

**Effect of nursing intervention program using abdominal
palpation of Leopold's Maneuvers on maternal-fetal
attachment**

(レオポルド触診法を用いた腹部触診による看護介入が
母児愛着に与える効果について)

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看護学専攻

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Abstract

Background

The aim of this study was to investigate whether a nursing intervention program using abdominal palpation would improve maternal-fetal relationships of pregnant women.

Methods

The subjects were Japanese women aged less than 40 years with singleton pregnancies. A nursing intervention involving abdominal palpations was performed for the intervention group ($n = 35$) in the 30th, 32nd, and 34th weeks' gestation, while ordinary health-related advice was provided to the control group ($n = 73$) in the corresponding period.

Results

At the 30th (baseline) week, no intergroup differences were observed. However, the intervention group showed higher Prenatal Attachment Inventory (PAI) scores in the 34th ($P < 0.01$) and 36th weeks ($P < 0.05$) as well as a higher frequency of talking to the fetus in the 32nd ($P < 0.01$), 34th ($P < 0.01$), and 36th weeks ($P < 0.05$). Furthermore, fetal position awareness score in the 32nd, the 34th, and the 36th weeks were higher in the intervention group than in the control group ($P < 0.001$).

Conclusions

Abdominal palpations enhanced maternal perceptions of fetal positions and the maternal-fetal relationship. Nursing interventions involving abdominal palpations may help develop the maternal-fetal relationship.

Key words

Pregnancy, Nonrandomized trial, Maternal-fetal attachment, Abdominal palpation, Fetal position awareness

要 約

【目的】

本研究の目的は、妊婦に対し、腹部触診法を用いた看護介入を実施し、胎児愛着の育成に結び付けられるか検討することである。

【研究方法】

研究対象者は、定期的に妊婦健康診査を受診しており、母子とも正常経過にある 40 歳未満の日本人、単胎妊娠の妊婦とした。介入プログラムは、Leopold 触診法を用いて腹部触診をしながら、胎児位置を助産師が妊婦と一緒に触診するものである。介入プログラムは妊娠 30 週、32 週、34 週の 2 週間ごとに行い、妊娠 36 週に同様の質問紙調査のみ実施した。対照群は、同時期に質問紙調査のみ実施した。妊娠 36 週までの最終協力者は、介入群 35 人 (76%)、対照群 73 人 (68%) であった。なお、両群とも施設主催の母親教室に参加している。

【研究結果】

妊娠 30 週（調査開始時）では、介入群と対照群とにおける PAI (Prenatal Attachment Inventory、胎児愛着)、胎児位置認知得点、胎児話しかけ頻度に有意差を認めなかった。

介入の結果、介入群の PAI は、34 週と 36 週とにおいて、対照群よりも高く有意差を認めた (それぞれ $P = 0.01$, $P = 0.05$)。同様に、胎児話しかけ頻度は、対照群よりも介入群のほうが妊娠 32, 34, 36 週と有意に多かった ($P < 0.05$ or $P < 0.01$)。さらに胎児位置認知得点は、介入群が対照群よりも妊娠 32, 34, 36 週と高く、有意差を認めた ($P < 0.001$)

【結論】

腹部触診法は、胎児の位置認知を促すだけでなく、胎児に対する話しかけ頻度を増加させ、胎児愛着促進に寄与することが示唆された。よって、腹部触診法を用いた看護介入は、母児愛着の育成に役立つかもしれない。

Key words

妊娠, 非ランダム化比較試験, 母児愛着, 腹部触診, 胎児位置認知

Background

Maternal–fetal attachment is defined as a mother’s affiliation with her child [1]. The development of maternal–fetal attachment greatly affects the postnatal child-care environment and child development [2-4]. It may influence mother–infant attachment after delivery and the maternal ability to care for the infant [5-7]. Hence, nursing interventions on expectant mothers are important for supporting the development of maternal–fetal attachment.

In Japan, the number of consultations for child abuse has been increasing in recent years [8], and children who are 3 years or younger account for approximately 80% of the children who die, with 0-year-old infants accounting for 60%. The main abusers of children are their mothers, and it is of primary importance that child abuse is identified at an early stage. A strong correlation has been reported between high-risk children and child abuse [9]. Higher maternal–fetal attachment would be necessary

to be developed by nursing care in the pregnancy period.

There are several studies to report effective intervention programs for the development of maternal-fetal attachment in expectant mothers, such as an intervention using fetal palpation [10], offering the knowledge of the child care for couples [11], providing information and teaching stress management methods [12], expressing affection to the fetus by writing letters and talking [13], and having singing, dancing, and massage-through-the-womb sessions [14]. Meanwhile, it is indicated that the attachment to the fetus can be enhanced by sensitive maternal perception of fetal movements [15-18] and positive child imaging [19-21]. Maternal-fetal attachment is also known to be associated with quickening of the fetus closely [22, 23]. Additionally, Shin et al. (2006) showed that more active mother-child interactions during pregnancy caused higher maternal attachment to the fetus [7].

Similarly, previously studies in Japan reported that maternal awareness of the fetal

position was associated with prenatal attachment to the fetus [24]. Imagining the fetus and writing a diary about the fetus also augmented interest in the fetus [25] [26]. Thus, nursing interventions to let mothers actively interested in the fetus may lead to higher maternal attachment to the fetus.

The abdominal examination method of Leopold's Maneuvers is a way to determine the position of a fetus inside the uterus by touching the abdomen by hands. This method is expected to enable expectant mothers to perceive the fetal position, and stimulate the awareness of child presence. Hence, we considered that a nursing intervention program using this abdominal palpation method might be useful for the enhancement of maternal-fetal attachment. The aim of this study was to investigate whether a nursing intervention program using abdominal palpation of Leopold's Maneuvers would improve maternal-fetal relationships of pregnant mothers.

Methods

Study setting and participants

The study subjects were singleton pregnant Japanese women under the age of 40 in two women's hospitals that are under the same management in Shiga, Japan. Because the study started at the 30th weeks of gestation, the participants were recruited from women who were 16 to 28 weeks gestation. They had regular prenatal care at the hospitals, and their pregnancies were progressing normally. The exclusion criteria were pregnant women who were having any complications related to the mother or fetus (for example, low-lying placenta, placenta previa, pregnancy-induced hypertension, intrauterine growth restriction, etc), pregnancies resulting from advanced assisted reproductive technology, and single mothers. They were recruited from November 2009 through August 2010.

All subjects participated in this study after signing the written consent. This study

protocol was approved by the Ethics Committee of Nagoya University School of Medicine (No. 9-163).

Assignment method

Of the total of 384 pregnant women in the target weeks' gestation, 227 (59.1%) agreed to participate in the study. Of those 227 subjects, 88 wished to participate in an intervention program. Thereby, they were non-randomly assigned to the intervention group (n = 88) or the control group (n = 139). In the intervention group, of the initial 88 subjects, 42 did not actually participate in the study at all. Of the 46 participants, seven women participated only once, because two were directed to rest by a physician, one was under hospitalized supervision due to threatened premature delivery, one withdrew due to breech presentation, and three were busy with other duties. Four women participated two times, because one delivered prematurely, two were ordered to rest by a physician due to threatened premature delivery, and one was in poor physical condition. In the end, 35 women participated in the intervention

program all three times and completed the questionnaire survey for the 36th week. In the control group of 139 women, 108 completed the questionnaire during the first survey, but 73 during fourth survey. As a result, the final analysis was conducted for 35 (76%) of 46 participants to the first intervention program in the intervention group and 73 (68%) of 108 participants to the first control program in the control group (Figure 1).

Procedures

All pregnant women at the hospitals were expected to participate in a pre-mothers' class to learn about general health care during the pregnancy a total of 3 times at the 30th, 32nd, and 34th weeks' gestation. Hence, subjects in the intervention group were to participate in both the pre-mothers' classes and additional intervention programs involving abdominal examinations. Those in the control group were supposed to participate in the pre-mothers' class (the control program) only. The intervention program (and the control program) was then performed at the 30th, 32nd, and 34th weeks' gestation.

At the women's hospitals in this study, all participants regularly received prenatal examinations including ultrasound examinations performed by a physician, and necessary health advice for normal pregnancies from midwives.

Intervention program

The intervention program was intended to help the pregnant participants to sense the fetal position in the uterus by touching the abdomen by performing an abdominal examination of Leopold's Maneuvers. Following the pre-mothers' class (the control program), the nursing intervention program was conducted by three midwives. Midwives explained the fetal position by taking the hand of each participant and touching the buttocks and the back of the fetus together, so that expectant mothers were actually able to touch their abdomens and the large and small body parts of the fetuses. After the practice was completed, a group discussion was held for about 20 min with all of the participants regarding whether they were able to sense the position of the fetus, their thoughts toward the fetus, and so on. Each intervention program took approximately 1 to 1.5 h.

The control group participated in the pre-mothers' classes. At the study institution, pre-mother classes are held 3 times from the second trimester to the last trimester of

pregnancy. The pre-mothers' classes generally provide information on general health care during pregnancy, such as nutritional intake and daily life, prenatal exercise, preparation for child birth and mental attitude, methods to alleviate delivery labor, infant bathing techniques, and they are also an opportunity to make friends with other participants. Each pre-mothers' class is held for about 1.5 h. These classes for expectant mothers are common at most of the institutions in Japan.

Measurements

A self-completed questionnaire survey of the same contents was conducted in the intervention group and the control group at the 30th (baseline), 32nd, 34th, and 36th weeks' gestation. In the intervention group, subjects completed the questionnaire after practicing the abdominal palpation in the intervention program at the 30th, 32nd, and 34th weeks' gestation. The survey at the 36th week was done by mail. In the control group, the questionnaire survey was conducted by mail 4 times at the same times as the intervention group. The present study was conducted from November 2009 to December 2010.

The questionnaire covered demographic characteristics, attachment to the fetus, frequency of talking to the fetus, and awareness of the position of the fetus.

For demographic characteristics, the following questions were asked: age, spouse's age, weight, primigravida or multigravida, nuclear family or extended family,

unplanned or planned pregnancy, employed or unemployed, social support, and educational background (to select from junior high-school graduate, high-school graduate, junior college graduate, or graduate of university or higher)

The relationship between the expectant mother and the fetus was examined using the PAI (Prenatal Attachment Inventory) by Muller [27]. We used the Japanese version of the PAI by Tujino [28]. The PAI consists of a 21-item scale that is designed to measure the behavior and feelings of an expectant mother toward the fetus. Each item has 4 Likert-type responses: 4 points are given for “almost always,” 3 points for “often,” 2 points for “sometimes,” and 1 point for “almost never.” The total score ranges between 21 and 84. A higher score is indicative of a higher attachment to the fetus. The Japanese-language version of the PAI has been validated for Japanese women [28]. The Cronbach's alpha of PAI were 0.89.

The question regarding the frequency of talking to the fetus was as follows: “How many times did you talk to your fetus every day during the last week on average?”

The frequency of talking to the fetus is thought to reflect the maternal attachment to the fetus [19-21].

The questionnaire about the awareness of the position of the fetus was intended to measure to what degree expectant mothers perceive the fetus position in the uterus. A 6-item scale with 5 Likert-type responses was prepared by the authors to assess maternal awareness of the fetal position: (1) I perceive that the fetus is moving his/her legs; (2) I perceive that the fetus is moving his/her hands; (3) When I touch the abdomen with my hands, I perceive the position of the back of the fetus; (4) When the fetus moves, I softly touch my abdomen; (5) I imagine the fetus' character from his/her movement; and (6) I can depict the appearance of the fetus. For each item, 5 points are given for "always," 4 points for "frequently," 3 points for "sometimes," 2 points for "occasionally," and 1 point for "almost never." A higher score is expected to show a greater awareness of the fetal position. Internal reliability was examined using Cronbach's alpha coefficient in this study. This was defined as the fetal position awareness score.

Statistical Analyses

Statistical analyses were performed using chi-square tests or Mann-Whitney *U* tests for categorical variables and Student's *t* tests for continuous variables. The internal reliability for the questionnaire on PAI and awareness of the fetal position was examined using Cronbach's alpha coefficient. For the relationship between these scales, the Spearman rank correlation coefficient was calculated.

In order to examine the effects of the intervention, Mann-Whitney *U* tests were employed for comparisons between the intervention group and the control group. For comparison of the time-series data after the intervention, Wilcoxon signed-rank tests were used with a Bonferroni correction because of a 3-time comparison (ie, of the 30th [baseline] with the 32nd, 34th, and 36th weeks' gestation). All analyses were 2-sided with *P* values less than 0.05 considered statistically significant. The statistical software package SPSS for Windows J ver. 16.0 (IBM Corporation, Armonk, NY, USA) was used.

Results

As shown in Table 1, the characteristics of the subjects at baseline showed no significant differences in age, family type, unplanned/planned pregnancy, unemployment, education, BMI, and acceptance of social supports between the intervention group and the control group. The proportion of primigravidae in the intervention group tended to be higher, although it was not significantly different between the groups. Prenatal attachment or fetal position awareness also did not differ between primigravidae and multigravidae. (Table 2-7)

As for the Cronbach's alpha coefficient, high internal reliability was verified for the PAI scale (0.884 - 0.926) and the fetal position awareness score (0.740 - 0.854) (Table 8).

In addition, the fetal position awareness score showed a significantly positive correlation with the PAI score ($r = 0.515$ to 0.678 ; $P < 0.01$ for all comparisons) and

the frequency of talking to the fetus ($r = 0.281$ to 0.402 , $P < 0.01$ for all comparisons) at all investigational time points. The correlation was relatively stronger between the fetal position awareness score and the PAI score than with the frequency of talking to the fetus. (Table 9)

At the baseline of the 30th weeks' gestation, the PAI score and the fetal position awareness score did not differ between the intervention group and the control group. Similarly, the frequency of talking to the fetus was not different between both groups at baseline (Table 10).

After the intervention programs, the PAI score in the intervention group was raised significantly at the 32nd, 34th, and 36th weeks' gestation compared to baseline ($P < 0.01$). Similarly, the control group showed an increase in the PAI scores at the 32nd, 34th, and 36th weeks' gestation ($P < 0.05$ or $P < 0.01$). Because the score increased more in the intervention group, significant differences between both groups were seen at the 34th and 36th weeks ($P < 0.01$ and $P < 0.05$, respectively) (Table 10).

The frequency of talking to the fetus in the intervention group also increased to be greater at the 32nd, 34th, and 36th weeks' gestation than at baseline ($P < 0.01$). In the control group, a significant increase was found at the 34th and 36th weeks' gestation ($P < 0.01$ and $P < 0.05$, respectively). Then, the frequency of talking to the fetus was higher in the intervention group than in the control group at the 32nd, 34th, and 36th weeks ($P < 0.05$ or $P < 0.01$) (Table 10).

Meanwhile, the maternal awareness score of fetal position increased to be significantly greater in the intervention group at the 32nd, 34th, and 36th weeks' gestation than at baseline ($P < 0.01$), as well as at the 34th and 36th weeks' gestation in the control group ($P < 0.05$ and $P < 0.01$, respectively). The score in the intervention group was then significantly higher than that of the control group at the 32nd, 34th, and 36th weeks' gestation ($P < 0.001$) (Table 10).

According to their fetal position awareness score, all subjects were divided into two subgroups of either low or high fetal position awareness, the fetal position awareness high score group (“HFPA”) for those with a score higher than the median (20 points or higher) and the low score Group (“LFPA”) for those with a score below the median (20 points).

The HFPA women at the 30th week of pregnancy comprised 15 subjects (42.9%) in the intervention group and 27 (37.0%) in the control group, which did not indicate a difference between the two groups ($P = 0.708$). However, the proportion of HFPA in the intervention group was significantly greater than in the control group at the 32nd, 34th, and the 36th weeks of pregnancy ($P < 0.01$ or $P < 0.001$). At the 36th week, the HFPA women comprised 30 subjects (85.7%) in the intervention group, and 42 (57.5%) in the control group, in which two-fifths of expectant mothers did not adequately perceive the fetal position (Table 11).

According to the median score (= 53) of the PAI scores at baseline, the subjects were divided into the following 2 groups: the low PAI group with PAI scores less than 53 and the high PAI group with scores of 53 or more.

The PAI scores increased from the 32nd week in the low PAI group of both the intervention and control groups. The scores were higher in the intervention group than those of the control subjects at the 34th weeks' gestation ($P < 0.05$). The high PAI group of the intervention group had significantly higher scores at the 34th and the 36th weeks' gestation ($P < 0.01$ and $P < 0.001$) (Table 12) .

A greater increase in the frequency of talking to the fetus was observed from the 32nd weeks' gestation in the low PAI group of the intervention group, whereas a significant increase was noted only at the 34th weeks' gestation in the control group ($P < 0.05$). The frequency of talking to the fetus was greater in the intervention group than in the control group at the 34th weeks' gestation in the low PAI group ($P < 0.05$) and at the 32nd week in the high PAI group ($P < 0.05$).

The fetal position awareness score significantly increased from the 32nd weeks' gestation in the low PAI group of the intervention group ($P < 0.01$), while a significant increase was not observed in the low PAI group of the control group until the 36th week ($P < 0.05$). The score was higher in both of the low PAI group and the high PAI group of the intervention group than those of the control group after the 32nd week ($P < 0.05$ or $P < 0.01$) (Table 12).

Discussion

In the present study, the PAI score and the frequency to talk to the fetus in the intervention group increased more greatly during pregnancy and were greater after the 32th week or the 34th weeks' gestation than in the control group. The maternal awareness score of fetal position was also higher in the intervention group after the 32nd weeks' gestation. Thus, the present nursing intervention using abdomen palpation was shown to be effective for promoting maternal-fetal attachment in normal expectant mothers.

At the 30th weeks' gestation (the baseline), there were no differences in the PAI score, the frequency of talking to the fetus, the fetal position awareness score, and the social backgrounds between the intervention group and the control group. It is known that the PAI scores are affected by age, marital status, parity, planned pregnancy, and education, and the like [29]. In this study those were not different between both groups, so that both groups under study were considered to have

similar social backgrounds.

Pregnant mothers of the normal pregnancy process naturally develop attachment to the fetuses as pregnancy progresses [16, 17, 30, 31]. Gestational age is reportedly the most powerful predictor of maternal-fetal attachment [29]. In this study as well, the maternal attachment to the fetus increased in both groups as pregnancy progressed. However, the PAI scores in the intervention group increased more greatly than in the control group, and the scores of the former subjects were significantly higher after the 34th week of pregnancy than those of the latter. Similarly, the frequency to talk to the fetus was also greater in the intervention group after the 32nd week, which may partly reflect increased maternal-fetal attachment.

The present intervention program was designed to facilitate the fetal position awareness of expectant mothers through abdominal examinations of Leopold's Maneuvers. Previously studies have suggested that maternal-fetal attachment develops especially after quickening of the fetus [22], and that a mother's sensitive

perception of fetal movements contributes to enhancing attachment to the fetus [15-18], though a recent study did not show the effectiveness of fetal movement counting on attachment [32]. It can be easier to sense fetal movement through the abdominal wall than with the central nervous system [33, 34].

In this nursing intervention program, midwives explain the fetal position by taking the hand of each participant and touching the head or the buttocks of the fetus. Such touching of the abdominal wall with midwives to perceive the fetal position could lead to more sensitive perception of fetal activity than fetal movement counting. Actually, the intervention increased the maternal awareness of the fetal position as well as maternal–fetal attachment.

The percentage of expectant mothers with high fetal position awareness increased to 85.7% by the 36th week of pregnancy in the intervention group in contrast to 57.5% at the same time in the control group. The fetal position awareness score was positively correlated with the PAI score and the frequency of talking to the fetus. It

is, hence, considered that the present nursing intervention using Leopold's Maneuvers facilitated fetal position awareness in expectant mothers, which contributed to better a maternal-fetal relationship.

In the third trimester of pregnancy, when the movements of the fetus become greater in frequency and the fetus pushes against the uterus, the position of the fetus is expected to be easily perceived by expectant mothers. Moreover, all women underwent a medical examination using ultrasound which can produce a real-time image of the fetus. However, 42.5% of expectant mothers in the control group were not adequately aware of the position of the fetus even at the 36th week of pregnancy.

On the other hand, in the intervention group, the high fetal position awareness score rose to 85.7% at the 36th week of pregnancy. The fetal position awareness score used in this study was formulated to assess maternal awareness of not only fetal movement but also position of the fetus.

These findings suggest that maternal awareness of the fetal position or movements through abdominal palpation could serve to strengthen maternal–fetal attachment. Nursing interventions that enhance fetal position awareness may be an effective method for developing maternal–fetal attachment.

It is also known that maternal attachment toward the child develops during the pregnancy by talking to the fetus or imagining the fetus [35]. Enhanced maternal awareness of the fetal position by abdominal palpation may further promote expectant mothers to feel the fetal presence, imagine the fetus figure, and communicate with the fetus, resulting in the development of maternal attachment to the fetus. In addition, social support is a moderate powerful predictor of maternal-fetal attachment [29]. The present intervention program might have partly worked as social support to pregnant women.

Prenatal examination using fetal ultrasound screening is also an effective predictor of maternal-fetal attachment [29]. The present subjects all regularly received

prenatal examination using ultrasound screening at the hospitals. In the present study, there were some expectant mothers with low PAI scores at baseline. They might have had high risks in managing their own health and postpartum child care [36]. This study showed that, even among those with low PAI scores, their scores were higher in the intervention group than in the control group after the intervention. These findings have demonstrated that the present intervention program improved maternal-fetal attachment.

O'Connor et al. (2002) indicated that low socioeconomic status, symptoms of depression, and fewer social resources of expectant mothers and families affect the mother-child relationship [37]. The present subjects were recruited from expectant mothers with normal social backgrounds. The effects of this intervention to high-risk subjects need to be investigated among pregnant women with high-risk backgrounds.

Study Strengths and Limitations

The participants were not randomly assigned to the intervention group or the control group. Hence, there may have been a bias to the motivation of the study participants. In addition, the dropout rates after the study started were 23.9% of 11 expectant mothers in the intervention group and 32.4% of 35 expectant mothers in the control group, though the dropouts were due to medical, social, or personal reasons. One of the reasons may be due to a gap of 4 to 6 weeks between the time of obtaining informed consent and that of starting investigation. However, there were no differences in the social backgrounds and maternal–fetal attachment between two groups at baseline.

Maternal-fetal attachment was assessed using a self-reported questionnaire of the PAI. The maternal awareness of the fetal position was measured with an original questionnaire. Their reliability was examined using the Cronbach’s alpha coefficient. They both showed high internal reliability.

The present subjects were 35 women in the intervention group and 73 in the control group, who were recruited in two women's hospitals that are under the same management. Further RCT (Randomized Controlled Trial) studies using more subjects from multiple institutions would be desirable to ascertain the accuracy of the present findings.

Conclusions

The present nursing intervention using abdominal palpations of Leopold's Maneuvers enhanced maternal awareness of fetal positions, maternal–fetal attachment and the frequency of the mother talking to the fetus. Nursing interventions using abdominal examinations can be useful in enhancing the maternal–fetal attachment as well as the maternal perception of the fetal position.

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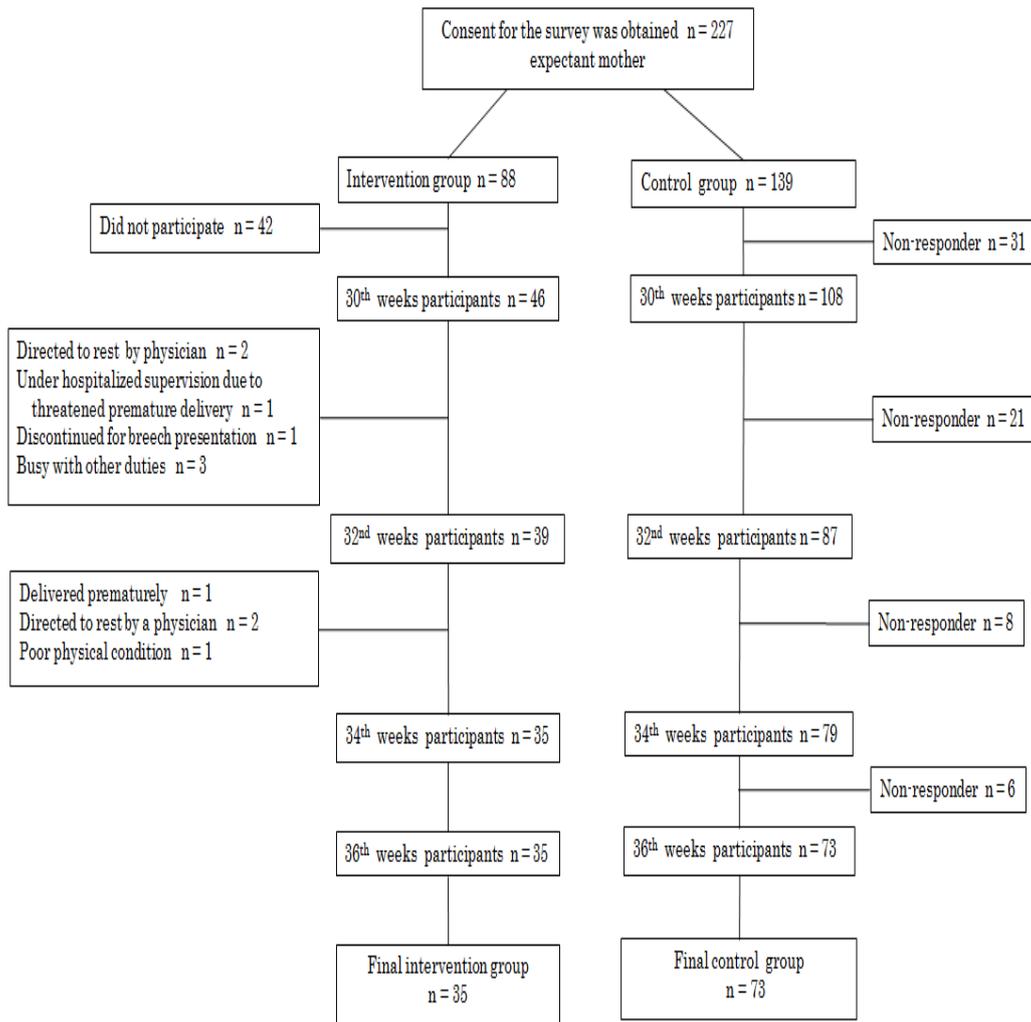


Fig 1. Schematic representation of study's sampling method.

Table 1. Characteristics of study subjects

(N = 108)

Characteristics	Category	mean (SD) or n (%)		P-value
		Intervention group (n = 35)	Control group (n = 73)	
Age in years	Expectant mother	30.3(4.7)	31.8(4.7)	0.142 ^{a)}
	Spouse	32.5(6.0)	33.0(4.9)	0.700 ^{a)}
Parity	Primigravida	26 (74.3)	42 (57.5)	0.092 ^{b)}
	Multigravida	9 (25.7)	31 (42.5)	
Family type	Nuclear family	28 (80.0)	58 (79.5)	0.720 ^{b)}
	Extended family	7 (20.0)	15 (20.5)	
Unplanned pregnancy	Yes	14 (40.0)	31 (42.5)	0.764 ^{b)}
Employment status	Employed	16 (45.7)	31 (42.5)	0.750 ^{b)}
	Unemployed	19 (54.3)	42 (57.5)	
Education Level (graduated)	< High school	0 (0)	3 (4.1)	0.440 ^{b)}
	High School	7 (20.0)	13 (17.8)	
	Specialty school	3 (8.6)	14 (19.2)	
	Junior college	10 (28.6)	21 (28.8)	
	University or above	15 (42.9)	22 (30.1)	

^{a)} Significance determined by t tests between the intervention group and the control group.

b) Significance determined by chi-square tests between the intervention group and the control group

Table 2. Comparison of BMI of the intervention group and the control group

(N = 108)

Investigation	mean(SD)		min-max		P-value ^{a)}
	Intervention group (n=35)		Control group (n=73)		
Before pregnancy	20.9 (2.2)	17.5 -27.7	20.4 (2.5)	16.0-29.0	0.615
30 th week	23.6 (2.8)	19.0- 34.1	23.5 (2.3)	19.0-30.5	0.859
32 th week	24.1 (3.0)	18.9- 34.2	23.8 (2.4)	19.1-30.5	0.654
34 th week	24.6 (3.0)	19.0-34.6	24.3 (2.4)	19.2-31.0	0.594

a) Significance determined by t tests between the intervention group and the control group.

Table 3. Adequate acceptance of social supports

(N = 108)

Variable	Category	frequency n (%)		P-value ^{a)}
		Intervention group (n = 35)	Control group (n = 73)	
Emotional support	Having	31 (88.6)	56 (76.7)	0.120
	Not Having	4 (11.4)	17 (23.3)	
Informational support	Having	25 (71.4)	46 (63.0)	0.518
	Not Having	10 (28.6)	27 (37.0)	
Experiential support	Having	28 (80.0)	43 (58.9)	0.052
	Not Having	7 (20.0)	30 (41.1)	
Substantial support	Having	33 (94.3)	59 (80.0)	0.120
	Not Having	2 (5.7)	14 (19.2)	

^{a)} Significance determined by chi-square tests between the intervention group and the control group

Table 4. Social background by PAI score of all study subjects

				(N=108)
Variable	Category	median	(IQR)	<i>P</i> -value ^{a)}
Parity	primigravida	53	(46 , 60)	0.741
	multigravida	53	(45 , 62)	
Employment status	employed	54	(47 , 61)	0.462
	unemployed	53	(45 , 61)	
Family type	unclear family	53	(46 , 60)	0.620
	extended family	56	(44 , 62)	
Unplanned pregnancy	unplanned	53	(45 , 61)	0.358
	planned	54	(47 , 62)	

PAI, Prenatal Attachment Inventory score

IQR, interquartile range

^{a)} Significance determined by Mann-Whitney *U* tests between the each category

Table 5. Social background by the fetal position awareness score of all study subjects

(N=108)

Variable	Category	median (IQR)	<i>P</i> -value ^{a)}
Parity	primigravida	18 (15 , 21)	0.294
	multigravida	19 (15 , 23)	
Employment status	employed	19 (15 , 21)	0.648
	unemployed	18 (15 , 22)	
Family type	unclear family	19 (15 , 21)	0.916
	extended family	18 (16 , 21)	
Unplanned pregnancy	unplanned	18 (14 , 20)	0.227
	planned	19 (16 , 22)	

IQR, interquartile range

^{a)} Significance determined by Mann-Whitney *U* tests between the each category

Table 6. Social background by PAI score of study subjects

(N = 108)

Variable	Category	median (IQR)		<i>P</i> -value ^{a)}	<i>P</i> -value ^{a)}
		Intervention group (n = 35)	Control group (n = 73)		
Parity	primigravida	56 (48 , 61)		0.540	0.342
	multigravida	48 (46 , 66)			
Employment status	employed	55 (47 , 60)		0.832	0.363
	unemployed	54 (46 , 63)			
Family type	uclear family	53 (46 , 62)		0.124	0.473
	extended family	60 (54 , 62)			
Unplanned pregnancy	unplanned	57 (45 , 62)		0.934	0.292
	Planned	54 (47 , 62)			

PAI, Prenatal Attachment Inventory score

IQR, interquartile range

^{a)} Significance determined by Mann-Whitney *U* tests between the each category

Table 7. Social background by the fetal position awareness score of study subjects

(N=108)

Variable	Category	median (IQR)		<i>P</i> -value ^{a)}	<i>P</i> -value ^{a)}
		Intervention group(n = 35)	Control group (n = 73)		
Parity	primigravida	19 (17, 21)	17 (13, 20)	0.838	0.128
	Multigravida	18 (16, 24)	19 (15, 23)		
Employment status	Employed	19 (16, 21)	18 (14, 21)	0.635	0.758
	Unemployed	19 (17, 22)	18 (15, 21)		
Family type	unclear family	19 (16, 22)	18 (14, 21)	0.300	0.650
	extended family	20 (18, 22)	17 (14, 20)		
Unplanned pregnancy	unplanned	18 (16, 20)	18 (14, 21)	0.145	0.673
	Planned	20 (16, 23)	19 (15, 21)		

IQR, interquartile range

^{a)} Significance determined by Mann-Whitney *U* tests between the each category

Table 8. Internal reliability (Cronbach's α) for PAI score and fetal position awareness score

(N = 108)

Variable	Investigation	median (IQR)	Cronbach's α
PAI	30 th week	53 (46 , 61)	0.884
	32 nd week	57 (49 , 63)	0.886
	34 th week	58 (50 , 64)	0.907
	36 th week	59 (52 , 66)	0.926
Fetal position awareness score	30 th week	18 (15 , 21)	0.740
	32 nd week	20 (16 , 23)	0.765
	34 th week	21 (17 , 24)	0.826
	36 th week	22 (18 , 25)	0.854

PAI, Prenatal Attachment Inventory score

IQR, interquartile range

Table 9. Spearman rank correlation coefficient of fetal position awareness score with PAI and frequency of talking to the fetus.

(N = 108)

Variable	Investigation	Fetal position awareness score			
		30 th week	32 nd week	34 th week	36 th week
PAI	30 th week	0.633**			
	32 nd week		0.515**		
	34 th week			0.614**	
	36 th week				0.678**
Frequency of talking to the fetus	30 th week	0.281**			
	32 nd week		0.338**		
	34 th week			0.402**	
	36 th week				0.396**

PAI, Prenatal Attachment Inventory

** $P < 0.01$ by the Spearman rank correlation coefficient

Table 10. Changes of maternal-fetal relationship by nursing intervention using abdominal palpations

(N = 108)

Variable	Investigation	median (IQR)		P - value ^{a)}
		Intervention group (n = 35)	Control group (n = 73)	
PAI	30 th week	54 (47, 62)	53 (45, 61)	0.546
	32 nd week	57 (54, 65)**	56 (49, 63)**	0.149
	34 th week	61 (55, 70)**	57 (50, 62)*	0.006
	36 th week	64 (57, 69)**	58 (51, 63)**	0.021
Frequency of talking to the fetus	30 th week	3 (2, 6)	3 (2, 5)	0.330
	32 nd week	5 (3, 10)**	3 (2, 5)	0.004
	34 th week	5 (3, 10)**	4 (2, 6)**	0.005
	36 th week	5 (3, 10)**	4 (2, 5)**	0.015
Fetal position awareness score	30 th week	19 (16, 22)	18 (15, 21)	0.270
	32 nd week	22 (20, 24)**	19 (15, 22)	< 0.001
	34 th week	24 (21, 27)**	18 (16, 23)*	< 0.001
	36 th week	24 (22, 27)**	21 (17, 23)**	< 0.001

IQR, interquartile range

PAI, Prenatal Attachment Inventory

* $P < 0.05$, ** $P < 0.01$ by the Wilcoxon signed-rank test compared to the 30th week (baseline)

^{a)} Significance determined by Mann-Whitney U tests between the intervention group and control group

Table 11. Changes of fetal position awareness after intervention using Leopold's Maneuvers

(N=108)

Variable	Investigation	frequency n (%)		P-value ^{c)}
		Intervention group (n = 35)	Control group (n = 73)	
HFPA ^{a)}	30 th week	15 (42.9)	27 (37.0)	0.708
LFPA ^{b)}		20 (57.1)	46 (63.0)	
HFPA	32 nd week	27 (77.1)	34 (46.6)	0.005
LFPA		8 (22.9)	39 (53.4)	
HFPA	34 th week	30 (85.7)	31 (42.5)	< 0.001
LFPA		5 (14.3)	42 (57.5)	
HFPA	36 th week	30 (85.7)	42 (57.5)	0.007
LFPA		5 (14.3)	31 (42.5)	

^{a)} HFPA = the group with high score of fetal position awareness

^{b)} LFPA = the group with low score of fetal position awareness

^{c)} P values by chi-square test between the intervention group and the control group.

Table 12. Comparisons of frequency of talking to the fetus, fetal position awareness score between the Low PAI Group and the High PAI Group.

(N=108)

Variable	Investigation	median (IQR)		P- value ^{c)}	
		Intervention group (n = 35)	Control group (n = 73)		
PAI	Low PAI group ^a	30 th week	45 (41 - 48)	45 (43 - 49)	0.947
		32 nd week	54 (45 - 57) ^e	49 (45 - 52) ^d	0.063
		34 th week	55 (46 - 61) ^e	50 (43 - 54) ^e	0.039
		36 th week	57 (48 - 61) ^e	53 (44 - 58) ^d	0.268
	High PAI group ^b	30 th week	60 (56 - 63)	60 (57 - 64)	0.918
		32 nd week	62 (57 - 68)	62 (57 - 67)	0.837
		34 th week	68 (59 - 72) ^e	62 (58 - 66)	0.032
		36 th week	68 (61 - 76) ^d	62 (57 - 69) ^f	0.035
Frequency of talking to the fetus	Low PAI group	30 th week	2 (1 - 3)	2 (2 - 3)	0.261
		32 nd week	3 (1 - 10) ^e	2 (1 - 3)	0.204
		34 th week	5 (2 - 10) ^d	2 (2 - 4) ^f	0.024
		36 th week	3 (2 - 7) ^e	2 (2 - 4)	0.088
	High PAI group	30 th week	5 (3 - 7)	3 (1 - 6)	0.167
		32 nd week	5 (4 - 8)	3 (1 - 5)	0.032
		34 th week	5 (3 - 10)	5 (2 - 7) ^f	0.156
		36 th week	6 (3 - 10) ^e	4 (2 - 7) ^e	0.117
Fetal position awareness score	Low PAI group	30 th week	16 (14 - 18)	16 (13 - 20)	0.982
		32 nd week	20 (19 - 22) ^d	17 (13 - 20)	0.005
		34 th week	21 (18 - 24) ^d	16 (14 - 20)	0.005
		36 th week	22 (19 - 24) ^d	18 (15 - 22) ^f	0.002
	High PAI group	30 th week	21 (19 - 23)	19 (17 - 23)	0.174
		32 nd week	23 (21 - 25) ^f	21 (16 - 23)	0.028
34 th week	25 (23 - 27) ^d	21 (17 - 25) ^e	0.003		
	36 th week	26 (23 - 28) ^d	22 (18 - 25) ^e	0.003	

IQR, interquartile range

PAI, Prenatal Attachment Inventory

a) Low PAI Group, Subjects at the 30th week of pregnancy with PAI scores below the median; n = 14 for the intervention group and n = 35 for the control group

b) High PAI Score Group, Subjects at the 30th week of pregnancy with PAI scores over the median; n = 21 for the intervention group and n = 38 for the control group

c) *P* values by Mann-Whitney *U* test between the intervention group and control group

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$ by Wilcoxon signed-rank test compared to the 30th week

(baseline)