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Effects of maternal singing during kangaroo care on maternal anxiety, wellbeing, and mother-infant relationship after preterm birth: a mixed methods study

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ABSTRACT

Introduction: Preterm birth may disturb the typical development of the mother–infant relationship, when physical separation and emotional distress in the neonatal intensive care unit may increase maternal anxiety and create challenges for early interaction. This cluster-randomized controlled trial examined the effects of maternal singing during kangaroo care on mothers' anxiety, wellbeing, and the early mother–infant relationship after preterm birth.

Method: In the singing intervention group, a certified music therapist guided the mothers ($n = 24$) to sing or hum during daily kangaroo care during 33–40 gestational weeks (GW). In the control group, the mothers ($n = 12$) conducted daily kangaroo care without specific encouragement to sing. Using a convergent mixed methods design, the quantitative outcomes included the State-Trait Anxiety Inventory (STAI) at 35 GW and 40 GW to assess the change in maternal-state anxiety levels and parent diaries to examine intervention length. Post-intervention, the singing intervention mothers completed a self-report questionnaire consisting of quantitative and qualitative questions about their singing experiences.


Results: The mothers in the singing intervention group showed a statistically significant decrease in STAI anxiety levels compared to the control group mothers. According to the self-report questionnaire results, maternal singing relaxed both mothers and infants and supported their relationship by promoting emotional closeness and creating early interaction moments.

Discussion: Maternal singing can be used during neonatal hospitalization to support maternal wellbeing and early mother–infant relationship after preterm birth. However, mothers may need information, support, and privacy for singing.

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KEYWORDS Early interaction; emotional connection; maternal anxiety; maternal singing; preterm birth; preterm infant

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 Supplemental data for this article can be accessed [here](#)

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Introduction

Preterm birth not only interrupts the neurological development of the fetus but may also interrupt the typical development of the mother–infant relationship. After birth, a mother and an infant normally connect through skin-to-skin contact. After preterm birth, however, mother and infant are physically separated due to postnatal care. In the neonatal intensive care unit, mothers often experience emotional distress (Miles & Holditch-Davis, 1997). The separation caused by the infant’s medical needs and the worry for the infant’s survival may cause stress that increases the risk of maternal anxiety and depression, especially in mothers of very preterm (< 32 gestational weeks; GW) (Davis et al., 2003; Trumello et al., 2018) and very-low-birth-weight infants (VLBW, < 1500 g) (Kerstin et al., 2004; Singer et al., 1999). The maternal stress and depressive symptoms may also carry a risk for the social, behavioral, and functional development of VLBW infants (Huhtala et al., 2012, 2014).

The neonatal intensive care environment may create difficulties for early mother–infant interaction, and mothers may be confronted with challenges when trying to interact with their infants. As the medical needs of the infant limit closeness during the hospitalization, a way to interact and build a connection as well as improve the infant’s postnatal development is to use the maternal voice. Due to prenatal auditory exposure, newborns have a tendency to prefer their mother’s voice (DeCasper & Spence, 1986; Lee & Kisilevsky, 2013) and also to respond to their father’s voice (Lee & Kisilevsky, 2013). Studies have suggested that listening to recorded mother’s voice evokes both behavioral and physiological responses in full-term infants, such as improved sucking behavior (DeCasper & Fifer, 1980) and decelerated heart rate (Fifer & Moon, 1994). In preterm infants, maternal voice has been found to enhance the pervasive growth, as it has improved feeding (Chorna et al., 2014; Krueger et al., 2010), autonomic stability (Picciolini et al., 2014; Rand & Lahav, 2014), cardiorespiratory regulation (Doheny et al., 2012a, 2012b), and neurobehavioral development (Picciolini et al., 2014). Furthermore, live maternal speech and singing have also been found to increase the oxygen saturation levels and decrease critical events such as hypoxemia, bradycardia, and apnea in preterm infants (Filippa et al., 2013).

One universal and cross-cultural use of maternal voice to soothe an infant and engage with early interaction is infant-directed (ID) singing. Thus, ID singing can be characterized as an intrinsic way of soothing and building a connection between the caregiver and the infant. This vocal communication can support early interaction, and communication as a mother’s singing is typically performed with a loving tone of voice and positive emotions (Smith & Trainor, 2008; Trainor, 1996). These elements enhance emotional closeness (Fancourt & Perkins, 2018) and draw infants’ attention towards the caregiver (Trainor, 1996) while engaging parents and infants to an interactive experience. Notably, with hospitalized infants, the use of ID singing can offer mothers a possibility to meet their infant’s needs and interact in a sensitive way appropriate for the infant’s medical condition (O’Gorman, 2006).

Studies have presented several benefits of using singing and live music in the neonatal intensive care unit. A review by Haslbeck (2012) demonstrated that music therapy can have short-term beneficial effects on preterm infants, especially by stabilizing and pacifying the infants’ physiological state. A meta-analysis by Bieleninik et al. (2016) showed that the use of music therapy may have positive effects, especially in preterm infants’ respiratory rate and on maternal anxiety. Standley (2012), in turn,

found in a meta-analysis that the benefits of music are most significant for live music therapy rather than for recorded music. Several studies have also focused on the effects of kangaroo care (skin-to-skin care) and music together. These studies have demonstrated that combining kangaroo care and maternal singing (Arnon et al., 2014), recorded music (Lai et al., 2006), live music (Schlez et al., 2011), and live music therapy (Ettenberger et al., 2017; Teckenberg-Jansson et al., 2011) can be especially beneficial for mothers by reducing their anxiety levels. Kangaroo care, together with live music, has, additionally, been experienced as more relaxing than when performing kangaroo care without music (Teckenberg-Jansson et al., 2011).

Physical and emotional closeness are crucial for the wellbeing of both infants and mothers (Flacking et al., 2012), and the wellbeing of mothers is fundamental to mother–infant bonding (Korja et al., 2012, 2009). Hence, the aims of our study were; (a) to examine if maternal singing during the early weeks of postpartum life after preterm birth can reduce maternal anxiety; (b) to investigate if maternal singing during kangaroo care has beneficial effects on the early interaction and emotional connection; (c) to determine how feasible it is to carry out a daily singing intervention in the neonatal ward. The hypotheses were that maternal singing during kangaroo care would decrease maternal anxiety and relax both mothers and infants, through which there would be better possibilities for early interaction. These, again, would support overall mother–infant wellbeing. The quantitative State-Trait Anxiety Inventory (STAI) questionnaire was used to answer research question (a). The self-report questionnaire offering quantitative and qualitative data were used to examine research questions (b), and (c).

Method

Study design

This study was conducted within the Singing Kangaroo randomized controlled trial, a longitudinal two-country study (ClinicalTrials ID IRB00003181SK). The data from this study were collected from the Singing Kangaroo Finnish cohort, aiming to determine whether early exposure to parental singing during kangaroo care enhances sound discrimination at term age, and promote later cognitive development in preterm infants. Furthermore, the aim was to examine whether singing decreases maternal anxiety and improves early mother–infant interaction. The inclusion criteria were as follows: infants were born between 26 GW and 33 GW to Finnish-speaking families; medically stable; and without needing a respirator (the use of continuous positive airway pressure was permitted). The exclusion criteria included: intraventricular hemorrhage stages III or IV; and congenital central nervous system abnormalities. All preterm infants included in this study were born in Helsinki University Hospital, Women’s Hospital, Helsinki, Finland. After neonatal intensive care, the infants were transferred to level 2 neonatal wards in Jorvi and in Kättilöopisto Maternity Hospitals, where they were recruited.

Rather than individuals being assigned to a group, each hospital was assigned to either the singing intervention or the control to avoid any contamination between the groups. Hence, using a cluster-randomization method, families were allocated either to the intervention or to the control group depending on the hospital they were admitted for care (detailed information below in the section *Intervention*). In the middle of the

recruitment period, the hospitals' assignment to the intervention or the control was switched to ensure that each location had an opportunity to participate in the intervention group. The parents started the intervention after giving their written informed consent to participate in the study. Hence, the starting point of the intervention varied between the families. Nevertheless, the aim was all the families to begin the intervention, preferably, during gestational week 33, at the latest. The gestational weeks of 33–40 were chosen as an intervention period as during late gestation, the cortical gyration, synaptic density, and myelination increases making the auditory cortex capable of receiving external stimuli. The flowchart of the Singing Kangaroo study is shown in Figure 1. (Note that the number of participants varies in different phases of the study due to families not completing all measurement points. The results concerning the auditory ERP measurements and Bayley III tests will be reported elsewhere).

Ethical considerations

This study was approved by the Ethics Committee of Hospital District of Helsinki (Ethics Committee for gynecology and obstetrics, pediatrics, and psychiatry 65/13/03/03/2012 and 93/13/03/03/2015), and by Helsinki University Central Hospital. The parents received written and oral information about the study at the beginning of recruitment and gave their written informed consent after deciding to participate.

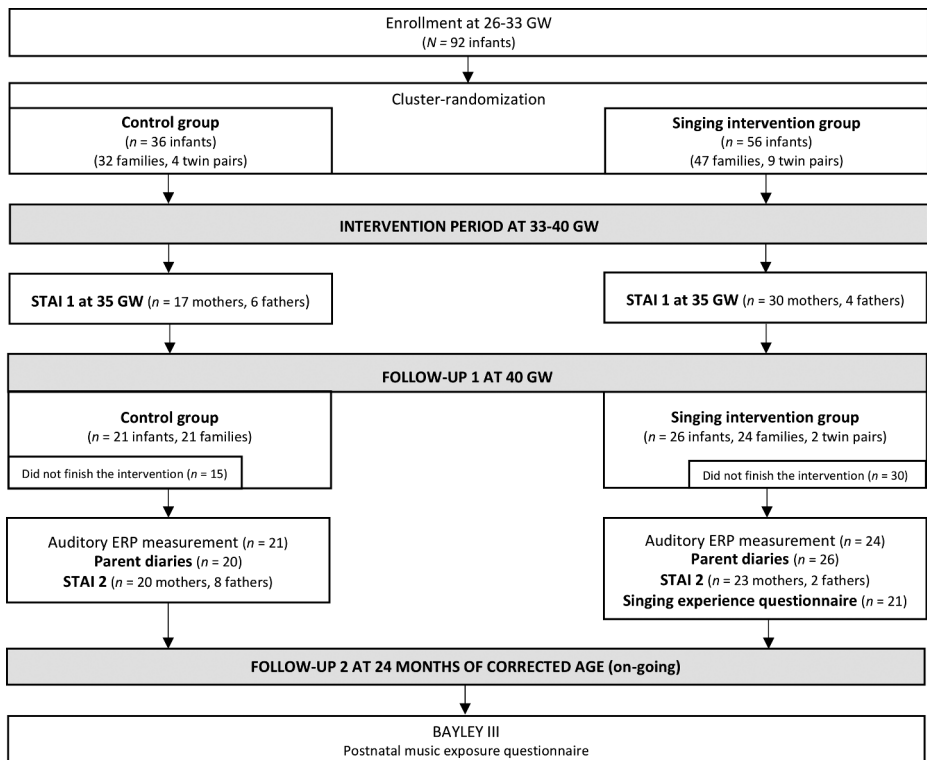


Figure 1. Flowchart of the Singing Kangaroo study (Finnish cohort). The data used in this study are highlighted with bold font

Intervention

Parents in both groups were instructed to perform kangaroo care, preferably at least 1.5–2 hours per day. In the Finnish neonatal wards, neonatal care is family-centered, and kangaroo care is standard practice. Due to the several beneficial effects of the care method (e.g. Boundy et al., 2016; Moore et al., 2012), parents are encouraged to perform kangaroo care daily as soon as the preterm infant's physical state is stable enough, usually starting already while in intensive care. In both groups, the participation of this study started in the hospital, and it continued at home after discharge. The time of hospital discharge varied between the families, and it was individually decided according to the infant's physical condition. After discharge, parents were encouraged to continue kangaroo care; however, they were also permitted to adapt the approach and hold their infants on their lap instead if needed.

Singing intervention group

After enrollment, a certified music therapist (KK) encouraged and guided the parents in the singing intervention group to sing or hum during the daily kangaroo care. Before the start of the intervention, the music therapist gave approximately 10–15-minutes verbal instructions on how to sing to preterm infants by creating a soothing sound environment without increasing the risk of overstimulation; with a slow tempo, a pleasant volume level and with repetitive, simple melodies (O'Gorman, 2006). In addition to this, the parents were given a song booklet made by the music therapist, including traditional Finnish lullabies and children songs with simple melody structures and lyrics. The parents were also encouraged to sing songs that were special to them, such as songs from their childhood that had emotional and personal relevance (Loewy, 2015). Parents were guided on what kinds of songs could be used in certain situations during the intervention period. Peaceful lullabies were suggested for preterm infants still with lower GWs and also when transitioning infants to sleep. Parents were informed of the fact that when infants start reaching full-term, they are awake for longer periods and begin to need more active interaction. For this reason, the song booklet also included energetic children's songs alongside the lullabies. For the daily singing to be feasible, the parents were instructed to sing or hum during the kangaroo care for the amount of time they felt natural.

Control group

The parents in the control group were not encouraged and instructed to sing during the daily kangaroo care. Hence, the parents in the control group continued offering kangaroo care as they would have done in any case as a standard practice.

Following these protocols, the parents in both groups were invited to continue the daily intervention on their own until their infants' postnatal age reached 40 GW.

Participants

Overall 79 mothers of preterm infants initially participated in the on-going Singing Kangaroo study (singing group, $n = 47$; control group, $n = 32$). The inclusion criterion was adjusted for one participant whose preterm infant was born at 24.7 GW but was

medically stable. Twenty-one mothers in the singing group and 20 mothers in the control group did not finish the intervention or complete the measurements and were, thus, excluded from this study. From the remaining 26 mothers in the singing intervention group, the data of two mothers were omitted from further analysis because, according to the parent diaries, they did not sing during the intervention period. However, the data of these two mothers were included in an additional sensitivity analysis conducted following the intention-to-treat (ITT) principle recommended for randomized controlled trials (reported in the Supplementary material). Finally, 24 mothers in the singing group aged between 23 and 43 years ($M = 32.0$ years, $SD = 5.65$) and 12 mothers in the control group aged between 25 and 44 years ($M = 32.8$ years, $SD = 5.46$) who had completed the STAI at both measurement points and/or had completed the self-report questionnaire post-intervention were included to this study. The participant information of the mothers and birth characteristics of the preterm infants are presented in Table 1. There were no statistically significant differences between the groups.

Data collection

This study is a convergent mixed methods design (Creswell & Plano Clark, 2017). Quantitative data were collected using STAI questionnaires and parent diaries. The self-report questionnaire for the singing intervention mothers was used to collect both quantitative and qualitative data. The rationale for adding qualitative questions to the questionnaire was to obtain complementary data and to expand the quantitative results. Including both quantitative and qualitative questions aimed to collect more in-depth information to better understand the individual experiences with maternal singing.

STAI

The State-Trait Anxiety Inventory is a widely used questionnaire for measuring both state (Y1) and trait (Y2) anxiety in adults (Spielberger et al., 1983). In this study, the change of maternal-state anxiety was assessed by measuring the STAI values at an early phase (35 GW) and at the end of the intervention (40 GW) with STAI form Y1. Two mothers in the singing intervention group did not fill out the STAI at the 35 GW measurement point, whereas three mothers did not fill out the form at 40 GW. Finally, the remaining 19 replies, including data for both measurement points in the singing

Table 1. Participant information of the mothers and the birth characteristics of the preterm infants (mean and range)

	Singing intervention group	Control group
Mothers, <i>n</i>	24	12
Age (years)	32 (23–43)	32.8 (25–44)
Preterm infants, <i>n</i>	26*	12
Male, <i>n</i>	20 (77%)	6 (50%)
Gestational weeks at birth	30.2 (24.7–33.3)	30 (27.1–33.3)
Weight (g)	1522 (900–2800)	1314 (925–2000)
Apgar 5**	6.8 (1–10)***	6.8 (4–9)

*includes two twin pairs.

**newborn health assessment on a scale 1–10 (Breathing effort, heart rate, muscle tone, reflexes and skin color, assessed 5 min postnatally).

*** Data of two infants not collected.

intervention group, were included in the analysis. In the control group, 12 mothers had filled out the STAI at both measurement points and were included in the analysis, respectively.

Parent diary

The duration of the intervention was collected in parent diaries. The parents in the singing intervention group reported the daily kangaroo care time (min) and singing time (min). In the control group, the parents reported the daily amount of kangaroo care (min) and described the auditory environment of each care situation (e.g. silence, singing, watching tv). Three parents in the singing intervention group did not return the data, resulting in 23 parent diaries (23 diaries from 21 mothers, including two twin pairs). In the control group, all 12 families returned the parent diary.

Self-report questionnaire

Post-intervention, data for maternal singing experiences in the singing intervention group were collected using self-report questionnaires. Due to a lack of existing and suitable measures for this study, a questionnaire including quantitative and qualitative questions for maternal singing experiences was designed (KK, JE). The questionnaire consisted of 18 mostly multiple-choice questions with a 5-point Likert scale (from “very little” to “very much”). After the multiple-choice questions, there was space where mothers could write freely about their individual experiences (see the original and translated questionnaires in Appendix A). Data of three mothers could not be collected due to a technical issue leading to not delivering the questionnaire in time. Hence, a total of 21 questionnaires from the singing intervention mothers were collected for further analysis.

Data analysis

Quantitative data analysis

The data were analyzed using SPSS Statistics 25 (IBM Corporation, NY, USA). Both hospitals where families were recruited were Helsinki University Hospital’s neonatal wards with similar demographics, using the same practices and treatment protocols. Due to cluster-randomization, the background information of the families was examined. No differences in the participant information of the preterm infants (gestational weeks at birth, birth weight, Apgar points assessed 5 min postnatally), nor the mothers (age) between the two hospitals were found (Supplemental Table B1 in Appendix B).

To study the change in maternal state-anxiety, the points of maternal state-anxiety change were calculated by subtracting the after intervention STAI value (40 GW) from the baseline STAI value (35 GW) in each participant in both groups. After verifying that the data were normally distributed, the between-group analyses were conducted using independent samples t-test. The effect sizes are reported with Hedges *g*, as the sample sizes differed between the groups (reported in the results section “*STAI Results*”). An additional sensitivity analysis was conducted following the ITT principle so that all the available data, also from those mothers who did not carry out the intervention, were included in the analysis (results reported in Appendix C in the Supplementary material). The mean values, ranges, and standard deviations of the parent diaries are reported in the results section “*Parent Diary Results*”. The mean values and standard deviations of the quantitative self-report questionnaire answers

and reported in Table A1 in the Supplementary material. The answers are also partly presented in the results section “*Quantitative Self-Report Questionnaire Results*” with answers on a scale from 3 (“*somewhat*”) to 5 (“*very much*”) included in the percent calculations.

Qualitative data analysis

A thematic analysis of the qualitative data from the self-report questionnaire was conducted. In this widely used analysis method, patterns, and themes within the data are carefully identified (Braun & Clarke, 2006; Clarke & Braun, 2013). Following the process of thematic analysis described by Braun and Clarke (2006), the data were first familiarized by reading it through several times and making notes. Second, the data were organized into tentative codes. After this, the codes were further organized to themes, and finally, these themes were defined and named. The qualitative results of the questionnaires are reported in the results section “*Qualitative Self-Report Questionnaire Results*” with further details provided in Table 2.

Results

Quantitative results

STAI results

No group differences were found at the baseline measurement at 35 GW, $t(29) = 1.607$, $p = .119$, $g = 0.58$ (singing intervention group: $M = 40.4$, $SD = 11.8$, range 22–63; control group: $M = 34.4$, $SD = 6.7$, range 25–45), making the groups comparable. When examining the change in maternal state-anxiety post-intervention, mothers in the singing intervention group experienced a statistically significant decrease in the STAI values, $t(29) = -2.548$, $p = .016$, $g = 0.94$, compared to the control group mothers (singing intervention group: $M = -8.6$, $SD = 10.2$; control group: $M = 0.2$, $SD = 7.7$). The maternal-state anxiety change points in each participant in both groups are presented in Figure 2.

Parent diary results

In the singing intervention group, kangaroo care was conducted on average 130 minutes per day ($SD = 52$, range 26–304) for an overall 41 days ($SD = 11$, range 25–68). The mothers sang, on average, 41 minutes per day ($SD = 36$, range 8–120), and the mean singing intervention length was 36 days ($SD = 12$, range 15–63). In the control group, kangaroo care was implemented, on average, 132 minutes per day ($SD = 42$, range 72–244), and the overall intervention length was, on average, 47 days ($SD = 20$, range 9–77). The parent diaries revealed no singing during kangaroo care in the control group.

Quantitative self-report questionnaire results

From the 24 mothers in the singing intervention group, 21 completed the self-report questionnaire post-intervention. Of the mothers, 16 (76%) were primipara mothers, 3 (15%) had a career college degree, 8 (40%) had completed a degree from a university of applied sciences, and 9 (45%) had a university degree (information of one mother could not be collected). The infants ($n = 23$, including two twin pairs) of these mothers in the singing intervention group were born between 24.7 GW and 33.3 GW, of whom

Table 2. The qualitative results of the self-report questionnaires

Theme 1	The effects of maternal singing on the mothers	Example quotes from the mothers' questionnaire replies
Sub-theme 1	Relaxation	<p>"Singing helped with coping occasional feelings of fear and worry ... Singing calmed my mind and decreased worrying" (P12)</p> <p>"[Singing] Also calms me." (P10)</p> <p>"[Singing] Relaxed and calmed mom down, too." (P1)</p> <p>"When the baby relaxes, I feel relaxed, too." (P9)</p>
Sub-theme 2	Improved mood	<p>"My mood has been good. I have been more stress-free." (P11)</p> <p>"Singing enhances my mood ... " (P10)</p> <p>"Singing has cheered me up in bad/tired days. It has also been a good 'activity' in a situation when you don't know/figure out what to do." (P1)</p> <p>"When singing I don't have to think about everyday life issues, but I can just be in the moment." (P18)</p> <p>"Even though I am not that musical and cannot even sing, singing relaxed my mind surprisingly much." (P12)</p> <p>"It [singing] helps me to cope better with everyday life." (P19)</p>
Sub-theme 3	Opportunity to be active	<p>"It was also wonderful to see how I could concretely help the baby to calm down by singing." (P21)</p> <p>"I felt that my baby could benefit and feel safe ... Good activity while breastfeeding and holding the baby. Better to sing than to be on your phone." (P3)</p> <p>"It felt important and good that you can affect the baby's development in a concrete way." (P9)</p>
Theme 2	The effects of singing on the preterm infants	Example quotes from the mothers' questionnaire replies
Sub-theme 1	Relaxation	<p>"It was great to see how singing/humming calmed the baby." (P4)</p> <p>"Singing helped to release stress when the baby was restless." (P18)</p> <p>"Clearly calmed down: heart rate decreased and breathing became steady." (P21)</p> <p>"Always calmed down and fell asleep." (P13)</p> <p>"Relaxed, seemed to fall into a deeper sleep." (P12)</p>
Sub-theme 2	Focused attention	<p>"With more age, the infant started to observe me sometimes and listened to my voice (focus the look accurately and he seemed to wonder my voice)." (P16)</p> <p>"[The infant] Occasionally lifted his head towards the voice and seemed to be listening." (P12)</p>
Theme 3	The effects of maternal singing on the early relationship	Example quotes from the mothers' questionnaire replies
Sub-theme 1	Emotional closeness and enhanced early interaction	<p>"[Singing] Increased feeling of togetherness and felt interactive between myself and the baby" (P12)</p> <p>"It felt good to be close to my baby and sing tenderly." (P7)</p> <p>"I felt I could build a deeper bond by singing. The songs brought us closer together and gave us a common language/way to communicate. The singing moments felt interactive and we both clearly enjoyed them." (P21)</p> <p>"Through singing, I transmitted a deeper emotional connection to the baby. I also became emotionally moved by some of the songs that had a special meaning for me." (P16)</p> <p>"Singing arose already in the hospital strong emotions, and that's why the emotional connection feels stronger." (P11)</p> <p>"Singing was an easy way to communicate at the beginning before I knew how to talk to the baby" (P10)</p>

(Continued)



Table 2. (Continued).

Sub-theme 2	Naturalness of singing	<p>"Singing while the infant was in my arms felt natural." (P4)</p> <p>"Already before the study, I felt the need to sing/talk and use my voice while holding the baby." (P1)</p> <p>"Women have been singing to their infants and children through the ages. It was great to be part of this tradition. It was also great to sing traditional Finnish lullabies from my childhood. For me, it is also about the chain of generations." (P16)</p> <p>"Singing felt a natural way to build a bond and connection with the baby." (P1)</p>
Sub-theme 3	Need for privacy	<p>"Singing became easier when we got a private room." (P21)</p> <p>"In the hospital, I sometimes felt uncomfortable to sing while others in the room. It interrupted building an emotional connection with the baby. Singing is in my experience very intimate and personal thing." (P16)</p> <p>"I was embarrassed to sing in the presence of others." (P13)</p> <p>"In the hospital, it [singing] is very difficult when you have a roommate." (P17)</p>
Sub-theme 4	Differences in combining maternal singing and kangaroo care and kangaroo care alone	<p>"I feel that singing and closeness (kangaroo care) created a strong emotional connection from early on." (P16)</p> <p>"I felt that singing and skin contact helped significantly to strengthen the emotional connection." (P1)</p> <p>"It felt more intensive and I felt experiencing a better 'connection' with the baby. It felt better and I experienced a stronger and closer bond." (P2)</p> <p>"When singing I was more present, and I also relaxed in a different way." (P6)</p> <p>"There were more feelings involved. I believe the experience was deeper." (P17)</p> <p>"Kangaroo care became more interactive." (P21)</p>
Sub-theme 5	Daily routines	<p>"From very early on the baby had favorite songs." (P19)</p> <p>"At home, we created a special evening ritual that included calming the baby down by singing after feeding while changing the diaper." (P16)</p> <p>"Singing became an important moment also at home. You stopped and just enjoyed the present moment." (P1)</p>

(P) = Participant ID number.

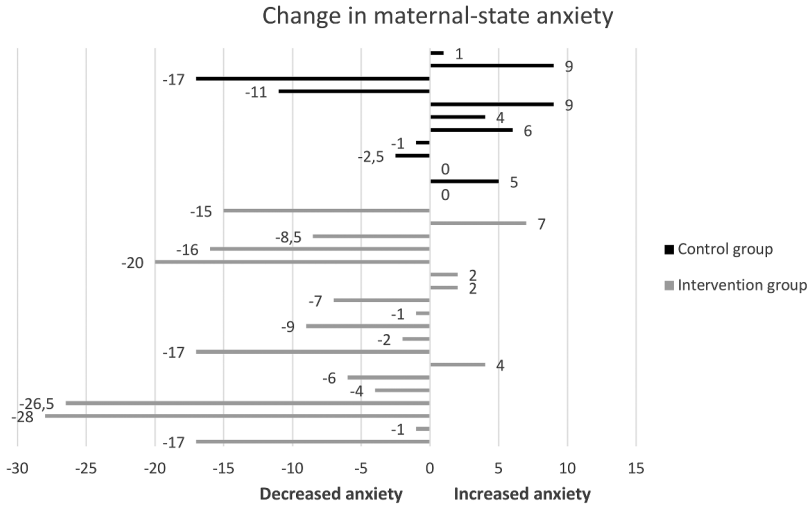


Figure 2. Maternal-state anxiety change in each participant in both groups post-intervention (group difference $p = .016$)

13 (57%) were very preterm (28–32 GW) and 5 (22%) extremely preterm (< 28 GW). Of these, 9 (40%) were also very-low-birth-weight (< 1500 g) infants. According to the replies, parents started singing on average at 32.8 GW (range 30–34.14 GW). The mothers carried out most of the intervention, yet 16 (76%) mothers reported that fathers sang to their preterm infants during the intervention as well.

The mean values and standard deviations of all the questionnaire answers are shown in Table A1 in the Supplementary data. Of the 21 mothers in the singing intervention group, 12 (57%) reported that they had heard of the positive effects of music on the development of preterm infants before the study started. All the mothers reported that singing daily felt useful and important. Nineteen of the mothers (90%) replied that their infants responded to singing with relaxation, and 17 (80%) of the mothers reported that their infants reacted to singing with falling asleep. Contrary to this, 3 (14%) of the mothers reported that their infants reacted to singing with restlessness and 1 (5%) with being tearful and irritated. However, these mothers also reported in the open questions that the infants were not feeling comfortable in the kangaroo care position. Hence, it was unclear whether these reactions were explicitly due to singing or due to a more general uncomfortable feeling in the kangaroo care situation. Of the mothers, 13 (62%) reported that infants tried to look in the direction of the sound, especially older infants that were awake for a longer time.

Eighteen (85%) mothers experienced that singing improved their mood and 14 (67%) that it helped them to cope. Furthermore, 16 (76%) mothers replied that singing had a positive impact on their overall wellbeing. Almost all, 20 (95%) mothers felt that singing enhanced interaction and made it easier to connect emotionally. According to 16 (76%) of the mothers' replies, kangaroo care was experienced in a different way when singing was added to the care. They reported that maternal singing provided an emotional and interactive component to the situation and that the combination was a more relaxing and all-encompassing experience than when performing kangaroo

care alone. In contrast to this, 5 (24%) mothers reported that kangaroo care alone was more relaxing than when singing was added.

All families reported listening to music in daily life to some extent, and in 7 (33%) families, musical instruments were played as well. Sixteen (76%) mothers were sung to in their childhood, and several of them replied that they sang songs during the intervention that their parents and/or grandparents had sung to them. Fourteen (66%) mothers reported that they were often singing in general and 18 (85%) stated not being ashamed of their singing voices. Nonetheless, 19 (90%) of the mothers felt the need for quietness and space while singing, and only 3 (14%) of the mothers reported singing in the presence of others.

Qualitative results

Qualitative self-report questionnaire results

The thematic analysis of the open questions revealed several themes and sub-themes from the data. Three main themes emerged overall, which describe the effects of maternal singing on (1) mothers; (2) preterm infants and; (3) their early relationship. These three main themes and sub-themes belonging to them together with participant answer examples are reported in [Table 2](#). According to the qualitative analysis, there were no actual negative effects of maternal singing for infants as reported by the mothers. Nonetheless, one of the mothers reported that singing for a long time was wearing for her voice, and one mother reported that singing felt tiring, and she often wanted to sleep instead. Moreover, one mother stated that singing for an extended period was difficult since she needed to learn new songs, which felt laborious. However, she wanted to do that to be able to continue singing in the future. According to the data, the mothers sang songs from the given song booklet and also familiar songs from their childhood.

Discussion

This mixed methods study investigated the effects of daily maternal singing combined with kangaroo care during the early weeks after preterm birth on maternal anxiety, wellbeing, and the mother–infant relationship. The data were collected using quantitative outcome measures assessing maternal-state anxiety and intervention length (STAI and parent diaries) and self-report questionnaires consisting of quantitative and qualitative questions to examine intervention group mothers' singing experiences.

The STAI results showed a statistically significant difference between the two groups, as the late STAI values in the singing intervention group were significantly lower than the early STAI values. This result of maternal-state anxiety decrease was strongly supported by the singing intervention group mothers' experiences reported in the self-report questionnaires. The replies to both quantitative and qualitative questions in the self-report questionnaire suggest that maternal singing during kangaroo care may improve mothers and preterm infants' wellbeing and support their early relationship by creating moments of interaction and helping to connect emotionally. [Figure 3](#) summarizes the self-report questionnaire results and their prospective implications on the development of an early relationship.

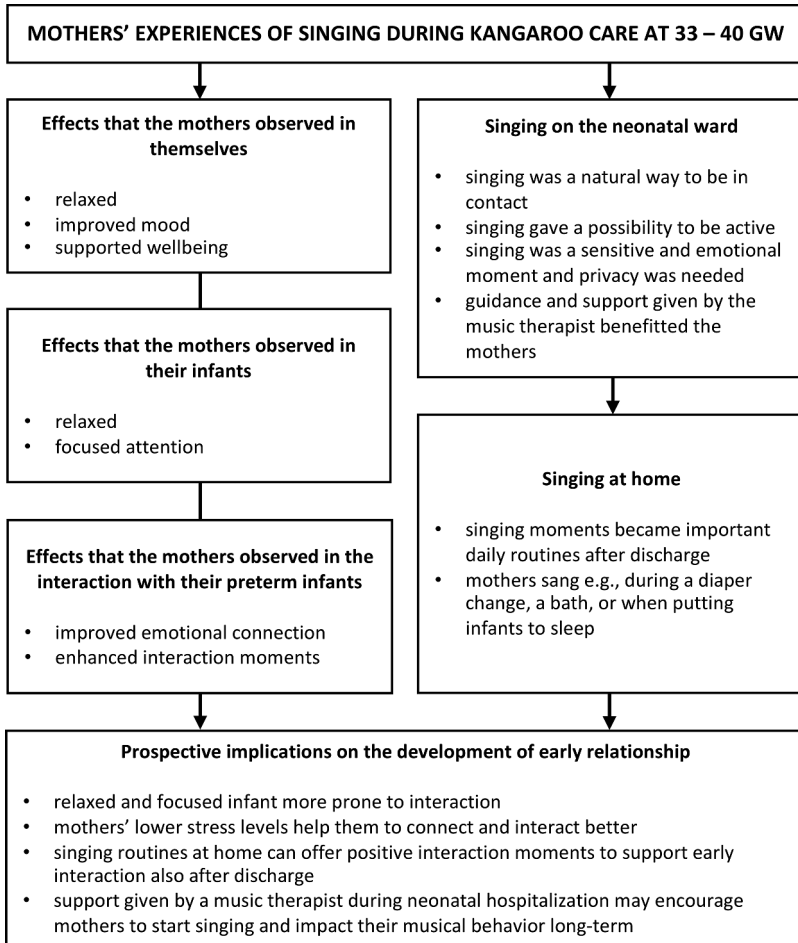


Figure 3. The results of the self-report questionnaires

During the intervention, singing was experienced as a natural way to connect with the infant. The mothers reported maternal singing as being relaxing for both the preterm infants and themselves and improving the mothers' mood. According to the data, singing can offer an opportunity for the mothers to be active during their infant's hospital care and do something practical to ease their infants' state. These kinds of mutual moments of relaxation, activity, and interaction may play an essential role in promoting maternal wellbeing and the development of maternal identity and early mother–infant relationship (McLean et al., 2019). Mothers also stated that noticing infants relaxing and calming down by their singing felt good, and they were more motivated to sing. As preterm birth can reduce parental sense of competence (Schappin et al., 2013), early musical interactions could offer a possibility for experiencing positive interaction moments and support parental self-esteem and sense of parental competence (e.g. Nicholson et al., 2008).

Kangaroo care combined with maternal singing was experienced mainly as relaxing. Several music therapy (Ettenberger et al., 2017; Teckenberg-Jansson et al., 2011) and music-medicine (Lai et al., 2006; Schlez et al., 2011) studies have demonstrated the beneficial effects of different music stimuli during kangaroo care on the mothers of preterm infants. Our results are in line with the music-medicine study by Arnon et al. (2014), indicating that maternal singing during kangaroo care may decrease anxiety. Our results also show similarities with another mixed methods study by Ettenberger et al. (2017), whose quantitative results showed that music therapy during kangaroo care decreased maternal anxiety and the qualitative results suggested that musical interaction helps parents to feel more connected to their infants. Furthermore, in line with our results, previous music therapy studies have demonstrated the positive effects of early family-based music interventions on maternal wellbeing (Haslbeck, 2014; Loewy, 2015; Loewy et al., 2013).

The singing moments were experienced interactively since preterm infants reacted by relaxing, or later by looking in the direction of the sound and focusing attention on it. Furthermore, most mothers experienced that singing added an emotional supplement to the physical connection in kangaroo care and made the care situation a more all-encompassing experience. Singing gave rise to emotions in the mothers and fostered the creation of an emotional connection. The mothers experienced that singing evoked feelings of connection and bonding. These results are supported by the studies of Koelsch (2010) and Blood and Zatorre (2001), which showed that music and singing could induce strong emotions and affect the mood. It has also been stated that singing can enhance wellbeing, and this effect might be connected to the release of two hormones in the brain while singing. These hormones are endorphins that are known to trigger feelings of pleasure (Dunbar et al., 2012); and oxytocin, which relieves feelings of anxiety and stress and improves feelings of bonding (Grape et al., 2003).

As maternal singing during kangaroo care was mostly experienced as a shared, intimate moment between the mother and infant, privacy for singing was needed in most families. For this reason, the singing moment was not always easy to arrange, when shared rooms and the presence of the nursing staff created barriers for singing. These results show similarities with both Shoemark and Arnup's (2014) as well as McLean et al.'s (2019) studies reporting that mothers' feelings of embarrassment brought challenges for singing in the ward. In our study, one of the mothers even reported going to the restroom to have some privacy and sing because she could not have that intimate space she needed otherwise. The impact of culture should also be taken into account when discussing parental singing behavior and the need for privacy during the singing. Different cultural norms about what is considered appropriate may affect the singing behavior of the parents (see e.g. Shoemark & Ettenberger, 2020).

Three of the mothers in the singing intervention group stated that the guidance and support they received from the music therapist on the ward encouraged them to start singing, which otherwise would not have happened. Graven (2000) emphasized the importance of hospitalized infants to be provided with the possibility of hearing their mother's voice in a live interaction. However, Coppola and Cassibba (2010) found that the more severe the preterm infant's physical state was, the fewer mothers talked to them on the ward. Thus, mothers as well as fathers may benefit from individual support from a certified music therapist during their infant's hospital stay. Information and guidance about how to use parental voice and singing as a way to regulate emotions, relax and create an interactive and emotional space for a mutual

meeting while simultaneously offering appropriate multisensory stimulation to promote their preterm infant's development could be beneficial. Nonetheless, despite the possible beneficial effects of singing, there should never be any pressure or blame put on the parents if they do not wish to sing. For these parents, motivation should be given to use their voices in other ways comfortable to them, such as by reading nursery rhymes or their favorite books aloud.

All 21 mothers continued singing to their infants after the intervention ended, and singing and music became a part of their everyday life. For example, the mothers sang to change the mood of the infant (activating, calming down), during a diaper change or when putting them to sleep. Early family-based interventions can reduce maternal stress and enhance positive parent–infant interactions after preterm birth (Forcada-Guex et al., 2006). Hence, the early relationship should be supported, not only during the hospitalization period but after discharge, in order for the parents to have tools for supporting early interaction and infant development also at home (Forcada-Guex et al., 2006; Nicolaou et al., 2009). Our results suggest that singing can offer this support not only during the early hospitalization period but also after discharge.

As parents of prematurely born infants may need support for the early parent–infant interaction, practical instructions and tips for creating mutual musical interactive moments could also be useful after discharge. For example, Shoemark (2018) has developed a psycho-educational program *Time Together* for supporting interaction between parents and hospitalized infants. In this program, parents are educated on observing infant cues and behaviors, and how to respond to them using parental voice, such as by talking, humming, and singing. Guiding parents toward mutual interaction through voice and supporting parents in these situations aims at building their trust in their capability of interacting and responding to their infant's needs.

Limitations

There were some limitations to this study due to the following reasons. First, while recruiting in two hospitals, issues, such as other ongoing studies and differences in family participation and hospital resources, were encountered. For these reasons, acquiring an equal distribution of participants in both groups was not possible. Also, families meeting the inclusion criteria were infrequently admitted to the ward, and an exception was made with one infant regarding the gestational age at birth. However, this infant was accepted to be included in this study since the primary research subjects of this study were the mothers. Second, the intervention period in our study was several weeks long, and the parents needed to conduct the daily intervention independently. Many families, especially with twins or older children, reported difficulties in finding the time and energy for the daily intervention after being discharged from the hospital. For this reason, the families did not partake in all the measurements, leaving the number of participants for this study smaller than initially planned. Hence, it should be taken into consideration that the participant drop-outs and the uneven number of participants between the groups may have affected the results.

Third, data was initially planned to be also collected from the fathers if they were conducting the intervention. However, as the data were collected in the hospital during office hours, the researchers did not get in contact with most of the fathers. For this reason, insufficient data for further analysis were collected, and information on how singing affected paternal wellbeing and early communication in building a father–

infant relationship could not be obtained. The majority of the research in this area has been focusing on maternal experiences and anxiety after preterm birth, while paternal experiences have not been studied with the same interest. Fathers of preterm infants also experience increased rates of stress (Garten, 2013; Hugill et al., 2013) and emotional distress (Mackley et al., 2010; Sloan, 2008) and the psychological wellbeing of fathers has been connected to the behavioral development of preterm infants (Huhtala et al., 2012). Therefore, future studies should be more focused on the wellbeing of the whole family as an entity and search ways to include fathers as participants (See also Mondanaro et al., 2016). Fourth, our results do not reveal experiences from mothers who dislike singing or do not experience it as a natural way of being and contacting with their infant. Indeed, not all mothers feel comfortable with singing, and the underlying reasons for that would be interesting to investigate.

Conclusion

Prematurity does not necessarily affect the quality of interaction between the mother and infant, however, it is a risk factor due to increased levels of maternal anxiety and depression (Korja et al., 2009). As maternal depressive symptoms and stress may carry a risk for the social, behavioral, and functional development of VLBW infants (Huhtala et al., 2012, 2014), the importance of maternal psychological wellbeing should be highlighted after preterm birth. These study results indicate that maternal singing during kangaroo care is suitable to be used in the neonatal ward; it may decrease maternal anxiety and support mother–infant wellbeing and early interaction. The combination may create interactive moments and offer an opportunity to experience both physical and emotional closeness that is crucial for the overall wellbeing and development of an early relationship. However, mothers may need information, support, and privacy for singing, especially those who have no musical background nor previous experience of singing. The long-term effects of parental singing and music on parental wellbeing, parent–infant relationship, and neurodevelopment in preterm infants should be further investigated.

Disclosure statement

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