better benefit from medical and care service.[38] Therefore, group training may reduce depression in pregnant women.[50]

Maternal–neonatal attachment interventions influencing postpartum maternal anxiety and depression

A review of the studies indicates that not only the postpartum interaction with a newborn but also the fetal interaction during pregnancy can affect maternal–neonatal attachment and the postpartum maternal mental health.[21,24,32,33] Maternal–fetal attachment training reduces postpartum anxiety through strengthening acceptance and complying with motherhood role.[51] It also improves the maternal confidence attachment and her adapting to maternity conditions and causes the mother to respond more positively to infant's behaviors and, as a result, reduces her postpartum depression.[52]

Reviewing the studies indicated that early maternal–fetal skin contact can be applied as an easy, inexpensive, and noninvasive technique to increase maternal–fetal attachment and to lower the anxiety about newborn.[31,32] Because of the maternal–neonatal close contact, verbal interaction, and more contact between the mother and the neonate and creating attachment between these two, the mothers prefer skin-to-skin contact to typical care approaches.[53-56] Attachment behaviors such as looking at, speaking with, and touching the neonate in the group with immediate contact with their neonate were more than those women having contact with their baby only at breastfeeding time.[57] Probably, the biochemical process by oxytocin, which is secreted by early maternal and infant contact, breast sucking, and the mother and the neonate room-in, leads to attachment formation.[58] The maternal–neonatal interaction increases during skin contact causing the mother's body to respond more to stimuli, and the nutritional behaviors will be stimulated and promoted due to neonatal smelling as a result of which the newborn gets the mother's breast and starts feeding. As a result of the newborn's sucking during the 1st h of birth, the maternal hormonal response is activated and oxytocin is secreted more.[59,60] The maternal–neonatal emotional connection is formed through touching, getting the baby close to the body, hugging and smiling at the newborn and speaking with it, calling its name, properly responding to the neonate's movements and hints, and directly and face-to-face looking at the neonate.[61] The results derived from the study revealed that pregnancy and postpartum presence of mind increases the maternal attention to perceiving, observing, and describing the neonate's movements, voice, and other behaviors that overall these factors promote the mother's attention to the baby and, as a result, decreases stress, anxiety, and attachment between the mother and the neonate.[62,63]

One of the strengths of this study is to investigate the effective methods to strengthen prenatal and postpartum maternal–neonatal attachment and its relationship with depression and anxiety in mothers, which has been less considered in previous surveys. One of the limitations of the study is failure to investigate the role of fathers in enhancing maternal-fetal/neonatal attachment, which is suggested to be assessed in future studies. Moreover, comparing various attachment techniques can define the efficiency of each of the techniques alone. Concerning this matter that most studies have surveyed anxiety and depression and the other maternal psychological health dimensions have not been much investigated and also, limitation of investigations about maternal–neonatal attachment, it seems required to do some studies in this area.

CONCLUSION

Considering the study extracted results, it seems that training attachment can cause maternal–fetal/neonatal attachment increase and the maternal perinatal depression and anxiety drop. Of course, in most studies, a series of attachment interventions, including various techniques for communicating with the fetus, have been trained

concurrently. Therefore, it is not possible to precisely conclude about the effect of each of these measures. On the other hand, concerning the mutual relationship that may exist between attachment and psychological health, it cannot be definitely concluded that the measures taken in cases like relaxation on which of these two variables have influenced first. By training the attachment formation techniques to health personnel before childbirth and establishing these behaviors in the mothers, it can be hoped that pregnant mothers and, as a result, the next generation will benefit from more appropriate mental health. Regarding the current study extracted results, the midwives and other health-medical group members are recommended to keep in contact with the mother in order to present maternal attachment behaviors counseling and training as a simple, inexpensive, and enjoyable technique as part of prenatal period in order to take steps toward maternal–infant health by achieving its results.

Conflict of interests

There is no conflict of interest for authors.

Authors' contribution

Mahmoudi and Shirvani were responsible for search and evaluation of articles, writing the first draft and revision of the final draft, Elyasi and Nadi contributed in critical revision and analyzed the data. All authors contributed to the development of the study design.

Financial support and sponsorship

This project was financially supported by Mazandaran University of Medical Sciences.

Acknowledgement

This study has been approved by the Student Research Committee of Mazandaran University of Medical Sciences (3650). Hereby, we sincerely appreciate the support by this committee and the vice president of research and technology of Mazandaran University of Medical Sciences.

REFERENCES

1. Mckee MD, Cunningham M, Jankowski KR, Zayas L. Health-related functional status in pregnancy: Relationship to depression and social support in a multi-ethnic population. Obstet Gynecol 2001;97:988-93.
2. Bennett IM, Schott W, Krutikova S, Behrman JR. Maternal mental health, and child growth and development, in four low-income and middle-income countries. J Epidemiol Community Health 2016;70:168-73.
3. Sadeghi N, Azizi, S, Molaeinezhad M. Anxiety study of pregnant mothers in the third trimester of pregnancy and its related factors in patients referring to Bandar Abbas hospitals in 2012. J Obstet Gynecol Infertil 2014;17:8-15.
4. Braverman J, Roux JF. Screening for the patient at risk for postpartum depression. Obstet Gynecol 1978;52:731-6.
5. Beck CT. Predictors of postpartum depression: An update. Nurs Res 2001;50:275-85.
6. Fink NS, Urech C, Berger CT, Hoesli I, Holzgreve W, Bitzer J, *et al*. Maternal laboratory stress influences fetal neurobehavior: Cortisol does not provide all answers. J Matern Fetal Neonatal Med 2010;23:488-500.
7. Solchany JE. Promoting Maternal Mental Health during Pregnancy. NCAST Programs; 2013.
8. Alhusen JL. A literature update on maternal-fetal attachment. J Obstet Gynecol Neonatal Nurs 2008;37:315-28.
9. Gotlib IH, Whiffen VE, Mount JH, Milne K, Cordy NI. Prevalence rates and demographic characteristics associated with depression in pregnancy and the postpartum. J Consult Clin Psychol 1989;57:269-74.
10. Karbakhsh M. Sedaghat M. Depression in pregnancy: Implications for prenatal screening. Payesh 2002;1:49-55.
11. Evans J, Heron J, Patel RR, Wiles N. Depressive symptoms during pregnancy and low birth weight at term: Longitudinal study. Br J Psychiatry 2007;191:84-5.
12. Lee DT, Chan SS, Sahota DS, Yip AS, Tsui M, Chung TK. A prevalence study of antenatal depression among Chinese women. J Affect Disord 2004;82:93-9.
13. Beck CT. A meta-analysis of predictors of postpartum depression. Nurs Res 1996;45:297-303.
14. Varvogli L, Darviri C. Stress management techniques: Evidence-based procedures that reduce stress and promote health. Health Sci J 2011;5:74-89.
15. Saastad E, Ahlborg T, Frøen JF. Low maternal awareness of fetal movement is associated with small for gestational age infants. J Midwifery Womens Health 2008;53:345-52.
16. Edwards LD. Adaptation to Parenthood. Maternity Nursing. 5th ed. St. Louis: Mosby; 1999. p. 449-88.
17. Ustunsoz A, Guvenc G, Akyuz A, Oflaz F. Comparison of maternal-and paternal-fetal attachment in Turkish couples. Midwifery 2010;26:e1-9.
18. Kim JS, Cho KJ. The effect of mother-fetus interaction promotion program of talking and tactile stimulation on maternal-fetal attachment. J Korean Acad Child Health Nurs 2004;10:153-64.
19. Cannella BL. Maternal-fetal attachment: An integrative review. J Adv Nurs 2005;50:60-8.
20. Dipietro JA. Psychological and psychophysiological considerations regarding the maternal-fetal relationship. Infant Child Dev 2010;19:27-38.
21. Toosi M, Akbarzadeh M, Zare N, Sharif F. Effect of attachment training on anxiety and attachment behaviors of first-time mothers. Hayat 2011;17:69-79.
22. Abasi E, Tafazzoli M, Esmaily H, Hasanabadi H. The effect of maternal–fetal attachment education on maternal mental health. Turk J Med Sci 2013;43:815-20.
23. Boukydis CF, Treadwell MC, Delaney-Black V, Boyes K, King M, Robinson T, *et al*. Women's responses to ultrasound examinations during routine screens in an obstetric clinic. J Ultrasound Med 2006;25:721-8.
24. Rafiee B, Akbarzade M, Asadi N, Zare N. Comparison of attachment and relaxation training effects on anxiety in third trimester and postpartum depression among primipara women. Hayat 2013;19:76-88.
25. Hosseinian S, Yazdi SM, Alavinezhad S. The effectiveness of fetal attachment training program on maternal- fetal relationship and mental health of pregnant women. JCMH 2016;2:75-87.
26. Kordi M, Fasanghari M, Asgharipour N, Esmaily H. Effect of guided imagery on maternal fetal attachment in nulliparous women with unplanned pregnancy. J Midwifery Reprod Health 2016;4:723-31.
27. Toosi M, Akbarzadeh M, Ghaemi Z. The effect of relaxation on mother's anxiety and maternal-fetal attachment in primiparous IVF mothers. J Natl Med Assoc 2017;109:164-71.
28. Ji ES, Han HR. The effects of Qi exercise on maternal/fetal interaction and maternal well-being during pregnancy. J Obstet Gynecol Neonatal Nurs 2010;39:310-8.

29. Akarsu RH, Rathfisch G. The effect of pregnancy yoga on the pregnant's psychosocial health and prenatal attachment. Indian J Tradit Knowle 2018;17:732-40.
30. Shin HS, Kim JH. Music therapy on anxiety, stress and maternal-fetal attachment in pregnant women during transvaginal ultrasound. Asian Nurs Res (Korean Soc Nurs Sci) 2011;5:19-27.
31. Nematbakhsh F, Kordi M, Sahebi A, Esmaeeli H. The effect of mother-infant skin to skin contact on mother's attachement. Q J Fund Ment Health 2007;9:25-32.
32. Karimi A, Tara F, Khadivzadeh T, Aghamohammadian-Sherbaf HR. Effect of mother and baby skin contact immediately after delivery on maternal attachment and anxiety related to neonate: Randomized clinical trial. IJOGI 2013;16:7-15.
33. Akbarzadeh M, Dokuhaki A, Joker A, Pishva N, Zare N. Teaching attachment behaviors to pregnant women: A randomized controlled trial of effects on infant mental health from birth to the age of three months. Ann Saudi Med 2016;36:175-83.
34. Bellieni CV, Ceccarelli D, Rossi F, Buonocore G, Maffei M, Perrone S, *et al*. Is prenatal bonding enhanced by prenatal education courses? Minerva Ginecol 2007;59:125-9.
35. Schmidt EB, de Lima Argimon II. Pregnant women's bonding and maternal-fetal attachment. Paidéia 2009;19:211-20.
36. Hart R, McMahon CA. Mood state and psychological adjustment to pregnancy. Arch Womens Ment Health 2006;9:329-37.
37. Ghelichi F, Roshan R, Khodabakhshi Kolaee A. Comparing of maternal -fetal attachment and pregnancy anxiety in surrogate women and normal pregnancy. Iran J Obstet Gynecol Infertil 2016;19:46-53.
38. Alhusen JL, Gross D, Hayat MJ, Rose L, Sharps P. The role of mental health on maternal-fetal attachment in low-income women. J Obstet Gynecol Neonatal Nurs 2012;41:E71-81.
39. Maeda K, Morokuma S, Yoshida S, Ito T, Pooh RK, Serizawa M. Fetal behavior analyzed by ultrasonic actocardiogram in cases with central nervous system lesions. J Perinat Med 2006;34:398-403.
40. Dykes K, Stjernqvist K. The importance of ultrasound to first-time mothers' thoughts about their unborn child. J Reprod Infant Psychol 2001;19:104-59.
41. Lerum CW, LoBiondo-Wood G. The relationship of maternal age, quickening, and physical symptoms of pregnancy to the development of maternal-fetal attachment. Birth 1989;16:13-7.
42. Velazquez MD, Rayburn WF. Antenatal evaluation of the fetus using fetal movement monitoring. Clin Obstet Gynecol 2002;45:993-1004.
43. Atkinson RL, Atkinson RC, Smith EE, Bem DJ, Nolen-Hoeksema S. Hilgards Introduction to Psychology. Fort Worth; London: Harcourt College Publishers; 2000.
44. Neff K, Hsieh Y, Dejitterat K. Self-compassion, achievement goals, and coping with academic failure. Self Identity 2005;4:263-87.
45. Yang KM, Kim SL. Effects of a Taegyo program on parent-fetal attachment and parenthood in first pregnancy couples. J Korean Acad Nurs 2010;40:571-9.
46. Liu YH, Chang MY, Chen CH. Effects of music therapy on labour pain and anxiety in Taiwanese first-time mothers. J Clin Nurs 2010;19:1065-72.
47. Bonde LO, Wiagram TA. Comprehensive Guide to Music Therapy: Theory, Clinical Practice, Research and Training. London: Jessica Kingsley Publishers; 2002. p. 384.
48. Sidorenko VN. Clinical application of medical resonance therapy music in high-risk pregnancies. Integr Physiol Behav Sci 2000;35:199-207.
49. Chang MY, Chen CH, Huang KF. Effects of music therapy on psychological health of women during pregnancy. J Clin Nurs 2008;17:2580-7.
50. Lara-Cinisomo S, Wisner KL, Burns RM, Chaves-Gnecco D. Perinatal depression treatment preferences among Latina mothers. Qual Health Res 2014;24:232-41.
51. Braveman PM, Sarnoff R, Egerter S, Rittenhouse D, Salganicoff A. Promoting Access to Prenatal Care: Lessons from the California Experience. Vol. 1. Menlo Park, Calif: Kaiser Family Foundation; 2003. p. 59-6.
52. Leifer M. Psychological changes accompanying pregnancy and motherhood. Genet Psychol Monogr 1977;95:55-96.
53. Carfoot S, Williamson P, Dickson R. A randomised controlled trial in the North of England examining the effects of skin-to-skin care on breast feeding. Midwifery 2005;21:71-9.
54. Khadivzadeh T, Karimi A. The effects of post-birth mother-infant skin to skin contact on first breastfeeding. Int J Nurs Midwifery Res 2009;14:111-6.
55. Mahmood I, Jamal M, Khan N. Effect of mother-infant early skin-to-skin contact on breastfeeding status: A randomized controlled trial. J Coll Physicians Surg Pak 2011;21:601-5.
56. Moore ER, Anderson GC. Randomized controlled trial of very early mother-infant skin-to-skin contact and breastfeeding status. J Midwifery Womens Health 2007;52:116-25.
57. Prodromidis M, Field T, Arendt R, Singer L, Yando R, Bendell D. Mothers touching newborns: A comparison of rooming-in versus minimal contact. Birth 1995;22:196-200.
58. Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database Syst Rev 2016;(8):CD002771.
59. Moore ER, Anderson GC, Bergman N, Dowswell T. Early skin-to-skin contact for mothers and their healthy newborn infants. Cochrane Database Syst Rev 2012;5:3519.
60. Velandia M, Uvnäs-Moberg K, Nissen E. Sex differences in newborn interaction with mother or father during skin-to-skin contact after caesarean section. Acta Paediatr 2012;101:360-7.
61. Carter-Jessop L. Promoting maternal attachment through prenatal intervention. MCN Am J Matern Child Nurs 1981;6:107-12.
62. Ghorbani N, Bing NM, Watson P, Kristl Davison H, Mack AD. Self-reported emotional intelligence: Construct similarity and functional dissimilarity of higher-order processing in Iran and the United States. Int J Psychol 2002;37:297-308.
63. Neff KD. The role of self-compassion in development: A healthier way to relate to oneself. Hum Dev 2009;52:211-4.