



The Impact of Kangaroo Care on Premature Infant Weight Gain



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ABSTRACT

Background: Preterm births occur among 11.4% of all live infant births. Without steady weight gain, premature infants may experience lengthy hospitalizations, neurodevelopmental deficits and hospital readmissions, which can increase the financial burden on the health care system and their families. The total U.S. health-related costs linked to preterm infant deliveries are estimated at \$4.33 billion. Kangaroo care is a feasible practice that can improve preterm infant weight gain. However, this intervention is utilized less often throughout the U.S. due to numerous barriers including a lack of consistent protocols, inadequate knowledge, and decreased level of confidence in demonstrating the proper kangarooing technique. An integrative review was conducted to evaluate the impact of kangaroo care on premature infant weight gain in order to educate nurses about its efficacy among preterm infants.

Data Sources: A literature search was conducted using CINAHL, PubMed, Cochrane Reviews, ClinicalKey and Google Scholar. Large volume searches were restricted using appropriate filters and limiters.

Conclusions: Most of the evaluated studies determined that weight gain was greater among the kangarooing premature infants. Kangaroo care is a low-tech low-cost modality that can facilitate improved preterm infant weight gain even in low-resource settings. Despite its current efficacy, kangaroo care is not widely utilized due to several barriers including an absence of standardized protocols and a lack of knowledge about its benefits. Kangaroo care can become a widespread formalized practice after nurses and parents learn about the technique and its numerous benefits for premature infants, including its association with improved weight gain.

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The preterm infant birth rate within the United States is rising every year (Ahmed & Sands, 2010) and premature infants represent approximately 11.4% of the delivered infant population (McCabe, Carrino, Russell, & Howse, 2014). Within the United States, the expenditures linked to the delivery of premature infants are estimated to be \$4.33 billion and approximately \$760 million of this cost has been allocated towards the health-related expenses of premature infant patients (Trasande, Malecha, & Attina, 2016).

Although preterm birth is linked to a higher incidence of infant mortality (Ahmed & Sands, 2010), the extent of morbidity is reduced among surviving infants with greater birth weights (Horbar et al., 2012). In addition, daily infant weight gain is also associated with decreased hospital readmissions, cerebral palsy and neurodevelopmental deficits (Ehrenkranz et al., 2006). To promote weight gain among preterm infants and reduce the onset of health complications, various low-tech low-cost modalities have been introduced in neonatal units including

kangaroo care, and infant massage (Baley et al., 2015; Ramanathan, Paul, Deorari, Taneja, & George, 2001; Vickers, Ohlsson, Lacy, & Horsley, 2004). Kangaroo care, in general, is only slowly gaining acceptance throughout the U.S. due to its positive effect on infant weight gain, development, bodily processes, physiological parameters, neurobehavioral functions and mother-infant bonding (Baley et al., 2015; Ramachandran & Dutta, 2013). Some of the other reported benefits of kangaroo care among premature infants include increased parental confidence, improved breastfeeding efforts, and decreased onset of infections (Ramachandran & Dutta, 2013).

Although kangaroo care, as a formal therapeutic modality has existed for the past few decades, only 57% of U.S. critical neonatal intensive care units are consistently employing this feasible practice due to a lack of knowledge about positive effects (e.g. weight gain) and concerns about adverse effects on preterm infants such as extubation, temperature loss, and stress (Sood et al., 2016; Hendricks-Munoz & Mayers, 2014; Stikes & Barbier, 2013). Therefore, prior to exploring the published medical content, the following PICO question was formulated: What is the effect of kangaroo care compared to standard neonatal care on premature infant weight gain?

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Table 1
Evidence evaluation table.
Author design sample setting.

Author/year	Participants	Methods	Findings	Level of evidence (Melnyk & Fineout-Overholt, 2011)	Limitations
Acharya et al.	N = 126 intervention group = 63; control group = 63; setting: nursery in Dharan, Nepal	Randomized controlled trial; descriptive statistics	On a daily basis, premature infants in the kangaroo care group gained 10 g while infants in the control group gained 7 g. The average weight gain among infants in the kangaroo care group was 12.11 ± 9.04 g and among control group infants, the resulting weight gain was 3.29 ± 15.81 g ($P < 0.001$). The infant scale was calibrated with a precision of 10 g.	Level II	Enrollment weight of the intervention and control group infants were not comparable.
Bera et al.	N = 500 intervention group = 300; control group = 200; setting: Neonatal unit at the SSKM hospital in Kolkata, India	Controlled trial; student's unpaired <i>t</i> -test	Once the premature infants reached their 3–6 month corrected gestational age, the average weight gain of kangaroo care infants was 7111.8 ± 1017.64 g and the control group infants' weight gain was 5668.4 ± 1101.46 g ($P < 0.001$).	Level III	No randomization; potential for selection bias when allocating infants to each study group; 10% of subjects left study because it was difficult for some mothers to carry out the appropriate kangaroo care technique.
Conde-Agudelo et al.	N = 2751; setting: Multiple international neonatal settings including Aligarh, India; Providence, United States; Kebangsaan, Malaysia; Addis Ababa, Ethiopia; Yogyakarta, Indonesia; Merida, Mexico; Bogota, Columbia; Bali, Indonesia; Rohtak, India; Hyderabad, India; Mumbai, India; Mahajanga, Madagascar; Aurora, United States; New Delhi, India; Darwin, Australia; Connecticut, United States; Quito, Ecuador and London, United Kingdom	Systematic review of randomized controlled trials; Review Manager Software	Each day, the average weight gain of kangaroo care infants was greater than the control group infants. Kangaroo care infants gained 3.7 g on a daily basis (CI 95%, 1.9–5.6) ($P < 0.001$).	Level I	Lack of researcher or subject blinding; some of the studies had unreported or high attrition data.
El Moniem et al.	N = 100 intervention group = 50; control group = 50; setting: Neonatal units at Ain Shams University and Cairo University hospitals, Egypt	Non-randomized controlled trial	Descriptive statistics and paired <i>t</i> -test. Among kangaroo care infants, the amount of weight gain was 723.6 ± 117.7 g while control group infants gained substantially less weight, 401 ± 68.7 g ($P < 0.0001$).	Level III	No randomization
Gathwala et al.	N = 100 intervention group = 50; control group = 50; setting: Neonatology section of a Pediatrics Department located at Pt BD Sharma PGIMS, Rohtak, India	Randomized controlled trial	Chi-square and unpaired <i>t</i> -tests. The mean weight gain among infants randomly recruited into the kangaroo care group was 16.23 ± 0.49 g/day while the weight gain acquired by infants in the control group was 14.10 ± 52 g/day ($P < 0.05$).	Level II	Kangaroo care sessions were not consistently carried out throughout the duration of the entire study.

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Table 1 (continued)

Author/year	Participants	Methods	Findings	Level of evidence (Melnyk & Fineout-Overholt, 2011)	Limitations	
Ghavane et al.	N = 140 intervention group = 70; control group = 70; setting: Tertiary hospital facility located in South India	Randomized controlled trial	Fisher exact, chi-square and student's <i>t</i> -tests.	From the infant's hospitalization period and up till their discharge, the overall weight gain of infants in the kangaroo care group was 18.01 g while the weight gain of the control group infants was 15.64 g ($P = 0.12$). In addition, the overall weight gain among infants who reached a term corrected age was 23.3 ± 8.7 g for the kangaroo care group and 22.64 ± 9.1 g for the control group ($P = 0.67$). Infant scale calibrated to an accuracy of 5 g.	Level II	The actual duration of the kangaroo care sessions was not precisely documented.
Mohammadzadeh et al.	N = 100 intervention group = 50; control group = 50; setting: Neonatal Research Center, Masshad, Iran,	Randomized controlled trial	Mann Whitney <i>U</i> test and independent <i>t</i> -test; chi-square; Fisher exact test.	The reported weight gain among kangaroo care infants was 18.31 ± 7.57 g vs. 4.8 ± 16.57 g among the control group infants ($P < 0.001$).	Level II	Potential for confounding biases due to large differences in the control group with regard to infant length, head circumference and birth weight when compared to the intervention group infants.
Nagai et al.	N = 73 intervention group = 37; control group = 36; setting: University Hospital in Mahajanga, Madagascar	Randomized controlled trial	Analysis of variance and Fisher exact test.	Preterm infants in the earlier kangaroo care group (intervention group) experienced a weight loss of 34.81 g within the 24 h period after birth while the later onset kangaroo care infants (control group) experienced a weight loss of 73.97 g ($P = 0.02$). At 14 and 28 days of life, there were no substantial differences in body weight among the earlier and later onset kangaroo care groups. The reported infant weight changes at 14 days were 207.78 g for the earlier kangaroo care group and 195.64 g for later kangaroo care group ($P = 0.98$). At 28 days, the infant weight changes were 713.24 g for the earlier kangaroo care group and 654.39 g for the later onset kangaroo care group ($P = 0.60$).	Level II	Changes in neonatal body weight was a secondary outcome.
Samra et al.	N = 40 intervention group = 22; control group = 18; setting: Fayoum University Hospital, Egypt	Non-randomized controlled trial	Chi-square test; the Mann-Whitney <i>U</i> test	The overall weight gain of the kangaroo care infants was 22.1 ± 2.5 g while the control group infants gained 10.4 ± 2.5 g on a daily basis ($P < 0.001$).	Level III	No randomization; small infant sample

Background

Although kangaroo care, more commonly known as skin-to-skin contact, has been practiced among mothers and infants for centuries (Nyqvist et al., 2010), kangaroo care as a formal technique was developed by two Colombian pediatricians, Edgar Rey and Hector Martinez in 1978 in response to low neonatal resources with few incubators or isolettes to contain infants with low body weight (Rey & Martinez, 1983). The idea for the kangaroo care technique was derived from the care kangaroos provide to their newly born offspring (Rey & Martinez, 1983). In addition, it was known that following human birth, infants innately exhibit certain behaviors and cues, prompting their mothers to offer them warmth and security with direct skin contact (Nyqvist et al., 2010). In particular, infants engage in a series of behaviors that include crying, calmness, alertness, feeding readiness and breast nuzzling to elicit maternal responses (Widström et al., 1987).

An essential component of kangaroo care is the vertical position of the premature infant's body in relation to the mother's chest and abdomen (Samra, Taweel, & Cadwell, 2013). Preterm infants can acquire adequate thermoregulation through lying directly on the mothers abdomen and in between her breasts (Bera et al., 2014). The duration of kangaroo care among preterm infants varies based on individual stability and condition (El Moniem & Morsy, 2011).

When kangaroo care is initiated in the immediate period following preterm birth, bonding can be fostered among mother and infant pairs, and the physiological parameters of neonates can also improve (Nyqvist et al., 2010). Specifically, kangaroo care enhances oxygenation and respiratory status, while decreasing periods of oxygen desaturations and apneic episodes (Ramachandran & Dutta, 2013). Research evidence about the effects of kangaroo care also suggests better weight gain and reduced frequency of infections among premature infants (Ramachandran & Dutta, 2013). Compared to standard practices, kangaroo care has contributed to substantially greater physical development among preterm infants with lower body weights (Bera et al., 2014).

According to Cooper et al. (2014) and Baley et al. (2015), several barriers including: inconsistent unit protocols, inadequate knowledge about the neonatal benefits of kangaroo care, negative attitudes among staff members, and a lack of confidence in demonstrating the proper kangarooing technique among healthcare staff and parents tend to limit its routine use throughout neonatal units in the US. Only 8% of neonatal health care workers regularly assist parents with the kangarooing technique in their respective units (Cooper et al., 2014).

Additional barriers to kangaroo care utilization in the neonatal intensive care unit include an uncondusive work environment and minimal staff assistance with the kangarooing sessions (Seidman et al., 2015). In a study conducted by Hendricks-Munoz and Mayers (2014), the implementation of a kangaroo care educational program helped to decrease some of the barriers to its use, including a limited scope of knowledge about its positive effect on premature infants and a lack of competency in demonstrating the kangarooing technique. In addition, barriers to kangaroo care performance can be overcome with greater education, advocacy and support of the kangarooing practice by neonatal nurses (Moore, 2015). The purpose of this literature review is to provide the most recent research evidence about the impact of kangaroo care on premature infant weight gain in order to educate nurses about its efficacy among preterm infants.

Search Methods

Studies were eligible for review if they met specific criteria including a publication date within the past five years, were written in the English language, and were either a systematic review, randomized controlled trial or a non-randomized controlled trial. Furthermore, retrieved studies that focused on neonatal outcomes without examining premature infant weight gain were excluded from the review process (see Table 1).

To retrieve relevant articles pertaining to kangaroo care, multiple searches were conducted in five different databases, including CINAHL, PubMed, Cochrane Reviews, ClinicalKey and Google Scholar. Search phrases including *premature infants*, *kangaroo care*, *kangaroo mother care*, *skin-to-skin care*, and *weight gain* were searched individually and together using a limiter specifying an article publication date within the past five years. In addition, therapy and high sensitivity clinical query was selected during the searches carried out in the CINAHL database. Filters related to the specialty (neonatal and perinatal medicine) and the type of content (journals), generated a list of relevant articles in the ClinicalKey database.

An example of one of the literature searches is illustrated by the search strategy utilized in the PubMed database, which used individual search terms and groups of terms or phrases. The first search primarily consisted of search term 1: *premature infants*, which produced 74,579 results and search term 2: *kangaroo care*, which generated 547 results while search term 3: *weight gain* resulted in 62,673 hits. The subsequent search combined search terms 1 and 2, using the "AND" conjunction, resulting in 264 results. The following search employed a grouping of terms 1, 2 and 3, using the conjunction, "AND" in between each short phrase, which reduced the article quantity to 23 items. Along with using the broad therapy clinical query in the final PubMed search, the limiters specifying the English language and a publication date within the past five years were selected, yielding 3 results. After searching all the databases in a similar fashion, a total of nine studies met the eligibility criteria for this review.

Efficacy of Kangaroo Care on Infant Weight Gain

Findings from several international and domestic studies suggest that kangaroo care has a positive effect on infant weight gain (Table 1). All the studies employed inclusion criteria: low-birth weight premature infants without any respiratory distress, infections or invasive respiratory support and any infants with major anomalies, illnesses, infections or respiratory complications were excluded from the study samples. In addition, all the reviewed studies defined kangaroo care as a practice where an infant is positioned vertically between the mother's breasts with only a diaper and a head cap. Furthermore, infant weight was recorded in most studies with an electronic weighing scale. Numerical findings were reported in studies reviewed, including confidence intervals if known.

A systematic review of randomized controlled trials used a sample of 2751 premature infant subjects from various international and domestic neonatal inpatient settings including Aligarh, India; Providence, United States; Kebangsaan, Malaysia; Addis Ababa, Ethiopia; Yogyakarta, Indonesia; Merida, Mexico; Bogota, Columbia; Bali, Indonesia; Rohtak, India; Hyderabad, India; Mumbai, India; Mahajanga, Madagascar; Aurora, United States; New Delhi, India; Darwin, Australia; Connecticut, United States; Quito, Ecuador and London, United Kingdom, and determined that kangaroo care infants acquired greater weight gain than infants who were randomly assigned to a control group (Conde-Agudelo & Díaz-Rossello, 2014). More specifically, the researchers focused on 10 different studies, comprised of 1027 infant subjects in total (Conde-Agudelo & Díaz-Rossello, 2014). Using the sample of 1027 subjects, it was determined that the infants in the kangaroo care group gained an average of 3.7 g more each day than the control group (CI 95%, 1.9–5.6) (Conde-Agudelo & Díaz-Rossello, 2014). The control group received standard neonatal care. Findings suggest that both continuous and intermittent forms of kangaroo care were associated with improved breastfeeding sessions and in turn, greater premature infant weight gain. The duration of the kangaroo care periods ranged from at least one hour per day to continuous intervals of skin to skin contact lasting the entire day. This study was limited by a lack of description about when the infants were weighed or what type of weighing device was used to measure their body weight. In addition, the researchers do

not specify whether they observed the mother performing kangaroo care.

Findings from four out of five international randomized controlled trials suggest that kangaroo care among non-critically ill premature infants promotes significant weight gain compared to those infants who did not receive kangaroo care. Specifically, in a randomized controlled trial of 126 infants conducted at a nursery in Dharan, Nepal, the consenting parents were educated about the kangarooing technique, its positive effects and possible stress-related responses that could occur during the kangaroo care sessions such as cyanosis or apnea. Thereafter, the mother and infant dyads engaged in four sessions of intermittent kangaroo care lasting at least one hour each. Every kangarooing session was recorded by the participating mothers in the kangaroo care chart. Infants were weighed twice daily before their feedings on an electronic scale. The study findings suggest that kangaroo care infants experienced significantly greater infant weight gain than those infants who did not engage in kangaroo care, but received standard care and parental holding (Acharya, Singh, Bhatta, & Poudel, 2014). In particular, premature infants in the kangaroo care group gained an average of 10 g daily compared to the control group infants who received routine neonatal care and gained an average of 7 g per day ($P < 0.001$). In addition, the average weight gain among infants in the kangaroo care group was substantially greater at 12.11 ± 9.04 g daily versus 3.29 ± 15.81 g daily among the control group infants ($P < 0.001$). The study, however, was limited by baseline infant weight differences between the groups, which could have affected the study's internal validity. The control group infants weighed more at baseline. In addition, the study does not mention whether the kangarooing sessions were observed by the researchers. Nevertheless, randomization was employed to reduce the possibility of confounding biases related to baseline infant weights among both groups (Acharya et al., 2014).

In Rohtak, India, a randomized controlled trial was conducted at the neonatal unit of Pandit Bhagwat Dayal (BD) Sharma Post Graduate Institute of Medical Sciences (PGIMS) using a sample of 100 non-critically ill premature infants on the basis of the study's inclusion and exclusion criteria. The kangaroo care group engaged in four different kangarooing sessions for at least one hour each and the mothers were encouraged to increase the length of each session if it was well tolerated by the infant and mother couplet. The control group infants were provided with routine neonatal care in an isolette or on a warmer. The hospitalized infants were weighed daily on an electronic scale and following their discharge, these infants were weighed on the same hospital scale on a weekly basis. This study found that weight gain was significantly greater among kangaroo care infants (Gathwala, Singh, & Singh, 2010). In particular, the mean weight gain of kangaroo care infants was 16.23 ± 0.49 g/day while control group infants acquired a weight gain of 14.10 ± 52 g/day ($P < 0.05$). The study was limited however, by the fact that the kangaroo care sessions were not consistently carried out throughout the duration of the entire study. In addition, the investigators did not specify when the infants were weighed, whether weighing occurred before or after feedings, and whether or not the researchers observed the kangarooing sessions.

In contrast, in a randomized controlled trial conducted at a tertiary hospital in South India, where 140 infants were randomly recruited, no significant differences were found between the weight gain of the kangaroo care and control group neonates when the infants reached a term corrected age (23.3 ± 8.7 g daily for the kangaroo care group vs. 22.64 ± 9.1 g daily for the control group, $P = 0.67$) (Ghavane et al., 2012). Participating mothers were advised to perform intermittent periods of kangaroo care for at least 8 h each day. Kangarooing infants were closely monitored by an experienced nurse, and infants in the control group primarily received standard neonatal care on a warmer or in an isolette. There were several limitations in this study, which could have affected the final results. Although the kangaroo care infants had gained more weight than the control group neonates (mean difference 2.4 g/kg/day), a significant difference was not identified because the

study was not powered to detect a difference in weight gain among the two infant groups by the discharge period (Ghavane et al., 2012). In addition, although the infants were followed from the post-delivery period to their discharge from the neonatal unit, the precise duration of kangaroo care was not defined, which may have also affected the final results. Finally, there was no report on how often the infants were weighed on the electronic scale or whether the weighing occurred before or after a feeding.

In a randomized controlled trial of 100 infants conducted at a hospital neonatal research center in Masshad, Iran, findings suggest that infant weight gain was significantly greater among neonates in the kangaroo care group (18.31 ± 7.57 g daily in the kangaroo group vs. 4.8 ± 16.57 g daily weight gain in the control group, where the infants were provided with routine neonatal care within the isolette) ($P < 0.001$) (Mohammadzadeh, Farhat, Jafarzadeh, Hasanzadeh, & Esmaili, 2011). The study was limited, however, by baseline differences in length, head circumference, and birth weight between infants assigned to the kangaroo care group vs. infants assigned to the control group. The differences in these baseline measures were controlled for by utilizing a general linear model (Mohammadzadeh et al., 2011). In addition, this study did not report the duration of the kangaroo care sessions, the specific weighing device used to weight the infants, the time period when the infants were weighed or whether the kangarooing sessions were observed by the investigators.

Finally, a randomized controlled trial of 73 infants conducted at a University Hospital in Mahajanga, Madagascar revealed that sudden weight loss was significantly reduced among infants who received continuous kangaroo care in the immediate 24-h post delivery period compared to those infants in the control group who received later onset continuous kangaroo care (weight loss of 34.81 g daily in the immediate kangaroo group at 24 h of age vs. weight loss of 73.97 g daily in the later onset kangaroo group at 24 h of age, $P = 0.02$) (Nagai et al., 2010). Mothers were instructed to perform kangaroo care on a continual basis when the infants were able to tolerate the kangarooing sessions. Infants were completely undressed and weighed on a calibrated electronic scale. There were, however, no significant differences between the immediate onset kangaroo care group and the later onset kangaroo care group at 14 days of life (immediate kangaroo onset group 207.78 g vs. 195.64 g total weight gain for the later kangaroo onset group, $P = 0.98$, 95% CI: $-85.23-109.52$) and 28 days of life (713.24 g total weight gain for the immediate kangaroo care group vs. 654.39 g total weight gain for the later onset kangaroo care group, $P = 0.60$, 95% CI: $-119.83-237.53$) (Nagai et al., 2010). Limitations included that the researchers did not specify the duration of the kangarooing sessions or mention whether the infants were weighed before or after feedings. In addition, the investigators did not disclose whether the kangaroo care sessions were observed.

Three non-randomized controlled trials also found evidence that kangaroo care promotes significant weight gain among premature infants. In the first non-randomized controlled trial of 500 premature infants conducted in the Seth Sukhlal Karnani Memorial (SSKM) Hospital in Kolkata, India, the participating mothers were educated about the kangaroo care benefits and its proper technique before the kangarooing sessions were initiated. The mothers were advised to perform kangaroo care for at least one hour during the first session and thereafter, gradually increase the duration by one additional hour during each consecutive session so long as the kangarooing periods were well tolerated by both the mothers and infants. The body weights of the infants were obtained by one of the researchers using an electronic scale. This study found that the average weight gain among the kangaroo care infants was closely comparable to the control group infants who received routine care when all participants reached a corrected gestational age of 40 weeks (Bera et al., 2014). However, the three to six month follow-up period found that premature infants in the kangaroo care group showed significantly greater improvements in total weight gain compared to the control group (7111.8 ± 1017.64 g in

the treatment group vs. 5668.4 ± 1101.46 g in the control group, $P < 0.001$). Limitations of the study included: 1) a small group of mothers who experienced some difficulty in carrying out the proper kangaroo care technique, and as a result, the infant sample was reduced by 10%, and 2) a lack of randomization. In addition, the study does not mention whether the kangarooing sessions were supervised or if the infant weights were obtained before or after feedings.

In the second non-randomized controlled clinical trial of 100 infants conducted at the neonatal units of Ain Shams and Cairo University hospitals in Egypt, participating mothers were thoroughly educated about the kangarooing technique and its benefits before carrying out the kangaroo care sessions in front of the researchers, three times a week for at least three hours. Mothers were also encouraged to provide continuous kangaroo care throughout the day. Infants were weighed by the researchers in the presence of their mothers. The control group infants were provided with standard care. This study showed significant differences in weight gain among the kangaroo care infants compared to those infants who did not receive kangaroo care (El Moniem & Morsy, 2011). Specifically, between the first and fourth weeks of life, premature infant weight gain was significantly greater among kangaroo care infants compared to the control group infants (treatment group total weight gain was 723.6 ± 117.7 g vs. control group infants' total weight gain of 401 ± 68.7 g, $P < 0.0001$). However, the investigators did not identify the specific type of weighing device used to obtain the infant body weights and it was unknown whether the infants were weighed before or after feedings.

Finally, in the third non-randomized controlled trial conducted at the Fayoum University Hospital in Egypt using a sample of 40 infants, the mother and infant couplets engaged in intermittent kangaroo care sessions twice a day for at least one hour. The same researcher weighed the infants naked, three times a day with an electronic scale and the mean weight was derived and later, documented as the daily weight. Infants in the control group received standard neonatal care. This study revealed that the weight gain of infants in the kangaroo care group was significantly greater than the control group weight gain (kangaroo care infants' weight gain 22.1 ± 2.5 g daily vs. control group infants' weight gain 10.4 ± 2.5 g daily, $P < 0.001$) (Samra et al., 2013). Moreover, premature infants in the kangaroo care group reached their birth weight in substantially fewer days than infants in the control group (15–17 days vs. 20–30 days respectively, $P < 0.001$). However, it is unknown whether the kangaroo care sessions were supervised or if the infants were weighed before or after feedings.

Findings of all studies, with the exception of Ghavane et al. (2012) suggest that kangaroo care promotes significantly more weight gain among non-critically ill premature infants compared to premature infants who did not receive kangaroo care. The Ghavane et al. (2012) study was limited by being underpowered to detect differences in weight gain. In addition, while one study found that immediate kangaroo care within the first 24 h of life facilitated less weight loss initially, there were no differences in weight gain between the immediate and later onset kangaroo care groups at 14 and 28 days of life. With the exception of one study conducted by Nagai et al. (2010), all of the evaluated studies specified the duration of the kangaroo care sessions.

The studies evaluated also contained some important limitations. Aside from Ghavane et al.'s (2012) study and El Moniem and Morsy's (2011) study where the kangarooing periods were supervised by an experienced nurse and the researchers respectively, none of the other studies reported whether the kangaroo care sessions were being closely observed. Furthermore, the weighing device was not specified in the following three studies conducted by Conde-Agudelo and Díaz-Rossello (2014), El Moniem and Morsy (2011) and Mohammadzadeh et al. (2011). Only one study carried out by Acharya et al. (2014) reported that the infants were weighed prior to their feedings. Finally, none of the studies evaluated kangaroo care among critically ill premature infants.

Discussion of Evaluated Studies

Kangaroo care is a low-tech low-cost intervention favored by a majority of the evaluated research studies. Among the nine reviewed studies including a systematic review, randomized controlled trials and non-randomized controlled trials, kangaroo care was associated with improved weight gain or reduced body weight loss among premature infants, with the exception of the study by Ghavane et al. (2012). Findings from all of the studies, however, were derived from samples of non-critically ill premature infants who did not require extensive respiratory support or medical treatments. Other limitations found in some studies included a lack of reporting on whether the kangaroo care sessions were being closely observed, the weighing device was not specified, and only one study reported that the infants were weighed prior to their feedings. Findings from the current literature review are limited by a lack of presenting evidence about extubation, temperature loss and stress that nurses have associated with risks of implementing kangaroo care.

Along with providing continuous medical care and necessary patient treatments, it is vital for the neonatal units to support measures that can improve the weight gain of premature infants on a daily basis (Field, Diego, & Hernandez-Reif, 2010). When premature infants do not reach an adequate body weight at the time of discharge, they may remain hospitalized for a longer duration (Field et al., 2010). Excessive hospitalizations as a result of delayed weight gain can substantially increase the healthcare costs of a particular institution (Field et al., 2010). Despite the international evidence-based research that supports the inclusion of kangaroo care practices in the neonatal unit, this measure is not widely utilized throughout healthcare institutions in the United States. This may be due, in part, to a lack of parental and neonatal staff education (El Moniem & Morsy, 2011). To formally integrate kangaroo care into the routine regimen of neonatal care, training programs and educational seminars could be offered to providers to highlight the beneficial aspects of the kangarooing sessions as well as to demonstrate the proper technique (El Moniem & Morsy, 2011). Furthermore, following admissions of premature infants to neonatal units, parents could be educated about the benefits of kangaroo care such as enhanced weight gain and reduced length of stay.

Based on the findings of these reviewed studies, kangaroo care is recommended for hospitalized premature infants without any serious health problems. The effect of kangaroo care on the weight gain and development of critically ill premature infants should be investigated in subsequent research pursuits. Since most studies were conducted internationally, further research is warranted to determine if these findings can be replicated within the United States (Samra et al., 2013).

Conclusions

Kangaroo care is a practical intervention that promotes greater pre-term infant weight gain since premature infants tend to deplete fewer calories while they are closely contained by their mothers (Dodd, 2005). Since all U.S. facilities have not adopted kangaroo care practices, nurses can be instrumental in overcoming the aforementioned barriers and fostering greater support for the implementation of this low-tech low-cost intervention to improve the outcomes of hospitalized premature infants.

Given that the reviewed studies excluded premature infants with medical complications, respiratory problems as well as those neonates needing intubation, subsequent research efforts should be focused on the effect of kangaroo care among critically ill infants who are ventilated or require extensive respiratory support and oxygenation. In addition, further studies should be conducted in the United States to expand the body of knowledge about kangaroo care practices among premature infants.

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