



# 모-태아 애착 증진을 위한 자비명상 프로그램 개발 및 효과

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## Development and Effects of a Loving-Kindness and Compassion Meditation Program to Improve Maternal-Fetal Attachment

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### Key messages

임부들의 심리적 건강과 태아와의 건강한 관계는 주산기 적응에 중요하다. 본 연구는 모-태아애착 증진을 위해 대인관계 개선에 효과적인 것으로 알려진 자비명상 프로그램을 개발하였다. 그리고 효과 검증을 위해, 자비명상 실험집단 · 임부요가 비교집단 · 무처치 통제집단의 모-태아애착 · 긍정정서 · 마음챙김 · 긍정태동경험을 사전 · 사후 · 한달 후 추수에 측정하였다. 그 결과 실험집단에서 다른 집단들에 비해 사전, 사후에 모든 변인들의 더 유의미한 향상과 추수까지 효과가 지속됨을 확인할 수 있었다. 본 연구의 의의는 임부들이 경험하는 부정적 요인개선을 목표로 하는 기존 연구들과 비교하여, 유익한 심리적 자원을 육성했다는 것이다. 또한 모-태아애착 증진을 위한 자비명상 프로그램을 개발하고 효과를 검증한 첫 번째 연구라는 점이다.

**중심단어:** 모-태아 애착, 자비명상, 긍정정서, 태동경험, 임부

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### Abstract

**Background:** The psychological health of a pregnant woman and a healthy fetal relationship are important for perinatal adaptation. This study aimed to develop loving-kindness and compassion meditation (LKCM), which are known to be effective for improving interpersonal relationships and to verify its effectiveness in order to promote maternal-fetal attachment (MFA).

**Methods:** We developed an LKCM curriculum and training program for pregnant women and assessed its efficacy for improving MFA, positive emotion, mindfulness, and positive fetal movement experience (PFME) through a pre-intervention, post-intervention, and one-month follow-up comparison with a yoga comparison group and an untreated control group.

**Results:** The LKCM experimental group showed significantly improved MFA, positive emotion, mindfulness, and PFME than did the other groups at post-intervention and follow-up.

**Conclusions:** Overall, this study confirmed that LKCM interventions can promote MFA, positive emotions, mindfulness, and PFME. Thus, it is meaningful that this study served to foster beneficial psychological resources compared to numerous studies aiming to improve deficits experienced by pregnant women. Additionally, this is the first full-scale study to develop a program based on specialized LKCM to enhance MFA during pregnancy and verify its efficacy.

**Key Words:** Maternal-fetal attachment, Loving-kindness and compassion meditation, Positive emotion, Fetal movement experience, Pregnant women

## Introduction

Pregnancy is an exceedingly important event for women, which brings many challenges, both mental and physical (Holmes *et al.*, 1967; Mercer *et al.*, 2006). Pregnant women must accept their roles as mothers and commit to fetus-orientated

health behavior (Cranley, 1981; Grace, 1989; Müller *et al.*, 1993), such as maintaining a nutritious prenatal diet, receiving timely prenatal care, and abstaining from smoking and drinking (Lee MR, 1985), to avoid deleterious outcomes including premature births, low birth weight, birth defects, and fetal death (Chaudhuri, 2000; Lampl *et al.*,

2003; Wu *et al.*, 2004).

To maintain such complex behavior, mothers form maternal-fetal attachment (MFA). MFA is defined as the affective relationship that mothers experience with their fetuses (Condon, 1993). Pregnancy can be considered as involving the act of acknowledging the fetus as an independent entity, accepting the pregnancy, and forming emotional bonds with said fetus (Cranley, 1981; Condon, 1985). Mothers' acceptance of their role in forming MFA and feeling that bond with the fetuses is important for their adherence to these necessary pregnancy maintenance health behaviors (Lindgren, 2001). Pregnant women who lack MFA may conceal their pregnancy and avoid these practices (Condon, 1993; Lindgren, 2001; Lee KS *et al.*, 2013). Pregnant women with high MFA interact more with infants after childbirth (Davoudi, 2014), which is important for early childhood development. Researchers conceptualized MFA as a progressive developmental notion resulting from the dynamic psychophysical event that is pregnancy (Leifer, 1977; Cranley, 1981; Valentine, 1982). In other words, during pregnancy, women can continuously develop by actively practicing and trying to increase MFA.

Loving-kindness and compassion meditation (LKCM) may be effective in developing MFA. It is a promising intervention for improving MFA as it fosters love and compassion for other beings. LKCM is intended to remind people of the image of another person or life, and pray for its goodwill and happiness with kindness and love (Gim WS, 2014). In the early Buddhist scripture, *Mettāutta*, in the *Suttanipāa*, the mothers' act of loving their children with all their heart and soul is considered LKCM (An YG *et al.*, 2011; Yang ES, 2016). Being based on mothers' love, LKCM therefore seems to be an excellent tool for increasing MFA.

However, scant research has investigated the use of LKCM to improve MFA, particularly among pregnant women. It can be arguably inferred that LKCM is effective for MFA based on the findings that LKCM promotes social bonding and prosocial emotions, attitudes, and behaviors (Hutcherson *et al.*, 2008; Leiberg *et al.*, 2011; Wang IS *et al.*, 2011; Gim WS, 2014; Kang *et al.*, 2014). LKCM is also likely to increase positive emotions like warmth, kindness, and empathy, as a form of emotion-centered training (Fredrickson, 1998; Fredrickson,

2001; Hutcherson *et al.*, 2008; Wang IS *et al.*, 2011; Gim WS, 2014). Seligman(2004) criticized psychology's focus on the negative, pathological aspects of the mind, advocating for "positive psychology" focusing on qualities that contribute to human growth and insight. Accordingly, to improve MFA, we might focus on positive emotions of love and bonding with the fetus, rather than attempts to eliminate negative feelings (e.g., stress, anxiety, depression). Indeed, improving negative emotions might not be as useful an intervention for healthy pregnant women with no psychopathology.

LKCM also improves mindfulness that is a prerequisite for all meditation methods. It means accepting any experience as it is, letting the attention remain in the present-moment experience rather than in the past or the future (Kabat-Zinn, 1990; Brown *et al.*, 2003; Park SH, 2006; Gim WS, 2014). Considering this definition, mindfulness can help to accept what happens during pregnancy as it is and improve MFA (Rubin, 1977; Carter-Jessop, 1981; Malm *et al.*, 2016).

On the other hand, it is likely to maximize MFA, which leads to a positive experience of fetal movement (Cranley, 1981; Rincy *et al.*, 2014; Malm *et al.*, 2016; Salehi *et al.*, 2017). Fetal movement is the basis of communication between the mother and the fetus (Carter-Jessop, 1981). Mothers begin recognizing fetal movement in the second trimester (15~27 weeks), thus becoming aware of and strengthening their interaction with the fetus. As they do so, they acquire the identity and role as 'mother' (Rubin, 1977). In addition, Heo JM *et al.*(2017) reported that the more pregnant women experienced positive fetal movements (happiness and well-being through fetal movement), the higher their fetal attachment.

As such, chances are high that LKCM will improve MFA, but few studies have been conducted on the LKCM program for pregnant women. In addition, although LKCM is effective in forming a positive relationship with others, a program needs to be developed that considers the specificities of pregnant women.

For this reason, before developing a full-fledged LKCM program for MFA, a preliminary program for pregnant women was constructed and conducted by referring to the existing research and the LKCM program for the general population. As a

result, LKCM confirmed the possibility that the positive emotion of the pregnant women would be improved, the mother-fetal relation could be improved positively, and the unexpected change in the fetal movement experience was confirmed (Kim MJ *et al.*, 2017). And through structural equation modeling in Heo JM *et al.*(2017), it was confirmed that mindfulness and positive emotion are important leading factors in MFA formation, and one of the key mechanisms is positive fetal movement experience. In other words, the mindfulness and positive emotion, known as the main effect of LKCM, means the possibility of improving the MFA through positive fetal movement experience. Therefore, it is necessary to confirm whether the LKCM not only improves MFA but also the mindfulness, positive emotion, and positive fetal movement experience that have significant effects on MFA.

Through the above process, this study concluded and emphasized that education of LKCM intervention to improve mindfulness, positive emotion, and a positive fetal movement experience can help in effecting a positive relationship with pregnant women and the fetuses. A program focused on this point was constructed. In other words, in this study, we developed the first full-scale LKCM curriculum and training program for pregnant women and assessed its efficacy for improving MFA, positive emotion, mindfulness, and positive fetal movement experience (PFME) through a pre-intervention, post-intervention, and a one-month follow-up comparison with a pregnancy yoga comparison group and an untreated control group.

## Materials and Methods

### 1. Participants

Participants were 109 South Korean pregnant women beginning to experience fetal movements (15~33 weeks' gestation). They were recruited over three months from December 1, 2017 to February 28, 2018, and completed three surveys: pre-intervention, post-intervention, and one-month follow-up. All surveys were received online. And before pre-intervention, all participants were informed and consented to participate in the study, consent to the use of personal information and

withdrawal of consent at any time. The LKCM experimental group consisted of 39 women recruited from two hospitals in Seoul and Chungcheongbuk-do. We recruited 37 women for a comparison group from two hospitals in Gyeonggi-do. Additionally, we recruited 33 people for an untreated control group from Web-based community related to pregnancy. None of these participants could participate in LKCM or yoga programs during the study period.

The LKCM experimental group participated in a three-week LKCM program with sessions held twice per week from March 2 to 23, 2018, at the Hospital Cultural Center. The reason for recruiting them is that in South Korea, education for pregnant women is mainly carried out at the Cultural Center for Obstetrics and Gynecology. Participants of pregnancy yoga sessions were selected for the comparison control group. Pregnancy yoga is the most prevalent intervention used by pregnant women in South Korea (Ryu, 2010; Park HS *et al.*, 2015). A typical program is conducted twice a week, once per month; each session is similar and consists primarily of yoga postures (*yoga asana*) and breath control (*pratyahara*), which is helpful for pregnant women (Narendran *et al.*, 2005; Chuntharapat *et al.*, 2008; Kwon HS *et al.*, 2016). Prior studies related to prenatal yoga are mainly about fatigue, anxiety, labor pain, self-confidence, and stress. Although it is difficult to find studies on the relationship of the mother and fetus (Narendran *et al.*, 2005; Chuntharapat S *et al.*, 2008; Song MS *et al.*, 2015; Kwon HS *et al.*, 2016), Kwon YK(2017) reported that in-depth interviews with participants attending pregnancy yoga showed that women reported emotional stability, mood improvement, positive fetal movement experience, and rapport with the fetus. Considering this study, MFA may be improved by enhancing mood and childbirth confidence through pregnancy yoga, strengthening pregnant woman's positive emotion, positive fetal movement experience, and connection with the fetus. In addition, because the LKCM proceeds in a group form, it was appropriate to compare it with the pregnancy yoga procedure in a group form to exclude the effect of mutual support that can be experienced in group dynamics. For this reason, to compare the relative effects of LKCM programs,

participants of pregnancy yoga were selected as a comparison group.

The untreated control group was recruited to examine whether the changes observed in the experimental group or comparison group were by-products of the psychological effects associated with gestational age.

## 2. Program facilitator

The LKCM program was conducted by a researcher who received the T-level leader qualification from the South Korean Meditation Society (SKMS) and had two years of experience in teaching meditation to pregnant women at cultural centers and postpartum care centers. The pregnancy yoga program was carried out by a qualified expert (Yoga Alliance E-RYT [Experienced Registered Yoga Teacher]) with over 10 years of experience in teaching pregnancy yoga and who actively educates pregnant yoga leaders.

## 3. Goals of the LKCM program and session content

The composition and contents of this session were revised and completed according to the studies conducted by Kim MJ *et al.*(2017) and Heo JM *et al.*(2017), existing research, and experts' feedback and consultation. The three people who provided feedback and consulting were experts on LKCM. They are with R-level leadership qualifications from the SKMS who had completed LKCM-related doctoral dissertations and had several related research achievements. Additionally, they are experts who have continued to oversee the preliminary study (Kim MJ *et al.*, 2017) for the development of LKCM programs for pregnant women. In this study, the following were modified: total number of sessions, duration of time, and composition. They were divided into aspects of time, content, training, and others.

With regard to time, first, each session time was increased to 1 hour 30 minutes from 1 hour in Kim MJ *et al.*(2017). This is due to the need for sufficient delivery of training content and feedback time for questions. Second, pregnant women also adopted a short-term intervention of six sessions, considering that the dropout rate increased with longer sessions (An YG *et al.*, 2011). In a study examining the relationship between treatment time and treatment effects (Howard *et al.*, 1986;

Requoted in Levenson, 1995/2008), there were claims that patients typically benefited from psychotherapy after six to eight sessions and the results of previous studies that the effects of LKCM are revealed appeared after three to four weeks (Wang IS *et al.*, 2011; Gim WS *et al.*, 2014), the six shortest configurations having been selected with the shortest effect. The other pregnancy-related programs were conducted twice a week, considering the familiarity of the time allocation. The participants were trained twice a week for a total of six sessions for three weeks (Park HS *et al.*, 2015; Song MS *et al.*, 2015; Kwon *et al.*, 2016).

In terms of contents, first, each session was conducted through psychological education and LKCM training to understand and acquire the subject of each session. This is a form that many meditation practice programs take to convey their purpose and inspire their motivation through pre-meditation psychological education (Kabat-Zinn J, 1990; Vieten C *et al.*, 2008; An YG *et al.*, 2011; Gim WS *et al.*, 2014). Second, fetal movement, MFA, maternal acceptance, and healthy childbirth were added in the psychological education to understand and acquire the subjects of each session besides the contents related to stress, mindfulness, and self-compassion during pregnancy. As a result, the subject of each session is composed as follows: pregnancy and a healthy mind (session 1), pregnancy and MFA (session 2), fetal movement and MFA (session 3), acceptance of motherhood (session 4), expansion of love (session 5), healthy birth (session 6). The object of each session is self-compassion meditation training for healthy pregnancy, baby LKCM training for improving MFA, fetal movement LKCM training for improving MFA, imagery LKCM training for acceptance of motherhood, for expansion of LKCM training for pregnant women, and LKCM training for the extension of love for other pregnant women.

In terms of trainings, first, the general training method of LKCM is to intentionally remind one of the image of self, others or other life forms, and the wishing of farewell and happiness through an attitude of love and kindness toward the object (Daelim, 2000; Gim WS *et al.*, 2014). However, considering that the purpose of this program is to improve MFA, the LKCM training target was

limited to the pregnant woman's self, her own fetus, other pregnant women and their fetuses, and all pregnant beings in the world. Second, the body scan, which helps sleep and relaxation (Yang HY, 2011), and the banding meditation to train physical and psychological connection with the fetus and to pay attention to fetal movement as designed by Kim MJ *et al.*(2017) were combined to be trained each session. This was called 'I-Mam meditation'. Third, a type of visualization (Gim WS *et al.*, 2014) which is characteristic of LKCM was further actively used. This is scientifically supported by the evidence that thinking and directly reminding a person of an image affects neurophysiological processes (Gilbert, 2009). Further, 'I-Mam meditation' and 'Baby LKCM' were used to guess and imagine the shape, posture, and location of the fetus. Many studies with pregnant women report increased MFA in pregnant women who are much imagining and thinking about the fetuses (Fuller, 1990; Müller *et al.*, 1993; Siddique *et al.*, 1999; Ryu HJ. 2010). In 'Mother-Mountain meditation', it embodies the image of the mountain in meditation and by matching pregnant women to the mountains to convey the message of a healthy motherhood to accommodate the fetus as it is. Fourth, in 'Fetal movement LKCM,' pregnant woman paid attention to the fetal movement that is currently taking place and the mother could respond to and interact to said fetal movement. This is based on studies that the greater the perception of the fetal movement, the higher the MFA (Rincy *et al.*, 2014; Malm *et al.*, 2016; Salehi *et al.*, 2017), the

formation of a communication system between the pregnant woman and the fetus during pregnancy, which is immediately harmonized between the mother and infant after birth (Brazelton, 1974) and the importance of positive fetal movement experience (Heo JM *et al.*, 2017). Fifth, 'LKCM for healthy birth' of each other was formed in the last session, the participants prayed together for the common goal of themselves and the group and encouraged LKCM training until the future and childbirth.

Another consideration is the use of smiles in LKCM training. The use of smiles is often done in LKCM (Cho HJ, 2012, 2013; Noh SS *et al.*, 2013; Park SH *et al.*, 2016). In particular, Misan's Heart Smile LKCM method (Seong SH *et al.*, 2016) was used. In other words, the participants were encouraged to give a soft and warm feeling with a gentle smile and to focus the feeling on the heart. In addition, this study led to a greater feeling of warmth and love with breathing. It was also conceived to smile with the fetus so that the mother and the fetus shared positive emotions.

The LKCM program is summarized in Table 1. Before the first session, participants initially completed a pre-test online. Each session lasted for 10~90 minutes of attendance checking and reviewing about previous sessions, 20 minutes of a theoretical lecture, 10 minutes of body relaxation, 20 minutes of the main activity, 15 minutes of I-Mom meditation (a combination of body scanning and meditation with a fetus), and 15 minutes of questions and discussion. Following each session, participants were sent a meditation recording corresponding to the theme of the session for

**Table 1.** Contents of each session

S	Subject	Object	Psychological education	Meditation activity
1	Pregnancy and a healthy mind	Self-compassion meditation training for healthy pregnancy	The importance of psychological health during pregnancy The importance of self-care during pregnancy	1. Self-compassion meditation 2. I-Mom meditation
2	Pregnancy and MFA	Baby LKCM training for improving MFA	The importance of MFA How to raise healthy MFA	1. Baby LKCM 2. I-Mom meditation
3	Fetal movement and MFA	Fetal movement LKCM training for improving MFA	The importance of fetal movement The relationship between fetal movement and MFA	1. Fetal movement LKCM 2. I-Mom meditation
4	Acceptance of motherhood	Imagery LKCM training for acceptance of motherhood	The importance of maternal acceptance The importance of healthy maternity	1. Mother-Mountain meditation 2. I-Mom meditation
5	Expansion of love	Other ways for expansion of LKCM training for pregnant women	The importance of maternity and love extension	1. LKCM for pregnant women 2. I-Mom meditation
6	Healthy birth	LKCM training to extend love for other pregnant women	The importance of positive origins	1. LKCM for healthy birth 2. I-Mom meditation

\*S=Session, \*MFA=Maternal fetal attachment, \*LKCM=loving-kindness and compassion meditation.

home training; the absentees were sent both the recording and a file on the training content for that session. At the end of the sixth session, participants were asked to complete the post-test online. Participants who attended four or more sessions were awarded a certificate of completion. A gift of 20,000 won was provided to all attendees as a reward for attending the program. A month after program completion, participants were sent a follow-up report online.

#### 4. Measures

##### 1) Maternal-fetal attachment

To measure emotional attachment to the fetus, we used the Maternal Antenatal Attachment Scale developed by Condon (Condon, 1993) and adapted it into Korean by Kang SK *et al.*(2017). This scale comprises 15 items measuring mothers' feelings toward the fetus. It contains two subscales: attachment strength and attachment quality. A five-point Likert-type scale was used, with higher scores indicating greater attachment. The Cronbach's  $\alpha$  for the total scale (.84) was good in this study, and those for attachment strength and quality were .78 and .75, respectively.

##### 2) Positive emotion

The Positive and Negative Affect Schedule (PANAS) developed by Watson *et al.*(1988) and validated in Korean by Park HS *et al.*(2016) was used. This scale comprises two subscales: positive emotions and negative emotions. Only the 10 items of the positive emotion subscale were used. The Cronbach's  $\alpha$  of the positive emotion subscale (.88) was good in this study.

##### 3) Mindfulness

Mindfulness is the ability to concentrate on the present moment, intentionally observe the mind and body, and experience each moment and accept it as it is (Kabat-Zinn, 1990). To measure it, we used the Mindfulness Scale developed and validated by Park SH(2006). The scale comprises 20 items in four subscales: attention, current awareness, acceptance of criticism, and decentered attention. This scale uses a five-point Likert-type scale with inverse items; after inversion, higher total scores indicate higher mindfulness. The Cronbach's  $\alpha$  of the whole scale (.94) was good in this study.

Attention at (.82), current awareness (.80), acceptance of criticism (.88), and decentered attention (.88) were also good in this study.

##### 4) Positive fetal movement experience

To measure positive fetal movement, we used the scale developed by Heo JM *et al.*(2017). The subjective experience of fetal movement scale comprises eight items in two subscales (four items each): positive fetal movement experience (PFME) and negative fetal movement experience (NFME). Only the four items of the PFME subscale were used. PFME evaluates participants' self-reported happiness and wellbeing in pregnancy due to fetal movements. The items use a five-point Likert-type scale ranging from "almost not at all" to "almost always," reflecting the extent to which the items reflected participants in the past week. The Cronbach's  $\alpha$  of PFME (.91) was good in this study.

#### 5. Data analyses

This study comprised a mixed design with 3 between-subject factors (groups: experimental, comparison, control) $\times$ 3 within-subject factors (times: pre-intervention, post-intervention, follow-up). We measured MFA, positive emotions, mindfulness, and PFME in all three groups at the pre-intervention, post-intervention, and one month follow-up points. Participants who did not complete all three questionnaires online or did not respond sincerely were excluded. Thus, 83 participants (n=27 experimental group, n=29 comparison group, n=27 untreated control group) were analyzed. Statistical analysis was performed using SPSS Statistics 22.0.

First, differences between the experimental and other groups on the demographic variables were analyzed using the chi-square test. Subsequently, an analysis of covariance (ANCOVA) was performed using pre-intervention scores as a covariate to examine the differences between groups for the post-intervention and follow-up scores. The Bonferroni correction was used for post hoc analysis.

## Results

### 1. Demographic characteristics of participants

The chi-square test revealed no statistically significant differences between the groups in terms of demographic characteristics. Table 2 shows the details of whether the pregnancy was planned, any previous birth experience, education level, and household monthly income level.

### 2. Verification of program effects at post-intervention and follow-up

#### 1) Maternal-fetal attachment

We observed significant differences between post-intervention and follow-up (post:  $F=16.93$ ,  $p<.001$ , follow-up:  $F=24.72$ ,  $p<.001$ ) MFA scores between the three groups with large effect sizes (post:  $\eta^2=0.30$ , follow-up:  $\eta^2=0.38$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups (post: MD= 4.90,  $p<.001$ , follow-up: MD=5.75,  $p<.001$ ) and between the experimental and untreated control groups (post: MD=6.12,  $p<.001$ , follow-up: MD= 6.97,  $p<.001$ ). There was no significant difference between the comparison and untreated control groups. Thus, MFA increased more significantly in the LKCM group after the intervention compared to the other groups. This means that the effect of LKCM intervention was sustained not only at the

post-intervention level but also at the follow-up.

As for attachment strength, we found significant differences in the post-intervention and follow-up scores (post:  $F=17.71$ ,  $p<.001$ , follow-up:  $F=29.17$ ,  $p<.001$ ) between the three groups, with large effect sizes (post:  $\eta^2=0.31$ , follow-up:  $\eta^2=0.42$ ). The post hoc analysis revealed significant differences between experimental and untreated comparison groups (post: MD=3.65,  $p<.001$ , follow-up: MD=4.55,  $p<.001$ ) and experimental and untreated control groups (post: MD=4.58,  $p<.001$ , follow-up: MD=5.26,  $p<.001$ ).

For attachment quality, we found significant differences in post-intervention and follow-up scores (post:  $F=5.89$ ,  $p<.01$ , follow-up:  $F=6.20$ ,  $p<.01$ ) between the three groups, with medium effect sizes (post:  $\eta^2=0.13$ , follow-up:  $\eta^2=0.14$ ). The post hoc analysis revealed significant differences between the experimental and untreated comparison groups (post: MD=1.19,  $p<.05$ ) and between the experimental and untreated control groups (post: MD=1.55,  $p<.01$ ) at post-intervention. At follow-up, we found only a significant difference between the experimental and untreated control groups (follow-up: MD=1.12,  $p<.01$ ). Thus, we saw significant increases in attachment strength and quality in the LKCM group compared to the other groups, which was sustained in the follow-up (Table 3).

**Table 2.** Demographic characteristics of participants

Variable	Division	Experimental group	Comparison group	Control group	Total	$\chi^2$
		n (%)	n (%)	n (%)	n (%)	
Pregnancy period (weeks)	Under 29	6 (22.2%)	9 (31.0%)	8 (29.6%)	23 (27.7%)	1.64
	30~35	14 (51.9%)	16 (55.2%)	13 (48.1%)	43 (51.8%)	
	35 or older	7 (25.9%)	4 (13.8%)	6 (22.2%)	17 (20.5%)	
Planned pregnancy	Less than 27	20 (74.1.0%)	17 (58.6%)	13 (48.1%)	50 (60.2%)	1.47
	More than 28	7 (25.9%)	12 (41.4%)	14 (51.9%)	33 (39.8%)	
Planned pregnancy	Yes	18 (66.7%)	20 (69.0%)	25 (92.6%)	63 (75.9%)	6.13
	No	9 (33.3%)	9 (31.0%)	2 (7.4%)	20 (24.1%)	
Birth experience	Primipara	25 (92.6%)	24 (82.8%)	19 (70.4%)	68 (81.9%)	4.52
	Multipara	2 (7.4%)	5 (17.2%)	8 (29.6%)	15 (18.1%)	
Employed	Yes	5 (18.5%)	8 (27.6%)	8 (29.6%)	21 (25.3%)	1.01
	No	22 (81.5%)	21 (72.4%)	19 (70.4%)	62 (74.7%)	
Education	Less than high school graduate	2 (7.4%)	1 (3.4%)	2 (7.4%)	5 (6.0%)	3.30
	College (including college)	18 (66.7%)	25 (86.2%)	21 (77.8%)	64 (77.1%)	
	Graduate school or higher	7 (25.9%)	3 (10.3%)	4 (14.8%)	14 (16.9%)	
Monthly average income (thousands won)	Less than 300	6 (22.2%)	6 (20.7%)	10 (37.0%)	22 (26.5%)	10.87
	Less than 300~400	11 (40.7%)	11 (37.9%)	4 (14.8%)	26 (31.3%)	
	Less than 400~500	5 (18.5%)	6 (20.7%)	2 (7.4%)	13 (15.7%)	
	Less than 500~600	3 (11.1%)	2 (6.9%)	6 (22.2%)	11 (13.3%)	
Total	600 or more	2 (7.4%)	4 (13.8%)	5 (18.5%)	11 (13.3%)	
Total		27 (100%)	29 (100%)	27 (100%)	83 (100%)	

**Table 3.** Between groups adjusted values of post and follow-up, effect size and post-analysis

Variable	a (n=27)			b (n=29)			c (n=27)			Post-analysis			
	Pre (SD)	Adjus-ted post (SD)	Adjus-ted follow-up (SD)	Pre (SD)	Adjus-ted post (SD)	Adjus-ted follow-up (SD)	Pre (SD)	Adjus-ted post (SD)	Adjus-ted follow-up (SD)	Partial $\eta^2_1$	Partial $\eta^2_2$	Pre-post	Pre-follow-up
MFA	58.19 (6.97)	66.77 (0.79)	68.64 (0.75)	60.10 (6.69)	61.88 (0.76)	62.89 (0.73)	58.70 (7.63)	60.66 (0.79)	61.67 (0.75)	0.30	0.38	a>b, c	a>b, c
Strength	32.26 (5.3)	38.35 (0.58)	40.51 (0.53)	33.66 (4.76)	35.10 (0.56)	35.96 (0.51)	32.93 (5.38)	34.17 (0.57)	35.25 (0.53)	0.31	0.42	a>b, c	a>b, c
Quality	25.93 (2.56)	28.00 (0.33)	28.10 (0.35)	26.82 (2.50)	27.03 (0.32)	26.98 (0.34)	25.78 (2.90)	26.46 (0.33)	26.41 (0.35)	0.13	0.14	a>b, c	a, b>c
Positive emotion	29.96 (7.51)	34.38 (0.98)	37.71 (0.84)	31.14 (7.79)	31.40 (0.97)	31.47 (0.81)	31.15 (7.51)	31.40 (0.97)	31.53 (0.84)	0.07	0.32	a>b, c	a>b, c
Mindfulness	81.59 (14.43)	84.34 (1.74)	83.05 (1.67)	78.45 (13.6)	77.01 (1.64)	71.60 (1.59)	68.00 (15.20)	74.80 (1.56)	63.40 (1.72)	0.58	0.45	a>b>c	a>b>c
Attention	19.00 (3.69)	21.03 (0.56)	21.73 (0.53)	20.76 (3.55)	18.74 (0.56)	17.63 (0.53)	17.26 (4.54)	18.26 (0.58)	15.80 (0.55)	0.15	0.45	a>b>c	a>b>c
Current awareness	20.15 (3.64)	21.75 (0.47)	21.98 (0.53)	20.38 (3.68)	20.05 (0.46)	17.56 (0.51)	18.74 (4.25)	19.28 (0.48)	15.74 (0.53)	0.15	0.48	a>b, c	a>b>c
Acceptance of criticism	18.22 (4.69)	21.81 (0.60)	22.30 (0.53)	20.62 (4.20)	19.42 (0.59)	17.99 (0.52)	17.81 (4.50)	18.85 (0.60)	15.48 (0.53)	0.15	0.52	a>b, c	a>b>c
De-centered attention	(5.41)	18.82 (0.64)	19.72 (0.58)	16.69 (5.11)	17.50 (0.62)	17.53 (0.56)	14.19 (4.79)	15.94 (0.65)	14.28 (0.58)	0.11	0.39	a>c	a>b>c
PFME	16.60 (3.66)	19.24 (0.27)	19.82 (0.32)	18.52 (1.10)	17.53 (0.26)	17.82 (0.29)	17.74 (1.83)	18.12 (0.26)	17.92 (0.30)	0.21	0.28	a>b, c	a>b, c

\*p<.05, \*\*p<.01, \*\*\*p<.001

MFA=maternal-fetal attachment.

PFME=positive fetal movement experience.

Pre=pre-intervention/Post=post-intervention.

a=experimental group, b=comparison group, c=untreated control group.

F1=verification of post-intervention score difference after controlling pre-intervention.

F2=verification of follow-up difference after controlling for pre-intervention.

Partial  $\eta^2_1$ =between-group effect size at post-intervention, controlling for pre-intervention value.

Partial  $\eta^2_2$ =between-group effect size at follow-up, controlling for pre-intervention value.

## 2) Positive emotion

We found no significant difference in positive emotion scores between the three groups at post-intervention ( $F=2.76$ ,  $p=.07$ ). However, the experimental group showed higher adjusted post-intervention scores than the other groups. Additionally, considering the effect size, the scores might have been moderately affected by the intervention ( $\eta^2=0.07$ ). We observed a significant difference between the three groups at follow-up ( $F=18.50$ ,  $p<.001$ ), with large effect sizes ( $\eta^2=0.32$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups ( $MD=6.24$ ,  $p<.001$ ), between the experimental and untreated control groups ( $MD=6.18$ ,  $p<.01$ ), and no significant differences between the comparison and untreated control groups. In other words, this means that the effect of LKCM intervention on positive emotion was sustained at the follow-up compared to the other groups (see Table 3).

## 3) Mindfulness

We observed no significant difference in mindfulness scores between the three groups at post-intervention ( $F=2.44$ ,  $p=.09$ ). However, the experimental group showed higher adjusted post-intervention scores than the other groups. Additionally, the large effect sizes suggest that the intervention might have had some effect ( $\eta^2=0.58$ ). We found a significant difference at follow-up ( $F=32.10$ ,  $p<.001$ ) with large effect sizes ( $\eta^2=0.45$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups ( $MD=11.45$ ,  $p<.001$ ), the experimental and untreated control groups ( $MD=19.65$ ,  $p<.01$ ), and the comparison and untreated control groups ( $MD=8.20$ ,  $p<.01$ ). This implies that the effect of LKCM intervention on mindfulness was sustained at follow-up, while the other groups showed consistent decreases in mindfulness.

For the attention subscale, we found significant differences at post-intervention and follow-up (post:  $F=6.96$ ,  $p<.01$ , follow-up:  $F=32.26$ ,  $p<.001$ ) between the three groups with large effect sizes (post:  $\eta^2=0.15$ , follow-up:  $\eta^2=0.45$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups (post:  $MD=2.30$ ,  $p<.05$ , follow-up:  $MD=4.09$ ,  $p<.001$ ), and the experimental and untreated control groups

(post:  $MD=2.80$ ,  $p<.01$ ), and the comparison and untreated control groups (post:  $MD=8.20$ ,  $p<.01$ ).

The results for current awareness showed a similar pattern: significant differences at post-intervention and follow-up (post:  $F=7.08$ ,  $p<.01$ , follow-up:  $F=36.75$ ,  $p<.001$ ) between the three groups with large effect sizes (post:  $\eta^2=0.15$ , follow-up:  $\eta^2=0.48$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups (post:  $MD=1.71$ ,  $p<.05$ , follow-up:  $MD=4.42$ ,  $p<.001$ ), and the experimental and untreated control groups (post:  $MD=2.47$ ,  $p<.01$ , follow-up:  $MD=6.24$ ,  $p<.001$ ), and the comparison and untreated control groups (post:  $MD=2.47$ ,  $p<.01$ , follow-up:  $MD=1.82$ ,  $p<.05$ ).

Acceptance of criticism scores showed a similar pattern as well: significant differences at post-intervention and follow-up (post:  $F=6.88$ ,  $p<.001$ , follow-up:  $F=43.53$ ,  $p<.001$ ) between the three groups with large effect sizes (post:  $\eta^2=0.15$ , follow-up:  $\eta^2=0.52$ ). The post hoc analysis revealed significant differences between experimental and comparison groups (post:  $MD=2.38$ ,  $p<.05$ , follow-up:  $MD=4.31$ ,  $p<.001$ ), and the experimental and untreated control groups (post:  $MD=3.00$ ,  $p<.01$ , follow-up:  $MD=6.82$ ,  $p<.001$ ) and the comparison and untreated control groups (follow-up:  $MD=2.51$ ,  $p<.01$ ). Together, the results imply that the LKCM group showed significantly greater improvements in attention, current awareness, and acceptance of criticism at post-intervention compared to the other groups, which were sustained in the follow-up; by contrast, the other groups showed consistent reductions in all three subscales.

For decentered attention, we found significant differences at post-intervention and follow-up (post:  $F=5.01$ ,  $p<.01$ , follow-up:  $F=22.00$ ,  $p<.001$ ) between the three groups with medium and large effect sizes (post:  $\eta^2=0.11$ , follow-up:  $\eta^2=0.39$ ). At post-intervention, the post hoc analysis significant differences were only between the experimental and untreated control groups (post:  $MD=2.88$ ,  $p<.01$ ). At follow-up, however, we found significant differences between the experimental and comparison groups (follow-up:  $MD=2.20$ ,  $p<.05$ ), experimental and untreated control groups (follow-up:  $MD=5.44$ ,  $p<.001$ ), and comparison and untreated control groups (follow-up:  $MD=3.25$ ,  $p<.01$ ). Thus, the experimental group showed a significant increase

in scores at follow-up, whereas the comparison group showed a decline in scores (See Table 3).

#### 4) Positive fetal movement experience

We found significant differences in post-intervention and follow-up PFME scores between the three groups (post:  $F=10.27$ ,  $p<.001$ , follow-up:  $F=13.80$ ,  $p<.001$ ), with a large effect size (post:  $\eta^2=0.21$ , follow-up:  $\eta^2=0.28$ ). The post hoc analysis revealed significant differences between the experimental and comparison groups (post:  $MD=1.71$ ,  $p<.001$ , follow-up:  $MD=2.04$ ,  $p<.001$ ), between the experimental and untreated control groups ( $MD=19.65$ ,  $p<.01$ ), and the comparison and untreated control groups (post:  $MD=1.12$ ,  $p<.05$ , follow-up:  $MD=1.94$ ,  $p<.001$ ). Thus, the intervention group showed a significantly greater increase in PFME scores at post-intervention than did the other groups, and this effect was sustained at follow-up (see Table 3).

## Discussion

This study aimed to develop loving-kindness and compassion meditation (LKCM), which are known to be effective for improving interpersonal relationships. In addition, the study aimed to verify its effectiveness in order to promote maternal-fetal attachment (MFA). The results indicated that the experimental group showed a greater increase in MFA than did the other groups at post-intervention and follow-up. As all three groups showed a significant increase in overall MFA at post-intervention and follow-up, the LKCM intervention seems effective in improving MFA compared to other groups. Furthermore, while attachment strength increased significantly up to the follow-up in all groups, attachment quality showed the greatest increase in the experimental group. The strength of fetal attachment is the mothers' degree of absorption (time spent thinking and talking about the fetus) in the fetus, and the quality of attachment is the emotional bond between the fetus and mother (close vs. distant, softness versus sensitivity). The results of the untreated control group suggest that the attachment strength increases with gestational age, whereas quality does not change substantively. Nevertheless, as all three groups showed a significant increase in

overall MFA at post-intervention and follow-up, MFA may to some extent increase with gestational age (Carter-Jessop, 1981; Ryu, 2010; Park HS *et al.*, 2015; Kwon *et al.*, 2016). Despite this, the LKCM intervention seems effective in improving overall MFA, given that it showed the greatest enhancements in attachment strength and quality. Moreover, although the comparison group was smaller than the experimental group, it still showed a greater increase in MFA than the control group, with the greater change being in attachment strength.

The positive emotion increased steadily in the experimental group at both post-intervention and follow-up. The comparison and untreated control groups showed almost unchanged positive emotion at post-intervention; the findings for the untreated control group suggest that positive emotions do not vary substantially as the pregnancy progresses, while those for the comparison group indicate that pregnancy yoga had little effect on the participants' positive emotions. This is consistent with several studies indicating that positive emotions do increase through LKCM (Fredrickson, 1998; Fredrickson, 2001; Hutcherson *et al.*, 2008; Leiber *et al.*, 2011; Wang IS *et al.*, 2011). According to Fredrickson's broaden-and-build theory of positive emotions, positive emotions not only expand the thought-action repertoire, but also effectively bolster future coping skills through learning experiences that contribute to the accumulation of personal resources (Fredrickson, 1998; Fredrickson, 2001). Positive emotions can increase flexibility (Isen *et al.*, 1984), creativity (Isen *et al.*, 1987), openness (Estrada *et al.*, 1997), and effective thinking and behavior (Fredrickson, 2001), thereby helping ensure a healthy pregnancy and mothers' adaptation to their new role and their new relationship with the fetus.

In mindfulness, the experimental group showed a larger increase at both post-intervention and follow-up in all aspects of mindfulness than the others groups. It means the LKCM intervention can continuously improve mindfulness that helps pregnant women adapt to the new and current changes of pregnancy (Rubin, 1977; Kabat-Zinn, 1990). However, the comparison groups showed significant decreases over time in all aspects of mindfulness (except decentered attention). It was

found that a systematic structured mindfulness yoga program for pregnant women is needed to improve the mindfulness of the pregnant women in the comparison group (Muziki *et al.*, 2013). The untreated control group showed a slight increase in the post-intervention level, which thereafter decreased at follow-up. It is a different result than that of Vieten *et al.* (2008) which showed the untreated control group continued to decrease in mindfulness in the post-intervention level. It seems as though further study is needed to know why the untreated group improved more mindfulness than the yoga intervention group in post-intervention.

As for PFME, the LKCM intervention group showed a steadily significant increase at both the post-intervention and follow-up levels, while the other groups showed little change. This is consistent with the finding of Heo JM *et al.* (2017) that the more pregnant women experienced a positive fetal movement, the higher the fetal attachment.

Overall, this study confirmed that the LKCM intervention can promote MFA, positive emotions, mindfulness and PFME. Thus, it is meaningful that this study served to foster beneficial psychological resources compared to numerous studies aiming to improve deficits experienced by pregnant women (Narendran *et al.*, 2005; Chuntharapat *et al.*, 2008; Vieten *et al.*, 2008). Additionally, this is the first full-scale study to develop a program based on specialized LKCM to enhance MFA during pregnancy and verify its efficacy.

This study has some limitations. First, we did not perform random allocation between groups. Participants of the LKCM and pregnancy yoga groups were mainly recruited from Seoul, Gyeonggi-do, and Chungcheong-do provinces in South Korea, while the control group was recruited nationwide; thus, equivalence sampling was limited. We should confirm the effects of this program with participants from a wider range of communities and using random allocation. Second, it is possible that differences in the personal competences of the facilitators may have influenced the results of the study. This is because there were different facilitators for LKCM and the pregnancy yoga programs. In the future, it is necessary to reconfirm the results by controlling the extra variables of the difference of facilitator. Third,

the program effects were limited mainly to positive variables. We might compare the differential effects of the program on negative variables such as stress, depression, and anxiety. Finally, we have to clarify whether the LKCM program goes on to influence childbirth and later on, infant developmental processes, MFA, maternal roles, and acceptance, given that MFA during pregnancy directly affects child development.

## Conflicts of interest

The authors declared no conflict of interest.

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