Infant Behavior & Development 36 (2013) 662–669

Contents lists available at ScienceDirect

Infant Behavior and Development

The efficacy of massage on short and long term outcomes in preterm infants

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ARTICLE INFO

Article history:
Received 8 February 2013
Received in revised form 9 June 2013
Accepted 28 June 2013
Available online 7 August 2013

Keywords:
Premature
Tactile massage
Pain
Bayley score
Breastfeeding
Cognitive development
Motor development

ABSTRACT

Purpose: Premature infants lack the tactile stimulation they would have otherwise experienced in the womb. Infant massage is a developmentally supportive intervention that has been documented for several decades to have a positive effect on both full term and preterm infants. The purpose of this study was to assess the short and long term benefits of massage on stable preterm infants.
Methods: A quasi experimental design was used, 66 infants were recruited from two university hospitals with tertiary level NICUs; 32 infants received the massage therapy by their mothers. Data collection by a researcher blind to the infants' group assignments included weight at discharge, pain responses on the PIPP scale at discharge, length of stay in hospital, neuro-developmental outcome (Bayley scores) and breastfeeding duration at 12 months corrected age.
Results: Infants who were massaged had significantly lower scores on the PIPP after a heelstick compared to before the massage and had lower PIPP scores at discharge compared to the control group. Massaged infants had higher cognitive scores at 12 months corrected age. Weight gain, length of stay, breastfeeding duration and motor scores did not differ between groups.
Conclusion: Stable preterm infants benefit from massage therapy given by their mothers and may be a culturally acceptable form of intervention to improve the outcomes of preterm infants.

Improved technology and treatment modalities have enhanced the outcomes of preterm infants yet have increased the days they spent in the Neonatal Intensive Care Unit (NICU). Separated from their mothers and admitted to the NICU directly after birth, for weeks and often for months, they are subjected to a highly stressful environment and to intensive invasive and painful treatments necessary for their survival. It has been postulated that these painful and stressful treatments play a role altering brain maturation and in negatively affecting the neurobehavioral outcomes of preterm infants (Rangon, Fortes, & Lelievre, 2007; Smith, 2012). In attempts to decrease the stress of the NICU and relieve pain in preterm infants, researchers have investigated a range of interventions in the past three decades. The aim of interventions is to improve neurologic and behavioral outcomes both short and long term (e.g. Als, Duffy, & McAnulty, 2004; Cignacco et al., 2012; Johnston, Campbell-Yeo, & Filion, 2011; Vandenberg, 2007). While some interventions such as sucrose and kangaroo care

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http://dx.doi.org/10.1016/j.infbeh.2013.06.009

have provided conclusive evidence as to their efficacy in both decreasing pain and promoting the wellbeing of preterm infants, other interventions have not provided strong evidence to date (Badr, Abdallah, & Purdy, 2011).

In addition, to the painful experiences in the NICU, premature infants lack the tactile stimulation they would have otherwise experienced in the womb. The sense of touch is the fastest-developing sense in the infant following birth and is particularly important for the growing and developing preterm infants who are often deprived of gentle human touch. Kangaroo care is an intervention that provides infants with positive tactile stimulation. However despite its popularity in developed countries, in many countries in the Middle East such an intervention may not be culturally acceptable. This could be due to the modesty of women; the lack of privacy in most NICUs and untrained staff to assist mothers (Badr et al., 2011; DeJong, Akik, El Kak, Osman, El-Jardali, 2007). Therefore, massage maybe an alternative intervention. Massage is defined as a systematic touch by human hands, which stimulates the tactile sense of the infant and which has been documented for several decades to have a positive effect on both full term and preterm infants. For preterm infants studies have documented increased weight gain (Ang et al., 2012; Field et al., 1987, 2004; Mathai, Fernandez, Mondkar, & Kanbur, 2001; Scafidi, Field, & Schanberg, 1993; Vickers, Ohlsson, Lacy, & Horsley, 2004), decreased pain responses (Diego, Field, & Hernandez-Reif, 2009; Jain, Kumar, & McMillan, 2006), improved digestion and less energy expenditure (Lahat, Mimouni, Ashbel, & Dollberg, 2007; Moyer-Mileur, Hale, Slater, Beachy, & Smith, 2012), increased temperature (Diego, Field, & Hernandez-Reif, 2008), a positive effect on Heart Rate Variability (Smith, 2012), a shorter length of hospital stay (Fucile, Gisel, Mcfarland, & Lau, 2011; Mendes & Procianoy, 2008; Vaivre-Douret, Oriot, Blossier, Py, Kasolter-Péré, & Zwang, 2009), reduced stress as reflected by lower serum cortisol levels (Guzetta et al., 2009); enhanced maturation of electroencephalographic activity and of visual function (Guzzetta et al., 2011), an enhanced immune system and less sepsis (Ang et al., 2012; Acolet, Modi, & Giannakoulopoulos, 1993; Hernandez-Reif, Diego, & Field, 2007; Mendes & Procianoy, 2008), improved neurologic, motor and behavioral development (Guzzetta et al., 2011; Procianoy, Mendes & Silveira, 2010), and modified sleep patterns as reflected by EEG power spectral density (Guzzetta et al., 2011).

A recent meta-analysis of 17 studies concluded that massage intervention improves daily weight gain and reduces length of stay but has limited effects on neurodevelopmental outcomes (Wang, He, & Zhang, 2013). An earlier review by Field, Diego, and Hernandez-Reif (2010a, 2010b) also states that moderate massage therapy leads to weight gain in preterm infants and shorter hospital days. However they indicate that the underlying mechanisms for the benefits of massage are not well understood and further research is necessary.

Based on the above, the purpose of this study was to assess the efficacy of massage on preterm infants taking into consideration the paucity of evidence to date and the limitations addressed in earlier studies. These include 1) massage provided by mothers found in six studies (Ferber et al., 2005; Gonzalez et al., 2009; Kumar et al., 2012; Livingston et al., 2009; Procianoy, Mendes, & Silveira, 2010; Teti et al., 2009), 2) long term assessment at two years age was found in one study (Procianoy et al., 2010) and at 4 months in two studies (Fucile & Gisel, 2010; Teti et al., 2009), 3) the effect of massage on pain responses in two studies (Diego et al., 2009; Jain et al., 2006), the use of oils during massage found in six studies (Arora, Kumar, & Ramji, 2005; Field et al., 1996; Kumar et al., 2012; Sankaranarayanan et al., 2005; Vaivre-Douret et al., 2009) and the effect of massage on the duration of breastfeeding in one study where the subjects were full term infants (Serrano, Doren, & Wilson, 2010).

Both short and long term outcomes were assessed in this study. Short term outcomes included weight gain in the NICU (calculated as average daily weight gain as well average weight gain during the NICU stay), length of hospital stay (LOS) and pain responses to a heel-stick procedure. Long term outcomes were duration of breastfeeding and mental and motor development at 12 months corrected age.

1. Methods

1.1. Design

A quasi experimental design was used to meet the objectives of this study. Settings: The setting for this study involved two university hospitals with tertiary level NICUs in Beirut-Lebanon. Each unit consisted of 20–25 beds with a neonatologist on site. The NICU environments in both hospitals did not have any protocols related to cluster care or developmental care and there was no policy for noise or light levels control. Heel-sticks are performed every 4 h, as a routine policy in both hospitals. Mothers are encouraged to breastfeed as soon as the infant was able to suck and to express their milk in a designated room with an electrical breast pump (Badr et al., 2011).

1.2. Participants

Sixty-six participants were approached to participate in the study from both hospitals with no refusals. To avoid contamination between groups, the first group of infants recruited was assigned to the control group ($n = 34$) and the second group was the intervention group ($n = 32$) which was recruited immediately after. Both groups were recruited within 6 months. Power analysis for two independent groups based on the study by Field et al. (1987) found that 15 infants per group was sufficient to detect the effect of massage therapy on weight gain ($p = .01$, two-tail), Thus, a sample of 30 infants in each group was more than adequate. Preterm infants were eligible for participation if they met the following criteria: (a) Gestational age (GA) is between 26 and 36 weeks assessed at delivery on the Dubowitz score, (b) Birth weight is between

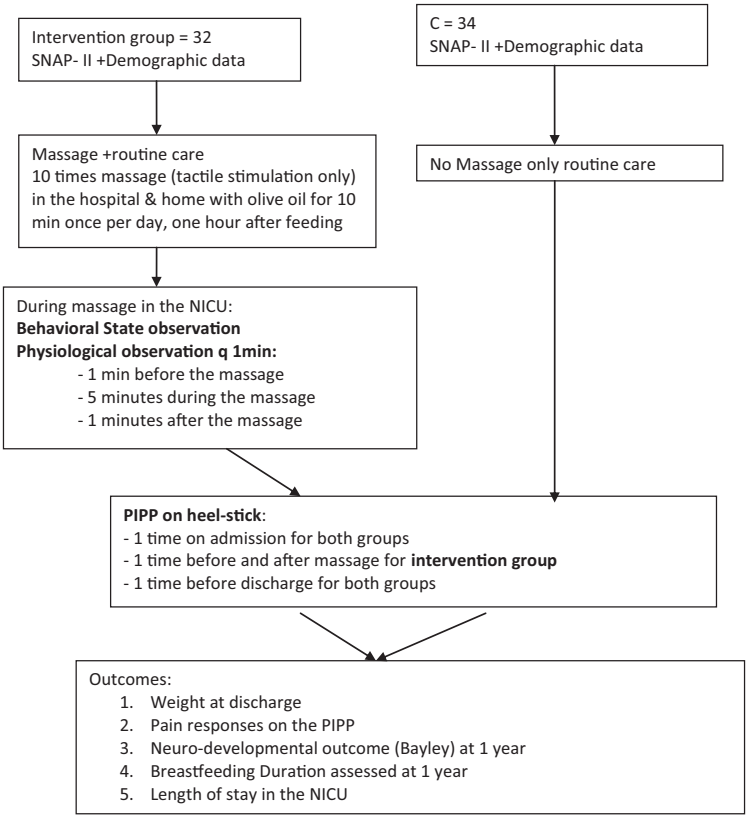

Fig. 1. Study design.

750 and 2500 g, (c) appropriate for gestational age (AGA), (d) stable by examination before the massage is initiated and (e) Apgar score of more than 7 at 5 min. Infants with medical conditions such as respiratory distress syndrome, apnea, elevated bilirubin, and mild hypoglycemia and hypocalcemia were not excluded. However, preterm infants were excluded if: they had congenital anomalies, evidence of intraventricular hemorrhage grade three and above on ultrasound, CT scan, MRI or neurological examination, there was a history of maternal drug use (by drug screen), if they required surgery or were on any kind of respiratory assisted devices. Mothers had to have at least a primary school education, were above 18 years of age and willing to participate in the study.

1.3. Procedure

Data collection in the hospital and at year was done by a nurse/researcher blind to the infants' group assignments. Although the health care providers were blind to the objectives of the study they often witnessed the massage therapy. Mothers and their infants who met the inclusion criteria from the two hospitals were approached when their infants were physiologically stable. Parents were informed about the study and if they agreed to participate signed a consent form approved by the IRB of each institution. The massage therapy designed originally by Field et al. (1987) was taught to mothers in the experimental group on the day following parental consent and was done anytime the parent visits the infant and as long as the infant is in the NICU. Teaching consisted of three phases. First, mothers were asked to watch the videotape by the Child Development Media; second, a trained research assistant applied the massage on an infant model with a return demonstration and correction whenever needed, third mothers were asked to apply the massage on their infants after warming their hands and rubbing six drops of olive oil (2 ml). The massage was applied 1 h after feeding and as long as the infant remained in the NICU (a minimum of 10 times for 10 min each time in the incubator). Mothers were asked to remain silent during the 10-min interval to limit the effect of voice stimulation. None of the mothers in the experimental group refused the massage protocol. In situations where infants in the experimental group were massaged less than 10 times during their hospital stay, mothers were instructed to continue the massage at home. To assure that mothers completed the 10 session massage therapy, a research assistant called mothers on a daily basis (see Fig. 1 for the details of the study protocol).

During the massage, the infant was placed prone and was given moderate pressure stroking with the flats of the fingers of both hands. Five 1-min intervals, consisting of six 10-s periods of stroking, was applied to the following body regions: (a) from the top of the infant's head, down the back of the head to the neck and back to the top of the head; (b) from the

back of the neck across the shoulders and back to the neck; (c) from the upper back down to the buttocks and returning to the upper back (contact with the spine was avoided); (d) simultaneously on both legs from the hips to the feet and back to the hips; (e) both arms simultaneously from the shoulders to the wrists to the shoulders (Field et al., 1987). The massage was repeated twice for a total of 10 min. The kinesthetic portion was omitted. Infants were massaged while naked in the incubator with a skin mode for temperature control. During the massage therapy, the infant's reaction to stimulation was continuously monitored by a research assistant for any adverse physical or behavioral signs. Oxygen saturation, heart rate and respirations were also continuously monitored throughout the duration of the procedure using a pulse oximeter and a cardiac monitor. At any sign of physiologic distress (i.e., heart rate greater than 200 bpm or Oxygen saturation less than 95%), massage was discontinued for 15 s, or until a return to baseline levels then resumed. None of the infants experienced any the above distress signs. The control group received identical treatment in all areas of the NICU care except for the massage intervention. For the heel stick procedure the following protocol was followed: (a) the heel was cleaned with an antiseptic immediately before heel stick, (b) the heel was punctuated with 21 gauge needle (this was hospital policy at the time of the study but changed since), and (c) the heel was compressed for blood collection. Infants in the intervention group received a heel stick before and after the first time the massage was performed to assess any changes in pain responses (The two heel sticks were used for the routine 4 h draw per hospital policy).

1.4. Instruments

Physiologic reactions were monitored through oxygen saturation, heart rate and respiratory rate by using the electrocardiography monitor and the pulse oximeter and recorded by the research assistant.

Perinatal risk status was assessed using the Score for Neonatal Acute Physiology Perinatal Extension-II (SNAPPE II). The SNAPPE II is a measure of severity of illness score for a neonate which was validated on 25,429 newborns in 30 locations. The score quantifies the severity of illness using six routinely obtained laboratory and clinical parameters (mean blood pressure, temperature, arterial/capillary serum pH, and the three worst blood gases). The greater the derangement from physiologic norm, the more severe is the illness. The most abnormal value for each item during the first 12 h of admission is selected for scoring. A score of zero is assigned to items which are normal or have not been assessed during a patient's routine clinical care. The SNAPPE-II values range from 0 to 162, with higher scores indicating higher mortality and morbidity risk. Infants with SNAPPE II >45 were excluded for this study.

Pain was assessed by the Premature Infant Pain Profile (PIPP) scale. The PIPP includes seven multidimensional indicators of pain (Stevens, Johnson, Petryshen, & Taddio, 1996), recorded on a four-point scale; behavioral, physiological, and contextual measures (gestational age, behavioral state, heart rate, oxygen saturation, brow bulge, eye squeeze, and nasolabial furrow). The higher the score, the greater the pain response. A total score of 6 or less indicates minimal or no pain and a score of 18 indicate maximum pain. Two independent observers, trained on the PIPP to a reliability of >.85 made the observations.

Weight gain: Was calculated by two methods: one method was the average daily weight gain and the second method was average weight gain during the NICU stay (calculated as weight at discharge minus birth weight divided by length of stay (LOS) in the NICU in days).

Duration of breastfeeding was assessed at one year during the follow up visit.

Motor and mental development was assessed at one year, corrected age for all infants using the Bayley scales (Bayley, 1969). The Bayley Scales of Infant Development are the most widely used standardized measures of cognitive (MDI) and motor development (PDI) in infancy and early childhood with documented reliability and validity. The Bayely was administered by the Co PI (LKB) who is certified on its use and who was blind to group assignment.

Data analysis: Data obtained during the study were entered on a regular basis. All the data were analyzed using SPSS (version 19.0, SPSS, Chicago, IL, USA). A level of significance at 0.05 was used for all statistical tests (two-tailed). ANOVA and Chi square were used to compare the baseline characteristics between the intervention group, the control group and those lost to follow up. Outcome variables were compared using ANOVA followed by post hoc Bonferroni-corrected *t*-tests. Before and after massage PIPP for the intervention scores were compared using paired *t*-test.

2. Results

At one year 50 subjects remained in the study (21% attrition) due to the following reasons: Two infants died, (one control, one intervention), 11 could not be reached due to wrong phone numbers (9 control and 2 intervention) and three refused to come for the 12-month follow up visit (2 intervention and one control). There were no differences between groups or between those who remained in the study and those lost to follow up except for socioeconomic status. It is worth noting that babies from low socioeconomic background lived in remote villages and refused to come back for the follow-up appointment at 12 months despite assurances that they will be reimbursed for transportation (see Table 1).

Infants who were massaged had significantly lower scores on the PIPP after massage, $t\,(2/21) = 2.19$, $p = 0.041$ the, and had lower PIPP scores on discharge, $F = 2/48 = 7.729$, $p = 0.011$ compared to the control group. The cognitive scores of massaged infants at 12 months corrected age were significantly higher, $F\,(2/48) = 9.34$, $p = 0.004$. Weight gain, LOS, breastfeeding duration and motor scores did not differ between groups.

Table 1
Sample characteristics with lost to follow up ($N = 64$) (excluding the infants who died).

Variable	Intervention ($N = 27$) %	Controls ($N = 23$) %	Lost to follow up ($N = 14$) p %	p
Gender				
Male	48.1	60.9	38.5	
Female	51.9	39.1	61.5	0.406[a]
Smoking mother				
Yes	29.6	43.5	7.7	
No	70.4	56.5	92.3	0.080[a]
SES				
Middle to high	70.4	86.4	38.5	
Low	29.6	13.6	61.5	0.012[a]
	Mean ± SD	Mean ± SD	Mean ± SD	
GA (weeks)	32.2 ± 1.9	32.6 ± 2.6	31.6 ± 2.8	0.511[b]
Birth weight (g)	1747 ± 389	1684 ± 446	1484 ± 438	0.272[b]
Apgar Score	8.8 ± 1.1	8.8 ± 1.1	7.9 ± 2.1	0.143[b]
Length of stay	26.0 ± 18.0	25.0 ± 18.5	21.1 ± 15.7	0.761[b]
SNAPPE II[c]	9.0 ± 11.7	5.7 ± 5.7	5.4 ± 6.2	0.373
Pain on admission[d]	11.9 ± 3.6	10.9 ± 1.5	12.6 ± 2.2	0.462

[a] Chi square test used for comparing proportions.
[b] ANOVA test for comparing means.
[c] The SNAPPE-II values range from 0 to 162, with higher scores indicating higher mortality and morbidity risk. Infants with SNAPPE II >45 were excluded for this study.
[d] p-Values also non-significant when using Kruskal Wallis tests where the distribution is not normal.

Table 2
Outcome variables excluding the lost to follow up and the deceased at 12 months corrected age.

Variable	Control ($N = 23$) Mean ± SD	Intervention ($N = 27$) Mean ± SD	p value	ES[a]	CI[b]
Average weight gain during NICU stay	1772.14 ± 143.65	1842.84 ± 174.34	0.15	−0.44	(−0.13, 0.99)
Average daily weight gain	6.03 ± 12.16	4.70 ± 9.07	0.68	−0.13	(−0.68, 0.43)
Weight at discharge	1903.81 ± 212.37	1950.21 ± 180.85	0.62	−0.24	(−0.32, 0.80)
LOS	25.04 ± 18.54	27.21 ± 18.67	0.16	−0.11	(−0.45, 0.67)
PIPP on discharge	10.90 ± 2.41	8.07 ± 2.25	0.01	−1.23	(−1.84, −0.62)
Breastfeeding duration	69.52 ± 146.86	50.92 ± 68.18	0.58	−0.16	(−0.72, 0.40)
Mental scores	106.25 ± 11.76	120.43 ± 15.73	0.004	1.02	(0.4, 1.61)
Motor scores	95.38 ± 14.26	99.26 ± 13.11	0.77	−0.53	(−1.09, 0.04)

[a] ES = effect sizes.
[b] CI = confidence interval.
Significance is set at P value < 0.05.

3. Discussion

This study suggests that the mother's participation in providing massage therapy with olive oil for healthy preterm infants had a positive effect on their pain scores before and after the massage, on their pain responses at discharge and on their mental development at 12 months. While some of the findings in this study are consistent with previous research others are not. The massaged group did not have a better average weight gain or more weight at discharge which is inconsistent with most earlier studies (Dieter, Field, & Emory, 2003; Fucile and Gisel, 2010; Scafidi et al., 1990). This could be attributed to three factors. First massage was done without kinesthetic stimulation once per day for 10 min; whereas with most earlier studies massage was done with kinesthetic stimulation (passive limb movement) for two or three 15-min periods per day. Second infants in both hospitals are often discharged when they reach a certain weight irrespective of their physiologic stability or ability to suck. Third as seen from Table 1 the intervention group had higher SNAPPE II scores indicating that they were sicker, albeit not a significant difference. Nevertheless, this may have placed them at a disadvantage in terms of LOS and weight gain (Table 2).

Likewise the LOS was not significantly different between groups a finding not supported by some earlier studies which have documented 3–6 days shorter hospital stays (Field et al., 2010a, 2010b; Ho et al., 2010; Mendes & Procianoy, 2008), yet supported by others (Lee, 2005; Massaro, Hammad, Jazzo, & Aly, 2009; Vaivre-Douret et al., 2009). The inconsistency in results warrants further investigation especially in terms of controlling for infant characteristics such as medical complications and Gestational age.

There were no differences between the two groups on the incidence of exclusive maternal breast-feeding at 12 months which is similar to one study which assessed breastfeeding at 2 and 4 months and found no difference between groups (Serrano et al., 2010). This could be explained by the fact that several socio-cultural factors affect the duration of breastfeeding that cannot be ameliorated by infant massage alone.

The pain scores reflected on the PIPP scores before and after massage for the intervention group and at discharge favored the massaged infants. This finding is supported by two earlier studies. In one study infants who received moderate pressure massage therapy exhibited lower increases in HR and returned to baseline faster than infants who did not receive massage or received light massage (Diego et al., 2009). In another study, providing a 2 min massage to 13 preterm infants of the ipsilateral leg prior to heel stick intervention, resulted in lower pain scores and lower heart rates after the heel stick compared to 10 infants who did not receive the massage (Jain, Kumar, & McMillan, 2006). It is worth noting that these two studies assessed pain responses at one time while we assessed pain responses before and after massage and at discharge.

Lastly our results note higher mental scores for infants who were massaged and this finding in supported by only one recently published study which looked at long term effects of massage (Procianoy et al., 2010). In this latter study, 73 infants who were randomly assigned to either massage by their mothers or to a control group found significantly higher mental scores on the Bayley than the control group. Although the PI of this study made sure that the massage was continued for a minimum of 10 sessions, we cannot ascertain if mothers continued the massage for months after discharge which may have positively contributed to the difference in their mental scores. Mothers who massaged their infants may have provided a more sensitive and appropriately stimulating home environment increasing the infant's attention, and exploratory skills, leading ultimately to better mental skills. Mothers may have also become more confident in their mothering skills, more sensitive and attuned to their infants which may have also resulted in a stronger mother infant relationship. This finding is in line with extensive previous research that points to the contribution of maternal involvement to cognitive development (Feldman et al., 2002; Tessier et al., 2009; Zahr, 1993). Another explanation may be due to the stimulatory effect of the massage rather than the massage itself, a fact that is difficult to decipher.

Similar to the study by Procianoy et al. (2010), we did not find significant differences in motor scores. Motor development may be affected by structural abnormities that are more difficult to ameliorate than mental development. Nevertheless, a study in Hong Kong with a small number of participants ($N = 24$) documented that among infants with below average pre-treatment motor scores ($N = 6$), those who received the massage therapy had significantly higher motor scores at 38 weeks post conception age (Ho et al., 2010). The inconsistencies in results warrant further research especially due to the fact that to date the underlying mechanisms for the physiologic and developmental benefits of massage are not well understood (Field et al., 2010a, 2010b; McGrath, 2009). It is worth noting again that infants in our study who received the massage as tactile stimulation were sicker and stayed in the NICU longer, albeit not a significant difference, yet may have affected our results.

4. Conclusion and implications for future research

The results of this study indicate that massage is beneficial for stable preterm infants. To our knowledge this is the first study to assess the long term motor and mental scores as well as duration of breastfeeding at 12 months corrected age. The impressive findings in this study warrant further research using randomized controlled trials (RCTs) with different populations which could provide further support to the benefits of massage. While Kangaroo care has provided conclusive evidence to its efficacy in enhancing short and long term outcomes, it may not be culturally acceptable in some cultures such as the Middle-East. Women in the Middle East may not feel comfortable exposing their skin in the NICU and massage therapy may provide an alternative to method of tactile stimulation. Empirical literature has demonstrated the positive effect of massage on growth and development; however scarce studies examined the facilitators and barriers for its implementation in NICU with special consideration to cultural relevance. Future studies are also recommended to identify the optimal massage protocol which remains controversial to date (e.g. type, frequency, mode of delivery, and kind of oil used). As well as, there is a need to address the social and situational barriers and enablers to implementation.

5. Limitations

In interpreting the results of our study, we should acknowledge several strengths and limitations of the study. The most important strengths are the design of the study, although not an RCT, the wash out period between groups prevented contamination of the control group which is difficult to eliminate in a NICU setting. We used power to estimate sample size and mothers used olive oil which is culturally acceptable when providing the massage. Three limitations are worth noting. First the lack of randomizations which would provide stronger evidence to the efficacy of massage therapy. Second, infants who had neurological conditions such as IVH or PVL were excluded although these infants may have potentially benefited most from massage therapy. Third, although there were no differences between those who remained in the study and those lost to follow up at baseline except for socioeconomic status, 21% attrition at the 12 month follow up is worrisome and raises concerns related to inequalities on psychological and social variables. In our study the lost to follow up group had lower socioeconomic status, yet this group may have benefited most from the massage therapy.

Acknowledgements

The authors would like to thank the parents and infants who participated in the study and the nurses who supported mothers. Funding was provided by the University of Balamand Research Grant, Lebanon.

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