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Rapid effects of neonatal music therapy combined with kangaroo care on prematurely-born infants

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The aim of this study was to investigate the influence of music therapy (MT) combined with kangaroo care as dual treatment (DT) on the physiological responses of preterm infants compared with the influence of kangaroo care (KC) only. The infants' heart rate, respiration, transcutaneous O2 saturation and blood pressure were measured before, during, and after every therapy session. Sixty-one preterm infants born at a 24 to 36 week gestational age (GA) participated in the study. During KC, each infant was kept in skin-to-skin contact or held by a parent, and during DT sessions, the infant received music therapy in addition to KC. The DT and KC therapy sessions alternated. The results revealed that repeated DT and KC decreased the pulse, slowed down the respiration and increased the transcutaneous O2 saturation. The DT affected the blood pressure significantly more compared with the KC. Self-reports by the parents post-therapy suggest that DT may relax and calm both infants (51%) and parents (63%). In conclusion we propose that repeated combination of music therapy and kangaroo care may be more beneficial for preterm infants than KC alone in terms of certain physiological outcomes and parent self-reports.

Keywords: premature infant; music therapy; kangaroo care; dual therapy; physiological response

Introduction

Premature birth exposes an infant to a range of developmental risks. Premature infants exhibit lower cognitive and motor skills as well as problems in behavioral outcomes that persist into childhood (Allin et al., 2001; Bhutta, Cleves, Casey, Cradock, & Anand, 2002) more often than

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full-term infants. Most premature infants are also exposed to a large number of painful procedures during their hospitalization that may contribute to an altered development of the pain system (Buskila et al., 2003). The brain responses to sounds in healthy, prematurely born infants and five-year-old children differ from those born full-term (Fellman et al., 2004; Mikkola et al., 2007). In addition, apart from the risks of the premature birth itself, developmental outcomes may arise from the challenges posed to the mother–infant relationship (Korja et al., 2008).

Literature review of KC on prematurely born infants

Skin-to-skin contact with the caregiver, referred to as kangaroo care (KC), has been reported to have many beneficial effects, both for preterm infants and for their parents. KC has been shown to be efficacious, especially in reducing pain responses in premature infants, including behavioral and physiological components (Chwo et al., 2002; Johnston et al., 2003; Ludington-Hoe & Hosseini, 2005; Konstandy et al., 2008; Johnston et al., 2008). KC also affects infant development and parent–child interaction (Feldman, Eidelman, Sirota, & Weller., 2002). For example, in a study by Ludington-Hoe & Hosseini (2005), premature infants' heart rates and crying responses to pain were significantly reduced during skin-to-skin contact, and the infants succeeded in sleeping more during KC than in incubator care. Furthermore, Johnston et al. (2008) sought to whether KC would be efficacious in very preterm infants during heel lance, and found that KC decreased the neonates' pain responses, such as facial expressions and changes of heart rate. Recovery time was also shorter in the KC group, which is clinically important in helping to maintain homeostasis in preterm infants. KC also helps infants gain more weight (Conde-Agudelo, Diaz-Rosssello, & Belizan, 2003; Dodd, 2005).

Literature review of MT on prematurely born infants

Music therapy (MT) is defined as professional, intentional use of music, live or recorded, for the purpose of evoking specific beneficial emotional or physiological reactions. The short-term effects of MT on preterm infants have been examined in many studies. Standley & Moore (1995) reported the therapeutic effects of music and the mother's voice on premature infants over a period of three consecutive days. Infants who heard music had significantly fewer occurrences of oxymeter alarms during auditory stimulation than did those who listened to their mother's voice only. Nöcker-Ribaupierre (2004) investigated how the mother's voice affects premature infants regarding the physiological activity and oxygen saturation and found out that the mother's voice significantly reduced physiological activity and increased the oxygen saturation. The results of the study by Chou, Wang, Chen, & Pai (2003) showed that premature infants receiving MT with endotracheal suctioning had significantly higher oxygen saturation, and the level of oxygen saturation returned to the baseline level faster than when the infants did not receive MT. Several other studies have also reported that music listening may improve oxygen saturation levels as well as decrease blood pressure and heart-rate levels for short periods of time (Butt & Kisilevsky, 2000; Bo & Callaghan, 2000; Standley, 2002; Pölkki, 2006).

MT also has a positive effect on long-term variables in premature infants. Continuous music stimulation, such as the use of recorded lullabies, can have a positive outcome on stress behaviors, weight gain and the duration of hospitalization (Caine, 1991; Standley, 1998, 2000; Standley, 2002; Cevasco & Grant, 2005). For example, Caine (1991) studied 52 preterm and low birthweight newborns in a neonatal intensive care unit and found that recorded vocal music significantly reduced the daily group mean of stress-related behaviors, the duration of hospitalization in the intensive care unit, and, overall, increased the daily average weight, and formula and caloric intake. In addition, Standley (2000) reported that music contributed significantly to the development of non-nutritive sucking in premature infants.

With the exception of a study by Lai et al. (2006) and a pilot study by Bissegger (1999), there seem to be no reports on the influences of MT during KC on preterm infants compared to influences during KC only. Lai et al. (2006) found that music of a lullaby improved infants' quiet sleep and reduced crying. Mother–infant dyads in the treatment group of this study were exposed to music during KC for 60 min/day for three consecutive days. The music was chosen by the mothers from three types of lullabies on a CD.

Most of the music interventions used in earlier studies has consisted of recorded music (Standley, 2002; Pölkki, 2006). Only a few studies have examined the effect of live MT on short-term physiological and behavioral parameters (Arnon et al., 2006; Bissegger, 1999; Haslbeck, 2004) or combined live music with multimodal stimulation (Standley, 1998) for premature infants during a stay in neonatal intensive care. Bissegger (1999) used live MT only and found that the effects of MT were not clearly visible in measured values but they emphasized the essential effect of the individual experience. Haslbeck (2004) sang for premature infants and was able to create a communicative contact with the infants as well as calm and stabilize the respiration.

Hypotheses

The aim of this study was to investigate the basic medical markers of the infant state (heart rate, respiration, transcutaneous oxygen saturation, and blood pressure) in a group of infants repeatedly receiving KC, and a dual treatment consisting of MT and KC. The age, gender, medical condition of the infant, and the number of times therapy was given were considered when investigating the effects of the therapies. Additionally, we wanted to determine whether the growth of those infants receiving DT would show any difference compared with infants receiving standard care in the same ward.

Our hypothesis is that several positive effects are achieved by combining MT and KC. First, we believe that the positive effects of both MT and KC are preserved and even enhanced when these two treatments are combined. Second, we believe that by relaxing the caregiver during KC, achieved via MT, more benefits will occur from KC than when the caregiver is not as relaxed. Further, we assume that the effects of the combined MT and KC are enhanced via learning; that is, the positive effects of the dual treatment are stronger after the infant has learned to expect the dual treatment and its positive effects.

Methods

Participants

This study was made in a level II neonatal ward of the Helsinki University Central Hospital, Finland, during November 2006 and November 2007. The design and procedures for this study were approved by the hospital's Ethics Committee. The parents of each stabile preterm infant on the neonatal ward, with a gestational age of less than 37 weeks, were given written and oral information about this study and asked whether they would be interested in participating. They were informed that participation was voluntary, and that they could terminate their participation whenever they wished. Only then did the parents give their consent. Altogether, parents from 77 families were given written information about the study, and 61 families with prematurely born, stabile infants decided to participate. As soon as an infant's therapy was concluded the parents were given a questionnaire with open-ended questions to evaluate their experience and describe the therapy received.

To compare the growth between the infants studied and the infants who received standard care on the same ward, an additional clinical data set such as GA, birth weight, gender, weight, and age in weeks when discharged was collected with matched control pairs for each participating infant (Table 1). All infants were treated in the same period, and the weight was chosen within +- 200g and the age +- 7 days for the control pairs.

The birth weight of the treatment group was approximately 1 *SD* below the mean weight of Finnish intrauterine growth charts (Pihkala, Hakala, Voutilainen, & Raivio., 1989), while at the start of the treatment it was 2.2 *SD* below the mean of Finnish growth charts. The median Apgar score at birth for the treatment group was 6 at 1 minute and 7 at 5 minutes.

The mean age of the mothers of the study infants was 31 years (range 20–42 years). The most common problem during pregnancy was pre-eclampsia or hypertension (19%). Antenatal betamethasone was given to 74% of the mothers. Before the DT treatment, the main problems of the infants were

Table 1. Clinical data on the participants.

	Total *N* of participants, *N* of males	Gestational age at birth (weeks)	Birth weight (g)	Gestational age at start of treatment (weeks)	Weight at start of treatment (g)
Treatment group	Total 61, 36 males	30.5, *SD* 2.9 range 24.1–36.1	1465, *SD* 53, range 400–3100	34.5, *SD* 2.4, range 31–44	1854, *SD* 352, range 1055–2595
Comparison group*	Total 52, 30 males	30.7, *SD* 3.0 range 24.4–36.3	1535, *SD* 474, range 660–2480	No DT treatment, many received KC	

*Comparison group consisting of infants on the same ward receiving standard care, which often included some KC.

intrauterine growth retardation in 16 infants (26%), RDS in 43 (69%), chronic lung disease in 15 (24%), verification or severe suspicion of sepsis in nine (15%), and intraventricular hemorrhage in nine (15%). The treatments that the infants had received before the study were respirator 51% (median for 5 days); nasal CPAP 77% (median for 5 days); antibiotics 73%; and indomethacin for patent ductus arteriosus 23%. During the study period, 18% of the infants had bronchodilator therapy for chronic lung disease. The infants were in stable health at the beginning of the DT treatment.

Measurements

The infants' heart rate and the transcutaneous oxygen saturation (Sa02) were measured with Philips IntelliVue MP30, Philips Neonatal V24CT, Hewlett Neonatal Viridia 24C, or the Radical™ Signal Extraction Pulse Oximeter Masimo Set System. The respiratory rate and non-invasive blood pressure were measured with the same monitors except the Radical™ Signal Extraction Pulse Oximeter Masimo Set System.

The first measurements were done 10 minutes to 2 hours before the therapy (Prior). The second measurement was done when therapy started (Start), then 10 minutes after starting the therapy (10 min), thereafter 20 minutes after starting the therapy (20 min) and finally, from 10 minutes to 2 hours after ending the therapy (After). During the Prior and After measurements, the infants lay in their own beds or incubators, while during the therapy itself (Start, 10 min, and 20 min) the infants were held by their mothers or fathers, typically in KC. The music therapist followed and registered the facial expressions of the infant, when the infant's face was visible during the therapy. She also registered whether the infant was awake or asleep. The therapy was given three days each week, on Monday, Tuesday, and Thursday. Each infant received both DT (combining MT and KC) and Control Therapy (only typical KC) in an alternating fashion: DT one time, Control Therapy the next. Most of the infants received more than six therapy sessions (three DT and three Control Therapy) (range 1–14 times) depending on the length of stay on the ward. The therapy ended when the infant was discharged from hospital. Altogether 400 therapy sessions were included in the analysis.

After the study period, all parents of the 61 preterm study infants were given a questionnaire in which they were asked to describe in their own words if and how they had experienced the effects of DT on the infant and on themselves. Furthermore, they were asked whether they had noticed any specific differences in the reactions of the infant when they received DT compared with when the infant was kept in KC only. Additionally, the parents were asked whether MT had inspired them to continue singing and otherwise making music at home.

Music therapy

The MT was given by a trained music therapist, who is also one of the authors (Pia Teckenberg-Jansson). The musical instruments used were a lyre with ten strings, tuned pentatonically (d',e',g',a',b', d'',e'',g'',a'',b'') and a female human voice, which hummed, or sang. The lyre is a wooden instrument with metal strings whose soft tones create an ambient sound. These soft sounds create a great contrast to the usual sound environment in a hospital, with its constant and abrupt mechanical sounds, and beeping caused by all the necessary technical equipment. Through the music it is possible to screen out the technical environment for a time, and help both the parent and the infant relax and get to know each other as well as to enjoy the warmth and loving care of being close and skin-to-skin. The MT was directed both to the parent and to the infant.

The pentatonic scale system is a simple scale structure that creates consonant harmonies. The human voice is especially effective in transmitting emotions. The combination of the scale, the lyre, and the voice were the main characteristics of the MT. Each MT session started with soft and calm lyre sounds, and continued with soft humming/singing accompanied by the lyre. The duration of the MT was approximately 20 minutes. The music therapist aimed at an interactive session with the infant and the parent, taking into account the infant's reactions to the music, especially to its intensity. The MT was adjusted individually to each infant and each session.

Statistical analysis

Although the study design was one of standard repeated measures, all analyses were carried out by using hierarchical linear modeling (i.e., multilevel modeling) (see, for example, Hox, 2002) instead of, for instance, a repeated measures analysis of variance. This type of analysis was selected because there were some missing values in the dependent variables, and the time interval within therapy occasions was not identical between the subjects. The estimation method for all analysis was the Restricted Maximum Likelihood (REML), and the covariance structure of the within-subject variables was specified to the first-order autoregressive (AR(1)), one of the most widely used covariance structures in physiological research (Kristensen & Hansen, 2004). All statistical procedures were 2-tailed, and significance was set at a α level of 0.05. Age was used as a co-variant to exclude the age effects from the results. The analyses were computed using SPSS 15.0 with a mixed module (Statistical Product and Service Solution Inc., Chicago, IL.). Only significant results are reported here, but full results are presented in the Appendix (online only).

Results

Effects of DT and KC on pulse

There were significant effects on pulse across the therapy sessions [$F(5, 643) = 2.66$, $p < .05$]; see Figure 1. Generally, the pulse decreased across the therapy sessions, possibly related to the maturation of the infant.

Significant differences were also found across the three consecutive pulse measurements (Start, 10 min, 20 min of one therapy session) [$F(2, 631) = 3.92$, $p < .05$]. The pulse decreased significantly towards the end of the session; see Figure 2. A tendency for an effect of the therapy type on pulse was observed: the effect of DT was stronger towards the end of the session than for KC, even though this effect did not attain significance [$F(1, 643) = 3.32$, $p = .07$].

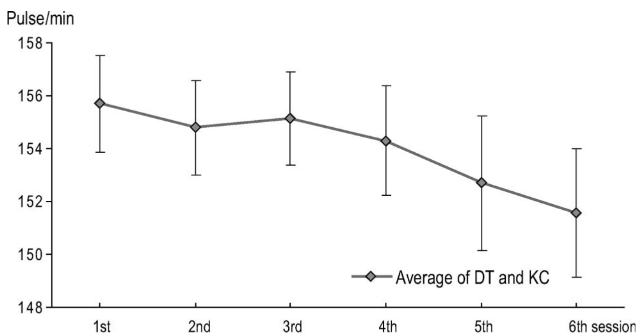

Figure 1. The development of the infant's pulse across the first six therapy sessions.

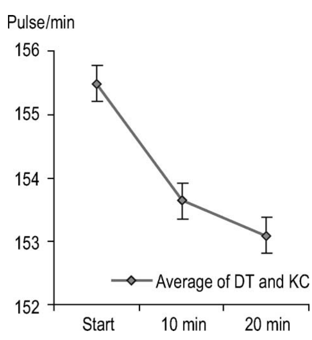

Figure 2. The development of the infant's pulse across the therapy sessions (average of DT and KC only).

Effects of DT and KC on respiration

Two significant effects of the therapy on respiration were observed. There was a significant therapy session main effect, i.e. calming, for respiration [$F(5, 267) = 3.63$, $p < .001$]; see Figure 3a. There was also a significant interaction between therapy session and therapy type [$F(5, 223) = 2.73$, $p < .01$]; see Figure 3b, showing varying respiration patterns in DT and KC across the therapy sessions.

Effects of DT and KC on transcutaneous oxygen saturation

There was a significant main effect of the therapy sessions on the transcutaneous oxygen saturation [$F(5, 644) = 2.34$, $p < .05$]; see Figure 4. The oxygen saturation increased towards the later sessions, partly reflecting the maturation of the infants, without difference between DT and KC.

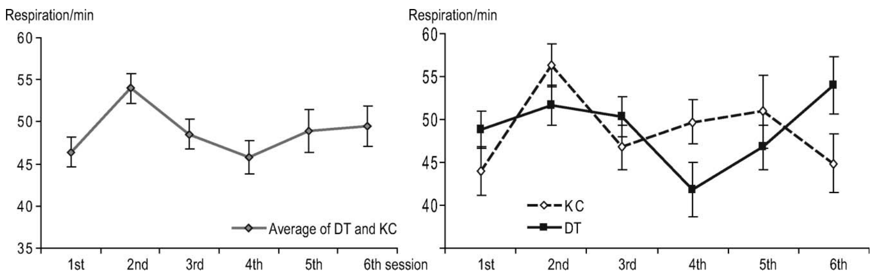

Figure 3. (a) The development of respiration across the first six sessions; (b) the development of respiration in the two therapy types (DT = continuous line, KC = broken line) across the first six therapy sessions.

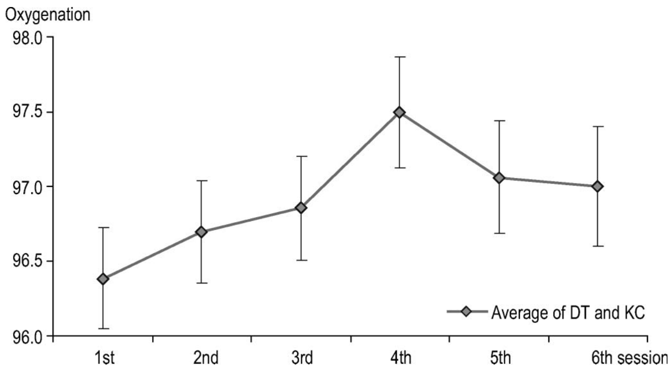

Figure 4. The effect of therapy session on oxygen saturation generally increased towards the last sessions.

Effects of DT and KC on blood pressure

Therapy type and therapy session interaction were significant both for mean blood pressure [$F(5, 41) = 2.94$, $p < .05$] and for systolic blood pressure [$F(5, 34) = 2.50$, $p < .05$]. In both cases, a tendency was observed for DT first to have higher and then later lower blood pressure values than KC alone. This trend was more visible for systolic blood pressure; See Figure 5.

Effects of DT and KC on growth

On discharge from the hospital, i.e. at the end of the music therapy, the 61 study infants had a GA of 36.5 wks (*SD* 2.2, range 33–43 wks) and a weight of 2248 g (*SD* 400, range 1360–3165 g), 2.0 *SD* below the mean of Finnish intrauterine growth charts. The mean increase of the infants' weight was 27.6 g/day, which is below the in-utero increases in wks 34–36 in girls and boys (28.5 and 35.7 g/day). Comparing the weight gain of the study infants (149.7 g/week) the weight gain of the 52 paired comparison infants (157.0 g/week) was no different. The hospitalization of the study infants was 7.0 days, and of the comparison infants, 6.8 days.

Informal observations on infant behavior during DT

The reactions of the infants to DT were typically visible in their eye movements and facial expressions. As soon as the music started, the infants often tried to open their eyes; sometimes a smile could be seen on their faces or the infant sighed loudly. Some infants started crying when the music stopped, and they stopped crying when the music started again. The respiration of the infants was in several cases more stable during DT, and not fluctuating as much as in measurements made just before therapy. Some infants' clear reactions to the music could also be seen in a few cases in the

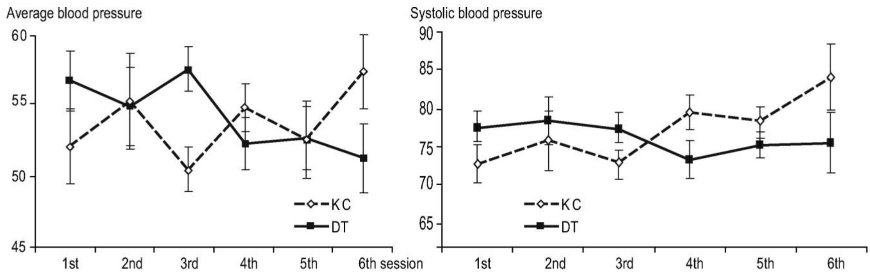

Figure 5. (a) The effect of the therapy session on the average blood pressure in the two therapy types (DT = continuous line, KC = broken line) across the first six therapy sessions; (b) the same effect for systolic blood pressure was even more noticeable.

increase of oxygen saturation, even though the room was full of disturbing noises such as beeping monitors or talking visitors. Over 90% of the infants fell asleep when in KC.

Parents' experiences of the effects of DT on infants

The DT was generally very well received. The parents commented that they found the sounds relaxing. None of the families wanted to discontinue their participation in the study.

Of all 61 questionnaires distributed to the parents, 49 (80%) were filled out and returned when the infant was discharged from the ward. The effects mentioned by the parents on their infants are listed in Table 2. Of a total of 49 parents, 46 experienced a noticeable effect from DT, either on the child or the parents themselves or both; two parents did not notice any clear effect or found DT disturbing; and one found that DT sometimes made the child more nervous. The main disturbing effect was one of scheduling: the parents found it difficult to match their individual schedules with the scheduled time of the DT, whereas with KC they had more freedom to choose the timing. The effects of DT on the parents themselves were generally described as positive. One parent did not find DT to be as relaxing as KC. Still, even this parent wanted to continue the DT.

When comparing the differences between the DT sessions and KC sessions, 24 parents (39%) found that DT added the most noticeable effects, 10 parents (16%) found it difficult to see any difference, 14 parents (23%) thought there was no difference, and one parent thought her child was calmer when receiving only KC. When comparing DT with singing or humming to DT with the lyre only, four parents reported that the singing and humming was more effective. (See Table 2 for more details.)

Discussion

We investigated the rapid effects of DT (MT combined with simultaneous KC) on prematurely born infants. We compared the basic medical indices of the infants in DT and the same infants during KC only. In interpreting the results, we took into account age, gender, the number of times therapy was received, and the medical condition of the infant.

We found that generally, during both therapies, the rapid effects on the basic medical indices were positive. This impact was seen primarily as a decrease of heart rates and respiration, and an increase of the transcutaneous oxygen saturation from the measurements taken immediately prior to the therapy compared with the measurements at the end of the therapy session. Other studies show similar results of the rapid effects of MT (Bo & Callaghan, 2000; Butt & Kisilevsky, 2000; Loewy, 2004; Pölkki, 2006;

Table 2. Parents' experiences of the effects of DT on their infants and themselves as well as parents' comparisons of DT and KC.

Parents' experiences of the effects of DT on their infants	No of parents mentioning the effect %
Calming and relaxing etc.	25 (51%)
The child seemed to listen	7 (14%)
Sleep seemed deeper and the baby more relaxed	6 (12%)
The child seemed to enjoy the therapy and smiled	5 (10%)
No noticeable effect	4 (8%)
Creates confidence and security in caring	3 (6%)
The heart rate was lower	2 (4%)
The breathing was more regular	2 (4%)
The child was brighter	2 (4%)
Strengthening	1 (2%)
The child "sings" along	1 (2%)
The child became nervous	1 (2%)
Parents' comparisons of DT and KC	
No difference	15 (30%)
The child listens to the music in DT	13 (26%)
The child calms down sooner in DT	10 (20%)
Not sure if there is any difference	8 (16%)
Dual therapy is more enjoyable	5 (10%)
The child sleeps better after DT	2 (4%)
The heart rate is calmer in DT	1 (2%)
The child is calmer in KC	1 (2%)
Effects of DT on the parents	
Calming and relaxing	31 (63%)
Pleasurable moment close to my child	13 (26%)
Peaceful moment without the noise and stress of the hospital environment	9 (18%)
Strengthening relationship with the infant	3 (6%)
Highly important moment	2 (4%)
Refreshing	2 (4%)
Time-wasting performance	1 (2%)
No effect	1 (2%)
Negative feeling due to schedule problems	1 (2%)

Schwartz, 2004; Standley, 2002) and KC (Chwo et al., 2002; Johnston et al., 2003; Konstandy et al., 2008; Ludington-Hoe & Hosseini, 2005). In general, DT was very well tolerated. In no case was there any need to interrupt or stop the therapy for any reason. During DT, the parents were typically calm and content.

When comparing the growth and the length of stay on the ward of the infants participating in the study with those infants receiving standard care, no significant difference could be found. The most probable cause for the lack of effect is that, for most infants, the length of stay on the ward was quite long, whereas the study on average lasted only two weeks. Therefore, significant difference could hardly be expected.

Some differences were found in the effects of the two types of therapy. Most importantly, we found that DT was more effective in obtaining the rapid positive effects on pulse, where it was stronger but not significant, and on blood pressure, where the interaction was significant. During therapy sessions with DT, the mother/father felt more relaxed and could focus on being together with the infant. The music helped to create a calm space in which for a while the parent was able to exclude all disturbing and stressful sounds, as well as stress and anxiety.

Additionally, we found that the positive effects of the therapy increased with the number of therapy sessions. In practice this means that the infant benefitted from the therapy session more if he/she had received some therapy beforehand. We propose three alternative explanations for this finding: (1) Infants are very prone to conditioning. It may be that the infants learned to combine the first sounds of MT with the positive effects of the DT that they received only after the therapy session. This would mean that the infants would require at least 2–3 sessions before being able to benefit fully from the therapy. (2) It may be that the parents' attitudes towards DT changed during the second, third or fourth therapy sessions. If the parents were slightly uneasy during the first therapy session because it was their first DT session ever, they may have unintentionally affected their infant's ability to benefit from the therapy. Later, after the second, third, or fourth session, the parents' relaxation made the therapy even more beneficial for the infant. (3) The increasing benefits from DT may be related to auditory learning. The infants were at an age in which their auditory system is highly functional and constantly learning. It may be that, through learning, the infants actually started paying more attention to the DT and thus benefitted more from it. (4) It is impossible to rule out the possibility that the increasing benefit from DT is due to the increasing age of the infants, even though age was used as a co-variant in the statistical analysis. Explanations 1, 2, and 4 can also explain the increasing positive effects of KC alone. It is also possible that several of these explanations are valid simultaneously in individual infants.

The limitations of the results of this study could be the wide time difference (10 min to 2 hours) in the measurements of the physiological parameters before and after therapy. The time of the therapy varied from day to day, depending on a suitable time for the parents and the timetable of the other study infants as well as on the availability of the measuring monitors. The circumstances were also affected by such things as the state of hunger of the infant. The rooms could also sometimes be loud when other infants were having medical examinations or when other parents or nurses were talking. Further limitations are the lack of a control group without KC, the lack of randomization to the two interventions and the lack of blinding. These limitations should be considered when evaluating the results of the study and may partly explain why the strong within-therapy effects were observed for the starting, 10-minute and 20-minute parameters and not for the before and after therapy parameters.

There seem to be only a few studies of live MT for premature infants; a larger study of the effects of live MT compared with recorded music would be important. Future research should address the limitations of this study and should be carried out in a ward in which KC is not normally proposed to families, should have a broader selection of outcomes in short- and long-term physiological measures as well as behavioral assessments, growth, length of stay, and other relevant measures.

Our results suggest that dual therapy, combining music therapy and kangaroo care, may have beneficial rapid effects on the physiological measures compared with kangaroo care alone in prematurely born infants.

Notes on contributors

Pia Teckenberg-Jansson, took her Music Therapy exam at the Musiktherapeutische Arbeitsstätte in Berlin, Germany, in 2004. She practices music therapy in Helsinki, Finland with retarded youths, and with people with dementia and in terminal care as well as conducting mother–baby music groups.

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Appendix

Fast effects of neonatal music therapy combined with kangaroo care on prematurely-born infants

Pulse

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	*p*
Therapy session number	5	643	2.66	0.02
Measurement occasion	2	631	3.92	0.02
Therapy type	1	643	3.32	0.07
Session × occasion	10	631	0.68	0.74
Session × type	5	647	3.07	0.01
Occasion × type	2	631	0.88	0.42
Session × occasion × type	10	631	0.64	0.78

Dependent variable: pulse at the beginning of therapy.

Therapy session number	*Mean*	95% confidence interval	*SEM*	
1	155.69	2.58	1.82	153.1141
2	154.79	2.62	1.78	152.1709
3	155.15	2.66	1.77	152.4971
4	154.31	2.81	2.05	151.4941
5	152.70	2.82	2.55	149.8772
6	151.57	3.00	2.43	148.5651

Therapy session × Therapy type.

Therapy session	Therapy type	*Mean*	95% confidence interval	*SEM*	
1	KT	159.60	3.30	1.67	156.31
	MT	151.78	3.03	1.53	148.75
2	KT	154.34	3.46	1.75	150.88
	MT	155.24	3.02	1.53	152.22
3	KT	155.46	3.37	1.71	152.09
	MT	154.84	3.22	1.63	151.63
4	KT	153.88	3.74	1.90	150.14
	MT	154.73	3.32	1.69	151.41
5	KT	154.56	3.64	1.85	150.92
	MT	150.84	3.42	1.74	147.41
6	KT	150.42	4.17	2.12	146.25
	MT	152.71	3.39	1.72	149.32

Dependent variable: pulse at the beginning of therapy, KT = kangaroo care, MT = kangaroo care with music therapy, dual therapy.

Therapy times	*Mean*	*SEM*	95% Confidence Interval	
1	155.4011713	1.230042374	152.9492	157.8531
2	153.6482585	1.230465776	151.1955	156.101
3	153.0526192	1.232896532	150.5954	155.5099

Dependent variable: pulse at the beginning of therapy.

Mean respiration rate

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	Sig.
Therapy session	5.00	267	3.63	0.00
Measurement occasion	2.00	244	1.86	0.16
Therapy type	1.00	260	0.01	0.94
Therapy session × Measurement occasion	10.00	244	0.58	0.83
Therapy session × Therapy type	5.00	223	2.73	0.02
Measurement occasion × Therapy type	2.00	244	0.13	0.88
Therapy session × Measurement occasion × Therapy type	10.00	244	0.39	0.95

Dependent variable: mean respiration rate at the beginning of therapy.

Terapia Therapy session	*Mean*	*SEM*	95% confidence interval		
1	46.41	1.82	3.61	42.81	50.02
2	54.00	1.78	3.53	50.47	57.53
3	48.52	1.77	3.52	44.99	52.04
4	45.79	2.05	4.06	41.73	49.85
5	48.86	2.55	5.03	43.83	53.89
6	49.48	2.43	4.79	44.70	54.27

Dependent variable: mean respiration rate at the beginning of therapy.

Therapy session	Therapy type	*Mean*	*SEM*	95% confidence interval	
1	KT	44.05	2.81	5.56	38.49
	MT	48.77	2.15	4.26	44.51
2	KT	56.31	2.53	5.00	51.31
	MT	51.69	2.40	4.75	46.94
3	KT	46.75	2.54	5.02	41.73
	MT	50.28	2.35	4.65	45.63
4	KT	49.73	2.54	5.02	44.71
	MT	41.85	3.13	6.18	35.67
5	KT	50.96	4.28	8.43	42.54
	MT	46.76	2.64	5.23	41.54
6	KT	44.90	3.36	6.62	38.28
	MT	54.06	3.34	6.58	47.48

Dependent variable: mean respiration rate at the beginning of therapy.

Oxygen saturation

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	*p*
Therapy session	5.00	644	2.34	0.04
Measurement occasion	2.00	630	2.31	0.10
Therapy type	1.00	644	0.24	0.63
Therapy session × Measurement occasion	10.00	630	1.17	0.30
Therapy session × Therapy type	5.00	638	1.61	0.16
Measurement occasion × Therapy type	2.00	630	2.76	0.06
Therapy session × Measurement occasion × Therapy type	10.00	630	1.04	0.41

Dependent variable: oxygen saturation at the beginning of the therapy.

Therapy session	*Mean*	*SEM*	95% confidence interval	
1	96.38	0.34	0.67	95.71
2	96.70	0.34	0.68	96.02
3	96.85	0.35	0.69	96.16
4	97.50	0.37	0.74	96.76
5	97.06	0.37	0.74	96.32
6	97.00	0.40	0.79	96.21

Dependent variable: oxygen saturation at the beginning of therapy.

Therapy session × Therapy type (a).

Therapy session	Therapy type	*Mean*	*SEM*	95% confidence interval	
1	KT	96.41	0.44	0.87	95.53
	MT	96.35	0.40	0.80	95.56
2	KT	96.89	0.47	0.92	95.97
	MT	96.50	0.40	0.80	95.71
3	KT	97.02	0.46	0.90	96.12
	MT	96.69	0.43	0.85	95.83
4	KT	96.77	0.51	1.00	5.76
	MT	98.23	0.45	0.88	97.34
5	KT	97.20	0.50	0.98	96.22
	MT	96.92	0.46	0.91	96.01
6	KT	96.91	0.57	1.13	95.78
	MT	97.10	0.46	0.90	96.19

Dependent variable: oxygen saturation at the beginning of therapy.

Measurement occasion × Therapy type.

Measurement occasion	Therapy type	*Mean*	*SE*	95%
1	KT	97.46527	0.374869	0.749739
	MT	96.95307	0.347439	0.694879
2	KT	96.51925	0.374411	0.748821
	MT	97.12399	0.348078	0.696156
3	KT	96.61313	0.376697	0.753395
	MT	96.8198	0.34835	0.6967

Dependent variable: oxygen saturation.

Mean blood pressure

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	Sig.
Therapy session	5	127	0.88	0.50
Measurement occasion	1	111	3.56	0.06
Therapy type	1	122	0.79	0.37
Therapy session × Measurement occasion	5	111	0.88	0.50
Therapy session × Therapy type	5	122	1.18	0.32
Measurement occasion × Therapy type	1	111	0.00	0.98
Therapy session × Measurement occasion × Therapy type	5	111	0.28	0.93

Dependent variable: mean blood pressure.

Measurement occasion (a).

Measurement occasion	*Mean*	*SE*
1	55.69410173	1.26
2	53.60287864	1.26

Diastolic blood pressure

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	Sig.
Therapy session	5.00	132	1.59	0.17
Measurement occasion	1.00	112	2.46	0.12
Therapy type	1.00	126	0.66	0.42
Therapy session × Measurement occasion	5.00	112	1.12	0.35
Therapy session × Therapy type	5.00	119	0.60	0.70
Measurement occasion × Therapy type	1.00	112	0.69	0.41
Therapy session × Measurement occasion × Therapy type	5.00	112	0.34	0.89

Dependent variable: diastolic blood pressure.

Systolic blood pressure

Type III tests of fixed effects (a).

Source	Numerator *df*	Denominator *df*	*F*	Sig.
Therapy session	5	125	0.48	0.79
Measurement occasion	1	111	0.27	0.60
Therapy type	1	120	0.00	0.98
Therapy session × Measurement occasion	5	111	0.46	0.81
Therapy session × Therapy type	5	124	1.51	0.19
Measurement occasion × Therapy type	1	111	0.31	0.58
Therapy session × Measurement occasion × Therapy type	5	111	0.35	0.88

Dependent variable: systolic blood pressure.