



**EFFECTIVENESS INFANT MASSAGE PROVIDED BY MOTHER
ON WEIGHT GAIN AMONG PREMATURE INFANTS: A SYSTEMATIC
REVIEW**

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ABSTRACT

Premature birth poses significant health challenges with implications of low birth weight in infants. Infant massage intervention by mothers shows potential in enhancing weight gain in premature infants and improving their neurological and emotional development. This study aims to evaluate the effectiveness of such interventions in promoting holistic growth in premature infants. Objective: This article aims to investigate the effectiveness of infant massage intervention involving mothers in enhancing weight gain in premature infants. Methods: This study employed a systematic review method. A search in the PubMed, Science Direct, Sage Journals, Scopus, Taylor & Francis, Proquest, Clinical Key to retrieve randomized controlled trial of premature infants receiving massage therapy by mother impact of weight gain on infant premature. The registration number was CRD42024622719. Results: Of 883 record article retrieved, 5 RCTs with 406 participants were included. Literature studies indicate that infant massage involving mothers has beneficial effects on premature infants, such as calorie intake, head circumference, body length, nerve development, length of stay (LOS), and sepsis incidence in premature infants. Massage therapy by the baby's mother also did not have any side effects or cause complaints, and no secondary effects were found. Conclusion: Infant massage by mothers is an effective intervention in enhancing weight gain in premature infants. Involving parents in the care of premature infants through interventions like this can provide significant benefits for the well-being and development of premature infants.

Keywords: infant massage; mother intervention; premature infants; weight gain

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INTRODUCTION

Premature infants are babies who born alive before the mother's gestsional age of 37 weeks. The handling of premature babies needs to be optimized, especially in fulfilling nutrition, skin care, pain management, infection prevention, and care that supports the development of babies (Trihono et al., 2023). Premature infants are have a high risk of low birth weight and are also at risk factors for stunting in children. The baby's weight at birth is a determining factor for the baby's chances of surviving, growing, and developing in the future (Damayanti et al., 2022). How to hold and care for premature babies is also very important to note. Containment techniques are proven to be more effective in providing a sense of security and comfort to premature babies compared to excessive holding. Containment is done by providing a safe and comfortable environment for the baby, which can be done by swaddling the baby or with minimal handling (Hartley et al., 2015; Marquez-Castro et al., 2023).

Tactile interventions such as infant massage also have positive effects in infant development. Infant massage has a positive effect in triggering myelination so that the baby feels comfortable because it is well supported as well as improving hypothalamic activity and somatotropin production so that it is beneficial in infant growth (Diah Budiarti & Suryawan, 2023). Massaging should be done by the infant's parents while interacting with the infant,

such as talking or singing. Variations in care from mothers trigger synaptogenesis, learning, and memory, so in caring for babies we need to involve parents (Trihono et al., 2023). Literature has shown infant massage has beneficial effects on premature infants in the NICU, including shorter length of stay; reduced pain; and improved weight gain, food tolerance, and neurodevelopment. Parents who massage their infants in the NICU report experiencing less stress, anxiety, and depression (Pados & McGlothen-Bell, 2019). Campbell & Jacobs, (2021) also mentioned that there were positive clinical effects on cognition, reflexes, and Visual-Motor Integration of premature infants, who received parent-supported infant massage. In addition, a strong correlation was established between the frequency of massage sessions and the emotional development of premature infants.

The World Health Organisation (WHO) emphasizes the importance of mothers and families taking a role in the care of their babies. The mother-infant relationship forms the basis of the newborn's later development. Kathryn E. Barnard's theory is one of the nursing theories that focuses on the interaction between mother and baby (Abdallah et al., 2013; World Health Organization, 2023). The care of premature infants requires consistent and comprehensive care to support the growth of premature infants. Infant massage has been shown to be effective in improving various aspects of preterm infant development, but there are still questions regarding whether massage interventions performed by the infant's mother have the optimal impact to maximize the benefits of infant massage on growth. Therefore, this systematic review is needed to identify and assess the effectiveness of infant massage interventions involving mothers in improving growth, especially body weight in preterm infants. By understanding the implementation of infant massage programs provided by mothers of preterm infants, it is expected to provide new insights for health practitioners to improve the quality of neonatal care services and the quality of life of preterm infants. This article aims to investigate the effectiveness of infant massage intervention involving mothers in enhancing weight gain in premature infants.

METHOD

This systematic review follows priority reporting guidelines by being registered with PROSPERO. The registration number is CRD42024622719. This systematic review was executed in accordance with the preferred reporting items for systematic review guidelines (PRISMA 2020) (Page et al., 2021).

Eligibility Criteria

The inclusion criteria in this study were preterm infant participants born at ≥ 29 weeks of gestation and less than 37 weeks, baby weight more than 1000 grams, massage therapy was done by the mother of the preterm baby. The type of research used uses the Randomized Control Trial (RCT) method, and displays the results of the baby's weight gain. The authors did not limit the search year. Exclusion criteria consisted of infant participants receiving massage therapy by the mother using oil or cream (it is feared that oil massage causes allergic reactions and changes in triglyceride and fatty acid profiles) (Adışen & Önder, 2007; Volkering et al., 2019), preterm infants with congenital abnormalities, infants with movement problems, infants using invasive breathing apparatus, non-English language literature studies, and outcome indicators that cannot be extracted or concluded.

Outcomes

The studies included reported effects of infant massage provided by mother on weight gain, intake kalori, lingkaran kepala, panjang badan, kejadian sepsis dan lama rawat inap. The authors employed established definitions to determine the study outcomes, with an explanation of the outcome is provided in Table 2.

Study Design

In this review, we incorporated randomized controlled trials (RCTs) that were published in English.

Search Strategy

We conducted a systematic literature search using the PICOS framework to formulate the research questions. The population (P) was preterm infants; the intervention (I) was infant massage by the infant's mother; the comparison (C) was no intervention; standard/routine care or other forms of intervention, the outcome (O) of interest was weight gain of preterm infants; and the research design (S) included RCTs. Two independent authors (KH and ED) searched articles from seven databases including: PubMed, Science Direct, Sage Journals, Scopus, Taylor & Francis, Proquest, Clinical Key. In addition, researchers (KH, RA, and MHH) performed manual searches to find any new papers that met the eligibility criteria. The search keywords used a combination of Medical Subject Headings (MeSH) terms and relevant text words as follows: (Infants, Premature) OR (Premature Infant) OR (Premature Infants) OR (Preterm Infants) OR (Infant, Preterm) OR (Infants, Preterm) OR (Preterm Infant) OR (Neonatal Prematurity) OR (Prematurity, Neonatal) OR (Infant, Premature) AND (Massage) OR (Massage Therapy) OR (Massage Therapies) OR (Therapies, Massage) OR (Therapy, Massage) AND (weight gain) OR (Gains, Weight) OR (gain, weight) OR (Weight Gains).

Data extraction

All retrieved article data were imported into Endnote software to remove duplicate articles and screened based on PICOS. Each study was evaluated by two reviewers (KH, & MHH) to see if the study met the inclusion and exclusion criteria. Disagreements between two reviewers were resolved through discussion with a third reviewer if needed (YR). Eligibility for inclusion was determined after reading the abstract and agreement was reached through discussion. Reviewers perform extractions using a format developed by the reviewers themselves. Extraction of relevant information included the intervention protocol, outcome indicators and extracted basic data from the article including author, year of publication, country, participant characteristics (gestational age, and weight on study), movement characteristics, intervention duration, outcomes, measurements, and risk of bias assessment. The RCT model was chosen as it is the reference standard for studying causal relationships between interventions and outcomes as randomization eliminates many of the biases inherent to research designs.

Risk of bias assessment

Three reviewers (KH, MHH & ED) conducted separate analyses of the methodological quality of RCTs assessed with the Cochrane "Risk of bias tool for randomized trials (Rob2)". Domains assessed included the randomization process, deviation from the intervention or the impact of assignment/adherence to the intervention, absence of outcome data, outcome measurement, and selection of reported outcomes (Higgins et al., 2019). Assessment results based on these domains were classified into 3 categories: low risk of bias, some concerns, and high risk of bias. Conflicting results were resolved through deliberation to reach consensus with YR.

RESULT

As a result of data retrieval from 7 different databases, 881 articles were identified. After removing 30 duplicate articles using EndNote software, the remaining 851 articles were reviewed based on title and abstract, and abstract, and study type did not meet the inclusion criteria. The text of the remaining 49 articles was reviewed to assess inclusion criteria and outcomes sought. Results from 7 databases yielded 3 studies that met all inclusion criteria. To

see the saturation of the data, the researchers conducted a search using other methods, which resulted in 2 articles that met both the inclusion and exclusion criteria. Finally, we reviewed 5 articles for analysis (Figure 1).

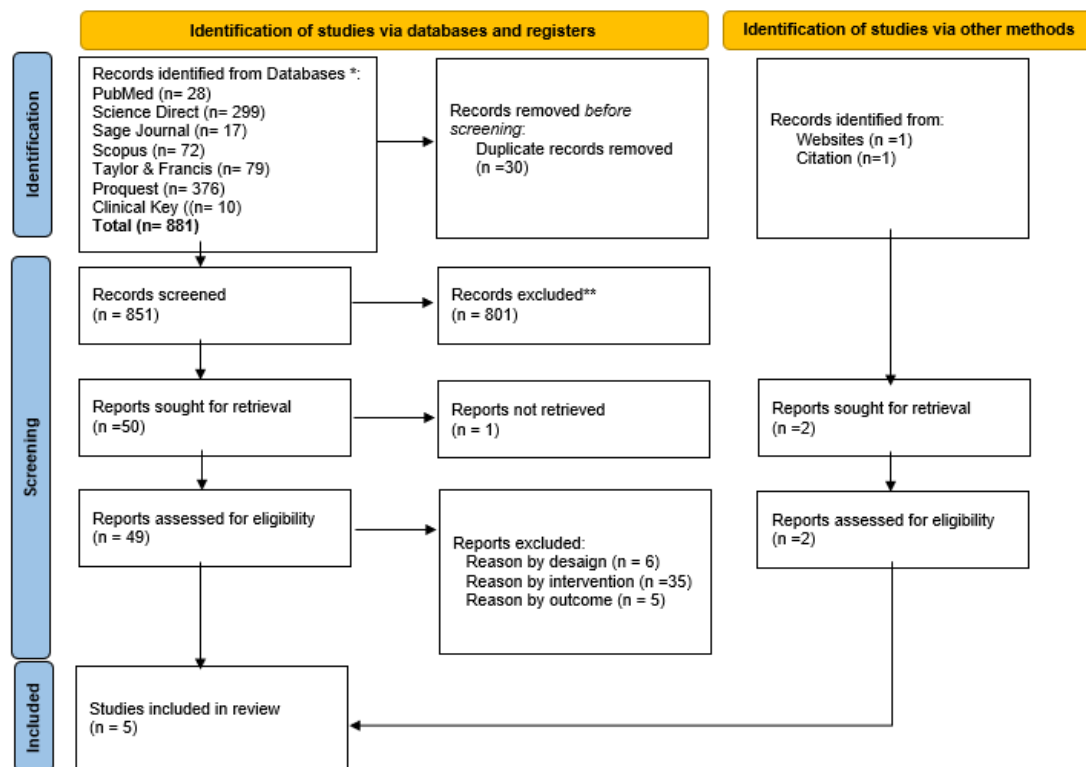


Figure 1. PRISMA Flow diagram

Studies that met the inclusion criteria, 5 RCTs published between 2002 and 2019. The study regions included Israel, Mexico, China and Brazil. Eligible studies had a total sample size of 406 participants, with gestational ages greater than 26 weeks and less than 35 weeks, infant birth weights greater than 600 grams and less than 2200 grams.

Table 1.

Selected studies of massage therapy provide by mothers among preterm infants

No.	Author, Year (Country)	Participant Characteristics	Group	Movement Characteristics	Duration	Outcome	Outcomes Measurement	Result	RoB 2
1.	Ferber et al., 2002 (Israel)	N: 57 Ia: 21 Ib: 17 C: 19 Age: Mean (SD) Ia: 17.28 (10.95) Ib: 12.47(8.39) C: 16.05(13.88) GA: Mean (SD) Ia: 30.90(1.94) Ib: 31.88(1.93) C:	Ia: Massage by mother Ib: Massage by nurse C: No Intervention	Massage therapy movements guided by Field et al, (1986), - Tactile stimulation movements	Duration of study: 10 days Frequency : 3x/day (3 consecutive hours) Duration: 15 minutes	Calorie intake/kg Body weight (grams)	Number of calories consumed per kilogram of body weight daily Calculation of weight gain at the end of the study	Ia= 1709.17 (432.98) Ib= 1738.57 (442.46) C = 1737.74 (585.80) Ia= 291.33 (95.54) Ib= 311.35 (86.48) C = 225.52 (109.74)	Low risk

No.	Author, Year (Country)	Participant Characteristics	Group	Movement Characteristics	Duration	Outcome	Outcomes Measurement	Result	RoB 2
		31.52(2.22) Weight on study: Mean (SD) Ia:1358.14 (267.79) Ib: 1453.82 (285.17) C: 1387.89 (329.15)							
2.	Gonzalez et al., 2009 (Mexico)	N: 60 I: 30 C:30 GA: Mean (SD) I: 31.4 (2.0) C: 31.7 (1.8) Weight on study: Mean (SD) I: 1364 (174) C: 1332 (196)	I: Vimala massage by mother C: Usual Care	Vimala massage (15)	Duration of study: 10 days Frequency : 2x/day Duration: 15 minutes	Calorie intake/kg/day Body weight (grams) Head circumference (cm) Length of hospitalization (days)	Total number of calories consumed per kilogram of body weight per day at the end of the study Calculation of daily weight gain in grams Calculation of weight gain at the end of the study Measurement of head circumference in centimeters at the end of the study Total duration of the patient's hospital stay from the time of admission to the time of discharge	I = 142 (11) C = 143 (19) I = 29,2 (5.3) C= 20,9 (7.6) I = 1526 (194) C = 1451 (226) I = 30.1 (1.4) C = 29.6 (1.6) I= 15.36 (5.41) C= 19.33 (7.92)	Low risk
3.	Zhang & Wang, 2019 (Tiongkok)	N: 112 I: 54 C:58 GA: Mean (SD) I: 32.0 (3.8) C: 33.2(3.1) Weight on study: Mean (SD) I:1635.4 (244.3) C: 156.9 (226.9)	I : Massage by mother C: Usual care	Field et al, (1986) guided massage movements, - Tactile stimulation movement s. - Kinesthetic stimulation movement s.	Duration of study: 14 days Frequency : 2x/day Duration: 15 minutes	Body weight (grams) Height (cm) Head circumference (cm)	Calculation of weight gain at the end of the study Measurement of head circumference in centimeters at the end of the study Total duration of the patient's hospital stay from the time of admission to the time of discharge	I = 2150.6 (327.4) C = 1747.8 (356.2) I = 46.9 (2.3) C = 45.0 (2.4) I = 32.5 (2.5) C = 31.0 (2.4)	Low risk

No.	Author, Year (Country)	Participant Characteristics	Group	Movement Characteristics	Duration	Outcome	Outcomes Measurement	Result	RoB 2
4.	Prociandy et al., 2010 (Brazil)	N:73 I: 35 C:38 GA: Mean (SD) I: 30.0 (1.55) C: 29.7(1.62) Weight on study: Mean (SD) I: 1973 (150) C: 2028 (247)	I: massage by mother & Kangaroo mother care C: Kangaroo mother care	Field et al, (1986) guided massage movements, - Tactile stimulation movement s. - Kinesthetic stimulation movement s.	Frekuensi: 4x/hari Interval 6 jam Durasi: 15 menit Lama Intervensi: 10 hari	Weight (grams) corrected age 2 years Height (cm) 2 years of corrected age Head circumference (cm) corrected age 2 years Body weight (gram/month) Height (cm/month) Head circumference (cm/month) <i>Mental Development Index/ MDI</i>	Calculation of weight gain at the end of the study Measurement of head circumference in centimeters at the end of the study Measurement of head circumference in centimeters at the end of the study Calculation of weight gain per month in grams Calculation of body length gain per month in centimeters Calculation of monthly head circumference gain in centimeters Mental development index assessment at 2 years of correction age	I = 11,403 (1558) C = 10,891 (932) I = 85.0 (2.91) C = 84.9 (2.86) I = 47.6 (1.50) C = 47.1 (1.60) I = 425 (62.4) C = 405 (37.8) I = 2.43 (0.14) C = 2.43(0.13) I = 0.43(0,09) C = 0.41(0,14) I= 85.1 (1.99) C= 82.9 (5.61)	Low risk
5.	Mendes, & Prociandy, 2008 (Brazil)	N: 104 I: 52 C:52 GA: Mean (SD) I: 29.7(1.6) C: 29.4(1.6) p-value: 0.33 Weight on study: Mean (SD) I: 1186.8 (194.1) C: 1156.7 (197.7)	I: massage by mother & Kangaroo mother care C: Kangaroo mother care	Field et al, (1986) guided massage movements, - Tactile stimulation movement s. - Kinesthetic stimulation movement s.	Duration of study: 10 days Frequency : 4x/day 6-hour interval Duration: 15 minutes	Length of hospitalization (days) <i>Neonatal sepsis (n, %)</i> Body weight (grams)	Total duration of hospital stay from time of admission to time of discharge Incidence of sepsis during the study Daily weight measurement at the end of the study Body length	I= 42 (38-46) C= 49 (42-56) I = 5 (10.9) C = 18 (38.3) I = 1973.8 (140.1) C = 2051.1 (270.6)	Some concerns

No.	Author, Year (Country)	Participant Characteristics	Group	Movement Characteristics	Duration	Outcome	Outcomes Measurement	Result	RoB 2
						Height (cm)	measurement in centimeters at the end of the study	I = 42.5 (1.1) C = 43.3 (1.5)	
						Head circumference (cm)	Measurement of head circumference in centimeters at the end of the study	I = 32.0 (1.0) C = 32.1 (1.5)	

As a result of the bias assessment of the 5 studies reviewed, almost all studies had no interventional deviations. One study had concerns in the randomization process and concerns in the delivery of the intervention because the people delivering the interventions were aware of the participants assigned to the intervention. Concerns regarding missing data, outcome data, and the selection of the reported result were appropriate (Table 2.)

Table 2.
Risk of bias assessment

Reference	Domain 1. Randomization process	Domain 2. Deviations from intended interventions	Domain 3. Missing outcome data	Domain 4. Measurement of the outcome	Domain 5. Selection of the reported result	Overall Bias
Ferber et al., (2002)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Mendes & Prociano y, (2008)	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Gonzalez et al., (2009)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Prociano y et al., (2010)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Zhang & Wang, (2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

This study will evaluate the weight gain of preterm infants who are given massage intervention by the infant's mother. Weight gain in premature infants undergoing massage therapy is usually measured as an increase in body weight over a certain period, often recorded daily or at the end of the intervention period (Lu et al., 2020). Almost all studies in the application of massage therapy research used by mothers were adapted from Dr. Field who divided 2 phases, namely the tactile phase and the kinesthetic phase. There was 1 study applying vimala massage therapy, and a study applying massage by combining KMC treatment. The comparison group in the study was a massage given by a health worker, a group that did not get massage therapy or only received standard care. The results obtained from the studies were quite varied. A review of the 5 included studies showed that massage therapy performed by mothers had the same effectiveness as massage therapy performed by trained health workers in increasing the weight of premature babies. Two studies found no significant weight gain with mother-massage therapy. Other outcomes included caloric intake, head circumference gain, body length, neurodevelopment, length of stay (LOS), and incidence

of sepsis in preterm infants. Massage therapy by the baby's mother was also found to have no side effects or complaints, and no secondary effects were found.

DISCUSSION

Infant massage has been recommended as an intervention to improve the growth and development of preterm and low birth weight infants (ÖzdemiR & Yildiz, 2019). In the review, it was found that massage therapy performed by the baby's mother was shown to significantly increase the weight of premature infants during infant care in the hospital. The results of this study are in line with the research of Ferber et al., (2002) seeing the effect of massage therapy with tactile and kinesthetic stimuli done by the baby's mother has similar benefits to massage therapy done by trained health care staff. In Zhang & Wang's (2019) study, massage performed by the baby's mother more significantly increased weight growth. Significant weight gain was also obtained in the application of infant massage with vimala massage by the baby's mother (Ferber et al., 2002). The results of the review also showed that the application of infant massage by mothers was effective and no side effects or secondary effects were found in the treatment (Ferber et al., 2002; Gonzalez et al., 2009; Zhang & Wang, 2019). Maternal massage therapy is a beneficial and low-cost intervention to promote weight gain in preterm infants, with potential positive effects on parent-child bonding and reducing parental stress (Alligood, 2018; M. T. Field et al., 1986; Gonzalez et al., 2009).

The results of a review of 2 articles found that massage therapy provided by the baby's mother combined with kangaroo mother care was no better than standard kangaroo mother care alone in increasing the daily weight of premature babies and after discharge from the hospital (Mendes & Procianoy, 2008; Procianoy et al., 2010). This is not in line with the research of Hwu et al., (2023) which states that massage provided with a longer duration $\pm$ 3 months after hospital discharge, consistently increases the weight gain of premature infants. The difference may be due to the application of massage interventions combined with kangaroo mother care, the results may be influenced by kangaroo care itself, where kangaroo care has been shown to increase weight gain in preterm infants compared to standard incubator care, and a meta-analysis study states that infants with kangaroo care for at least 6 hours per day experience more weight gain of 8.99 grams / day compared to standard care (Charpak et al., 2021; Kashaninia & Dehghan, 2015).

Secondary results obtained from the review included body length gain, and head circumference. The results of two studies stated that there was a significant increase in body length (Mendes & Procianoy, 2008; Zhang & Wang, 2019). This is similar to several studies that mention that massage therapy can have a positive impact on infant body length, in the study mentioned that infants who received massage, had significantly higher average body length at the end of week 20 than the control group (Erçelik & Yılmaz, 2023). Another systematic review showed that full-body massage can increase infant length at the end of a 6-week intervention period (Priyadarshi et al., 2022). The impact of maternal infant massage on head circumference is less clear. One study reported a significant increase in head circumference in preterm infants who received maternal massage (Zhang & Wang, 2019). Another review also found a modest but significant effect on head circumference (Bennett et al., 2013). However, one study showed no significant difference in head circumference gain in preterm infants who were given massage therapy by the infant's mother (Procianoy et al., 2010). One study found that massage therapy by mothers of preterm infants did not significantly alter caloric intake (Gonzalez et al., 2009). This is in line with Zhang et al., (2023) that weight gain is not due to increased caloric consumption but may be due to increased metabolic efficiency.

Massage therapy-associated weight gain may be due to increased vagal activity, which increases gastric motility and insulin release thereby contributing to nutrient absorption, better metabolic efficiency and indicates a positive response to stress and relaxation behavior in infants. In addition, massage therapy has been shown to decrease energy expenditure, which may support weight gain (Diego et al., 2014; M. T. Field et al., 1986; T. Field et al., 2010; Lahat et al., 2007). Massage therapy has also been shown to increase sleep duration and efficiency in preterm infants, reduce the number of awakenings and improve overall sleep quality, which is important for physical and neurological development in infants (Düken & Yayan, 2024). Physical contact between parents and infants during massage stimulates the release of oxytocin, thereby facilitating parent-infant attachment, which reduces maternal stress and may provide ongoing benefits for parents and preterm infants (Hwu et al., 2023). One study found that maternal massage therapy combined with kangaroo mother care during hospitalization significantly improved mental development index (MDI) scores at two years of corrected age, compared to a control group that received only kangaroo mother care (Procianoy et al., 2010). Abdallah, et al.'s (2013) study also reported that infants who received maternal massage therapy had higher cognitive scores at 12 months of age, although there was no significant difference in motor scores. This suggests that infant massage by mothers can have a long-term positive impact on cognitive development.

In a previous study Mendes & Procianoy, (2008) mentioned that the incidence of late-onset sepsis was significantly lower in the infant massage group by the mother (10.8%) compared to the group that received standard care (38.3%). Late-onset sepsis has the impact of increasing the length of hospitalization and morbidity in premature infants (Downey et al., 2010; Valls-i-Soler et al., 2014). Studies suggest that massage therapy can shorten the length of infant hospitalization (Gonzalez et al., 2009). Mendes & Procianoy, (2008) mentioned that infants who received maternal massage were discharged from the hospital 7 days earlier than those who did not receive massage. One study mentioned there was no significant difference in the length of stay in the group of infants who received massage therapy by the mother in combination with kangaroo mother care compared to standard kangaroo mother care (Mendes & Procianoy, 2008). (Badiie et al., 2011) mentioned that there was no significant difference in the length of stay in the group of infants who received massage by mothers compared to massage done by nurses or standard care. For this reason, massage therapy can be taught to the baby's mother or the baby's parents to increase the weight of premature babies and increase the attachment of mother and child. Massage therapy that can be applied by mothers is therapy with tactile and or kinesthetic stimulation, and vimala massage therapy. Massage therapy can be done at least twice a day for 15 minutes, and done 1 hour before or after drinking. Massage therapy can be done during hospitalization and continued at home (Ferber et al., 2002; Gonzalez et al., 2009; Mendes & Procianoy, 2008; Procianoy et al., 2010; Zhang & Wang, 2019).

CONCLUSION

Based on the findings of the systematic review, it is highlighted that maternal infant massage is an effective intervention to increase the weight of preterm infants. Mothers have an important role in participating in providing infant care in the hospital and supporting infant development. Recommendations for health practitioners to provide infant massage training to mothers or parents especially before the baby goes home, so that mothers can continue the infant massage intervention at home to improve the growth and development of premature babies.

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