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Gracey, J., Urquhart, O., & Urquhart, C. (2018). Maternally-administered massage and weight gain in preterm and low birth weight infants:a systematic review. *Infant*, 14(5), 1-5.

[Link to publication record in Ulster University Research Portal](#)

Publication Status:

Published (in print/issue): 02/09/2018

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Maternally-administered massage and weight gain in preterm and low birthweight infants: a systematic review

Early tactile experiences have long-term effects on preterm infants' sensory performance. Weight gain is key to infant development; while research confirms that massage impacts positively on weight gain in this population, most of the literature focuses on massage administered by health professionals/researchers. This review aims to examine whether massage provided by an infant's mother impacts on weight gain in preterm and/or low birthweight infants.

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Keywords

massage; weight gain; child development; infant; low birth weight; premature; occupational therapist

Key points

Urquhart O., Urquhart C., Gracey J. Maternally-administered massage and weight gain in preterm and low birthweight infants: a systematic review. *Infant* 2018; 14(5): x-x.

1. Many premature and extremely low birthweight infants experience functional difficulties in later childhood.
2. Available evidence suggests that maternally-administered massage positively impacts on weight gain in stable preterm and/or low birthweight infants.
3. Occupational therapists and allied health professionals are key members of the NICU multidisciplinary team to promote neuroprotective and family-centred developmental care.
4. Further studies need to determine the parameters of massage that best impact on weight gain.

While survival rates of premature infants are at an all-time high due to advances in medical interventions,¹ numerous studies have reported associations between prematurity and neurodevelopmental difficulties later in a child's life.^{2,3} Problems for this population during infancy and early childhood include auditory and visual deficits, hyperactivity and delays in sensorimotor integration,^{4,6} with up to 74% of extremely low birthweight infants experiencing alterations in functional outcome at five years of age.⁷

Allied health professionals such as occupational therapists are typically involved in the early intervention of these infants. Neonatal units are increasingly recognising the importance of neuroprotective interventions to support optimal synaptic neural connections, promote normal development, and prevent disabilities.^{8,9}

The National Institute for Health and Care Excellence guidance for developmental follow-up of children and young people born prematurely recommends enhanced developmental support and surveillance by a multi-disciplinary team for children born before 30 weeks' gestation, with access to allied health professionals including occupational therapists noted as key.¹⁰ Such multi-disciplinary developmental care teams incorporating therapists into neonatal intensive care units (NICU) have evolved in response to the evidence that this is a cost-effective way of improving outcomes for premature and critically ill infants, by

promoting foundational skills.¹¹⁻¹³ The importance of allied health professionals working as part of the NICU team to provide parental education and support in relation to specific areas of specialisation has also been recognised in the literature.¹⁴

One such area of specialisation that occupational therapists specifically contribute specialist knowledge and skills to a NICU team is that of the child's sensory experiences and environment.^{11,15} This includes evaluation of the infant's response to being touched or to self-touch, and his or her reactions to proprioceptive input such as weight bearing and swaddling. The environment of the incubator provides minimal positive tactile interaction unless parent visiting is extensive.¹⁶ Prematurely born babies are exposed to differences in temperature, touch, vestibular, gustatory, olfaction, noise, light, oxygen and nutrients, which are very different from those they have experienced *in utero*. Such negative sensory inputs can permanently alter normal brain development.⁸ While preterm infants exhibit more frequent behaviours indicating tactile defensiveness than full-term infants,¹⁷ early tactile experiences have positive long-term effects on the preterm infant's sensory performance.¹⁵ Healthcare staff have in the past been reluctant to provide massage therapy to young infants due to concerns that they may become over-stimulated.¹⁸ Although intuitively appealing, research consistently debunks the over-stimulation hypothesis with findings instead reporting that frequent

maternal-touch stimulation may help to compensate for early neurosensory deficits and promote neurodevelopment for these infants, with the benefits of such touch clearly outweighing any risks once the infant is medically stable.¹⁸

With family-centred developmental care becoming standard in NICUs internationally the important role that families play in the lives of children with special healthcare needs is increasingly emphasised.¹⁹ One of the major goals of family-centred care is to support families in their natural caregiving roles²⁰ with an emphasis on positive touch, including massage.²¹⁻²²

The vast majority of the literature examining touch interventions focuses on kangaroo mother care. While kangaroo mother care is established as a safe, effective and comprehensive intervention in the NICU setting that positively impacts on infant weight gain,²³ it is also proven that kangaroo care is linked to longer duration of breastfeeding.²⁴ It is therefore difficult to determine whether it is in fact the tactile element of kangaroo care, or the associated breastfeeding element that impacts on infant weight gain. Adding to this, kangaroo mother care is not always realistic, comfortable or acceptable for families from different cultural backgrounds due to the skin exposure and time commitment typically involved.

The literature also generally looks at massage provided by researchers/health professionals and not the child's mother. Based on the literature examined it is clear that increasing weight is positively associated with improved health outcomes for premature and low birthweight (LBW) infants. While research has shown that massage can increase weight gain in this group,²⁵ the degree to which this can be facilitated by the mother rather than by a healthcare professional is unclear. This study proposes to address this gap in the literature by systematically reviewing published articles that examine the outcome of maternally-administered massage on weight gain in premature and/or LBW infants.

Methodology

Design

A systematic review was undertaken based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart (PRISMA) review principles.²⁶ The objective was set to synthesise data

Infants born before 37 completed weeks of pregnancy and/or a birth weight of $\leq 2,500\text{g}$.

Massage administered exclusively by the child's mother.

Quantitative, experimental study designs including randomised controlled trials and non-randomised controlled trials were included.

TABLE 1 The inclusion criteria.

from recent studies in answering the review question: does maternally-administered massage impact on weight gain in preterm and LBW infants?

The inclusion criteria for the review can be seen in **TABLE 1**.

Information sources

The sources were: Medline Ovid, CINAHL Plus, Scopus, Cochrane Central, PsychINFO and Google Scholar. The search terms used included (maternal OR mother) AND (touch OR tactile OR haptic OR massage OR deep pressure) AND (low birth weight OR premature OR preterm) AND (baby OR babies OR infant OR neonat OR newborn) AND (weight gain). The search included articles published between 2004 and 2017 utilising multidisciplinary literature.

Study selection

The searches identified 103 articles. Following the removal of 47 duplicate citations, the primary researcher screened 56 titles and abstracts to remove any clearly inappropriate articles. The remaining 20 articles were retrieved in full-text and screened for appropriateness with respect to the inclusion criteria by the primary researcher and an independent reviewer using a specifically designed template. Three studies were identified as meeting all criteria for inclusion. A fourth potential study was excluded following communication with its author.

Data collection process and synthesis

Data was extracted using an adapted version of the Cochrane Effective Practice and Organisation of Care data extraction form. The data extracted included specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives. Due to the heterogeneity of included studies in terms of population, study design and outcomes,

the data relevant to each question was synthesised and presented in narrative form.

Results

Following implementation of the search strategy and application of inclusion/exclusion criteria, only three studies met all of the inclusion criteria for this systematic review:

1. Abdallah et al²⁷
2. Badiie et al²⁸
3. Karbasi et al.²⁹

The three studies are compared in **TABLE 2**.

Quality and design

The Critical Appraisal Skills Programme (CASP) tool was used to study the quality of each study; all three studies involved an experimental design that yielded methodologically sound findings. Based on the analysis of each article using the CASP tool and using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) framework, it was determined that the studies by Karbasi et al and Badiie et al provided moderate level of evidence, while Abdallah et al's study provided a low level of evidence given a lack of randomisation and lack of statistically significant results.

Participants

While Abdallah et al and Badiie et al focus on premature infants, Karbasi et al's study targets LBW infants. Prematurity and LBW commonly occur together in the literature with previous studies combining the terms when completing research. It was decided to look at both together given the limited amount of available literature. Adding to this, Karbasi et al's study stipulates that infants are born before 37 weeks of completed pregnancy as well as being of LBW (1,500-1,999g). Infants in Abdallah et al's study also had birth weights of $< 2,500\text{g}$ along with meeting the inclusion criteria of being born before 37 weeks of completed pregnancy. While average percentage weight gain is described as an outcome in Badiie et al's study, birth weight is not specified. However, when taking this into consideration there was general homogeneity among the included studies in respect to the participants in the massage and intervention groups. The included studies had 32, 20 and 20 mother-infant pairs in their intervention groups respectively. All authors stipulated that infants

	Abdallah et al 2013 ²⁷	Badiee et al 2012 ²⁸	Karbasi et al 2013 ²⁹
Level of evidence	Low	Moderate	Moderate
Participants	66 infant-mother pairs recruited from two university hospital NICUs in Beirut, Lebanon. 34 infants assigned to control group. 32 infants in intervention group.	60 infant-mother pairs recruited from an Iranian NICU during 2009-2010. 20 infants were assigned to each of three groups (massage by mother, massage by nurse, control).	40 infant-mother pairs recruited from a NICU in Iran from March to December 2011. 20 infants assigned to each of intervention and control groups.
Intervention	Infants received maternally-administered massage according to a defined protocol. Teaching provided to mothers in three phases prior to initiation. Massage applied in incubator one hour after feeding for as long as the infant remained in the NICU (minimum of 10 times) for 10 minutes each time. Olive oil used.	Massage provided to two intervention groups (provided by mothers or nurses). Massage provided three times daily for five consecutive days, each time for five minutes according to specific guidelines outlined in the study. Timing for massages: one hour after morning feed, 30 minutes after mid-day feed, and 45 minutes after completion of the second massage.	Massage provided by mothers. Each session 10 minutes, three times daily (morning, noon and before bed) for 14 consecutive days. Massage was given to infant in a prone and supine position according to a defined protocol.
Design	Quasi-experimental design. Participants approached to participate from both hospitals with no refusals. Control group recruited first, and intervention group recruited immediately after within six months. Power analysis used to detect effect of massage therapy on weight gain.	A randomised clinical trial conducted on three groups: i) infants who received routine care/no massage ii) infants received massage by expert nurse iii) infants received massage by their mothers. One-way ANOVA test used to measure mean percentage of weight gain in all groups.	Randomised clinical trial with 20 neonates in each of two groups. Chi-square test or Fisher exact test was used for data analysis of qualitative variables and mean values were compared using independent student t-test. Differences were considered significant at <i>p</i> -values of less than 0.05.
Results	Massage had no statistically significant impact on weight gain for the intervention group.	Mean percentage weight gain in the massage-by-nurses group was significantly higher than the other two groups. Between the other two groups, the massage-by-mother group had 0.5% more weight gain than controls, which was statistically significant.	Weight gain was higher at all measurement points in the massage group; however this difference was only statistically significant at age two months.

TABLE 2 A comparison of the three studies in the systematic review.

had to be medically stable for inclusion.

Massage: frequency, duration, and physiological and behavioural measures

Each study provides specific techniques and instructions for mothers giving massage. As well as variation in methodology, duration, timing and level of support/training provided between studies, there was also variation in the amount of detail provided regarding these elements. There are varying levels of rationale as to why each set of authors chose a specific protocol or system for massage.

The lack of clear rationale regarding frequency, timing, dosage or protocol was notable across all three studies and viewed as a limitation of this research. There is a huge variation in the total massage time in each of the studies, and it is unclear if there was a dose-response effect. In other words, it cannot be deduced whether greater massage time resulted in greater weight gain.

Abdallah et al and Badiee et al provide details of how the infants' reaction to

stimulation was monitored, ie measurement of physiological or behavioural reactions during massage.

Other factors

The amount and type of oil used was described in Abdallah et al as 2mL of olive oil. No details are available regarding choice or amount of oil used in the other two papers. No rationale is provided in any of the papers for amount or type of oil used.

There were varying lengths of follow-up between the three studies, with Abdallah et al measuring both daily weight gain during NICU stay as well as average weight gain upon discharge. Badiee et al report weight gain after the five days of massage intervention, and Karbasi et al follows-up infants at two weeks post-intervention and twice more at the age of one month and two months. The different lengths of follow-up between the three studies means it is more difficult to generalise the results and also difficult to reach any firm conclusions regarding the dose-response effect.

Despite some variation in design, when

mapped out using the CASP tool the overall quality of the included studies was relatively high.

Massage impacting on weight gain

Badiee et al examined three groups (massage by mother, massage by nurse, and control) and found that the infants receiving massage in the two intervention groups did gain weight significantly more than those in the control group. According to one-way analysis of variance testing, the mean percentage of weight gain in the massage by nurses group was significantly higher than the other two groups. Between the other two groups, the massage by mother group had 0.5% more weight gain than controls, and this difference was also statistically different. Weight gain was measured before intervention, and after five days of massage.

Karbasi et al measured weight gain after 14 days of intervention, at age one month and two months. It was found that weight gain was higher at all measurement points

in the massage group; however this difference was only statistically significant at age two months.

Abdallah et al measured average daily weight gain and weight gain at discharge. They found that there was no statistically significant impact of massage on either measure of weight gain. The authors note that these findings are inconsistent with earlier studies and attribute the results to a number of factors including:

- a lack of kinaesthetic stimulation during massage and the decreased frequency and duration of massage when compared to earlier studies
- infants in their intervention group measured higher on 'severity of illness' scores than those in the control group placing them at a disadvantage in terms of weight gain
- some of the infants who may have potentially benefited most from massage were excluded from the study, ie infants with neurological conditions.

Other reported outcomes

Abdallah et al examine a variety of other outcomes alongside weight gain including pain, duration of breastfeeding and motor/mental development. Massaged infants scored lower on the pain profile after massage and on discharge. No difference was found in relation to duration of breastfeeding between the massage and control groups. Cognitive scores of massaged infants were significantly different when measured using the Bayley Scales of Infant Development.

Badiee et al reported only on weight gain, while Karbasi et al also measured height and head circumference. Neither height nor head circumference were significantly different in infants who received massage vs those who did not. In their experimental study, which did not meet the inclusion criteria for this review, Biswal et al³⁰ found that oil massage for this population had a relaxing effect that not only improved weight gain but also stabilised vital parameters and induced sleep. Medical benefits are also reported, with Basiri-Moghadam et al³¹ citing that infant massage can result in less need for phototherapy in premature infants presenting with jaundice. Furthermore an Australian study that trained first-time fathers in infant massage for their (full-term) infants, demonstrated that infants in the treatment group greeted their fathers

with more eye contact, smiling, vocalising, reaching, and orienting responses and showed less avoidance behaviours.³²

Summary of results

The results taken from the systematic review indicate that massage provided by the infant's mother may support weight gain in stable preterm and LBW infants. Although the three studies described varied in their approach, a number of new insights emerged that contribute to what is already known in this area. Infants in the massage intervention groups in two of the three studies gained more weight than those infants not receiving massage by their mothers.^{28,29} There was no significant impact in the third study.

One of the three studies included in the review discusses additional benefits to weight gain including lower pain scores and higher cognitive scores for infants who were massaged.²⁷ Apart from potential benefits to the mother-infant relationship, having mothers complete the massage would likely lower the cost of the intervention, since hiring nurses to complete this intervention would be costly. Taking the study designs, study quality, consistency and directedness into consideration, there is some low-moderate evidence for supporting mothers to provide massage to their premature/LBW infants for weight gain.

Discussion

The findings of this review indicate that there is some evidence for maternally-administered massage to positively impact on weight gain in stable premature and/or LBW infants.

There are various debates in the literature about how massage might influence weight gain in this population. Diego et al³³ found preterm neonates exhibited increased vagal tone and gastric motility during and immediately after moderate pressure massage, which was significantly related to weight gain. Solanki et al³⁴ concluded that the oil applied during massage can be absorbed by neonates and is possibly available for nutritional purposes. The fatty acid constituents of the oil can influence changes in the fatty acid profiles of massaged babies, with possible impact on weight gain. Overall the underlying mechanisms are not well understood, highlighting the need for further studies.³⁵

While there is no cost analysis provided

in any of the three studies, research has demonstrated that weight gain is associated with shorter hospital stays and therefore significant hospital cost savings.³⁵ With mothers able to achieve the same 'effect size' as that of trained professionals, maternally-administered massage in the NICU can be regarded as cost-effective.³⁶

Given the disparity between massage protocols within the studies, the most appropriate and evidence-based intervention strategy should be determined before implementing it. While different authors have set out specific protocols as seen throughout this review, Bond³⁷ holds the opinion that massage at predetermined times and for set durations should be avoided altogether for this population, given the developmental challenges they face in a neonatal care environment. Rather, she suggests that caregivers provide consistent and predictable touch, with movements provided one at a time in a slow, rhythmic manner, paying attention to the babies' cues all of the time. Vickers et al²⁵ found no evidence that still, gentle touch is of benefit, yet Diego et al³³ found that those receiving moderate pressure massage therapy exhibited greater weight gain (compared to preterm neonates receiving light pressure massage).

It is also worth considering the other benefits of teaching mothers to give massage as a form of positive touch to their infants while in the NICU – a means to increase maternal engagement, facilitate attachment and bonding, increase confidence in holding the preterm/LBW baby, and to improve longer term neuro-developmental outcomes. The benefits of positive maternal touch on cognitive and social development, attachment and bonding, maternal mood and earlier discharge have been demonstrated.^{18,19} However, further exploration of the specific impact of massage provided by the mother in these domains would be beneficial. While many point out that providing massage is not a cost-effective or even realistic use of nurses' time, educating mothers to provide this intervention can achieve clinically significant results at a low cost, while being consistent with the values of developmental and family-centred care practices.^{8,18}

Limitations

There are a number of limitations to this review. Firstly there were only a small number of studies available for inclusion.

Secondly, there was a lack of statistical analysis in the included studies that did not permit a methodologically sound meta-analysis, meaning a narrative description of results was presented. The small number of studies confirms that this is a novel area of research that is still in its infancy and presents us with many more questions worthy of exploration.

Conclusion

Occupational therapists are well placed to support and educate families regarding appropriate developmental stimulation including tactile engagement and positive touch. While acknowledging that further research is needed regarding a protocol of massage, providing mothers with the competencies and confidence to deliver massage as a form of positive touch to their stable premature or LBW infant within the NICU environment may be a cost-effective way to impact on longer-term outcome including, but not limited to, weight gain.

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