A Feasibility Study: Adaptation of an online real-time mindfulness-based program for mothers of NICU graduates in Japan

By

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B.A., Brown University, 2022

Thesis

Submitted in partial fulfillment of the requirements for the
Degree of Master of Public Health in the Brown University School of Public Health

PROVIDENCE, RHODE ISLAND
MAY 2023

This thesis by Kento Suzuki is accepted in its present form
by the Brown University School of Public Health as satisfying the
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Preface and Acknowledgements

I would like to express my heartfelt gratitude to all those who have supported me throughout this project, including my research collaborators, participants, mentors, friends, and family. It has been an absolute privilege and joy to work alongside Dr. Takeshi Arimitsu, President of the Japanese Organization for NICU Families (JOIN). Without his consistent support and contribution, this work would not have been possible. I also extend my deepest appreciation to all the participants of this trial for their valuable time and effort in participating in the study.

I have been incredibly fortunate to be surrounded by exceptional mentors, including Dr. Jeffrey Proulx, Dr. Margaret Bublitz, Dr. Emily Jones, and Dr. Caitlin Elsaesser, to name a few. My dear friends, Madeline Noh, Zoie Carter, Kayla McLymont, Lia Antico, Dichuan Gao, and Ken Kawamura, have always been a source of encouragement and support, and for that, I am truly grateful.

Finally, I would like to convey my genuine gratitude to my parents, Koji and Yumiko Suzuki, who are NICU parents themselves, for their unwavering love, encouragement, and inspiration.

Table of Contents

Abstract

Background

Mothers with their children hospitalized in the NICU disproportionately experience severe negative emotions such as self-guilt, anxiety, and sadness that could lead to various mental disorders. In many cases, this emotional distress persists long after the infants are discharged from the NICU. This feasibility study employed a Japanese online real-time mindfulness-based program called "MELON Online" and assessed its feasibility and acceptability as well as preliminary efficacy on trait anxiety, parenting stress, mindfulness, and self-compassion among Japanese mothers whose children used to be hospitalized in the NICU.

Methods

20 Japanese NICU mothers were enrolled in the study. Joining or watching recordings of at least two 15- to 90-minute-long mindfulness-based programs per week was defined as the completion of the program. The pre-post changes in the outcome variables were examined for the intention-to-treat sample using paired sample t-tests and Hedge's g effect size estimates. Correlations between variables were assessed using the Spearman rank correlation coefficient. The post-intervention group interviews were analyzed using the Sort and Sift, Think and Shift qualitative data analysis approach.

Results

15 (75%) met the threshold of feasibility, which was set as completing the program for two weeks or more. 96% of the real-time classes taken during the intervention were more than 30 mins long, and the two 30-min-long classes focused on breathing meditation and loving-kindness meditation were particularly popular. Among the 16 pre- and post-intervention survey completers, there was a small statistically significant reduction in trait anxiety, as well as small marginally statistically significant increases in mindfulness and self-compassion. Taking more live classes than archived ones had a statistically significant moderate positive association with increases in FFMQ-C-SF total scores, but no significant changes were seen in other outcome measures. Post-intervention interviews revealed that many participants agreed that the intervention led to small but significant positive changes in their daily stress response patterns. The interviews also revealed many concrete ways to make MBIs more feasible and acceptable for caregivers of preterm infants in Japan.

Conclusion

This study provided preliminary evidence that a brief real-time online mindfulness-based program is acceptable and feasible as well as efficacious, particularly in reducing trait anxiety in caregivers of prematurely born children. There is a need of larger RCTs with greater statistical power and sensitivity to temporality that examine the efficacy of online mindfulness-based interventions for caregivers of preterm infants. Further research is needed to gain insight into the optimal timing for them to engage in mindfulness practices.

Introduction

The proportion of low birthweight (LBW) of less than 2500 grams is considered a very important indicator of maternal and infant health. Despite a small reduction in the last two decades, approximately 15 percent of babies are still born at LBW globally (Blencowe et al., 2019). Especially for such low birthweight and very low birthweight (VLBW) babies, the quality of neonatal care they receive plays a significant role in their health and that of their mothers. Japan is known to have some of the best neonatal healthcare in the world, especially given that it has one of the highest LBW prevalence rates and one of the lowest birth weight-specific mortality rates among OECD countries (Kim et al., 2016; Mine et al., 2021).

Despite this, the risk of complications and disabilities among such babies after delivery is still high in Japan (Isayama, 2019), and mothers whose children are hospitalized in the Neonatal Intensive Care Unit (NICU) disproportionately experience severe negative emotions such as self-guilt, anxiety, and sadness, due to the uniquely stressful and worrisome circumstances in which they find themselves (Shimoda et al., 2001). Such emotional distress has been found to lead to mental disorders such as depression and posttraumatic stress disorder (PTSD), at markedly higher rates compared to parents of term infants with extremely high prevalence of up to 81% (Beck & Woynar, 2017; Feeley et al., 2011; Lefkowitz et al., 2010; Miles et al., 2007), and is also considered to be significantly associated with parental behavior, even more so compared to the medical risk of the newborns. Furthermore, it has been reported that such mental distress experienced by caregivers of NICU infants is substantially underreported and undertreated (Tahirkheli et al., 2014).

Very importantly, this mental health distress among mothers of NICU infants persists long after the infants are discharged from the NICU (Gerstein et al., 2019). A recent longitudinal study revealed that 20 percent of mothers who exhibited clinically significant depressive symptoms at the time of their infants' NICU discharge continued to experience

clinically significant depression 5 years after the discharge (Gerstein et al., 2019). Furthermore, this disproportionate nature of mental health distress among mothers of preterm babies has been reported to be strongly associated with poorer child cognitive development for at least 3 years after birth, as well as significantly greater parenting stress that they continue to face while raising their preterm infants compared to their counterparts with term infants (Gray et al., 2018; Singer et al., 1999; Treyvaud et al., 2014).

Particularly in the last decade, an increasing number of research studies have been conducted to examine the types of interventions that are effective in reducing mental distress in parents of preterm infants. Recent systematic reviews have found that interventions with family-centered instructions are effective in reducing parental stress among parents of preterm infants that are currently hospitalized in the NICU (Mendelson et al., 2017; Sabnis et al., 2019). Specifically, among parent-focused interventions evaluated in randomized controlled trials, Cognitive Behavioral Therapy (CBT) has been shown to have the greatest impact on reducing maternal depressive symptoms (Mendelson et al., 2017). However, a paucity of high-quality studies on the effect of CBT on NICU parents' mental distress has been noted. For example, only 3 CBT trials were included in a recent meta-analysis (Mendelson et al., 2017), and some of them were reported to lack the necessary data to be included in a quantitative meta-analysis (Sabnis et al., 2019).

In recent years, there has been growing interest in the potential of Mindfulness-Based Interventions (MBIs) as an effective alternative to CBT for treating a range of mental health conditions, such as anxiety, depression, and PTSD, across diverse demographic groups worldwide (Boyd et al., 2018; Hofmann et al., 2010). Besides, there have been increasing efforts to assess the efficacy of MBIs in reducing mental health distress among parents of NICU infants, particularly as correlations have been found between mindfulness levels and state/trait anxiety as well as parental stress among mothers of VLBW infants hospitalized in

the NICU (Khoramirad et al., 2021). Although still small, there is a growing body of scientific evidence supporting the efficacy of MBIs in ameliorating the unique mental distress experienced by these parents. For instance, a recent systematic review of single-armed trials has shown that MBIs are effective in reducing anxiety as well as depressive symptoms among NICU parents (Ginsberg et al., 2022; Marshall et al., 2019; Mendelson et al., 2018). Furthermore, a recent randomized controlled trial found that Mindfulness-Based Stress Reduction resulted in a statistically significant greater reduction in posttraumatic stress compared to routine care control, both immediately after the intervention and at a 1-month follow-up (Izadi et al., 2022).

Despite the chronic nature of parental distress experienced by parents of preterm infants, the efficacy of MBIs in reducing such persistent distress after their infants are discharged from the NICU has rarely been studied anywhere in the world, including Japan (Thomson & Feeley, 2022). Moreover, there has been no literature on the feasibility as well as acceptability of MBIs for mothers following NICU discharge in Japan. In order to address this research gap, this study aims to evaluate the feasibility and acceptability of an online mindfulness-based intervention as well as its preliminary efficacy in ameliorating mental distress experienced by such Japanese mothers. Post-intervention qualitative group interviews were also conducted to learn participants' ideas on how to make such interventions more acceptable and feasible for Japanese mothers like themselves.

As in-person modalities have been reported to be infeasible for many NICU parents (Mendelson et al., 2018), this study employed a Japanese live, web-based mindfulness-based program service called "MELON Online". This allowed the participating mothers to complete the lessons based on their schedules and interests, enabling us to identify which programs were most feasible and acceptable to the participants. Although the majority of the MBIs for parents examined so far have lasted 8 weeks or longer (Burgdorf et al., 2019), there

is a growing evidence that shorter programs, as short as 4 weeks, lead to significant improvements in parental stress and other forms of mental distress, including anxiety and depression (Cheung et al., 2022; Sherwood et al., 2023). Moreover, given the sheer time constraints experienced by many parents, shorter interventions are considered to be more accessible to them (Potharst et al., 2019; Sherwood et al., 2023). Combining this series of evidence with the results of the formative interview conducted by the PI with Japanese mothers of preterm infants who had previously been hospitalized in the NICU, the study team decided to set the intervention duration to 4 weeks.

We hypothesized that "MELON Online" would be both feasible and acceptable to the participants, and that using it for 4 weeks would lead to a significant reduction in their anxiety and parental stress levels, as well as an increase in their mindfulness and self-compassion levels. We also hypothesized that these changes would be correlated with each other.

Methods

Participants

20 Japanese mothers whose children had been hospitalized in the NICU were enrolled in the study. Recruitment and data collection were conducted from November 2022 to January 2023. Inclusion criteria were 1) having at least one child who is currently 18 years of age or younger, born at a gestational age of less than 35 weeks, and who was hospitalized in the NICU for at least 1 month immediately after birth, 2) being between 18 and 60 years of age, 3) living in Japan, and 4) being able to read, write, and speak Japanese, as all study activities were conducted in Japanese. Exclusion criteria were 1) having a self-reported psychotic disorder (e.g., bipolar disorder, schizophrenia, schizoaffective disorder, or

psychosis), 2) cohabiting with a study participant. This research was approved by the Brown University Institutional Review Board, and all participants provided informed consent.

Measures

Sociodemographic and clinical information was collected at baseline, regarding age, education, the number of children, marital status, employment status, and prior experience with meditative practices. In addition, gestational age at birth, length of their children's NICU hospitalization, and childrens' current medical as well as psychiatric conditions were asked in the post-intervention survey.

Engagement with MELON Online was assessed by 1) duration of participation in both live and recorded programs, 2) program selection, and 3) frequency of program use, all of which were collected automatically and digitally by the MELON platform.

Trait anxiety was assessed using the trait anxiety scales of the Japanese version of the State-Trait Anxiety Inventory (清水 & 今栄, 1981). The Japanese version of the State-Trait Anxiety Inventory is based on the original English version of the State-Trait Anxiety Inventory (STAI) formulated by Spielberger (Spielberger, 1970). The STAI is a 40-item scale that has been widely used in clinical research settings to evaluate state and trait anxiety, particularly among caregivers, including parents of children with medical conditions (Dol et al., 2020; Pripp et al., 2010). In this study, only the 20 trait anxiety scales were employed to probe whether there were any difference in the trait anxiety levels before and after the intervention. As with the original version of the STAI (Dol et al., 2020), its Japanese version has also shown moderately high internal consistency, test-retest reliability, and convergent validity (清水 & 今栄, 1981).

Parenting stress was evaluated using the Japanese Version of the Parenting Stress Index-Short Form (Hatakeyama et al., 2022; Narama et al., 1999). The Japanese Version of

the Parenting Stress Index-Short Form is based on a shortened version of the original English version of the Parenting Stress Index (PSI) developed by Abidin (Abidin, 1995). The PSI, as well as its shorter versions, have been used in studies of mothers of very preterm infants as a means of assessing their stress levels (Gray et al., 2018; Thomas et al., 2004). The scale consists of 19 items: 9 items regarding the children's characteristics and 10 items about themselves (Hatakeyama et al., 2022; Narama et al., 1999). As with the original version of the PSI, the version used in this study is also reported to have acceptable to good internal consistency, test-retest reliability, and construct validity (Hatakeyama et al., 2022).

Mindfulness was assessed using the Japanese version of the Short-Form of the Five Facet Mindfulness Questionnaire (FFMQ) (Hou et al., 2014; Sugiura et al., 2012). The FFMQ aims to measure one's state as well as trait mindfulness with a total of 39 items on the following five constituent factors of mindfulness: observing experiences, acting with awareness, describing or labeling experiences, nonjudging of experiences, and non-reactivity to inner experiences (Baer et al., 2006). As with the original version of the FFMQ (Baer et al., 2006, 2008), its Japanese version has demonstrated good internal consistency, test-retest reliability, and convergent validity (Sugiura et al., 2012). Based on this validated translation of the original FFMQ, this study employed only the 20 questions used in the Short-Form of the FFMQ created by Hou et al. (Hou et al., 2014). This version was recently shown to have a strong fit with the original version of the FFMQ in terms of the factor structure in the Japanese public (高橋 et al., 2019). In this study, the scale is used as a means to assess the level of both state and trait mindfulness among the study participants.

Self-compassion was measured using the Japanese version of a 12-item Self-Compassion Scale-Short Form (Arimitsu et al., 2016), which is based on the original English version of the 26-item original Self-Compassion Scale (SCS) created by Neff (K. D. Neff, 2003). As the name suggests, the SCS is a 26-item scale designed to examine the level

of self-compassion, which is one's capacity to be kind, accepting, and understanding to themselves in instances of suffering and failure (K. Neff, 2003). As with the original version of the SCS (K. D. Neff, 2003), the Japanese translated version of the SCS (SCS-J) showed acceptable to good internal consistency, test-retest reliability, and convergent validity (Arimitsu, 2014). Moreover, the shortened version also demonstrated satisfactory internal consistency and a near-perfect correlation with the longer version, the SCS-J (Arimitsu et al., 2016).

Participants' experiences with the intervention were explored through weekly small group semi-structured conversation sessions as well as the post-intervention semi-structured group interviews. All of the sessions were video-recorded and conducted by the principal investigator (PI). Questions asked in the conversation sessions include which programs they chose, their impressions of the programs, and what changes, if any, they noticed after taking the programs. Questions asked in the interviews include pros and cons of the experience with the intervention, burdens related to the study procedure, and suggestions for maximizing the acceptability and feasibility of MBIs for parents of NICU hospitalized infants and graduates. We also asked the participants to enter a brief sentence about their impressions after each program using the MELON Online "log" function.

Procedure

An email was sent to the presidents of all 38 individual local NICU family support groups that are part of the Japanese Organization for NICU Families (JOIN). Prior to enrollment, participants were asked to complete a brief online screening form via Qualtrics. Those screened as eligible then received an email from the PI where they were able to view and download the informed consent form. Participants were then asked to sign and return the form to the PI if they fully understood the study procedures and agreed to participate in the

study. During the week prior to the start of the intervention, participants were gathered in an online orientation session where they were provided with an overview of the intervention and instructions on how to complete the pre- and post-intervention Qualtrics surveys and sign up for the post-intervention group interviews. Participants were asked to participate in three 30-minute weekly group conversation sessions after the first, second, and third weeks of the intervention, as well as an one-hour post-intervention group interview at the end of the intervention. Both conversation sessions and interviews were conducted online in groups of 2 to 6, depending on availability. Participants received a 3000 JPY gift card if they completed all study components.

Intervention

MELON Online is an online mindfulness-based program that is commercially available throughout Japan. MELON Online provides several mindfulness-based programs every day from 6 a.m. to 10 p.m. JST, with program durations ranging from 15 to 90 minutes. Each program begins with a brief introduction to its topic via Zoom. The programs include various meditation and mindful movement exercises grounded in mindfulness-based stress reduction (MBSR). Participants were asked to attend or watch recordings of at least two programs per week for 4 weeks, and there was no set rule about which program to choose.

Statistical Analysis

Quantitative analyses

Acceptability and feasibility were assessed by the frequency with which participants attended the live programs and viewed their recordings, in combination with the weekly conversation sessions and post-intervention interviews. Feasibility was defined as attending or watching recordings of at least two programs per week for 2 weeks or more, consistent

with previous MBI RCTs in parents and perinatal women (Bublitz et al., 2023; Lo et al., 2017). Self-reported changes in quantitative measures before and after the intervention were examined for the intention-to-treat (ITT) sample using paired-sample t-tests and Hedge's g effect size estimates. Although the study design does not allow for causal inference between variables, correlations between assessed variables were examined using the Spearman rank correlation coefficient (Khamis, 2008). Hedge's g was chosen over other effect size estimates, including Cohen's d, because it takes into account the sample size and thus provides a more realistic estimate of the population effect size compared to the latter (Lakens, 2013). All missing data were removed using the listwise deletion technique if more than 15% of items were missing, and missing items were imputed using multiple imputation if 15% or less were missing (Mendelson et al., 2018). All of the data analysis was conducted using R. For statistics that were shown statistically significant, statistical power calculations were performed using the G*Power software (Kang, 2021). T-scores and correlation coefficients were used to calculate statistical power of the effect sizes of pre-post differences and correlations, respectively.

Qualitative analyses

The post-intervention group interviews were all transcribed verbatim by the PI, who is fluent in Japanese. The PI then used the Sort and Sift, Think and Shift qualitative data analysis approach to analyze the transcribed data, which consists of data inventory, written reflection, diagramming, topic monitoring, and bridging (Maietta et al., 2021). This methodology has been widely used in public health research including ones that are on mental health conditions (Pahwa et al., 2020; Passmore et al., 2017).

Results

20 out of 34 mothers that were screened eligible commenced the study by responding to the pre-intervention survey. The ages of the participating mothers ranged from 32 to 45 years (M = 39.4, SD = 4.24), and 30% had at least one other child. The vast majority had at least a 4-year college degree (80%) and were employed at least part-time at the time of the intervention (85%). Many had no prior experience with meditation (75%), and none had two or more preterm children in the family. The majority of the NICU hospitalized children were born very prematurely, at an average of 28.1 weeks (SD = 2.74), and all were hospitalized in the NICU for at least 2 months (M = 3.05, SD = 0.99 months). The average current age of the children was 5.44 years (SD = 2.91) (see Table 1).

Feasibility and Acceptability

Average completion weeks across the 20 mothers was 2.5 weeks (62.5%). Two of the participants did not participate in any of the sessions at all (10%). Six participants completed all four weeks (30%), five participants completed three weeks (25%), four participants completed two weeks (20%), and three participants completed one week (15%). 15 mothers completed the intervention for 2 or more weeks, and 17 either responded to the post-intervention survey (n = 16) or participated in the post-intervention interview (n = 15). A total of 166 live and 101 recorded classes were attended, and 96% of the live classes selected were 30 minutes or longer. The recorded classes were only viewed in their entirety 34.7% of the time. For both live and recorded classes, the two 30-minute classes called "Basic" and "Heart", based on focused attention and loving-kindness meditation, respectively, were by far the most frequently chosen by participants.

The following barriers to feasibility and acceptability of the program were raised in the post-intervention interview: lack of 1) shorter sessions, 2) explanation of mindfulness, 3)

focused sessions with clearer goals, 4) sample program sequences, and 5) platforms to ask questions.

Preliminary intervention outcomes

Three out of the 16 participating mothers in the post-intervention survey had missing data. One mother missed a question on the STAI-T, another missed one question on the FFMQ-C-SF Observing subscale, and the third mother missed all of the FFMQ-C-SF questions. The first two missing data items were imputed using multiple imputation. At baseline, there was a statistically significant strong positive correlation between maternal education level and their FFMQ total scores ($r(14) = 0.82$, $p < .01$), with a statistical power of 0.74 (see Figure 1) (Schober et al., 2018).

There was a statistically significant small pre-post intervention decrease in STAI-T scores ($g(15) = -0.38$, $p = .013$) ($1-\beta = .21$), and marginally statistically significant small increases in FFMQ-C-SF total scores ($g(14) = 0.33$, $p = .099$) ($1-\beta = .47$) as well as SCS-SF total ($g(15) = 0.24$, $p = .089$) ($1-\beta = .33$) and common humanity subscale scores ($g(15) = 0.31$, $p = .090$) ($1-\beta = .44$) (see Table 2) (Brydges, 2019). Although not statistically significant, signals suggesting improvement were seen in all of the other variables, except for the SCS-SF Isolation subscale.

Notably, there was a statistically significant moderate positive correlation between attending live sessions versus watching recorded sessions and pre-post changes in FFMQ-C-SF total scores ($r(14) = 0.67$, $p < .01$) ($1-\beta = .72$) (see Figure 2). This finding was also reflected in the participants' preference for live sessions over recorded ones found in the post-intervention group interviews: one mentioned that “the recorded ones didn't go straight to my heart, and I felt like I was listening to TV, so I thought the live ones would be better”, and another reported that “I watched both live and recorded ones, but the live ones felt more like we were doing it together”.

However, it should also be noted that no statistically significant correlation was observed between the number of weeks completed or cumulative minutes of service use and any of the outcome variables. Unexpectedly, there was also a statistically significant negative correlation between the number of weekly sessions attended and pre-post changes in STAI-T scores.

Lastly, the post-intervention group interview revealed that the brief intervention yielded many positive changes in participants' daily lives, including helping them to 1) appreciate self-care and well-being, 2) calm themselves and feel more at ease, and 3) have a healthier relationship with their emotions toward their children, and there was no comment on negative changes in life (see Figure 3).

Discussion

Our findings suggest that an online real-time mindfulness-based intervention can be feasible and acceptable among Japanese mothers with children who have been hospitalized in the NICU. The post-intervention group interview informed us of concrete positive changes that participants experienced in their daily lives, and no negative changes were reported in any of the groups. Participants reported that the intervention helped them to 1) appreciate self-care and well-being, 2) feel calmer and more at ease, 3) have a healthier relationship with their emotions toward their children, all of which have been reported for mothers of infants currently hospitalized in the NICU (Grieb et al., 2023). This could be seen as an implication that MBIs may have similar benefits for NICU families at different stages of parenting.

The intervention can be said to be feasible and acceptable among participants, as the majority, 75%, completed the intervention for 2 or more weeks, and the retention rate was 85%. In addition, there were no reports of adverse events throughout the study. However,

these results must be viewed with caution, as the majority of the participants did not watch the recorded classes in their entirety, and we were not able to track whether participants fully attended the real-time classes. In terms of preference for live classes, although 30-minute classes were the most popular, many participants requested greater availability of shorter live classes. It should also be noted that some reported in the post-intervention group interview that they felt "obligated" to do the programs and that "the thought of having to do it was stressful," which casts a shadow on the feasibility of the program outside of research settings.

As reported elsewhere, at baseline, there was a positive correlation between education level and mindfulness level, as measured by the FFMQ (Wang et al., 2022). In terms of pre-post changes, it is important to note that there was a statistically significant, small reduction in trait anxiety among the participating mothers. This is consistent with findings from a pilot study of a very brief audio-guided mindfulness meditation program among mothers of infants currently hospitalized in the NICU (Mendelson et al., 2018). However, there is still very little research on the efficacy of MBIs for anxiety among caregivers of currently NICU hospitalized infants, and none for those of NICU graduates to the authors' knowledge (Ginsberg et al., 2022).

There were also marginally statistically significant small increases in FFMQ-C-SF as well as SCS-SF total and common humanity subscale scores. Two previous pilot studies of mothers of children currently hospitalized in the NICU similarly found no statistically significant pre-post changes in mindfulness and self-compassion scores, with an alpha level of .05 (Marshall et al., 2019; Mendelson et al., 2018). As with trait anxiety, there is no evidence to support the efficacy of MBIs in improving mindfulness and self-compassion in caregivers of NICU graduates.

Contrary to our expectations, there were no significant changes in parental stress. There have been mixed results regarding the efficacy of MBIs on parental stress in similar

pilot studies with mothers of children currently hospitalized in the NICU (Marshall et al., 2019; Mendelson et al., 2018). The fact that the only study that found a significant change in parental stress used an intervention formulated on the basis of formative research underscores its importance in maximizing the efficacy of MBIs.

While no statistically significant changes were observed, all other outcome measures showed positive trends except for the SCS-SF Isolation subscale, which exhibited a non-significant pre-post deterioration. This was surprising to us, given the large body of evidence that MBIs, especially those of longer duration, significantly reduce levels of loneliness in people without mental health conditions (Teoh et al., 2021). It needs to be noted here, though, that "isolation" here refers to isolation that one feels specifically when they encounter challenges and personal failures, and it was particularly interesting that there was a marginally statistically significant small increase in the Common Humanity subscale, which is often deemed as the antithesis of the Isolation subscale.

Correlation analysis revealed that taking more live classes than archived ones led to a statistically significant moderate increase in FFMQ-C-SF total scores, but no significant changes were seen in other outcome measures. There has been no academic literature comparing the efficacy of online MBIs for caregivers of currently NICU hospitalized or NICU graduates based on the modality of program delivery. However, this finding is consistent with recent larger studies conducted in a variety of settings, including the workplace and college settings, where there is promising evidence that live MBIs delivered in group settings significantly outperform videotaped ones and those delivered in solitary settings. (Hanley et al., 2022; Wolever et al., 2022).

It was also surprising to see that there was no significant correlation between FFMQ-C-SF and SCS-SF total scores versus STAI-T and PSI-SF total scores, especially given the growing evidence that there is a significant inverse relationship between one's own

level of mindfulness and their parental stress among mothers of infants currently hospitalized in the NICU (Khoramirad et al., 2021). More surprisingly, there was a statistically significant negative correlation between the number of weekly conversation sessions attended and pre-post changes in participants' trait anxiety levels. Although the authors were unable to find academic literature on this, we hypothesized that mothers with higher baseline anxiety levels would choose to attend more conversation sessions. However, no significant correlation was found between these two variables. This is particularly intriguing given that many participants reported in the post-intervention interview that they "enjoyed the conversation sessions and talking with other mothers in the same situation", especially for those that "had not had connections with other mothers" during their children's NICU hospitalization. These findings suggest that even an average of 5 years after the child's birth, anxiety can still be induced by talking with other NICU mothers, although not to the extent that it is reported as an adverse event.

Strengths

This is the first study to examine the feasibility, acceptability, and preliminary efficacy of an online MBI in a group of Japanese mothers of infants formerly hospitalized in the NICU. Only a handful of experimental studies (Izadi et al., 2022; Khoramirad et al., 2021; Marshall et al., 2019; Mendelson et al., 2018; Petteys & Adoumie, 2018) and one qualitative study (Grieb et al., 2023) have been conducted on mothers of currently NICU hospitalized children, and no study on caregivers of NICU graduates to the author's knowledge. In addition, the mixed-methods design of this study allowed us to capture personal experiences with the program and obtain mothers' opinions about the implementation of MBIs for other NICU caregivers. Few studies have included qualitative research components in intervention studies in this population (Grieb et al., 2023), and qualitative research is known to be key to facilitating interpretation of findings and optimizing interventions for target populations

(O'Cathain et al., 2013). A post-hoc power analysis was also performed to better understand the statistical power of the results, which has been reported to be lacking in other similar feasibility studies (Ginsberg et al., 2022).

Limitations

This does not mean that the study is immune to any limitations. For instance, the small sample size significantly undermined the statistical power, and made it difficult to make deductions on any causal relationships between variables. In addition, the effect size estimates of the FFMQ-C-SF total score, FFMQ-C-SF observing subscale, and STAI-T all decreased slightly after the two missing individual data points were imputed using multiple imputation. This suggests the possibility of overestimation of effect sizes in several outcome variables due to the small sample size. Besides, the heterogeneity of instructors undermined the internal validity of the results (Galante et al., 2018), and we also cannot overlook the influence of external factors that influenced the participants' mental state, as witnessed by one of the participants during the interview: "I started to feel more calm, but I am not sure if it is due to mindfulness or external factors. I am wondering if it is more of an external factor."

It is also possible that the duration of the intervention was not long enough for many of the participants to experience significant change given their comments at the interview: "Four weeks was not enough time to find a program that I liked and wanted to do." "I would think that in six months or years, my thought patterns would change, but in a month or two, it would be difficult." The fact that no statistically significant correlation was observed between weeks or minutes completed and any of the outcome variables further supports this. Furthermore, some of the sociodemographic characteristics of participants, including their educational attainment and employment status as well as the presence of current medical complications of their children, may limit the generalizability of the findings of this study to the entire population of Japanese NICU graduate mothers.

Future Directions

Various forms of mental distress experienced by caregivers of infants hospitalized in the NICU have been found to be significantly underreported and undertreated (Tahirkheli et al., 2014), and such mental distress is known to have debilitating impacts on the health of both caregivers and children (Grieb et al., 2023). Given the chronic nature of mental distress (Gerstein et al., 2019), it is imperative that future research efforts be dedicated to the sustainable promotion of well-being in NICU families. This focus on sustainability is particularly important given that a recent study found that NICU mothers that continued their mindfulness practice after an 8-week MBI experienced significantly greater sustained benefits compared to those who discontinued (Lönnberg et al., 2021). In this way, further research is needed to formulate MBIs that are feasible and acceptable enough that can motivate NICU caregivers to continue their practice after the intervention.

The authors would suggest four concrete ways to promote mindfulness practices among NICU caregivers, ensuring their sustainability: introduction of shorter practice sessions, inclusion of peer-support, explanation of mindfulness, and collaboration with healthcare professionals as well as caregivers of NICU graduates. The introduction of more brief mindfulness sessions may be a significant facilitator of acceptability among NICU caregivers, as evidenced elsewhere and in the post-intervention interview of this study (Grieb et al., 2023; Mendelson et al., 2018).

Even though qualitative research shows that peer support from other NICU caregivers can effectively alleviate NICU parents' mental distress and empower them in their parenting role (Dahan et al., 2022), longitudinal peer support alone may not be sufficient to address their persistent mental distress in the long term and promote their infants' developmental growth (Fratantoni et al., 2022). Hence, there is a need for more academic explorations on the potential clinical benefits of combining peer support and mindfulness practices for caregivers

and their preterm infants, which has not been addressed in the existing literature (Grieb et al., 2023; Izadi et al., 2022; Khoramirad et al., 2021; Marshall et al., 2019; Mendelson et al., 2018; Petteys & Adoumie, 2018).

While it may sound simple, an accessible introduction to mindfulness can go a long way toward cultivating interest in mindfulness practices among NICU caregivers, which may ultimately lead to greater clinical efficacy (Mendelson et al., 2018). In the post-intervention interview, some participants reported that they “would have been more interested in trying mindfulness” and “would have enjoyed it more” if there had been a clearer explanation of what mindfulness is at the beginning. In addition, one participant witnessed that an instructor’s explanation of mindfulness actually facilitated interest in mindfulness practices: “The instructor explained what mindfulness is, which made me become more interested in it.”

There is growing evidence that multisectoral collaborations between clinical, academic, and NICU family settings, based on community-based participatory research (CBPR) approaches, are also critical for sustainable promotion of NICU family well-being (Weber et al., 2022). This is also reflected in the post-intervention interview in this study; many mothers agreed that they would be highly inclined to engage in mindfulness practices “if individuals like healthcare professionals that they trust recommend mindfulness” especially because they “think that self-decisions can be detrimental”. At the same time, some also shared that they would "appreciate initiatives from mothers who are or used to be in similar situations" because they "sometimes cannot fully open up to health professionals" and "do not really want to see other people".

Further research is warrented on the efficacy of MBIs during pregnancy and its sustainability after preterm birth. There is promising evidence that higher levels of mindfulness in pregnant women are significantly associated with better birth outcomes and

mental health outcomes for both the mother and the infant after controlling for their demographic characteristics and medical conditions (Nyklíček et al., 2018). Furthermore, MBIs for pregnant mothers with depressive symptoms have been reported to produce substantial and sustained improvements in their symptomatology, as well as in their levels of mindfulness and self-compassion, which also promoted the well-being of their infants (Guo et al., 2020). Further investigation is needed to determine if these benefits extend to preterm births. The post-intervention interview showed that the health benefits of mindfulness practices for preterm infants, not just for the caregivers themselves, would be an extremely strong motivational factor for NICU caregivers. Thus, it is imperative to initiate further investigation in this domain in the immediate future.

Finally, further academic efforts are needed to explore interventions for other NICU caregivers besides mothers, including but not limited to fathers, especially as they have been reported to experience similar levels of mental distress as mothers during their infants' NICU hospitalization (Noergaard et al., 2018; Prouhet et al., 2018). This is also addressed in the post-intervention interview: “Fathers are also very surprised and shocked, so I wish there were mindfulness programs that couples could participate in together.” Only when other caregivers are included in the interventions will there be true "family-centered care" in the NICU.

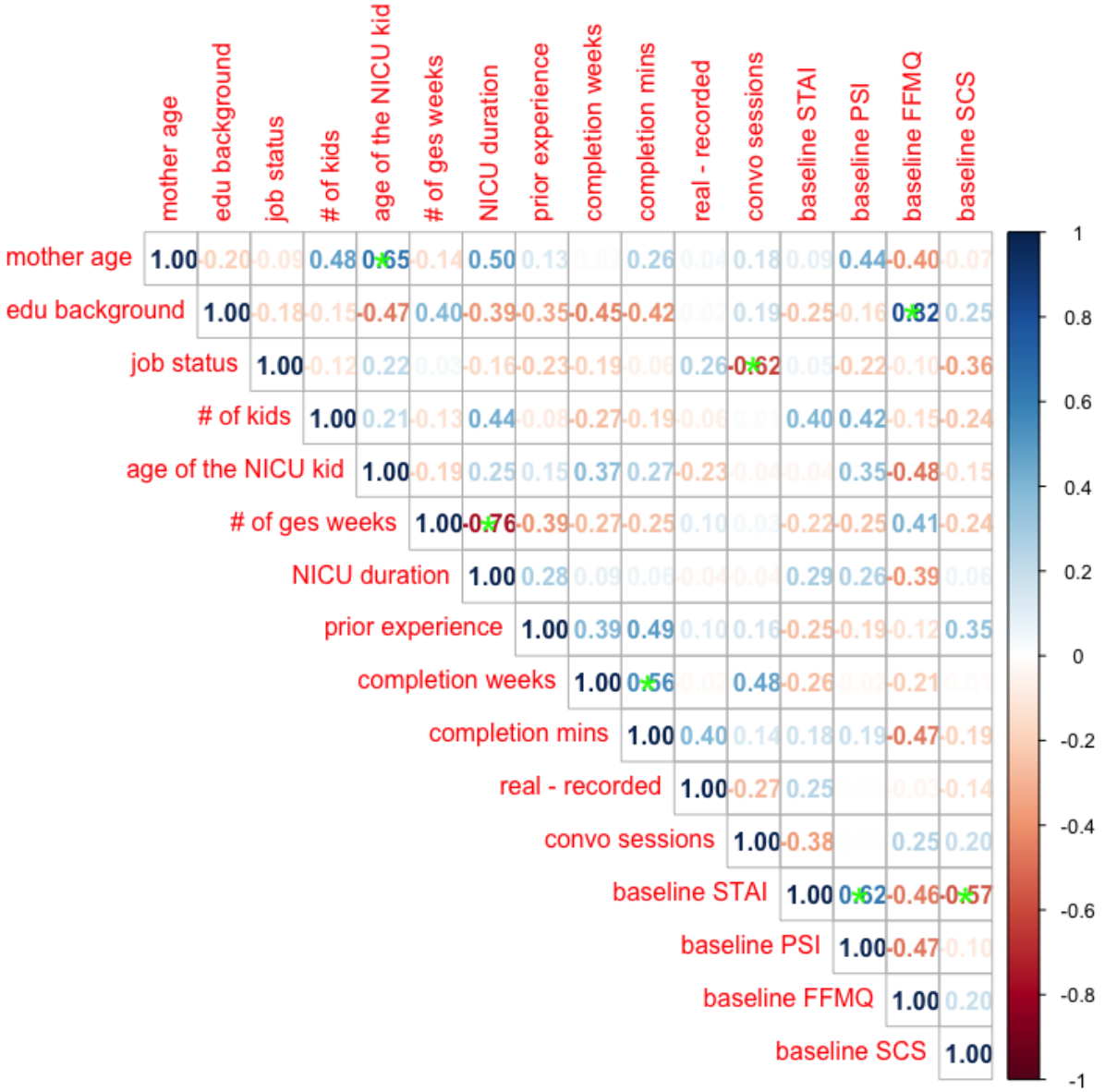
Conclusion

This study provided preliminary evidence that a brief real-time online mindfulness-based program is acceptable and feasible as well as efficacious, particularly in reducing trait anxiety. The post-intervention interviews revealed many concrete ways to make MBIs more feasible and acceptable for caregivers of preterm infants in Japan. It is evident

that there is a need for larger randomized controlled trials with greater statistical power and sensitivity to temporality that examine the efficacy of online mindfulness-based interventions based on extensive formative research. Further research is needed to gain insight into when these caregivers should also begin to engage in mindfulness practices. Finally, close collaboration with healthcare professionals and other NICU parents is necessary for sustained and effective mindfulness practice.

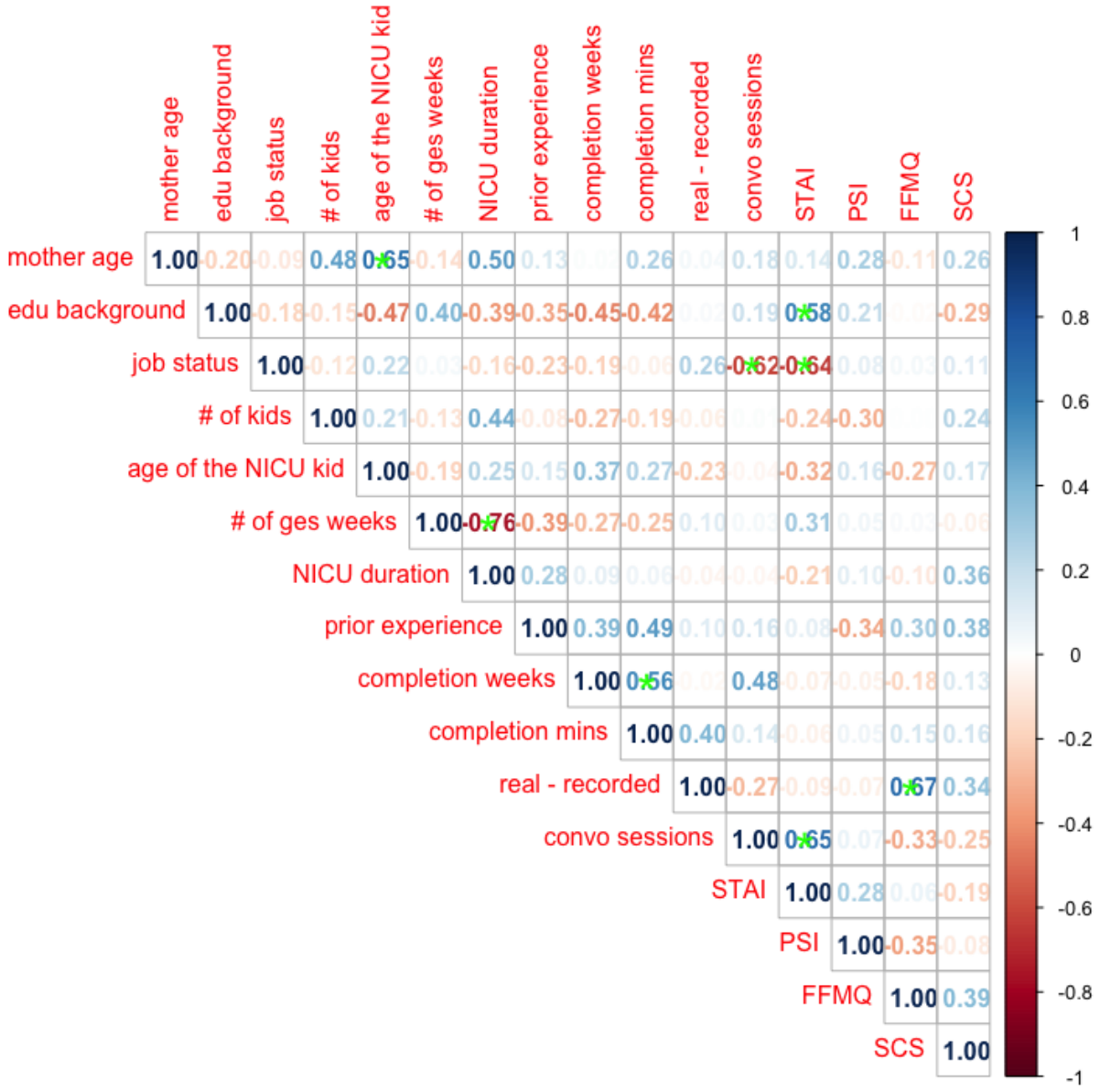
Appendix

Figure 1 Correlation matrix of sociodemographic variables and baseline outcome measures (n = 15)



Green asterisk denotes $p < 0.05$.

Figure 2 Correlation matrix of sociodemographic variables and pre-post changes in outcome measures (n = 15)



Green asterisk denotes $p < 0.05$.

Figure 3 Domains of intervention impact identified through qualitative analysis of the post-intervention interviews (n = 15)

Domain	Sub-domain	Sample Quotes
Appreciate self-care and well-being of the self	Improved sleep	*It was hard to go to bed thinking about the things that make me feel irritated, sad, and worried and then wake up in the morning, but doing the melon program has really made it better. After completing the program, I feel like my sleep has become shallow again now that I no longer do the program.* [ID#15]
	Taking time for yourself, being nice to yourself	*I became more conscious of taking time for myself. I wish I had known mindfulness and made time for myself when things were more difficult.* [ID#5]
		I have come to feel like it is okay to be kind to myself. I often feel bad about myself in daily life, but I am now able to look at it from a distance and be like "Ahh, now I am thinking that way… " when that happens. [ID#22]
	Feeling more refreshed	*In addition to calming the mind and being aware of one's feelings, mindfulness was also surprisingly physically refreshing. I was able to feel the connection between the mind and the body.* [ID#1]
Feel calmer and more at ease	Grounding oneself for a moment	*Even at work, when I am being like "Ughhh", I am now able to just close my eyes and calm down a bit, and so I am experiencing the benefits even after just one month.* [ID#6]
	Feeling more relieved by focusing on the present moment	*Even when I am not doing the MELON, I came to just accept it as it is when something negative happens, and, when I become frustrated, I came to think that it's not about something in the present moment. I feel so much better now, and I learned how not to dwell on negative things.* [ID#7]
Have a healthier relationship with their emotions toward their children	Accepting their emotions towards children as they are	*I wanted to be a mom who is always calm and smiles all the time and never gets mad at my pretty child, but I came to feel that it is okay to be emotional and I became less upset about me getting upset.* [ID#21]
	Feeling less stressed when facing their children	*I often get frustrated when I am taking care of my child, so it was great that that got better.* [ID#15]
	Less negative emotions toward their children	*I think it was a good mental training to objectively observe myself being anxious and worried at the moment. My second child is now one year old, and his cognitive development is on a slower side, and I have been very worried about it, but after getting to know about mindfulness, I came to feel more positively and be like "it's going to fine" and "there is no need to panic".* [ID#17]

Table 1 Participant sociodemographic characteristics (n = 20)

Measures	Mean	SD
Age of mothers (years)	39.4	4.24
Age of NICU graduate children [a]	5.44	2.91
Number of children	2.10	0.85
Gestational age at birth (weeks)	28.2	2.74
Length of NICU hospitalization (months) [b]	3.17	1.07
	N	%
Educational attainment		
High School	1	5.0
Vocational School	2	10
Junior College	1	5.0
University	13	65
Graduate School	3	15
Employment status		
Employed full-time	10	50
Employed part-time	5	25
Business owner	2	10
Not employed	2	10
Others	1	5.0
Experience with meditation		
Yes	5	25
Less than once a week	4	20
Almost everyday	1	5.0
No	15	75
Availability of health complications (children) [c]		
Yes	3	23.1
One	2	15.4
Two	1	7.69
No	10	76.9

[a] Only 18 responded to this question, and thus the percentage is calculated from a total of 18.

[b] Only 15 responded to this question, and thus the percentage is calculated from a total of 15.

[c] Only 13 responded to this question, and thus the percentage is calculated from a total of 13.

Table 2 Pre-post changes in outcome measures (n = 16)

Measures	Baseline α	Baseline score M (SD)	Post-program score M (SD)	t-score	Hedge's g (95% CI)
STAI-T	0.92	45 (9.83)	41.2 (7.51)	-2.81*	-0.38* (-0.67 ~ -0.09)
PSI-SF – total	0.81	44.7 (9.11)	43.4 (9.62)	-0.81	-0.13 (-0.47 ~ 0.20)
PSI-SF – self	0.61	25.4 (4.79)	24.7 (5.11)	-1.00	-0.14 (-0.44 ~ 0.15)
PSI-SF – children	0.77	19.3 (5.41)	18.7 (5.11)	-0.54	-0.10 (-0.49 ~ 0.28)
FFMQ-C-SF – total [a]	0.65	63.3 (6.44)	65.9 (8.53)	1.77†	0.33† (-0.06 ~ 0.71)
FFMQ-C-SF – observing [a]	0.73	12.8 (3.19)	13.2 (3.63)	0.58	0.09 (-0.23 ~ 0.40)
FFMQ-C-SF – describing [a]	0.85	12.6 (2.83)	13.6 (3.24)	0.64	0.10 (-0.23 ~ 0.43)
FFMQ-C-SF – acting with awareness [a]	0.81	13.1 (3.19)	13.8 (2.57)	1.42	0.18 (-0.08 ~ 0.44)
FFMQ-C-SF – non-judgement [a]	0.38	13.3 (1.70)	13.9 (2.84)	1.02	0.32 (-0.35 ~ 1.00)
FFMQ-C-SF – non-reactivity [a]	0.77	11.4 (2.93)	12.3 (2.22)	1.38	0.27 (-0.14 ~ 0.69)
SCS-SF – total	0.91	36.1 (9.73)	38.6 (10.2)	1.82†	0.24† (-0.03 ~ 0.51)
SCS-SF – self-kindness	0.58	6.56 (2.00)	7.13 (2.28)	1.35	0.25 (-0.13 ~ 0.63)
SCS-SF – self-judgement	0.74	5.69 (2.24)	6.31 (2.15)	1.50	0.27 (-0.10 ~ 0.64)
SCS-SF – common humanity	0.79	6.19 (2.23)	6.94 (2.38)	1.81†	0.31† (-0.04 ~ 0.66)
SCS-SF – isolation	0.78	6.75 (1.88)	6.25 (2.11)	-1.58	-0.23 (-0.54 ~ 0.07)
SCS-SF – mindfulness	0.50	6.13 (1.54)	6.63 (1.67)	1.10	0.30 (-0.27 ~ 0.86)
SCS-SF – over-identification	0.71	4.75 (2.11)	5.31 (2.21)	1.41	0.25 (-0.11 ~ 0.61)

†$p < 0.10$, *$p < 0.05$

[a] There were only 15 respondents after imputing missing FFMQ observing sub-scale question responses, and thus the post-program mean score and standard deviation as well as the effect size statistic is calculated from a total of 15.

α = Chronbach's alpha; STAI-T = State-Trait Anxiety Inventory - Trait Version; PSI-SF = Parenting Stress Index-Short Form; FFMQ-C-SF = Five Facet Mindfulness Questionnaire Short Form; SCS-SF = Self-Compassion Scale-Short Form

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