

# Infant Massage Therapy Research Review

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## ABSTRACT

This review on infant massage therapy research is based on literature searches of PubMed, Medline, and PsycINFO for studies published during the last 7 years. Inclusion criteria were randomized controlled trial studies, systematic reviews, and meta-analyses on the effects of massage therapy on preterm and full-term infants. Several studies have focused on the effects of different pressure massage and various oils to enhance weight gain in preterm newborns. Other conditions that have benefited from massage therapy include hyperbilirubinemia and colic. Mothers have experienced less depression, anxiety, and sleep disturbance after massaging their infants and fathers and couples' relationships have benefited as well. Despite the limitations of the literature reviewed here including small sample sizes and the need for more randomized controlled trials on a standard moderate pressure massage protocol, the data suggest that both infants and their parents benefit from massage therapy.

**Key words:** Preterm infant massage, full-term infant massage, infant massage research

## INTRODUCTION

Infant massage therapy research has been the focus of a growing literature over the last several years. This review is derived from literature searches of PubMed, MEDLINE, and PsycINFO for infant massage studies published during the last 7 years following an earlier review published in 2010.<sup>[21]</sup> In most of the studies reviewed by Field *et al.*,<sup>[21]</sup> massage therapy led to greater weight gain and shorter hospital stays for preterm newborns who had received moderate pressure massage. The weight gain was related to increased vagal activity, gastric motility, insulin, and IGF-1 levels following the stimulation of pressure receptors under the skin.<sup>[21,23]</sup> The current review includes randomized controlled trial studies, systematic reviews, and meta-analyses on the effects of massage therapy on preterm and full-term infants [Table 1 for listing of effects]. The recent studies on preterm infants have continued to focus on weight gain and have included research documenting the effects of the different pressures and the different oils used in massage therapy. Mothers of preterm infants have benefited from massaging their infants including decreased depression and anxiety. Although massage therapy studies with full-term

infants are still rare, this review includes studies on the effects of massage therapy on sleep patterns of the infants and their mothers and on hyperbilirubinemia, pain, colic, cortisol, and HIV. These different literature on preterm and full-term infants are reviewed separately here.

## PRETERM INFANT MASSAGE THERAPY EFFECTS

Preterm infant massage therapy studies have predominantly focused on weight gain and the potential underlying mechanisms for massage leading to weight gain. The earlier studies labeled the massage therapy protocol tactile-kinesthetic stimulation to be specific about the two types of stimulation that were included in the massage therapy protocol. These were followed by studies comparing different pressure massages and different oils.

### Tactile-kinesthetic stimulation

Tactile-kinesthetic stimulation of preterm infants with moderate pressure was introduced in 1986.<sup>[26]</sup> Most of the replication studies have used this protocol. This protocol includes 5 min of tactile stimulation (with the infant in a

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**Table 1: Preterm and full-term infant massage effects and authors**

Preterm infants	First author
Effects	
Greater weight gain	Salam, Jabielle, Saeadi, Kumar, Gonzalez, Moyer-Milleur, Ang, Badr, Fucile, Wang, Li, Ho, Telkgunduz, Ferreira, Niemi
Lower incidence infection	Salam, Ang, Saeadi
Shorter hospital stay	Wang, Ferreira, Fucile, Gonzalez, Ho, Niemi
Better development	Abdallah, Fucile, Procianny, Hu, Alvarez
Less parent stress	Afand, Holditch-Davis
Full-term infants	
Less bilirubin	Chen, Dali, Lin, Garg, Eghbalian
Better sleep	Ferber, Field, Sheidaei
Less crying	Koc, Sheidaei, Nahidi, Cetinkaya
Better interactions	Vicente, Guroi, Porreca
Better development	Perez
Less parent stress	Porter, Cheng, Gnazz

prone position stroking the head, shoulders, arms, back, and legs with moderate pressure), then 5 min of kinesthetic stimulation (with the infant on the back, moving legs in flexion and extension as in bicycling legs and then arms) and then 5 min stroking as in the first 5 min.

Most of the researchers cited in a recent review had used the Field *et al.*<sup>[26]</sup> preterm massage protocol.<sup>[47]</sup> Following a search of two databases (PEDro and PubMed) by these authors, 520 titles were found, but only 31 met inclusion criteria. In the more recent studies, the preterm infants who received tactile-kinesthetic stimulation showed: (1) greater weight gain,<sup>[38]</sup> (2) increased skinfold thickness,<sup>[41]</sup> (3) increased natural killer cell activity,<sup>[4]</sup> and (4) increased bone mineralization and bone strength.<sup>[33]</sup> Although these reports were based on statistically significant gains for the preterm infants, methodological limitations included small sample sizes and variability on the standard therapy protocol.

In a more recent review of randomized, controlled preterm infant massage studies, similar effects were noted including weight gain, improved developmental scores, enhanced immune function, increased pain tolerance, and earlier discharge.<sup>[3,27,30,59]</sup> Increased vagal activity may have been an underlying mechanism for these effects. The author concluded, however, that the review was based on a small number of randomized controlled trials.

A meta-analysis documented the positive effects of massage on different growth measures.<sup>[60]</sup> Several preterm infant massage studies were identified on MEDLINE, Embase, CINAHL, Dissertation Abstracts, and the Cochrane databases. Although 611 articles were retrieved, only 17 studies met criteria. This meta-analysis showed a greater daily weight gain averaging 5.3 g and a reduced length of hospital

stay by 4.4 days. A similar meta-analysis was conducted using MEDLINE, PubMed, Ovid, the Cochrane library, and Chinese databases.<sup>[39]</sup> Although 625 articles were retrieved, only eight studies met inclusion criteria. Their summary suggested that preterm infant massage had increased not only weight gain but also length and head circumference.

### Moderate pressure massage therapy

Moderate pressure is thought to stimulate pressure receptors under the skin that, in turn, leads to enhanced vagal activity and gastric motility as well as increased insulin and growth hormone (IGF-1).<sup>[22]</sup> A demonstration of this underlying mechanism involved a comparison between moderate pressure massage and exercise effects (repeatedly moving each limb into flexion and extension) on preterm infants.<sup>[16]</sup> In this study, vagal activity was the mediator for weight gain for the massaged infants while formula intake was the mediator for the weight gain of the exercised infants, suggesting two different underlying mechanisms for the two different types of stimulation.

In a recent review of randomized controlled trials on moderate pressure massage, the studies converged to suggest increased weight gain, enhanced vagal activity, greater pain tolerance, and earlier discharge in preterm infants given the massage.<sup>[45]</sup> The longitudinal studies included in this review suggested that the preterm infants who were given moderate pressure massage also had better developmental scores and immune function.

In a meta-analysis on moderate pressure massage research, 34 studies met inclusion criteria including three quasi-experimental studies, one pilot randomized controlled study, and 30 randomized controlled trials.<sup>[5]</sup> These included studies from the US ( $n = 15$ ), South America ( $n = 5$ ), Europe

( $n = 2$ ), India ( $n = 5$ ), the Middle East ( $n = 6$ ) and Hong Kong. ( $n = 1$ ). Most of the studies ( $n = 25$ ) used the moderate pressure massage protocol described by Field *et al.*<sup>[26]</sup> In the more recent studies included in this meta-analysis, the average weight gain was 19.9 g per day as opposed to 15.7 mean weight gain per day for the control group, and the length of hospital stay averaged 27.2 days for the massage therapy group infants as opposed to 31.1 days in the NICU for the control group infants. The average daily weight gain was greater in this meta-analysis likely because moderate pressure massage was used in these studies.<sup>[14,22]</sup>

### Oil massage enhances growth and reduces infection

Many studies have shown weight gain effects following massage with different oils and by different therapists (researchers, massage therapists, nurses, and mothers). For example, in a quasi-experimental study from Pakistan, nurses gave coconut oil massages twice daily to 258 preterm infants.<sup>[52]</sup> The massages were continued by the infants' mothers at home for the 1<sup>st</sup> month of life. The researchers who were blind to the infants' group assignment documented 11.3 g greater weight gain for the massage versus the control group infants. In addition, the massaged infants were 6 times less likely than the control infants to have infections. This could relate to an increase in natural killer cells that have been noted in massaged preterm infants in as much as natural killer cells ward off viral and bacterial cells.<sup>[4]</sup> In the Salam *et al.*<sup>[52]</sup> study, the massaged infants also had better skin condition, possibly again because of greater natural killer cell activity. Another possibility is suggested by the decrease in transepidermal water loss following coconut oil application.<sup>[43]</sup> In this study, the preterm infants who had coconut oil applied had less transdermal water loss, better skin condition and lower bacterial growth. Certainly, however, the Salam *et al.*<sup>[52]</sup> study did not include a no-oil massage control group and the Nangia *et al.*<sup>[43]</sup> study only involved the application of oil, not massage with oil.

In another single-blind, randomized controlled clinical trial, preterm infants were given olive oil massages by their mothers.<sup>[36]</sup> In this study, the massages were 15 min 3 times a day for 10 days. The massaged infants' daily weight gain was 21 g versus 7 g daily for the group who received massages without oil. Data from an earlier study had shown greater vagal activity in infants receiving massage with oil versus without oil.<sup>[25]</sup> Greater vagal activity has led to greater gastric motility and weight gain in at least two other studies.<sup>[14,16]</sup> Higher cortisol levels were also noted in the non-oil massage group in the Field *et al.*<sup>[25]</sup> study which would suggest discomfort possibly related to the greater friction in massages without oil.

In another single-blind, randomized clinical trial (from Iran), medium-chain triglyceride oil massage was used as

supplemental nutrition.<sup>[51]</sup> In that study, 121 preterm infants were randomly assigned to three groups including an oil-massage group, a non-oil massage group, and a non-massage control group. The groups did not differ on gender, gestational age, birth weight, head circumference, delivery, and feeding type. By the 7<sup>th</sup> day of the study, the oil massage group had a mean weight gain of 105 g as opposed to 52 g for the non-oil massage group and a weight loss of 54 g for the control group. The authors also noted no incidence of necrotizing enterocolitis in the massage groups (one of the most common infections for preterm infants).

Cautionary notes have been reported on allergic reactions to natural oils. For example, a recent study comparing sunflower and olive oil on the skin of adults was thought to have implications for neonatal skin care.<sup>[13]</sup> While sunflower oil improved hydration, olive oil damaged the skin barrier and was thought to have the potential for exacerbating any existing atopic dermatitis.

### Pain reduction

Massage is often used to reduce pain during heelsticks and other invasive procedures on the NICU. For example, in a crossover, double-blind, randomized controlled trial, 80 newborns in the NICU received a 2-min upper limb massage before a heel stick and then usual care and the second group received usual care and then a heel stick.<sup>[11]</sup> The Premature Infant Pain Profile Scores were significantly lower when receiving the massage as compared to the control condition. As another example, preterm newborns who were massaged by their mothers during their stay in the NICU had lower scores on a pain scale after a heel stick.<sup>[1]</sup> At a follow-up assessment 1 year later they also had higher cognitive scores. Although this finding is consistent with earlier findings on massaged preterm infants having better cognitive development, the long-term effects may have also been mediated by the mothers continuing to massage their infants at home.<sup>[21]</sup>

### Other conditions associated with prematurity

Other conditions that are associated with prematurity were found in the recent literature on preterm infant massage including feeding intolerance, hyperbilirubinemia, and brain injury. In a quasi-experimental design study on the prevention of feeding intolerance, preterm infants were given abdominal massage for 15 min just before feedings twice per day for 5 days.<sup>[55]</sup> By the 5<sup>th</sup> day, the massaged infants showed greater daily weight gain than the control infants as well as less frequent vomiting, gastric residual volume, and abdominal distension. Although these findings suggest that feeding intolerance can be prevented in preterm infants, the study was not a randomized controlled trial.

In a randomized controlled trial on hyperbilirubinemia in preterm infants in Iran, a massage group was compared to a routine therapy group.<sup>[6]</sup> The massage group received 4 days

of routine therapy plus 20 min massages twice per day for 4 days. By the end of the study, the massage group had lower bilirubin levels and more frequent stooling.

Infant massage on HIV-exposed infants has been effective for the HIV-infected mothers who were taught to massage their infants.<sup>[46]</sup> Following 10 weeks of the mothers massaging their infants, the mothers were less depressed; the infants experienced growth gains and mother–infant interactions were improved.

Preterm newborns with brain injury have also benefited from massage. In a study from China, 210 preterm newborns with brain injury were assigned to a massage group or a control group.<sup>[35]</sup> Both groups received routine therapy while the intervention group also received acupoint massage (moderate pressure massage) for the duration of their stay in the NICU. At a corrected age of 6 and 12 months, the massage group as compared to the routine therapy control group had a significantly higher developmental quotient on gross motor, fine motor, and language scales. At the 12-month period, their developmental quotients were also higher for social and adaptive functions. Further, the massage group had one-third the incidence of cerebral palsy as compared to the control group. Certainly, this study was also limited by its lack of random assignment to groups, and the group differences on cerebral palsy were likely present at baseline, thus confounding the results.

Brain maturation has reputedly been advanced by massage therapy in a program of studies measuring electroencephalogram (EEG) in preterm infants.<sup>[32]</sup> In this study, the research team demonstrated that EEG delta activity was greater for the massaged versus the non-massaged infants which would be related to their greater amount of deep/restorative sleep.

### **Mothers have also benefited from massaging their preterm infants**

In at least two recent studies, mothers who massaged their preterm infants had less psychological distress. In a very brief quasi-experimental clinical trial, 70 preterm infants who were scheduled to be discharged from the NICU within 1 day were massaged by their mothers or were assigned to a control group.<sup>[2]</sup> The infants were massaged for 8 min on the morning before discharge and on the discharge day. The mothers who massaged their infants had lower State-Trait Anxiety Inventory Scores on the discharge day. Certainly, however, this was not a randomized controlled trial, and it was also limited to the anxiety measure. In a randomized controlled study in Iran, 20 mothers massaged their preterm infants 15 min per day in a NICU.<sup>[54]</sup> The mothers in the massage group showed more frequent attachment behaviors.

In a more comprehensive observation study, 240 mothers were randomly assigned to a massage, a kangaroo care or a control group.<sup>[34]</sup> The groups were compared on depression,

anxiety, post-traumatic stress, parenting stress, HOME scores (a measure of stimulation in the home), and 45–min videotaped mother–infant interactions. The questionnaires were completed during hospitalization and at 2, 6, and 12 months corrected age. The massage group mothers experienced a more rapid decrease in depressive symptoms and had better HOME scores. However, the massage protocol featured several types of stimulation including visual, verbal, tactile, and vestibular stimulation, thus confounding the massage effects.

### **Summary**

In summary, preterm infants have benefited from being massaged. In most of the studies, the massaged infants gained significantly more weight. In several studies, the hospital stay was also shorter which would be expected given that weight gain is typically the criterion for discharge. In research that compared massages delivered by oil versus no oil, the oil massages had more positive effects whether it was coconut oil, olive oil, or triglyceride oil. The lubricious quality of oil would reduce friction, making the massage more comfortable, and the absorption of these oils could also add to weight gain. Most of the studies featured moderate pressure massage which has been noted to increase vagal activity and gastric motility which, in turn, may contribute to the weight gain noted. In comparisons between mothers massaging their infants versus mothers not massaging their infants, the massage group mothers experienced fewer anxiety and depression symptoms and had better home environment scores. The benefits for both the mothers and their preterm infants suggest that this is a cost-effective way to provide infants massage. In addition, feeding intolerance and hyperbilirubinemia have been reduced in some studies and hospital infections reduced in others, possibly because natural killer cell number and/or natural killer cell activity were increased by the massage. Although a few of these studies were limited by being quasi-experimental, most were randomized controlled trials with significant effects at least on weight gain and hospital stays. These findings were further supported by systematic reviews and meta-analyses. The sham control (light pressure massage) is no longer suitable as it is aversive to infants based on their squirming and grimacing. Moreover, a waitlist control group would not be appropriate because the groups would likely vary on days in the NICU which was the most significant predictor variable in at least one study.<sup>[26]</sup> This variable along with others including gender, gestational age, and birth weight are important random stratification variables. A suitable control group could be simple hands-on or holding the preterm infant, and different dose massage protocols could be compared for their relative efficacy.

## **FULL-TERM INFANT MASSAGE THERAPY EFFECTS**

Fewer massage therapy studies were found in the literature on full-term infants, perhaps because those studies are less



often funded than therapeutic massage research on preterm infants. The recently published studies on full-term infants involved enhancing sleep, physical, and mental development during early infancy and reducing several conditions including hyperbilirubinemia, colic, and reflux, and enhancing development in HIV infants. In addition, mothers benefited from massaging their infants including decreasing their sleep problems and post-partum depression, increasing their attachment, and facilitating their interactions with their infants.

### Enhancing sleep in infants and their mothers

Sleep disturbances are one of the most difficult problems for parents and infants over the 1<sup>st</sup> months of life.<sup>[20]</sup> A research team from Israel first documented improved sleep and increased melatonin levels following 2 weeks of massage during the 1<sup>st</sup> month of life.<sup>[19]</sup> Moreover, melatonin levels and eye movements were inversely related, suggesting that the massaged infants were getting more deep/restorative sleep. These effects were sustained over the first few months. Although vagal activity was not measured in this study, increased vagal activity may have contributed to the increased melatonin. This study needs to be replicated on a larger sample given that only 16 of the 26 infants had complete data.

In a recent sleep study, 76 newborns were randomly assigned to a lotion massage group versus a non-lotion massage group and a non-massage control group.<sup>[24]</sup> Their mothers were taught a simple massage (described above), and they were asked to massage their infants for 15 min at bedtime every night for 1 month. The mothers completed an adaptation of the Brief Infant Sleep Questionnaire on their infants' and their own sleep behaviors. The mothers of the lotion massage group versus the other two groups fell asleep faster and slept longer and their infants had fewer night wakings and slept longer. The lotion group mothers also massaged their infants more frequently and the number of massages was correlated with sleep time and negatively correlated with night wakings at 1 month for both the mothers and their infants. The more positive effects of lotion massage are similar to those noted earlier for oil massage.<sup>[25]</sup> The lotion massage study results, however, are limited to self-reports by mothers, and they need to be replicated with more objective measures.

### Promoting parenting

A number of studies have promoted parenting including parent–infant interactions by having the mothers massage their infants. In a study from Korea, mothers ( $n = 60$ ) gave their infants a 15-min massage every day for 38 days, and those mothers were compared to a group of non-massaging mothers on an attachment inventory.<sup>[31]</sup> By the last day of the study, the massage group mothers had higher attachment scores. A similar study was conducted in Italy on a sample of 194 mothers and their newborns.<sup>[58]</sup> By 12 months, the mothers and infants in the massage group had a better

relationship. The ratings in these studies were self-reported which could result from a “social desirability effect” of the mothers answering questions in a positive way to be viewed favorably by the researchers.

In an observational study, 20 mothers participated in infant massage classes with their 2–7-month-old infants.<sup>[49]</sup> The results showed an increase in the mothers' and infants' emotional availability which contributed to improvement in the mother–infant interactions. Still another study on substance-addicted mothers, 138 recovering mothers were randomly assigned to massage, educational or control groups.<sup>[50]</sup> By the end of the 12-week period, the mothers who were massaging their infants were showing decreased parenting stress and fewer depressive symptoms.

Fathers have also experienced a reduction in paternal stress after massaging their infants.<sup>[10]</sup> And finally, an infant massage program was developed for both mothers and fathers.<sup>[29]</sup> At the end of this 4-week training period, the parents reported decreased depression and decreased stress.

### Promoting mental and physical health during early infancy

A review of several databases including MEDLINE and PsycINFO on randomized controlled trials included 34 studies.<sup>[7]</sup> Their meta-analysis favored the massage group on weight, length, head circumference, arm and leg circumference, 24-h sleep duration, time spent crying/fussing, and decreased levels of bilirubin and diarrhea. In addition, significant effects were noted for gross motor skills, fine motor skills, social behavior, and psychomotor development. When these data were reanalyzed, sensitivity analyses suggested that when studies at high risk for bias and studies conducted in the East were excluded from the meta-analysis, the significance levels were decreased.<sup>[56]</sup>

### Reducing hyperbilirubinemia

Hyperbilirubinemia affects approximately 15% of newborns.<sup>[28]</sup> In a study from Japan, 44 newborns who did not require phototherapy were assigned to massage and control groups.<sup>[9]</sup> The 15–20 min moderate pressure massages were given by staff twice a day for 5 days. They were applied with oil to the face, chest, abdomen, limbs, and back. As early as the 2<sup>nd</sup> day of the study, the massaged versus the control newborns had a greater stool frequency. By the 4<sup>th</sup> day of the study, the massaged infants had more frequent stools and lower bilirubin levels. The more frequent stooling may have derived from increased vagal activity and gastric motility which would be expected following massage.<sup>[15]</sup> In a study from Iran, mothers were taught the same moderate pressure massage by midwives.<sup>[12]</sup> The mothers gave their newborns 15-min massages twice daily for 4 days. By the end of the study, the bilirubin levels were lower for the massaged versus then on-massaged newborns.

In a randomized, double-blind clinical trial, 134 newborns were randomly assigned to a phototherapy only or a phototherapy plus massage group.<sup>[18]</sup> By the 3<sup>rd</sup> day of massages, the bilirubin levels had decreased and bowel movements increased, and those measures were significantly related. A research group from Taiwan similarly assessed massage effects on newborns ( $n = 56$ ) who had elevated bilirubin levels and were receiving phototherapy.<sup>[40]</sup> The newborns were randomly assigned to a phototherapy group or to a phototherapy plus massage group. The massages were given for 15 min 2 times per day for 3 days. By the 3<sup>rd</sup> day of the study, the massaged infants had more frequent stools and lower bilirubin levels. The massaged infants also went off phototherapy earlier and had a shorter hospital stay. These authors interpreted the more frequent stooling and lower bilirubin as resulting from increased vagal activity and gastric motility that would follow from massage.<sup>[15]</sup>

In a recent review of 8 randomized controlled trials on the use of massage for infants with hyperbilirubinemia, 6 of the 8 trials resulted in reduced bilirubin.<sup>[28,48]</sup> In 5 of the 8 trials, increased stool frequency was noted. Again, increased vagal activity could have led to increased gastric motility in these studies, although these measures were not taken in these trials. Vagal activity and gastric motility as well as the duration of phototherapy and days to discharge could be measured in the future studies on massage therapy for hyperbilirubinemia. Future studies might also have mothers providing the massages, as the study using mothers as therapists had positive results.

### Reducing pain during vaccinations

Infants have been massaged to reduce the pain associated with vaccinations. For example, in a randomized controlled trial in Turkey, 60 infants were given foot massages 20–30 min before vaccinations.<sup>[37]</sup> Pain responses were observed, and heart rate, oxygen saturation levels, and crying time were recorded. The massaged infants' pain scores were lower, they cried less, and they had lower heart rates and higher oxygen saturation levels than the non-massaged infants.

### Reducing infant colic

Irritability and infant colic are common problems presented to pediatricians during the 1<sup>st</sup> months of life.<sup>[53]</sup> In this single-blind randomized controlled trial, 100 infants were assigned to a massage or a rocking control group. A methodological difference between the groups was that the massaged infants received massages for 15–20 min once per day and once per night for 1 week, while the rocked infants were rocked for 5–25 min whenever the infants had colic symptoms. Despite the greater amount of physical contact for the rocked infants, the massaged infants spent less time crying and slept longer.

In another comparison of massaging and rocking to reduce infant colic, 100 infants were randomly assigned to a massage

or a rocking group at 12 weeks of age.<sup>[42]</sup> The parents were asked to massage their infants or rock their infants 3 times a day. The massage group experienced a greater reduction in the total number of cries, the length of crying, and the severity of crying. Aromatherapy massage has also been used as a treatment for infant colic.<sup>[8]</sup> For this study, 40 infants between 2 and 6 weeks of age were assigned to either a lavender oil massage group or a control group. The lavender oil massage group showed a greater decrease in colic symptoms.

### Gastroesophageal reflux disease (gerd)

In a randomized controlled trial, 36 infants with GERD were randomly assigned to a massage or a non-massage group.<sup>[44]</sup> Although the massaged infants received 30-min massages two times per week for 6 weeks, their GERD symptoms remained the same. However, they had lower cortisol levels by the end of the study which could lead to fewer GERD symptoms if the massage was continued for a longer period.

### Hiv-exposed infants

HIV-infected mothers in South Africa ( $n = 120$ ) were taught massage and asked to massage their infants for 15 min per day for a 1-month period (Perez *et al.*, 2015). The massaged infants had significantly higher mental scores and higher hearing and speech scores. However, they did not differ from the control group on growth measures.

### Down syndrome infants

Visual function was explored in a massage study on infants with Down syndrome.<sup>[61]</sup> Following random assignment to either a massage or a standard care group, visual acuity and stereopsis were assessed. Greater visual acuity was noted in the massaged infants by 6 months followed by accelerated development at 12 months and stereopsis had an earlier onset and faster maturation in the massaged infants.

### Summary

These studies highlight the positive effects of massage on full-term infants and their mothers. Both the infants and mothers had longer sleep time and fewer night wakings. A number of infant conditions were improved following infant massage including hyperbilirubinemia, colic, and GERD. Some limitations of these studies included the small samples, the lack of randomization and the frequent use of self-report measures. Selecting a control group is also difficult now that positive effects have been documented for moderate pressure massage. Depriving a control group of an effective therapy might be considered unethical. Some control group comparisons might be acceptable such as the exercise control group used by some researchers.<sup>[16,41]</sup>

### Limitations and future directions

Many randomized controlled trials have been conducted with similar outcome variables on preterm infant massage (e.g. weight gain and hospital stay). However, only 3-6% of

the 500-600 studies identified in the literature searches met criteria for reviews. The reason typically given for studies not meeting criteria were that the trials were only single-blind, that is, group assignment was not known to the assessment researchers but was known by the participants. Another reason often given for studies in these literature not meeting criteria for meta-analyses is that standard deviations were missing from the published papers. Moreover, many of the studies were rejected for being quasi-experimental or quasi-random. Statistical techniques were rarely used to control for covariates, possibly because the confounding variables had not been identified. Despite the power of meta-analyses, those data analyses are limited to making conclusions regarding the variables common to all studies. In the case of the preterm newborn massage literature, those variables are weight gain and hospital stay.

The number of full-term newborn massage studies is very limited, possibly because of the short hospital stay during which breastfeeding and bathing classes fill the time so that massage therapy is not a nursery protocol and is not researched. However, studies on massage therapy for hyperbilirubinemia have been needed in as much as approximately 15% of newborns have that problem, and the phototherapy effects have been facilitated by massage therapy. Surprisingly, only a few sleep and colic studies have been published recently even though sleep and irritability (colic) are the most common problems presented to pediatricians that might be prevented by infant massage.

The greater weight gain and shorter hospital stay in preterm newborns as reported in meta-analyses have not been sufficiently compelling for the medical community to adopt massage into practice. Some have said that the neonatal staff are too busy to even teach the parents. Despite this limitation, mothers are increasingly being taught massage, at least for the research studies that were reviewed here. Still, the medical community is looking for underlying mechanisms that might contribute to weight gain, for example, the increase in gastric motility<sup>[15]</sup> and the mechanism for enhanced immune function, for example, the increased natural killer cell activity<sup>[4]</sup> especially given that necrotizing enterocolitis is a serious infection. More underlying mechanism studies like these are needed to adopt infant massage into medical practice. Despite these limitations, the data converge to suggest that both preterm and full-term infants benefit from being massaged by their mothers, and their mothers also benefit when they are providing the massages.

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**How to cite this article:** Field T. Infant Massage Therapy Research Review. *Clin Res Pediatr* 2018;1(2):1-9.