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Original Research

Prenatal education program decreases postpartum depression and increases maternal confidence: A longitudinal quasi-experimental study in urban Japan

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ABSTRACT

Background: Mothers in urban Japan are at high risk for postpartum depression. Previous research indicates that parents who understand their baby's behavior may have lower risks for postpartum depression. HUG Your Baby helps parents understand their baby's behavior.

Aim: The purpose of this longitudinal study was to determine whether mothers receiving prenatal HUG Your Baby teaching would have better outcomes than a control group with respect to postpartum depression and related factors.

Methods: Pregnant women, after thirty weeks' gestation, were recruited to either the intervention or the control group. The intervention group received HUG Your Baby education, which teaches how to recognize and respond to a baby's behavior. The control group received a leaflet and regular, prenatal treatment. Participants completed the Edinburgh Postnatal Depression Scale, Karitane Parenting Confidence Scale, and three other scales at one and three months, postpartum. Questions about knowledge of baby's behavior was administered prenatally, and at one and three months, postpartum.

Findings: Data derived from 221 mothers (Control 100, Intervention 121) were included in the analysis. Researchers found significant differences regarding postpartum depression at one and three months and parenting confidence at one month. Scores were favorable for the intervention group.

Conclusions: The HUG Your Baby program has a positive impact on preventing postpartum depression and increasing parenting confidence. It warrants wider implementation and evaluation in prenatal programs.

Statement of significance

Problem

Mothers who live in nuclear families in urban Japan are at increased risk for postpartum depression.

What is already known

Teaching parents to understand their baby's behavior possibly reduces risks for postpartum depression. HUG Your Baby was developed to help parents understand their baby's behavior. The program has been found to increase fathers' knowledge of preterm

Abbreviations: HUG, Help Understanding Guidance; MoHLW, Ministry of Health, Labor and Welfare; NICU, Neonatal Intensive Care Unit; SOSs, Signs of Over Stimulations; EPDS, Edinburgh Postnatal Depression Scale; J-MCQ, Japanese version of Maternal Confidence Questionnaire; GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index; KPCS, Karitane Parenting Confidence Scale; MAI-J, Maternal Attachment Inventory Japanese Version.

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infants in NICU as well as to decrease maternal stress and increase maternal confidence in mothers with babies in a Special Care Nursery.

What this paper adds

Mothers who received HUG Your Baby education in Japan showed significantly reduced scores on tools that measure postpartum depression and significantly increased scores on tools that measure parenting confidence, compared to a control group. Thus, HUG Your Baby education was shown to have a positive impact on preventing postpartum depression and increasing parenting confidence.

Introduction

Mothers in Japan today are giving birth later in life and living in nuclear (rather than extended) families in cities. These changes in lifestyle potentially reduce the support new parents receive and may contribute to the rising rate of maternal postpartum depression which is becoming a public health concern [1]. Japan's Ministry of Health, Labor and Welfare (MoHLW) [2] has been running an initiative, "Healthy Parents and Children 21 (2nd Phase)," with two aims: (1) to support parents who face difficulties raising their children, and (2) to prevent child abuse from pregnancy onward.

Large-scale and nation-wide birth cohort studies [3–7] in Japan confirm that Japanese mothers suffer from anxiety and depression. Postpartum depression was shown to be associated with poor maternal infant bonding [3] as well as with increased prevalence of conditions such as wheezing and asthma [7]. One study reveals that first-time mothers have increased postpartum depression and decreased maternal-infant bonding compared to multiparas [5]. Another study draws attention to the relationship between anxiety/depression and maternal-infant bonding. Anxiety/depression scales were higher in primiparas than in multiparas [8]. The current authors surmised that interventions such as those using videos to depict newborn behaviors and effective parenting strategies would likely decrease postpartum depression and increase maternal-infant bonding in primiparas.

Evidence is widely available regarding negative relationships between postpartum depression and self-efficacy [9–11]. Bandura [12] defines self-efficacy as "the conviction that one can successfully perform the actions required to produce results." Coleman and Karraker [13] show that self-efficacy is strongly correlated with positive child-rearing behaviors, and that maternal depression, children's tantrums, lack of social support and poverty are factors that negatively impact effective parenting. Recent studies confirm that mothers with depression and anxiety, mothers who suffered parental abuse during their childhood, and mothers with attachment avoidance all tend to have lower self-efficacy [14].

In traditional Japanese culture, grandparents and other extended family members provide support for new mothers. More recently, many Japanese mothers prefer that grandparents and others should remain "properly distant" and that their partners should participate more actively in parenting [15]. However, paternal participation in parenting is still very limited in Japan. MoHLW recently reported that mothers of children six years old or less parented 7 h and 27 min per day, whereas the fathers of those children averaged just one hour per day. This rate of paternal participation in parenting is the lowest among developed countries [16].

Research by Ito et al. reveals more about the role of fathers in Japan [17]. These researchers indicate that the higher the level of paternal parenting, the lower the level of maternal anxiety. However, greater paternal participation leads to more formula use and lower breastfeeding rates [18]. This decline in breastfeeding may suggest the need to give fathers more information about the benefits of exclusive breastfeeding, about strategies to support a breastfeeding partner, and about techniques to engage with infants in ways other than feeding. While oxytocin increases in breastfeeding mothers and enhances bonding [19], fathers who spend more time in caregiving activities also have higher oxytocin levels [20]. Perhaps that is why Japanese fathers who spend more time parenting report greater happiness and a sense of having gained maturity from parenting their child [21].

In Japan, as in other countries, it often is the responsibility of midwives to educate both mothers and their partners about infant behavior and parenting, so that both can parent with confidence. The HUG (Help-Understanding-Guidance) Your Baby program was developed in the United States by Jan Tedder, a family nurse practitioner and lactation consultant. Tedder was recently named the American Nurses Association "Nurse Innovator" of the year (2020) for her work developing HUG Your Baby, which is currently available in English, Japanese, Italian, Dutch, Spanish, and Farsi. This program has been presented in 46 countries and is used in clinical settings throughout the world [22,23]. For example, HUG Your Baby was used to educate Iranian fathers of NICU babies, who then showed increased knowledge of infant behavior, and decreased stress, when compared to a control group [24]. More recently, the program was applied to a Special Care Nursery and found to decrease maternal stress and to increase maternal confidence [25].

The first and second authors of the present article translated the English version of HUG Your Baby into Japanese. A professional translator was hired to confirm the accuracy of the content by back-translating from Japanese to English. The Japanese HUG Your Baby program was well-received when first introduced to health care providers and university midwifery students in 2013 [26]. A subsequent study evaluated Japanese mothers' responses to the HUG program, and that research indicated both the need for this kind of parent education and the positive perceptions of the mothers who received Japanese HUG Your Baby teaching [27]. The present study took a further step. It examined whether differences might be found, using standardized measures of maternal psychology, between mothers who received HUG Your Baby teaching and mothers who did not. The primary outcome of the present study was that HUG Your Baby education was shown to reduce postpartum depression. Secondary outcomes included: increased parent confidence, decreased maternal distress and greater maternal knowledge about and attachment to her baby.

Method

Study design and setting

The present study employed a longitudinal, quasi-experimental design, with an intervention and a control group, to examine differences in postpartum depression and related factors at one month, and at three months postpartum. In order to prevent sharing of the intervention tool (and potential contamination of the intervention group), data collection was completed in the control group before it was begun in the intervention group. Data was collected from only one control and one intervention group. Women (at 30 weeks' gestation or later) who were interested in this study were assigned to the group available during their pregnancy. Therefore, random assignment was not used.

From February 2015 to February 2016 recruitment took place in the antenatal clinics of a birth center and of a hospital in Tokyo, Japan. The birth center had 19 beds; the hospital's obstetric ward had 31 beds. Since this was the first project to apply the HUG Your Baby program with Japanese mothers, the study took place at only the researchers' institution. A recruitment poster informed potential participants about the purpose and content of the study. Pregnant women could scan a QR on the poster to register for it.

Once a pregnant participant registered for the study, she received an email containing either (1) an online questionnaire, or (2) information about HUG Your Baby. Prior to completing the online questionnaire, women in the control group were asked to read, and agree to, details of the study. Women in the intervention group received the same

information about details of the study and were asked to answer the questionnaire when they came to the HUG Your Baby class.

HUG Your Baby is based upon T. Berry Brazelton's Neonatal Behavioral Assessment Scale (NBAS) [28] and *Touchpoints* [29], as well as other literature from pediatric developmental science and lactation research [30]. The HUG program aims to help parents understand their baby's behavior and to respond with appropriate parenting techniques. Understanding a baby's behavior has been shown by previous studies to increase parenting confidence, maternal self-efficacy, and father's participation in parenting—and enhance parent-infant interaction, infant development [31], and breastfeeding duration [32]. Research has also shown that mothers with anxiety and depression are not able to identify their baby's smile [33]. Thus, the intervention program was designed to teach parents about infant behavior in order to promote parent-infant attachment and prevent postpartum depression.

The HUG Your Baby intervention class lasted approximately two hours. The first half was a lecture on the ideas described above. The first and second authors were the lecturers; they used a PowerPoint presentation and the HUG Your Baby 20-min parent video (both in Japanese) to explain the program's two essential skills. The first skill is to understand newborn sleep-wake cycles and a baby's states (Resting/Ready/Rebooting "Zones"). Understanding the three "Zones" (rather than the six "states" described in child development literature) empowers parents to notice when their baby is ready to eat, sleep, or play.

The second skill that HUG Your Baby teaches is how to respond to a baby's stress response. Since the phrase, "stress response," can convey negative connotations to parents, HUG Your Baby uses instead the phrase, "Signs of Overstimulation (SOSs)." SOSs include physical responses such as changes in skin color, movement or breathing, and behavioral responses such as gaze aversion. The lecture given to the intervention group also included HUG Your Baby's *Roadmap to Breastfeeding Success* (in Japanese) (Fig. 1), a handout that teaches about child development and its impact on breastfeeding from birth to one year.

The second half of the intervention class included participatory activities, which are known to have a positive impact on learning, according to Medical Professional Workshop Guide [34]. Participants learned safe swaddling practices by using a baby doll. HUG Your Baby recommends swaddling only after breastfeeding is well established, only for short amounts of time, and only until about four months of age, when a baby begins to roll over. The HUG Your Baby parent video, the *Roadmap* handout, and an appropriate cloth for swaddling were provided to intervention group participants for use at home.

Data collection and participants

The intervention group met in a university classroom in Tokyo. Ten to fifteen mothers attended each class. Participants were asked to complete a questionnaire that included socio-economic and clinical data, as well as their contact details. Each mother indicated how they preferred to be contacted at one month and at three months after the birth of their child (mail or email). The same data and contact preferences were collected from control group participants.

The pregnant women who took part in the study were both primiparas and multiparas, as a preliminary study had shown that the intervention was effective with both groups [27]. Pregnant women with serious complications were excluded from both the control and intervention groups because such complications might have prevented their participation in the class and/or significantly impacted their postpartum experience.

An appropriate sample size was calculated for a two-sided alternative

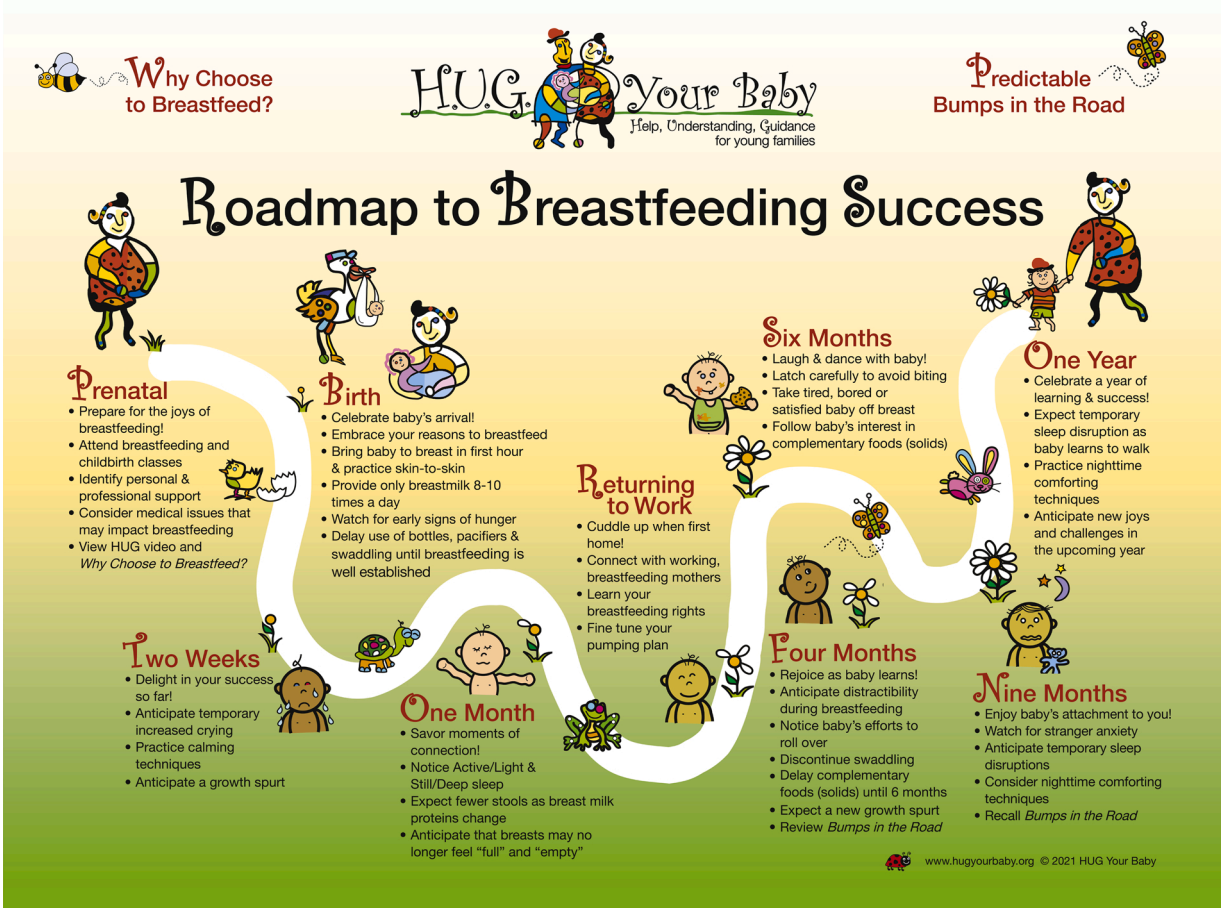

Fig. 1. Roadmap to breastfeeding success (English version).

and normal distributions with the same variances. Sixty-four was deemed to be a good sample size for detecting a difference (10 points) between groups at a 5% level of significance with 80% power. Assuming a 20% rate of missing data at each of the follow-ups, the minimum number of participants needed for the pregnancy period (baseline) was set at 200 (100 in each group).

Socio-economic and clinical data were collected on both mothers and their infants using a questionnaire designed by the researchers. It included maternal age, gestational age, parity (primipara; multipara), employment (not employed; part-time), main support after birth (biological mother; only from partner; others), occupation (administration; health & welfare; skilled; unskilled; others), educational (graduate school; high school; junior college; technical college), marital status (not married; married; plan to marry), family income (3–5 million yen; 5–7 million; 7–9 million; above 9 million), mode of childbirth, infant weights and gender, and breastfeeding status (whether exclusive, mostly breastmilk, mostly formula, or formula only).

Primary outcome

The Edinburgh Postnatal Depression Scale (EPDS) [35] in Japanese is a 4-point Likert scale questionnaire that identifies postpartum depression symptoms. It is generally used in Japan with ten items, each rated from 0 to 3 (0 indicating better health). Total scores range from 0 to 30. A study conducted by Okano et al. set a score of 9 points as the cut-off. The sensitivity of this scale was 75%, while its specificity was 93%. Cronbach's alpha was 0.78 in normal-term pregnant women, 0.67 at one month postnatal, and 0.74 at three months.

Secondary outcomes

The Karitane Parenting Confidence Scale (KPCS) has fifteen items, scored on a 4-point Likert scale [36]. Scores range from 0 to 45, and higher scores indicate greater confidence. This tool, developed in Australia and available in Japanese, measures self-efficacy in parenting. In the two-factor model without items 9, 12 and 15, the first factor of the best-fitting model included KPCS items 2–8, all with factor loadings of >0.35. The Cronbach's alpha coefficients of the "self-efficacy for infant care" and the "self-efficacy for parental role" subscales were 0.84 and 0.72, respectively.

Parents' knowledge of baby's behavior was assessed in both groups by means of ten Yes/No questions created by the researchers. Specific terminology used in the HUG Your Baby program was replaced with more general terms in order to measure the knowledge and perceptions of both groups of mothers.

Tabuchi and Shimada's Maternal Difficulty with Infant Crying Scale [37] is an 11-item, 4-point Likert tool used in Japan to measure difficulties in caring for crying babies. Scores range from 11 to 44, and higher scores indicate better understanding of baby's crying and less maternal stress. Validity and reliability of this scale were examined. The first factor's contribution rate was 22%; the accumulated contribution rate was 41.2%; Cronbach's alpha was 0.84.

The Japanese version of the Maternal Confidence Questionnaire (J-MCQ) has fourteen items, scored on a 5-point Likert scale. Scores range from 14 to 70, and higher scores indicate greater confidence [38]. This tool measures a mother's confidence to parent and to identify her child's needs. Validity and reliability were examined. Exploratory factor analysis revealed at one month after birth GFI = 0.935 and AGFI = 0.908, and at four months after birth GFI = 0.937 and AGFI = 0.906. Cronbach's alpha at one month was 0.837; at four months it was 0.798.

The Maternal Attachment Inventory Japanese Version (MAI-J) assesses maternal-infant attachment. This tool consists of eight items, each measured on a 4-point Likert scale [39]. Scores range from 8 to 32, and higher scores indicate greater attachment. Validity and reliability were examined; factor analysis revealed the eigenvalue of the first factor to be 5.4; proportion of variance explained was 68.7%, and "can explain" was almost 70%. The Cronbach's alpha was 0.94.

Data analysis

Data from the paper questionnaires were entered, checked, and merged with data from the electronic questionnaires, which were automatically sorted. The merged data was analyzed using R version 3.0.1 and Oracle® R Enterprise version 1.4.1 (Oracle, Redwood Shores, CA, USA). Socio-demographic characteristics were presented as mean with standard deviation or frequency and compared between groups by non-paired t-tests for continuous variables and chi-square tests for categorical variables. To explore the association between the intervention and each of all primary and secondary outcomes, the researchers conducted multiple regression analyses. Independent variables included age and gestational age as continuous variables—and parity, education, employment, family income, and main support after birth as nominal variables. We did not include marital status and occupation because some of the category groups of these variables did not include any pregnant women, and regression analyses could not run if empty data sets were included.

The researchers hypothesized that data were missing at random for our study cohort and used multiple imputation to replace missing values on all independent and dependent variables excluding one participant in the control group, who agreed to participate but never answered a questionnaire. For multiple imputation, we imputed 10 datasets by chained equations (R package: "mice"; R Foundation for Statistical Computing, Vienna, Austria), and then combined estimations from these equations with Rubin's rules for combining multiply-imputed data. All statistical analyses were two-tailed, and the threshold of significance was $P < 0.05$. The fourth, fifth and sixth authors sorted the data and conducted the basic analysis. The third author conducted the basic and multiple regression analysis. The first author supervised and checked all the analyzed results.

Ethical considerations

The Research Ethics Committee of St. Luke's International University approved implementation of this study (No. 14-092). Participation was voluntary, and participants were assured that data would be anonymous and confidential. Data were stored in locked cabinets and computers, accessible only by the research team members.

Findings

Demographic characteristics

In total 222 women (121 in the intervention group and 101 in the control group) agreed to participate in the study. As one person did not answer the questionnaire, the number of answered questionnaires were 221 (121 in the intervention group and 100 in the control group). Attrition rates were 28.4% at one month after birth, and 2.5% at three months. More participants left the control group than the intervention group. 177 (105 in the intervention group and 72 in the control group) answered the questionnaire at one month, and 171 (102 in the intervention group and 69 in the control group) answered the questionnaire at three months. Because multiple imputation was used for analysis, the sample size of the present study is 221.

Demographic characteristics of the women in both groups are displayed in Table 1. The mean age was 34.55 (SD4.32) in the intervention group and 35.33 (SD4.1) in the control group. Most participants were married and had university or higher education. In both groups, more than half the women worked full time (62.0% and 62.0%, respectively). The majority worked in administration (30.6% and 38.0%, respectively), and their family income was more than 900 million yen (57.9% and 56.0%, respectively). No significant differences were found between the two groups with respect to mothers' age, gestational age at the baseline, education levels, employment, occupation, or family income. However, differences were observed between the two groups in terms of

Table 1
Sociodemographic and clinical characteristics of the participants.

	Control	Intervention	P-value
n	100	121	
Age (mean (SD))	35.33 (4.10)	34.55 (4.32)	0.173
Gestational age (mean (SD))	35.05 (2.60)	34.39 (2.80)	0.077
Parity (%)			0.002*
Primipara	58 (58.0)	96 (79.3)	
Multipara	41 (41.0)	25 (20.7)	
NA	1 (1.0)	0 (0.0)	
Marital status (%)			0.354
Not married	1 (1.0)	0 (0.0)	
Married	98 (98.0)	120 (99.2)	
Plan to marry	0 (0.0)	1 (0.8)	
NA	1 (1.0)	0 (0.0)	
Education (%)			0.323
High school	5 (5.0)	2 (1.7)	
Junior college	9 (9.0)	12 (9.9)	
Technical college	8 (8.0)	12 (9.9)	
University or above	76 (76.0)	95 (78.5)	
NA	2 (2.0)	0 (0.0)	
Employment (%)			0.959
Not employed	30 (30.0)	37 (30.6)	
Full-time	62 (62.0)	75 (62.0)	
Part-time	7 (7.0)	7 (5.8)	
NA	1 (1.0)	2 (1.7)	
Occupation (%)			0.052
Administration	38 (38.0)	37 (30.6)	
Health & Welfare	11 (11.0)	11 (9.1)	
Others	0 (0.0)	9 (7.4)	
Skilled	14 (14.0)	17 (14.0)	
Unskilled	7 (7.0)	16 (13.2)	
NA	30 (30.0)	31 (25.6)	
Family income (%)			0.448
3 to 5 million [30 K–50 K USD]	6 (6.0)	10 (8.3)	
5–7 million [50 K–70 K USD]	14 (14.0)	11 (9.1)	
7–9 million [70 K–90 K USD]	23 (23.0)	25 (20.7)	
Above 9 million [90 K USD]	56 (56.0)	70 (57.9)	
NA	1 (1.0)	5 (4.1)	
Main support after birth (%)			0.167
Biological mother	58 (58.0)	53 (43.8)	
Only from partner	34 (34.0)	59 (48.8)	
Others	7 (7.0)	8 (6.6)	
NA	1 (1.0)	1 (0.8)	
Mode of birth (%)			0.68
Emergency caesarean section	7 (7.0)	14 (11.6)	
Planned caesarean section	6 (6.0)	8 (6.6)	
Vaginal	59 (59.0)	65 (53.7)	
NA	28 (28.0)	34 (28.1)	
Infant gender (%)			0.144
Boy	34 (34.0)	54 (44.6)	
Girl	38 (38.0)	32 (26.4)	
NA	28 (28.0)	35 (28.9)	
Breastfeeding at 1month (%)			0.898
Exclusive	33 (33.0)	36 (29.8)	
Majorly breastfeeding	29 (29.0)	37 (30.6)	
Majorly formula	9 (9.0)	14 (11.6)	
NA	29 (29.0)	34 (28.1)	
Breastfeeding at 3month (%)			0.604
Exclusive	42 (42.0)	41 (33.9)	
Majorly breastfeeding	19 (19.0)	27 (22.3)	
Majorly formula	7 (7.0)	12 (9.9)	
NA	32 (32.0)	41 (33.9)	
Infant weight (mean (SD))	3147.38 (412.92)	3049.48 (369.52)	0.118

SD: standard deviation, *: P-value < 0.05.

parity. The intervention group had more primiparous women, whereas more multiparas women were in the control group.

Clinical characteristics of the women in both groups are also shown in Table 1. The average gestational age at the time of answering the baseline survey was 34.39 weeks (SD = 2.8) in the intervention group and 35.05 weeks (SD = 2.6) in the control group. Infants' weights at birth were close to the average of newborn babies in Japan and showed normal development at 1 and 3 months in both groups. No significant differences were observed between the groups in terms of mode of birth, infant's sex, or exclusive vs. partial breastfeeding at one month and three months. Nor were significant differences observed between the two groups in terms of infant's weight at birth, at one month, or at three months.

Comparison of the means

Table 2 compares the mean and standard deviation at baseline (pre-test), one month, and three months for each measurement outcome. Analysis of these data found significant differences between the two groups with respect to: knowledge of baby's behavior (baseline, one month, and three months) ($p < 0.01$); KPCS scores at one month ($p < 0.01$); and EPDS scores at three month ($p < 0.01$). These outcomes showed greater improvement in the intervention group than in the control group.

As for the J-MCQ, the MAI-J, and the Tabuchi and Shimada's Difficulty with Infant Crying Scale, no significant differences were observed between the two groups. Comparison of the EPDS cut-off scores (9 or above) at one month and three months showed no difference between the two groups.

Multiple regression with the adjustment of demographic characteristics and baseline scores

Table 3 shows the results of multiple regression with the adjustment of demographic characteristics and baseline scores of knowledge of baby's behavior. A significant difference was observed in EPDS scores,

Table 2
Simple comparison of means of the two groups.

	Control	Intervention	Range	P-value
n	100	121		
Prenatal Knowledge (mean (SD))	7.06 (1.40)	7.87 (1.52)	2–10	<0.001*
Knowledge at 1st month (mean (SD))	8.06 (1.42)	9.09 (0.89)	4–10	<0.001*
Knowledge at 3rd month (mean (SD))	8.12 (1.51)	9.24 (0.82)	4–10	<0.001*
EPDS at 1st month (mean (SD))	6.93 (5.28)	5.66 (4.13)	0–22	0.093
EPDS at 3rd month (mean (SD))	6.10 (3.07)	4.00 (3.79)	0–16	<0.001*
EPDS ≧ 9 at 1st month (n (%))			NA	0.731
No	50 (50.0)	66 (54.5)		
Yes	22 (22.0)	22 (18.2)		
NA	28 (28.0)	33 (27.3)		
EPDS ≧ 9 at 3rd month (n (%))			NA	0.676
No	56 (56.0)	74 (61.2)		
Yes	12 (12.0)	11 (9.1)		
NA	32 (32.0)	36 (29.8)		
J-MCQ at 1st month (mean (SD))	47.90 (8.17)	48.42 (7.48)	30–64	0.68
J-MCQ at 3rd month (mean (SD))	54.03 (6.84)	54.89 (6.79)	31–70	0.438
KPCS at 1st month (mean (SD))	28.11 (5.89)	34.42 (7.48)	11–48	<0.001*
KPCS at 3rd month (mean (SD))	32.63 (5.75)	32.20 (5.32)	14–45	0.641
MAI-J at 1st month (mean (SD))	29.78 (3.77)	29.70 (3.88)	10–32	0.9
MAI-J at 3rd month (mean (SD))	29.97 (3.71)	30.95 (2.66)	16–32	0.059
Difficulty with Infant Crying Scale at 1st month (mean (SD))	28.15 (4.52)	29.23 (4.71)	14–39	0.146
Difficulty with Infant Crying Scale at 3rd month (mean (SD))	31.22 (4.46)	31.77 (5.17)	16–42	0.487

SD: standard deviation, *: P-value < 0.05.

Table 3
Outcomes of multiple regression analysis.

	Coefficient	95% CI		P-value
		Low	High	
Knowledge difference at 1st month	0.420	−0.127	0.966	0.138
Knowledge difference at 3rd month	0.407	−0.107	0.920	0.123
EPDS 1 month	−1.567	−3.046	−0.088	0.042*
EPDS 3 month	−1.891	−3.073	−0.708	0.003*
J-MCQ at 1st month	0.937	−1.248	3.121	0.403
J-MCQ at 3rd month	0.420	−0.127	0.966	0.138
KPCS at 1st month	6.297	4.359	8.235	<0.001*
KPCS at 3rd month	−0.116	−1.865	1.633	0.897
MAI-J at 1st month	−0.213	−1.357	0.932	0.717
MAI-J at 3rd month	0.736	−0.261	1.733	0.154
Difficulty with Infant Crying Scale at 1st month	1.355	−0.124	2.835	0.078
Difficulty with Infant Crying Scale at 3rd month	0.718	−0.792	2.227	0.354

*: P-value < 0.05. Knowledge was the difference between prenatal score and the score at 1st or 3rd month.

both at one ($p < 0.05$) and at three months ($p < 0.01$). A significant difference in KPCS scores at one month ($p < 0.01$) was also observed. As for the knowledge of baby's behavior the J-MCQ and the MAI-J, and the Tabuchi and Shimada's Difficulty with Infant Crying Scale, no significant differences were observed between the two groups' scores.

Discussion

The present study showed significant findings in the primary outcome: lowering the risk for postpartum depression in the intervention group. Since the mean EPDS scores were high among participants in this study (6.93 and 5.66 in the control and the intervention group at 1 month, respectively), the participants in the present study were at higher risk for postpartum depression as compared to a recently studied cohort drawn from throughout Japan [3,4,5,6]. (That cohort's mean EPDS scores at one month and six months were 5.1 and 4.6, respectively.) Thus, it can be said that the HUG Your Baby intervention decreased maternal depression in high-risk mothers living in urban Japan.

Significant findings were also observed with respect to the secondary outcome, parenting confidence as measured by KPCS. The intervention group had high scores (i.e., much confidence) at one month, which persisted at three months. The control group had lower KPCS scores (i.e., less confidence) at one month, but their scores significantly increased, and caught up with, the intervention group at three months. Since the KPCS is a task-specific scale designed for practitioners and researchers to use in a clinical setting with parents of infants aged 0–12 months [40], one might expect scores to increase as mothers spend more time with their babies. Though the scores of the two groups did not exhibit a statistically significant difference at three months, the intervention group's higher confidence at one month is notable, since a major postpartum depressive disorder typically has its onset within one month after giving birth [41]. These findings are supported by another Japanese study that evaluated the HUG Your Baby program [27]—a study which showed that the HUG Your Baby class was useful for learning to calm crying babies, for learning from other parents, and for sharing its educational materials with partners and extended family members.

Although use of postpartum care centers has increased recently in Japan, early parenting support is not routinely provided between the birth facility discharge at day 4–5 and the baby's one-month check-up. A postnatal study by Komoto et al. [42] provided individual mother-child dyads a 60−90-min session designed to promote responsiveness of mothers to their child. These mothers increased their responsiveness to their children's cues and decreased their parenting stress and negative emotions. In contrast to Komoto's study, the present intervention achieved statistically significant positive outcomes on postpartum depression and maternal confidence by providing a two-hour class and parent education resources. Educators who complete a twelve-hour HUG Your Baby Teacher curriculum can readily be trained to replicate this intervention [43].

Though "live" classroom teaching, as utilized in the present study, enhances social connections and promotes hands-on learning, the COVID-19 pandemic caused HUG Your Baby to broaden its outreach efforts beyond face-to-face encounters. Because HUG's family-friendly language (*Zones* and *SOSs*), engaging graphics (*Roadmap to Breastfeeding Success*) and video-rich resources allow parents and professionals to see, rather than just to hear or read about, a baby's behavior, HUG Your Baby is now especially well-positioned for virtual teaching. The newly developed *HUG Your Baby Digital Parent Resource Page* [44], currently available in English and Spanish, provides ongoing, virtual child development and breastfeeding education (birth to one year). To enhance the use and availability of these resources, HUG Your Baby offered free introductory Zoom classes for parents and professionals during the pandemic. More than 600 parents and 4000 professionals from ten countries attended HUG Your Baby Zoom presentations from March 2020 to September 2021 [45]. Favorable results were published about the implementation of HUG Your Baby virtual training and resources by state-wide lactation programs in the United States [46]. Furthermore, several major nursing schools in the USA report that offering their students a two-hour online HUG course enhanced both their knowledge of baby's behavior and their confidence to teach parents [47]. Similar outcomes have been reported by HUG trainers working with professionals and parents in Asia-Pacific, Europe, and North and South America.

Limitations of this study were identified. Since participants in the present study were more urban, had more education, and earned higher incomes than the mean Japanese population, generalizations drawn from the present study need careful consideration and qualification. Participants in the present study also appear to have been at greater risk for postpartum depression than the general Japanese population is. In comparable studies, local characteristics of participants were also incongruent. For example, in the study conducted by Mishina et al. [48] the households receiving public assistance had a positive correlation with rates of postpartum depression symptoms ($r = 9.90$, $p = 0.04$). As those authors stated, not only individual income but also social capital is an important factor to consider—as a study in Sweden [49] suggested. Future studies need to better account for the support that participating mothers receive, both in terms of individual income and of resources that benefit them in the surrounding community (i.e., social capital).

Because maternal attachment seemed to exhibit a ceiling effect in the intervention group, attachment might have been better measured by using an evaluation of interaction. For example, Matthies et al. [50] measured maternal trait-anxiety and early infant regulatory problems and found that these factors were important predictors for maternal self-confidence. Also, Swain et al. [51] found that their attachment-based parenting intervention decreased parenting stress and increased child-focused responses in social brain areas and brain function, which are key components of reflective self-awareness and decision-making neurocircuitry.

Finally, Kashiwabara et al., who interviewed mothers choosing to participate in the HUG Your Baby class, suggested that selection bias could be a limitation of the present study [27]. The requirement of the intervention group to attend a HUG Your Baby class might have been an obstacle for multiparas. Mothers who choose to participate in the class most often responded that they were interested in the positive message of HUG Your Baby and thought it would make their parenting easier. Thus, the content and implementation of the HUG Your Baby program tended to convey to mothers a positive impression about understanding their own baby.

Conclusion

The present study from Japan shows that the HUG Your Baby parent education program, administered prenatally, has positive effects on preventing postpartum depression and increasing parenting confidence. The growing research base for this program suggests that it should be continued, expanded (perhaps with a greater virtual component), and more closely studied by other researchers to better understand and develop its proven potential to increase positive parenting experiences, both in Japan and elsewhere in the world.

Author contributions

YSh, MI, and SH conceptualized and designed the study. YSh, MI, YSe, KN, and SH performed the intervention. YSh, MI, YSe, and AK contributed to data collection and data management. NH, KT, TT, and AK contributed to data analysis and drafting the tables. YSh drafted the manuscript, and all authors contributed to its content and approved its submission.

Ethical statement

The Research Ethics Committee of St. Luke's International University approved the implementation of this study (No. 14-092). Participation was voluntary, and participants were assured that data would be anonymous and confidential. Data were stored in locked cabinets and computers, accessible only by the research team members.

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Conflict of interest

A swaddle company, Aden & Anais, Inc., provided swaddles and baby gifts to women who responded to the survey. They had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. Otherwise, all authors have no conflict of interest.

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