Early skin-to-skin contact for mothers and their healthy newborn infants (Review)

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TABLE OF CONTENTS

[Intervention Review]

Early skin-to-skin contact for mothers and their healthy newborn infants

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ABSTRACT

Background

Mother-infant separation postbirth is common in Western culture. Early skin-to-skin contact (SSC) begins ideally at birth and involves placing the naked baby, covered across the back with a warm blanket, prone on the mother's bare chest. According to mammalian neuroscience, the intimate contact inherent in this place (habitat) evokes neurobehaviors ensuring fulfillment of basic biological needs. This time may represent a psychophysiologically 'sensitive period' for programming future behavior.

Objectives

To assess the effects of early SSC on breastfeeding, behavior, and physiological adaptation in healthy mother-newborn dyads.

Search strategy

Cochrane Pregnancy and Childbirth Group's and Neonatal Group's Trials Registers (August 2006), Cochrane Central Register of Controlled Trials (*The Cochrane Library* 2006, Issue 2), MEDLINE (1976 to 2006).

Selection criteria

Randomized and quasi-randomized clinical trials comparing early SSC with usual hospital care.

Data collection and analysis

We independently assessed trial quality and extracted data. Study authors were contacted for additional information.

Main results

Thirty studies involving 1925 participants (mother-infant dyads), were included. Data from more than two trials were available for only 8-of-64 outcome measures. We found statistically significant and positive effects of early SSC on breastfeeding at one to four months postbirth (10 trials; 552 participants) (odds ratio (OR) 1.82, 95% confidence interval (CI) 1.08 to 3.07), and breastfeeding duration (seven trials; 324 participants) (weighted mean difference (WMD) 42.55, 95% CI -1.69 to 86.79). Trends were found for improved summary scores for maternal affectionate love/touch during observed breastfeeding (four trials; 314 participants) (standardized mean difference (SMD) 0.52, 95% CI 0.07 to 0.98) and maternal attachment behavior (six trials; 396 participants) (SMD 0.52, 95% CI 0.31 to 0.72) with early SSC. SSC infants cried for a shorter length of time (one trial; 44 participants) (WMD -8.01, 95% CI -8.98 to -7.04). Late preterm infants had better cardio-respiratory stability with early SSC (one trial; 35 participants) (WMD 2.88, 95% CI 0.53 to 5.23). No adverse effects were found.

Authors' conclusions

Limitations included methodological quality, variations in intervention implementation, and outcome variability. The intervention may benefit breastfeeding outcomes, early mother-infant attachment, infant crying and cardio-respiratory stability, and has no apparent short or long-term negative effects. Further investigation is recommended. To facilitate meta-analysis, future research should be done using outcome measures consistent with those in the studies included here. Published reports should clearly indicate if the intervention was SSC and include means, standard deviations, exact probability values, and data to measure intervention dose.

PLAIN LANGUAGE SUMMARY

Early skin-to-skin contact for mothers and their healthy newborn infants

Skin-to-skin contact between mother and baby at birth reduces crying, improves mother-baby interaction, keeps the baby warmer, and helps women breastfeed successfully.

In many cultures, babies are generally cradled naked on their mother's bare chest at birth. Historically, this was necessary for the baby's survival. In recent times, in some societies as more babies are born in hospital, babies are separated or dressed before being given to their mothers. It has been suggested that in industrialized societies, hospital routines may significantly disrupt early mother-infant interactions and have harmful effects. The review was done to see if there was any impact of early skin-to-skin contact between the mother and her newborn baby on infant health, behavior and breastfeeding. The review included 30 studies involving 1925 mothers and their babies. It showed that babies interacted more with their mothers, stayed warmer, and cried less. Babies were more likely to be breastfed, and to breastfeed for longer, if they had early skin-to-skin contact. Babies were also, possibly, more likely to have a good early relationship with their mothers, but this was difficult to measure.

BACKGROUND

Early skin-to-skin contact (SSC) is the placing of the naked baby prone on the mother's bare chest at birth or soon afterwards. The rationale for SSC comes from animal studies in which some of the innate behaviors of neonates that are necessary for survival are shown to be habitat dependent (Alberts 1994). In mammalian biology, maintenance of the maternal milieu following birth is required to elicit innate behaviors from the neonate and the mother that lead to successful breastfeeding, and thus survival. Separation from this milieu results in immediate distress cries (Alberts 1994) and "protest-despair" behavior. In rodent studies, the pups who had the least attentive contact from their mothers were the ones whose health and intelligence were compromised across the lifespan (Francis 1999; Liu 1997; Liu 2000, Plotsky 2005). In humans, routine separation shortly after birth is unique to the 20th century. This practice diverges from evolutionary history, where neonatal survival depended on close and virtually continuous maternal contact. SSC through sensory stimuli such as touch, warmth, and odor is a powerful vagal stimulant, which among other effects releases maternal oxytocin (Uvnas-Moberg 1998; Winberg 2005). Oxytocin causes the skin temperature of the mother's breast to rise, providing warmth to the infant. Oxytocin antagonizes the flight-fight effect, decreasing maternal anxiety and increasing calmness and social responsiveness. During the early hours after birth, oxytocin may also enhance parenting behaviors (Uvnas-Moberg 1998; Winberg 2005). Delivery room and postpartum hospital routines may significantly disrupt early maternal-infant interactions (Odent 2001; Winberg 1995). The possibility that postnatal separation of the human neonate is stressful and results in harmful effects that may persist across the lifespan needs careful evaluation using the allostatic theoretical framework. The theory of allostasis is the relationship between psychoneurohormonal responses to stress and physical and psychological manifestations of health and illness (McEwen 1998; Shannon 2007). Although from an evolutionary perspective SSC is the norm, separating the newborn from its mother soon after birth has now become common practice in many industrialized societies. Therefore, for the purpose of this review, SSC is considered the experimental intervention. Ironically, the experimental intervention in studies with all other mammals would be to separate mothers from their new-

borns.

Healthy, full-term infants employ a species-specific set of innate behaviors immediately following delivery when placed in SSC with the mother (Righard 1990; Varendi 1994; Varendi 1998; Widstrom 1987; Widstrom 1990). They localize the nipple by smell and have a heightened response to odor cues in the first few hours after birth (Porter 1999; Varendi 1994; Varendi 1997). This 'sensitive period' predisposes or primes mothers and infants to develop a synchronous reciprocal interaction pattern, provided they are together and in intimate contact. These innate behaviors can be disrupted by early postpartum hospital routines as shown experimentally by Widstrom 1990 and in descriptive studies by Righard 1990, Jansson 1995, and Gomez 1998. Gomez 1998 found that infants were eight times more likely to breastfeed spontaneously if they spent more than 50 minutes in SSC with their mothers immediately after birth, and concluded that the dose of SSC might be a critical component regarding breastfeeding success.

Infants who are allowed uninterrupted SSC immediately after birth and who self-attach to the mother's nipple may continue to nurse more effectively. Effective nursing increases milk production and infant weight gain (De Carvalho 1983; Dewey 2003). Anderson 2004a used SSC as an intervention for 48 healthy mother/full-term infant dyads with breastfeeding problems identified between 12 to 24 hours postbirth. SSC was provided during the next three consecutive breastfeedings. Breastfeeding was exclusive in 81% of these dyads at hospital discharge, 73% at one week, and 52% at one month postbirth. In this same study, temperatures were taken before (baseline), during, and after each SSC breastfeeding. Baseline temperatures reached, and remained in, thermoneutral range (Chiu 2005), suggesting that mothers have the ability to modulate infant temperature if given the opportunity to breastfeed in SSC. Because these mothers and their infants were having breastfeeding difficulties, hospital staff and parents can logically be reassured that healthy newborn infants, with or without breastfeeding difficulties, may safely breastfeed in SSC so far as temperature is concerned.

SSC outcomes for mothers suggest improved bonding/attachment (Affonso 1989); other outcomes are increased sense of mastery and self-enhancement, resulting in increased confidence. Sense of mastery and confidence are relevant outcomes because they predict breastfeeding duration (Dennis 1999). Women with low breastfeeding confidence have three times the risk of early weaning (O'Campo 1992). Low breastfeeding confidence is also associated with perceived insufficient milk supply (Hill 1996).

In previous meta-analyses with full-term infants, early contact was associated with continued breastfeeding (Bernard-Bonnin 1989; Inch 1989; Perez-Escamilla 1994). Just altering hospital routines can increase breastfeeding levels in the developed world (Rogers 1997). In a Cochrane review of kangaroo mother care with infants who weighed less than 2500 g at birth, Conde-Agudelo, Diaz-Rossello, and Belizam found that preterm 'kangaroo' mother care was associated with reductions in several clinically important adverse outcomes, including nosocomial infections, severe illness, lower respiratory tract disease, maternal dissatisfaction with the method of care, and failure to exclusively breastfeed at hospital discharge (Conde-Agudelo 2003). Maternal sense of competence was improved but no differences were found in infant mortality. These reviewers noted, however, that methodological flaws in the reviewed studies attenuated their confidence in the findings.

Separation of mothers from their neonates at birth has become standard practice, despite mounting evidence that this may have harmful effects. A concurrent widespread decline in breastfeeding is of major public health concern. The purpose of this review is to examine the available evidence of the effects of early SSC on breastfeeding exclusivity and duration and other outcomes in mothers and their healthy full-term and late preterm newborn infants. Although our intent is to examine all relevant outcomes, breastfeeding is the predominant outcome investigated so far in healthy newborns. Hence, our emphasis is on breastfeeding, although we also will examine maternal-infant behavior and physiology. Because the focus of this review is on mothers and their healthy infants, potential effects of early SSC on father-infant attachment and resistance of the staff to this intervention are beyond the scope of this review. Maternal feelings about early SSC and satisfaction with the birth experience are important and relevant but require more qualitative methods. The focus of this review is on randomized or quasi-randomized clinical trials used to test the effects of SSC.

OBJECTIVES

The objectives of this review are to examine whether early skin-to-skin contact for mothers and their healthy newborn infants has any beneficial or adverse effects on lactation, maternal-infant behavior, and infant physiology.

METHODS

Criteria for considering studies for this review

Types of studies

All controlled trials, whether truly randomized or quasi-randomized, in which the active encouragement of early skin-to-skin contact (SSC) between mothers and their healthy newborn infants was compared to usual hospital care. SSC cannot be implemented masked, but the assessment of physiologic changes or outcomes can often be carried out by individuals masked to allocation.

Types of participants

Mothers and their healthy full-term or late preterm newborn infants (34 to 37 weeks' gestational age) having early SSC starting less than 24 hours after birth, and controls undergoing standard patterns of care.

Types of interventions

Early SSC for term or late preterm infants can be divided into several subcategories.

(a) In 'birth SSC', the infant is placed prone skin-to-skin on the mother's abdomen or chest during the first minute postbirth. The infant is suctioned while on the mother's abdomen or chest, if medically indicated, thoroughly dried and covered across the back with a prewarmed blanket. To prevent heat loss, the infant's head may be covered with a dry cap and replaced when it becomes damp. Ideally, all other interventions are delayed until at least the end of the first hour postbirth.

(b) In 'very early SSC', beginning approximately 30 to 40 minutes postbirth, the naked infant, with or without a cap, is placed prone on the mother's bare chest. A blanket is placed across the infant's back.

(c) 'Early SSC' can begin anytime between 1 and 24 hours postbirth. The baby is naked (with or without a diaper and cap) and is placed prone on the mother's bare chest between the breasts. The mother may wear a blouse or shirt that opens in front, or a hospital gown worn backwards, and the baby is placed inside the gown so that only the head is exposed. What the mother wears and how the baby is kept warm and what is placed across the baby's back may vary. What is most important is that the mother and baby are in direct ventral-to-ventral skin-to-skin contact and the infant is kept dry and warm.

In the future these groups may be analyzed separately. However, at present, not enough studies are available for subgroup analysis.

Types of outcome measures

(a) Breastfeeding status (exclusivity) and duration;

(b) success of the first breastfeeding;

(c) breastfeeding problems such as breast engorgement, infant latch-on difficulties, sore nipples;

(d) breast milk maturation;

(e) changes in infant physiological parameters during and after skin-to-skin contact (e.g., temperature, respiratory rate, heart rate, blood glucose);

(f) infant stabilization (e.g., SCRIP scores);

(g) transfers to the neonatal intensive care unit (NICU), hospital length of stay, economic data, longer-term morbidity;

(h) behavioral changes in the infant during and after SSC (e.g., amount of crying and grimacing, flexed movements);

(i) maternal bonding attachment behaviors (e.g., affectionate, proximity-maintaining and care-taking behaviors);

(j) maternal psychological changes after SSC (e.g., state anxiety, self-efficacy, parenting competence, perception of bonding/connection to the infant).

Success of the first breastfeeding, infant SCRIP scores, transfers to the NICU, hospital length of stay, maternal parenting competence and perception of bonding/connection to her infant are all new outcomes added to this updated review.

Search methods for identification of studies

Electronic searches

We searched the Cochrane Pregnancy and Childbirth Group's and the Cochrane Neonatal Group's Trials Registers by contacting the Trials Search Co-ordinator (August 2006).

The Cochrane Pregnancy and Childbirth Group's Trials Register is maintained by the Trials Search Co-ordinator and contains trials identified from:

1. quarterly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. monthly searches of MEDLINE;
3. handsearches of 30 journals and the proceedings of major conferences;
4. weekly current awareness search of a further 37 journals.

Details of the search strategies for CENTRAL and MEDLINE, the list of handsearched journals and conference proceedings, and the list of journals reviewed via the current awareness service can be found in the 'Search strategies for identification of studies' section within the editorial information about the Cochrane Pregnancy and Childbirth Group.

Trials identified through the searching activities described above are given a code (or codes) depending on the topic. The codes are linked to review topics. The Trials Search Co-ordinator searches the register for each review using these codes rather than keywords.

Details of the search strategies for the Cochrane Neonatal Group's Trials Register can be found in the 'Search strategies for identification of studies' section within the editorial information about the Cochrane Neonatal Group.

In addition, we searched the Cochrane Central Register of Controlled Trials (*The Cochrane Library* 2006, Issue 2) the MEDLINE database (1976 to 2006) and using the terms in Appendix 1.

We did not apply any language restrictions.

Searching other resources

We also handsearched the following journals from January 1976 to May 2006: *Acta Paediatrica Scandinavica, American Journal of Maternal Child Nursing, Archives of Disease in Childhood, Biology of the Neonate, Birth, British Medical Journal, Current Opinion in Pediatrics, Developmental Medicine and Child Neurology, Early Human Development, European Journal of Pediatrics, Journal of Devel-*

opmental Physiology, Journal of Human Lactation, Journal of Midwifery and Women's Health, Journal of Nursing Measurement, Journal of Obstetric, Gynecologic and Neonatal Nursing, Journal of Perinatology, Journal of Pediatrics, Journal of Tropical Pediatrics, Lancet, Neonatal Network, New England Journal of Medicine, Nursing Research, Pediatric Research and *Pediatrics*. We will add the new journal, *Breastfeeding Medicine* to this search in the future.

Data collection and analysis

Each study that we identified as a result of the search strategy was evaluated independently for inclusion in the review by two review authors. We rejected trials without a concurrent control group (e.g. those with historical controls). We included relatively high quality quasi-randomized studies in the review. If the assignment to groups appeared to create equivalent groups, then the study was included even if a truly random process was not used for group assignment. For example, if women were alternately assigned to treatment and control groups and there was no reason to think that this should result in nonequivalent groups, that study was included. On the other hand, if assignment to groups was based on woman or provider preference, the study was excluded. Studies conducted by each of the three authors were reviewed for inclusion by the other two authors and a consensus was reached regarding inclusion of these studies in the review. Methods used for generation of the randomization sequence were described for each trial. Each identified trial was assessed for methodological quality with respect to (1) selection bias, (2) attrition bias, and (3) performance bias. We assigned a quality score for each trial, using the following criteria.

(1) Selection bias (allocation concealment)

(A) Adequate concealment of allocation: centralized randomization, sequentially-numbered, sealed opaque envelopes, computerized minimization technique;
(B) unclear whether adequate concealment of allocation: sealed envelopes but not sequentially numbered or opaque, a trial in which description suggests adequate concealment but other features suspicious, e.g. markedly different treatment and control groups, stated random but unable to obtain further details;
(C) inadequate concealment of allocation: any allocation procedure transparent before assignment, such as open list of random-number tables, use of case record numbers, dates of birth or days of the week.

(2) Attrition bias

We assessed completeness to follow up using the following criteria: complete follow up of all study participants/reasons given for attrition/NSD between participants who terminated their involvement in the study and those who remained enrolled (yes/no/unclear).

(3) Performance bias

We assessed blinding using the following criteria:
(A) blinding of participants (yes/no/unclear);
(B) blinding of caregiver (yes/no/unclear);
(C) blinding of outcome assessment (yes/no/unclear).
We designed a form to extract data. Several review authors extracted data and assessed the methodological quality of each study independently and compared results. Disagreements about study inclusion and methodological quality were resolved through discussion until a consensus was reached. We reviewed the inclusion criteria and therapeutic interventions for each trial to see how they differed between trials. We examined the outcomes in each trial to see how comparable they were between studies. We contacted investigators (if possible) to obtain information about any missing data. For categorical data, we made 2 x 2 tables from each trial for each important outcome, and used odds ratios with 95% CI in the meta-analysis. For continuous variables, we calculated weighted mean differences with 95% CI. We used standardized mean differences to combine trials that used different scales to measure the same outcome. We used fixed-effect meta-analysis for combining data in the absence of significant heterogeneity. We used random-effects meta-analysis for trials with significant heterogeneity identified by using the I^2 statistic. We were unable to explore heterogeneity using subgroup analysis or sensitivity analysis because there were not enough clinical trials included for the heterogeneous outcomes.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.
Thirty studies with 1925 mother-infant dyads met the inclusion criteria. None of the 30 studies met all of the methodological quality criteria. Of the 30 studies, 29 were randomized controlled trials and one study (Anisfeld 1983) was quasi-randomized (group assignment by day of the week). Anisfeld 1983 stated that the groups were similar in socio-economic and medical characteristics. The total sample sizes in the studies ranged from eight to 204 mother-infant pairs. The studies represented very diverse populations in Canada, Chile, Guatemala, Israel, Japan, Nepal, Poland, Russia, South Africa, Spain, Sweden, Taiwan, Thailand, the United Kingdom, and the United States. All but four of the 30 studies included only healthy full-term infants. Four studies (Anderson 2003; Bergman 2004; Chwo 1999; Syfrett 1996) were

done with healthy late preterm infants who were assigned to the normal newborn nursery. A large number of outcomes (64) was utilized in the analysis, but only 20 included multiple trials. Details of each included study are in the table of 'Characteristics of included studies'.

Thirty studies were assessed and excluded from the review. The primary reason for exclusion was that the investigators did not state that the infants in the intervention group received early skin-to-skin contact (SSC) with their mothers. When the information in the research report was unclear, the investigators were contacted, if possible, to determine whether the early contact was indeed skin-to-skin (*see* the table of 'Characteristics of excluded studies').

Risk of bias in included studies

The overall methodological quality of the included studies was considered marginally adequate. The two most problematic areas were allocation concealment and provider performance bias. In 22 of the 30 studies, not enough information was provided to determine if the method of random assignment was robust before allocation of the participants to groups occurred. In three studies (Anisfeld 1983; De Chateau 1977; McClellan 1980), allocation concealment was clearly inadequate. Only seven studies (Anderson 2003; Bergman 2004; Chwo 1999; Moore 2005; Punthmatharith 2001; Shiau 1997; Syfrett 1996) provided enough information to determine that allocation concealment was controlled by using a computer program to assign women to groups (the minimization method). Although the Syfrett 1996 study was small (n = 8), the recruiter was naive to the minimization method of random assignment. In 10 studies (Carlsson 1978; Christensson 1992; Christensson 1995; Hales 1977; Mazurek 1999; Mizuno 2004; Svejda 1980; Thomson 1979; Vaidya 2005; Villalon 1993), the researchers indicated that women were randomly assigned to groups but no further information was provided about the randomization method. In seven studies (Bystrova 2003; Carfoot 2004; Craig 1982; Curry 1982; Sosa 1976a; Sosa 1976b; Sosa 1976c), sealed envelopes were used but the investigators do not state whether the envelopes were sequentially numbered or opaque.

None of the research reports stated that the delivery and postpartum staff were unaware of the group assignment of the mothers. Ferber 2004, however, stated that the nursery staff were blind to patient group assignment. Therefore, control for provider performance bias was difficult to determine. In the seven studies that evaluated infant physiological outcomes (Bergman 2004; Bystrova 2003; Christensson 1992; Fardig 1980; Mazurek 1999; Syfrett 1996; Villalon 1993), however, patient or provider performance bias would not be as significant an issue as it might be with maternal attachment and breastfeeding outcomes. Surprisingly, patient performance bias was more adequately controlled than provider performance bias. In six studies (Carlsson 1978; Craig 1982; Curry 1982; Ferber 2004; Thomson 1979; Svejda 1980), the women were not aware that they were receiving an experimental treatment and/or they were not informed about the true purpose of the study. Adequate control for patient performance is problematic in the more recent studies because of Institutional Review Board requirements that investigators disclose the true purpose of the study and/or the experimental conditions.

Detection and attrition bias were the threats to validity that were most adequately controlled. In 14 of the 30 studies, outcome assessors (whenever possible) were not aware of the woman's group assignment. In several studies, when infant physiological or crying data were obtained by observation during skin-to-skin contact (Bergman 2004; Bystrova 2003; Christensson 1992; Christensson 1995; Fardig 1980; Mazurek 1999; Syfrett 1996; Villalon 1993), the outcome assessors could not be masked. In all but one study (Carlsson 1978) outcome data were either obtained on all the enrolled women or reasons were provided for women who withdrew or had to be withdrawn. Three investigators (Bergman 2004; Carfoot 2005; Moore 2005), utilized the Consort Guidelines (Moher 2001) to document the flow of participants through their clinical trial.

Effects of interventions

Twenty-nine of the 30 studies reviewed were randomized controlled trials. Sixty-four clinical outcomes were included, although only 20 were measured in more than one study. The results of heterogeneity of the analysis using more than one study were significant for 10 outcomes: breastfeeding status day 28 to one month postbirth; breastfeeding one month to four months postbirth; duration of breastfeeding in days; respiratory rate 75 minutes to two hours postbirth; heart rate 75 minutes to two hours postbirth; axillary temperature 90 minutes to two hours postbirth; hospital length of stay in hours; affectionate love/touch during a breastfeeding 36 to 48 hours postbirth; mother kissing infant during a play observation three months postbirth; and maternal enface behavior during a play observation three months postbirth. The analysis of the studies for the remaining 10 outcomes were non-significant for heterogeneity.

Breastfeeding outcomes

Breastfeeding outcomes were measured in 16 studies (Carfoot 2004; Carfoot 2005; Carlsson 1978; Chwo 1999; De Chateau 1977; Mizuno 2004; Moore 2005; Punthmatharith 2001; Shiau 1997; Sosa 1976a; Sosa 1976b; Sosa 1976c; Syfrett 1996; Thomson 1979; Vaidya 2005; Villalon 1993).

Breastfeeding status and duration

Early skin-to-skin contact (SSC) resulted in statistically significant and better overall performance on all measures of breastfeeding status (using the Index of Breastfeeding Status) (Cadwell 2002; Labbok 1990), and duration except breastfeeding status at

day 28 to one month postbirth (WMD 0.86, 95% CI -0.73 to 2.44). Moore 2005 suggested that barriers to long-term breastfeeding that exist in the United States, especially the customary absence of or very brief paid maternity leave, attenuated the effectiveness of early SSC on this outcome variable. The mothers in Punthmatharith 2001 delivered in a Baby Friendly Hospital in Thailand with 24-hour rooming-in. Control infants were cup fed if they needed supplementation. In addition, most of the SSC took place in extremely warm, unairconditioned eight-bed postpartum rooms with frequent visitors so that contextual issues, such as body warmth and modesty, may have changed SSC desirability and also effectiveness. More SSC dyads were still breastfeeding one to four months postbirth (odds ratio (OR) 1.82, 95% CI 1.08 to 3.07). This meta-analysis included 10 studies and involved 552 mother-infant pairs. In eight of the 10 studies, SSC dyads were more likely to be breastfeeding one to four months postbirth, although the difference reached statistical significance in only two studies (Sosa 1976c; Thomson 1979). One study (Carlsson 1978) found no differences between groups. In one study (Sosa 1976a), women in the control group were more likely to breastfeed one to three months postbirth. These investigators speculated that their findings might be explained by the fact that more women, who had recently come from rural areas, where breastfeeding was common, were in the control group. Apparently simple random assignment was not effective on this potentially confounding variable. This variable could have been controlled by random assignment by minimization or stratified random assignment. Carfoot 2005 stated that barriers to long-term breastfeeding, such as returning to work, and breastfeeding problems contributed to the minimal effect that early SSC had on this outcome in her two studies. In De Chateau 1977, and Shiau 1997 (n = 62), more SSC dyads were breastfeeding at one year (OR 7.62, 95% CI 0.89 to 65.23), however, this analysis did not reach statistical significance (P = 0.06). Seven studies also obtained data on the duration of breastfeeding in days. Six of the seven studies (De Chateau 1977; Mizuno 2004; Shiau 1997; Sosa 1976b; Sosa 1976c; Svejda 1980) found a longer duration of breastfeeding in the SSC dyads (WMD 42.55 days, 95% CI -1.69 to 86.79). Again, Sosa 1976a found that women in the control group breastfed longer than those in the intervention group. This meta-analysis must be interpreted with caution, however, primarily because of the inflation of standard deviations in several studies due to the long duration of breastfeeding for some of the mothers.

Successful breastfeeding and infant mouthing movements

Carfoot 2004 and Carfoot 2005 found that infants held SSC were more than twice as likely to breastfeed successfully during their first feeding postbirth than those who were held swaddled in blankets by their mothers (OR 2.65, 95% CI 1.19 to 5.91). These findings were obtained using a modification of (Matthews 1988; Matthews 1991) Infant Breastfeeding Assessment Tool (IBFAT). These findings were confirmed by Moore 2005 (WMD in IBFAT scores 2.40, 95% CI 0.33 to 4.47). Moore 2005 also found that SSC and the mother's nipple protractility contributed equally to the variance in infant IBFAT scores. Infants held SSC also established effective breastfeeding sooner postbirth than swaddled infants (WMD -13.37 hours, 95% CI -27.34 to 0.60). The time of effective breastfeeding was defined as the time of the first of three consecutive infant IBFAT scores of 10 to 12 in Moore 2005. The mother's nipple protractility was extremely important in relation to the infant's ability to establish competent suckling. Dewey 2003 also found that suboptimal breastfeeding behavior during the first 24 hours postbirth was associated with the mother's flat or inverted nipples (rr = 1.56) These infants were also 2.6 times more likely to have excessive weight loss.

Infants held SSC immediately postbirth and allowed to suckle at their mother's breast exhibited significantly more mouthing movements when exposed to their own mother's milk odor on a filter pad at four days postbirth (WMD 0.70, 95% CI 0.45 to 0.95) (Mizuno 2004) than infants who were separated from their mothers for 24 hours postbirth. Infants held SSC also displayed a larger difference in the frequency of mouthing movements when exposed to their own or another mother's milk on a filter pad than control infants (WMD 1.70, 95% CI 0.76 to 2.64). Mizuno 2004 stated that SSC results in better infant recognition of their own mother's milk odor.

Maternal breast engorgement, milk maturation and infant weight changes

No between-group differences were noted in maternal chest circumference (measured in centimeters across the nipples) three days postbirth (WMD -0.80, 95% CI -3.95 to 2.35) (Shiau 1997) or breast milk maturation (OR 1.00, 95% CI 0.35 to 2.86) (Shiau 1997); that is, progression from colostrum to mature milk (measured by the Maturation Index of Colostrum and Milk) (Humenick 1994). No differences were found in infant body weight change day 14 postbirth (WMD -8.00 grams, 95% CI -175.60 to 159.61) (Chwo 1999; Moore 2005). Breast engorgement pain (measured by the self-reported Six Point Breast Engorgement Scale (Hill 1994) was less for SSC than non-SSC mothers on day three postbirth (WMD -0.80, 95% CI -1.46 to -0.14) (Shiau 1997).

Maternal feelings

Mothers who held their infants SSC indicated a strong preference for the same type of postdelivery care in the future (86%) whereas only 30% of mothers who held their infants swaddled indicated that they would most certainly prefer this type of care in the future (OR 13.58, 95% CI 6.70 to 27.51) (Carfoot 2005). Mothers who held their infants SSC displayed less state anxiety day three postbirth (WMD -5.00, 95% CI -9.00 to -1.00) (Shiau 1997) and more confidence about their child care abilities at hospital

discharge (OR 7.73, 95% CI 2.89 to 20.69) (Villalon 1993) than control mothers who were separated from their infants for four (Villalon 1993) to 24 hours (Shiau 1997) immediately postbirth. However, no significant differences were found between groups in mother's perceptions of the adequacy of their milk supply (WMD 0.21, 95% CI -1.65 to 2.07) (Moore 2005; Punthmatharith 2001); number of breastfeeding problems (WMD -1.79, 95% CI -6.77 to 3.19) (Moore 2005); or parenting confidence (WMD 5.60, 95% CI -6.24 to 17.44) (Moore 2005) at one month postbirth between mothers who held their infants SSC or swaddled.

Intervention and control condition characteristics for the breastfeeding outcomes

The characteristics of the intervention varied greatly between studies. Duration of SSC ranged from approximately 15 minutes (De Chateau 1977; Thomson 1979; Vaidya 2005) to a mean of 37 of 48 hours (84%) of continuous SSC (Syfrett 1996). Although SSC began by 0 to 15 minutes postbirth in eight of the 16 studies, the SSC dyads in the study by Shiau 1997 could not begin until four hours postbirth because of hospital policy. SSC did not begin until M = 21.3 hours postbirth in the study by Chwo 1999 of late preterm infants 34 to 36 weeks' gestational age. In 15 of the 16 studies the infants were given the opportunity to suckle during SSC but only three studies (Carfoot 2004; Carfoot 2005; Moore 2005) documented the success of the first breastfeeding attempt. The amount of assistance the mothers received with breastfeeding during SSC is unclear in many of the research reports. Assistance with the first breastfeeding may be a necessary component of SSC because many mothers are often very insecure about their ability to successfully initiate breastfeeding. Substantial differences were found between studies in the amount of separation that occurred in the control group. In six studies (Chwo 1999; Mizuno 2004; Shiau 1997; Sosa 1976a; Sosa 1976b; Sosa 1976c), infants were removed from their mothers immediately postbirth and reunited 12 to 24 hours later. In two studies (Carlsson 1978; Thomson 1979), the mothers held their swaddled infants for about five minutes soon after birth. Control mothers held their infants for six times for 60 minutes in Chwo 1999, 60 minutes in Moore 2005 and for two hours in the recovery room in Punthmatharith 2001. In Syfrett 1996 all dyads received 24 minutes of SSC before randomization.

Infant temperature outcomes

Although six studies examined infant temperature outcomes (Bystrova 2003; Christensson 1992; Christensson 1995; Fardig 1980; Syfrett 1996; Villalon 1993), the studies used different modalities and time-frames. Abdominal, interscapular and axillary temperatures, rather than rectal temperatures, were used in the meta-analysis because skin temperatures are considered to be the most accurate reflection of fluctuations in environmental temperatures according to Fardig 1980. Only Fardig 1980 obtained rectal temperatures. Christensson 1992 and Christensson 1995 did not obtain rectal temperatures because they were measuring infant crying outcomes. Syfrett 1996 did not obtain rectal temperatures because the procedure would be stressful for the infants.

Infant abdominal skin temperature

Fardig 1980 obtained data on the number of infants with abdominal skin temperatures in the neutral range after 21 and 45 minutes of SSC. SSC infants were placed on the mother's bare chest and covered with three prewarmed cotton blankets. Control infants remained under the radiant warmer or were swaddled in warm blankets and given to their parents to hold if requested. Fardig 1980 defined neutral thermal range as abdominal skin temperatures of 36 to 37.5 degrees centigrade. At 45 minutes postbirth, more SSC infants had abdominal skin temperatures in the neutral thermal range (OR 13.75, 95% CI 1.45 to 129.99).

Infant axillary temperature

In the studies by Christensson 1992 and Christensson 1995, infants had SSC or were placed in a 'cot' (bassinet) next to the mother during the first 90 minutes postbirth. Neither group of infants were fed. Christensson 1992 obtained infant axillary temperatures after 90 minutes of SSC and found that SSC infants had a mean skin temperature of 37.1 compared with 36.7 in the cot control group. Christensson 1995 found that SSC infants had a mean skin temperature of 36.9 compared with 36.4 in the cot control group. Villalon 1993 found that there were no significant between-group differences in infant axillary temperature at two hours postbirth. Meta-analysis of these three studies resulted in a WMD of 0.25 degrees centigrade 95% CI -015 to 0.65 favoring the SSC group. Bystrova 2003 found a larger axillary temperature change 30-120 minutes postbirth in SSC infants than in the nursery control group (WMD 0.81, 95% CI 0.31 to 1.31). Similar results were obtained by Syfrett 1996. Mean hourly axillary temperature was 37 in the SSC infants and 36.7 in control infants (WMD 0.30 degrees, 95% CI 0.22 to 0.38). Syfrett 1996 also found that SSC infants had significantly less temperature variability around their temperature mean and that their temperatures were more likely to remain in the neutral thermal range (defined as 36.5 to 37.5 degrees centigrade). All infant temperature results except Villalon 1993 were statistically significant.

Infant physiological outcomes

Infant heart rate, respiratory rate, and blood glucose

Three studies (Christensson 1992; Mazurek 1999; Villalon 1993) obtained data on infant heart rate and respiratory rate 75 minutes - two hours postbirth. SSC infants had a lower mean heart rate

(WMD -3.05 beats per minute (BPM), 95% CI -7.84 to 1.75) and respiratory rate (WMD -2.76 RPM, 95% CI -7.29 to 1.77) than control infants who were separated from their mothers, but these results did not reach statistical significance. In two studies (Christensson 1992; Mazurek 1999), infant blood glucose was examined at 75 minutes - two hours postbirth. Blood glucose was higher in SSC infants (WMD 10.56 mg/dl, 95% CI 8.40 to 12.72) and this result was statistically significant.

Infant stabilization and neonatal intensive care unit (NICU) admissions

Bergman 2004 utilized SCRIP scores (a measure of infant cardio-respiratory stability in preterm infants that evaluates infant heart rate, respiratory rate and oxygen saturation) (Fischer 1998) to compare healthy late preterm SSC infants (mean gestational age (GA) = 34.2 weeks) to late preterm infants (mean GA = 35.3 weeks) placed in a servo-controlled incubator next to their mothers. SSC infants had higher SCRIP scores during the first six hours postbirth, indicating better stabilization (WMD 2.88, 95% CI 0.53 to 5.23). A subset of infants below 1800 grams birthweight also demonstrated better stabilization (WMD 4.92, 95% CI -1.67 to 11.51). Bergman 2004 also compared the number of infants in the two groups who did not exceed physiological parameters requiring medical attention. The five parameters were infant skin temperature less than 35.5 degrees centigrade on two consecutive occasions, heart rate less than 100 or more than 180 BPM on two consecutive occasions, apnea more than 20 seconds, oxygen saturation less than 87% on two consecutive occasions, blood glucose less than 2.6 mmol/L and FIO2 up to 0.6 with continuous positive airways pressure (CPAP) up to 5 centimeters of water pressure. Fifteen of the 18 SSC and one of the 13 control infants did not exceed parameters (OR 60.00, 95% CI 5.51 to 652.90). The most common reasons for exceeding parameters in control infants were hypothermia, hypoglycemia, and respiratory problems. There were no significant differences between groups in infant admissions to the NICU. Two SSC infants and one control infant required CPAP and they were inadvertently transferred to the NICU by the night call physicians unaware of the study protocols. Two studies (Chwo 1999; Syfrett 1996) examined hospital length of stay in late preterm infants 34 to 36 GA and found no significant between group differences in this outcome variable (WMD -95.30 hours, 95% CI -368.50 to 177.89).

Infant behavior outcomes

A large between-group difference in infant crying was found. Christensson 1992 found none of the 18 SSC infants were crying at 60 minutes postbirth compared to 10 of the 18 control infants (OR 29.95, 95% CI 1.57 to 572.87). Christensson 1995 found that 12 of the 14 SSC infants cried no more than one minute during the 90-minute observation compared to only one of the 15 control infants (OR 21.89, 95% CI 5.19 to 92.29). Mazurek 1999 found that SSC infants cried for a shorter length of time during a 75-minute observation period than control infants (WMD -8.01 minutes 95% CI -8.98 to -7.04). SSC infants also exhibited more optimal flexed movements during a one-hour observation starting four hours postbirth (WMD 0.05, 95% CI 0.01 to 0.09) (Ferber 2004). All results were statistically significant.

Maternal attachment behavior outcomes

Measurement, context and timing of maternal attachment behavior

Maternal attachment behaviors were analyzed in 10 studies (Anderson 2003; Anisfeld 1983; Carlsson 1978; Craig 1982; Curry 1982; De Chateau 1977; Hales 1977; McClellan 1980; Punthmatharith 2001; Svejda 1980). Several researchers obtained data on a number of discrete behaviors such as en face (mother-infant face-to-face contact), kissing, smiling, holding, and encompassing (Curry 1982; De Chateau 1977). Other researchers obtained summary scores of maternal affectionate, proximity maintaining, and caretaking behaviors (Hales 1977; Svejda 1980), or affectionate behaviors alone (Anisfeld 1983; Punthmatharith 2001). In two studies, summary scores of contact and noncontact behaviors were obtained (Anderson 2003; Carlsson 1978). In another study, one summary score for maternal holding, touching, and enface behaviors was obtained (McClellan 1980). The context for measuring these variables varied greatly, taking place during breastfeeding, a play observation, or a physical exam. Timing for measurement of these variables ranged from 15 minutes (De Chateau 1977) to one year postbirth. This variability in instruments used, context, and timing made it extremely difficult to combine many of the outcomes for meta-analysis.

Intervention and control condition characteristics

Dose of SSC ranged from 15 minutes (De Chateau 1977) to 10.56 hours (Anderson 2003) in this group of studies. In three studies (Anisfeld 1983; Hales 1977; McClellan 1980), control mothers were given a brief glimpse of their infants and then the infants were transferred to the newborn nursery. In four studies, control mothers held their swaddled infants from three to five minutes (Carlsson 1978; Craig 1982; Svejda 1980) to 35 minutes (Curry 1982). In Punthmatharith 2001, control mothers held their swaddled infants for two hours in the recovery room. In Anderson 2003, control mothers held their wrapped infants 13.9% of the time (M = 6.67 hours). SSC mothers gave SSC 22% of the time and held their wrapped infants 11.6%.

Early maternal affectionate and contact behavior

Summary scores for affectionate contact during breastfeeding 36 to 48 hours postbirth were obtained in three studies (Anisfeld 1983; Hales 1977; Punthmatharith 2001). Curry 1982 also obtained a score for maternal affectionate love touch in her study. In a meta-analysis of these four studies, SSC increased the amount of maternal affectionate behaviors (standardized mean difference (SMD) 0.52, 95% CI 0.07 to 0.98). Svejda 1980 found only marginal differences in maternal affectionate behaviors during breastfeeding at 36 hours. Mean frequency of affectionate behaviors was 38.54 for SSC infants and 36.87 for control infants. These results could not be added to the meta-analysis (graphs), however, because neither standard deviations nor specific levels of significance for the results were provided in the research report. SSC also increased the frequency of maternal contact behaviors during breastfeeding at two (WMD 47.04, 95% CI 7.65 to 86.43) and four (WMD 59.23, 95% CI 21.72 to 96.74) days postbirth (Carlsson 1978). McClellan 1980 found that SSC increased summary scores for maternal holding, touching and enface behavior during a feeding on postpartum day one or two (WMD 28.40, 95% CI 9.25 to 47.55) and 28 to 32 days postbirth (WMD 19.90, 95% CI 10.87 to 28.93). The overall effect size of the summary scores for affectionate and contact behavior was not inflated because both non-significant and positive findings on a number of discrete behaviors were combined to obtain the summary scores. All of these results reached statistical significance.

Several results (maternal affectionate love touch; contact behavior; and the summary score for maternal holding, touching, and en face behavior) were combined into an overall measure of maternal attachment behavior again favoring the SSC group (SMD 0.52, 95% CI 0.31 to 0.72). The attachment outcomes were measured in frequencies during a consecutive series of 15 to 30-second maternal behavioral observations with 30 to 45 seconds allowed for recording the data on a code sheet between the observations. Total observation time varied from 10 to 15 minutes. Individual scores for the discrete behaviors (such as touching the infant) were obtained for each woman by adding the frequency scores for the specified time frame. Summary scores were obtained by adding the scores for the discrete behaviors.

Later maternal en face, kissing, and affectionate touch

The effects of early SSC may be attenuated over time. Data were obtained on two discrete affectionate behaviors (en face and kissing the infant) during a play observation three months postbirth in two studies (Curry 1982; De Chateau 1977) and their results were combined for meta-analysis. Early SSC did not increase the amount of maternal en face (SMD 2.07, 95% CI -1.34 to 5.48) or kissing behavior (SMD 0.28, 95% CI -0.93 to 1.48) at this time. De Chateau 1977 also examined the amount of maternal affectionate touching and positive holding during an infant physical exam at one year postbirth. Statistically significant between-group differences, favoring the SSC group, were found in affectionate touching (WMD 0.85, 95% CI 0.09 to 1.61) and the amount of positive holding (WMD 1.50, 95% CI 0.51 to 2.49).

Maternal perceptions of connection to her infant

SSC marginally increased maternal scores on the Neonatal Perception Inventory (WMD 1.90, 95% CI 0.15 to 3.65) at day one or two postbirth (McClellan 1980), but had no effect on maternal scores on the Neonatal Perception Inventory on days 25 to 32 postbirth (WMD 0.40, 95% CI -1.25 to 2.04) (Craig 1982; McClellan 1980). Punthmatharith 2001 found no significant between-group differences in the mother's perceptions of bonding/connection to her infant during week four postbirth (WMD 0.08, 95% CI -0.01 to 0.17). Results need to be interpreted with caution in the analyses based on the results from the De Chateau 1977 study (holding, encompassing during breastfeeding, and kissing the infant during a play observation) because the standard deviations are greater than the mean in the control groups, which violates the assumptions of the analytic method.

A link may exist between maternal affectionate behaviors observed after SSC and breastfeeding success. In the study by Thomson 1979, an observer recorded whether the mothers had a happy reaction to their infants, defined as smiling, touching, looking en-face and verbalizing to the infant. A lack of reaction was defined as exhibiting few of these affectionate behaviors following the delivery room experience. The eight mothers (two SSCs and six controls) who did not have a happy reaction to their infants were not breastfeeding at two months postbirth. Thirteen of the 15 SSC mothers displayed a happy reaction to their infants; however, only nine of the 15 control mothers had a happy response.

Summary

In summary, the results of this review demonstrated a statistically significant positive effect on the success of the first breastfeeding, breastfeeding status day three postbirth, breastfeeding one to four months postbirth, breastfeeding duration, maternal breast engorgement pain, state anxiety, and infant recognition of their own mother's milk odor. Also statistically significant were maintenance of infant temperature in the neutral thermal range, infant crying, flexed movements, blood glucose, SCRIP scores, and maintenance of physiological parameters. All significant differences favored the SSC group. Significant between-group differences favoring SSC mothers were noted in summary scores of affectionate love/touch, contact behavior early postpartum, and holding the infant positively and affectionate touch at one year. Mothers also indicated that they preferred SSC over holding their infants swaddled in blankets. No significant between-group differences were found in breastfeeding status day 28 to one month postbirth, breast milk maturation, infant body weight change, number of breastfeeding problems, mothers' perceptions of the adequacy of their milk supply, infant heart rate, respiratory rate, hospital length of stay, or

NICU transfers. No significant negative effects of early SSC were found during this review.

DISCUSSION

Breastfeeding

Mothers of skin-to-skin contact (SSC) infants were more likely to be breastfeeding one to four months postbirth than mothers in the control groups. Infants in the SSC group breastfed an average of 42.55 days longer than control infants. The positive results in this review were obtained in diverse countries and among women of low and high socioeconomic class. Timing may be critical because most healthy full-term infants spontaneously grasp the nipple and begin to suckle by approximately 55 minutes postbirth. During the first 30 minutes postbirth, they may only lick the nipple. After the first two hours postbirth, they often become sleepy and difficult to arouse. Also, because many primipara are so insecure during their first breastfeeding attempt, the intervention may be more successful if a clinician provides initial breastfeeding assistance as part of the intervention. Babies breastfed more successfully during SSC immediately postbirth than if they were held swaddled in blankets, probably because of the extra tactile, odor, and thermal cues provided by SSC, but this result did not translate into a longer duration of breastfeeding in two studies (Carfoot 2004; Carfoot 2005). Early SSC appears to have less of an effect on breastfeeding exclusivity or duration in studies where control infants are held swaddled by their mothers and given the opportunity to breastfeed soon after birth than in studies where control infants are separated from their mothers for 12 to 24 hours immediately postbirth. Given the strong evidence of the negative impact of early mother-infant separation, it is noteworthy that in some hospitals usual care still includes this practice for healthy full-term newborns (Mizuno 2004).

Contextual issues may be critical as well. Such factors as room temperature, lack of privacy, modesty, overcrowding, supplemental bottle or pacifier use, and 24-hour rooming-in may play a role in the effectiveness of SSC. Early SSC may not have as strong an effect on long-term breastfeeding in countries with a widespread bottle feeding culture compared to countries with cultures that are supportive of breastfeeding. In the studies by Carfoot 2004, Carfoot 2005, and Moore 2005, mothers in the control group received extra assistance with breastfeeding, which is not always available with usual hospital care. In Moore 2005, the investigator was an experienced lactation consultant who assisted mothers in both groups with initiating breastfeeding. In Carfoot 2005, the midwife usually provided breastfeeding assistance, but if she was unavailable, the research assistant often provided help with breastfeeding. More definitive results might have been obtained if the control groups received only usual hospital care.

Infant physiology

The between-group differences in SCRIP scores and maintenance of physiological parameters in late preterm infants is certainly clinically significant, especially given the fact that SSC was compared to a servo-controlled incubator. The clinical significance of some of the other physiological outcomes for healthy full-term infants is debatable. Full-term infants in the SSC group were less than one degree warmer than control infants. Their heart rate was three beats per minute slower and their respiratory rate was three breaths less per minute, on average. However, their blood glucose was 10.56 mg/dl higher, a significant finding. It can be said with certainty that early SSC is a safe intervention for healthy infants and that it does increase cardio-respiratory stability, thermal stability, and blood glucose in late preterm infants. Lagercrantz 1996 and Lagercrantz 1986 found that newborn infants experience a catecholamine surge after vaginal birth, caused by compression of the fetal head and intermittent hypoxia during contractions. This response is felt to aid in adaptation to the extrauterine environment immediately postbirth by causing an increase in infant level of alertness, lung compliance, blood glucose, body temperature, and shunting of blood to the vital organs. However, this response may become maladaptive if allowed to continue. Bystrova 2003 found a decrease in foot temperature (indicating peripheral vasoconstriction) in control infants cared for in the nursery and an increase in foot temperature in SSC infants. She proposed that this difference was related to vasodilatation caused by decreased sympathetic tone in the SSC infants and hypothesized that SSC may activate the somatosensory nerves, thus antagonizing the "stress of being born". These findings correlate accurately with findings predicted from mammalian research on separation in the newborn period. The neurobehavioral stabilization achieved in SSC correlates in mammalian studies with a parasympathetically mediated homeostasis, the purpose of which is growth and development. The stabilization achieved in the separated state is mediated by a sympathetically driven defense program, whose purpose is primarily to survive the period of separation. In so far as the differences observed corroborate the findings from mammalian research, they can be considered clinically significant.

Infant crying

The large between-group difference in the amount of crying is certainly clinically significant. Anderson 1989 proposed an evidence-based rationale that maternal-infant separation is associated with excessive infant crying and can be harmful because crying re-establishes portions of the fetal circulation. Each cry cycle causes a bolus of desaturated venous blood to shunt through the foramen ovale into the systemic circulation instead of the lungs, creating hypoxemia. This may result in delayed closure of the foramen ovale or explain the approximately 20% incidence in apparently normal adults of a permanently patent foramen ovale (estimates

in numerous recent studies range from 15% to 35% (Del Sette 1998). Anderson 1989 further proposed that crying wastes calories meant for growth, and causes increased and fluctuating cerebral blood flow, cerebral blood flow velocity, and intracranial pressure, thereby increasing the risk of intraventricular hemorrhage in preterm infants. Consequences for healthy full-term infants are unknown, but may be similar and correlated with gestational age.

Maternal attachment behaviors

The results of this analysis indicate that SSC may affect maternal attachment behaviors, although these results may be attenuated over time. A dose-response relationship may exist as well. In the three studies with no significant between-group differences in attachment behaviors (Curry 1982; Punthmatharith 2001; Svejda 1980), the swaddled control infants were held by their mothers for five to 120 minutes. In four (Anisfeld 1983; Carlsson 1978; Hales 1977; McClellan 1980) of the five studies with statistically significant results favoring SSC, control mothers were given only a glimpse of their infants immediately postbirth. Probably the act of holding the infant (swaddled or in SSC) soon after birth decreases stress for the infant, and primes the mother during the early postpartum to exhibit more affectionate contact behaviors. Therefore, a very small dose of the intervention may be all that is necessary and the early contact (either swaddled or SSC) may be the critical component of the intervention. These findings would make sense from the perspective of programming (Lucas 2005) and early evolution, where human mothers would be expected to form a rapid attachment to their infants to protect them from predators and to provide the high level of parental care necessary for such physiologically immature newborns. However, no information was provided in the 10 attachment studies about how many infants in the SSC group breastfed or how effectively they nursed. Breastfeeding during SSC stimulates the secretion of hormones such as oxytocin that promote maternal attachment and prolactin which promotes lactation and, at least in rodents, maternal behavior. Breastfeeding has been considered an integral part of the intervention in Kangaroo Mother Care research in low- and middle-income countries. In this review, breastfeeding has been considered an outcome and SSC the habitat that elicits this outcome. However, mothers would logically nurse their infants soon after birth in early human evolution. Early and effective breastfeeding while in SSC may increase the strength of this intervention with respect to maternal attachment behaviors.

The two studies with impoverished women (Anisfeld 1983; Hales 1977) had statistically significant differences in affectionate contact behaviors favoring the SSC group. The four studies with middle-class women had mixed results: two with significant results favoring SSC (Carlsson 1978; McClellan 1980), and two with non-significant results (Curry 1982; Svejda 1980). Svejda 1980 speculated that middle-class mothers may exhibit a ceiling effect for maternal responsiveness where the majority of scores are near the maximum on the attachment measurement instrument .

No negative outcomes were reported in any of the studies except Sosa 1976a, who reported a longer duration of breastfeeding in the control group.

Limitations

The presently available evidence has a number of limitations.

(1) Design limitations

Of the 30 studies reviewed, 29 were randomized trials. One study was quasi-randomized (Anisfeld 1983) because assignment to groups was based on day of the week. In only eight trials was allocation to groups adequately concealed from the investigators.

(2) Outcome variability

Meta-analysis was limited in this review, due to the numerous outcomes and the limited number of randomized trials that could be included for each outcome. Although many of the studies measured similar outcomes, the outcomes were too dissimilar to be included in a meta-analysis. In some studies, means were reported without standard deviations and/or p values. The context, the instruments used, and the timing of the measurement of attachment and temperature outcomes varied greatly among studies. Breastfeeding was measured as a dichotomous variable in some studies or as an interval level measure of breastfeeding exclusivity in three. Modality for measurement of temperature outcomes varied between studies. These contextual and measurement differences should be noted when considering the results of the review.

(3) Long-term outcomes

Two randomized controlled trials included long-term breastfeeding and attachment outcomes. SSC had a positive effect on long-term breastfeeding (De Chateau 1977; Shiau 1997) and on long-term attachment (De Chateau 1977). No negative long-term outcomes were found.

AUTHORS' CONCLUSIONS

Implications for practice

The main results of the meta-analysis, and from the single studies, indicate that skin-to-skin contact (SSC) may have a positive effect on long-term breastfeeding and on infant temperature. Although a number of the infant physiological outcomes, (except SCRIP scores, blood glucose, and maintenance of physiological

parameters), and attachment outcomes demonstrated little or no clinically significant differences with or without SSC, no negative short- or long-term effects were found. Based on the available evidence, SSC appears to have some clinical benefit, especially for breastfeeding and for temperature and cardio-respiratory stability in late preterm infants. The timing of the intervention may be important, because most infants are very alert in the first two hours postbirth and, if undisturbed and unmedicated, will self-attach to the nipple, and do so correctly, at approximately 55 minutes postbirth. The temperature of a healthy newly delivered infant will remain in a safe range, provided ventral-to-ventral SSC is uninterrupted; the infant is thoroughly dried and covered across the back with a prewarmed blanket; and the head is covered with a dry cap that is replaced if it becomes damp.

Implications for research

Future investigations are recommended because the methodological quality of the included studies is marginally adequate, the characteristics of the SSC and control conditions are diverse, and many outcome measures are difficult to combine. Only four studies (Anderson 2003; Bergman 2004; Chwo 1999; Syfrett 1996) examined the effects of early SSC on late preterm infants who were judged healthy enough to remain on the postpartum ward. The effects of this intervention may be different in this more vulnerable population, and more research is definitely indicated. More research needs to be conducted on the effects of early SSC on mothers who deliver by caesarean birth. To facilitate meta-analysis of the data, future research in this area should involve outcome measures consistent with the best measures used in previous studies or measures developed recently to increase methodological rigor (Anderson 2004b, Labbok 1990). The CONSORT guidelines (Moher 2001) should be used to document the flow of participants through all clinical trials. Studies should make explicit SSC initiation time, frequency and duration to investigate a possible dose-response relationship.

Suggestions for improvement of clinical trials examining early SSC and breastfeeding outcomes include the following. The mother's prenatal breastfeeding intention (how long she planned to nurse her infant) was not controlled in any study except Punthmatharith 2001 and Moore 2005. Only Shiau 1997, Punthmatharith 2001, and Moore 2005 used breastfeeding status (Labbok 1990) to measure the degree of breastfeeding exclusivity. In all the other studies, breastfeeding was considered a dichotomous variable. Only Carfoot 2004, Carfoot 2005, and Moore 2005 evaluated the success of the first breastfeeding in both the SSC and control groups. A valid measure of effective suckling at a single feeding remains elusive (Riordan 1997) and is needed to identify problems in time to minimize breastfeeding attrition; this would be a major contribution to the field. It remains extremely difficult to disentangle the effects of early SSC from the effects of assistance provided by an experienced nurse with the first breastfeeding. The protractility of the mother's nipples is a potential confound that could influence breastfeeding outcomes and should be measured in future studies that evaluate breastfeeding and infant suckling patterns.

Improvement is needed as well for examining maternal attachment behaviors. These studies are all weakened by the lack of consistency in the measurement of these variables. Each research team appeared to have its own ideas about how to operationally define attachment behavior. No information was provided about how many infants successfully breastfed in either group.

To improve the methodological quality and reporting in similar clinical trials would be relatively easy. Investigators can provide more details in research reports regarding the method and timing of random assignment, allocation concealment scheme, measures used to control for selection bias, context, timing, and modality of outcome measurements, and means and standard deviations for the interval or ratio level outcome variables examined. However, control for provider and patient performance bias may continue to be problematic, because Institutional Review Boards now require investigators to disclose the purpose of their study to potential participants so they can be informed when they consent to random assignment. Labor and delivery room staff often ask for group assignment of women before delivery so that they will know how to manage the infant immediately postbirth. Speaking more generally, recommendations by Thomson 1984 provide guidelines for well-controlled clinical trials that remain important to this day.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Anderson 2003

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	91 healthy preterm infants 32-36 weeks' gestation and their mothers. Only data from the 31 infants on the postpartum unit were included in the analysis; the 60 NICU infants were excluded. Mean gestational age of the included infants was 35.6 weeks.
Interventions	1) SSC group = diaper clad infants placed prone and SSC near their mother's breasts as soon as possible for as long as possible postbirth. Along with SSC mothers also held their infants wrapped in blankets. 2) Control group = infants kept warm in incubators, warmer beds, bassinettes or held wrapped in blankets.
Outcomes	Mean % contact time during hours 0-48 spent in SSC or wrapped holding by mother, father or others. Mean % noncontact time (no hold) hours 0-48 postbirth.
Notes	Study was done in the USA, participants were mixed parity.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	A - Adequate

Anisfeld 1983

Methods	Quasi-randomized controlled trial. Group assignment by day of week.
Participants	59 healthy, fullterm infants and their mothers immediately postbirth.
Interventions	1) Control group = briefly shown to the mothers, no contact until 3 hours postbirth, then contact at feedings every 4 hours. 2) Extra contact group = 45-60 min of SSC with the mother, then contact at feedings every 4 hours.
Outcomes	Observation of maternal affectionate behaviors during feeding on day 2. Interview at 3 months old.
Notes	Study was done with low-middle income mothers in the USA, mixed parity.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	No	C - Inadequate

Bergman 2004

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	35 healthy late preterm infants and their mothers. Mean GA SSC group 34.2 weeks, control group 35.3 weeks.
Interventions	All infants had a brief period of SSC immediately postbirth. 1) SSC group = after the 5 min Apgar the naked infant was secured to their mother's chest by a towel. A shirt with long ties was placed around the mother's waist to secure the baby below. The dyad was transferred to the observation area of the neonatal unit at 60 min postbirth. SSC was continuous for at least 6 hours 2) Control group = after the 5 min Apgar the infant was transferred to an incubator which remained with the mother in the delivery room for 60 min. At 1 hour the infant in the incubator was transferred to the observation area of the neonatal unit.
Outcomes	Transfers to NICU, exceeded parameters -temp < 35.5, HR < 100 >180 BPM, Apnea > 20s, O2 sat < 89%, blood glucose < 2.6, SCRIP score during the first 6 hours postbirth, SCRIP score in the 6th hour postbirth.
Notes	Study was done with indigent participants in 2 secondary level referral hospitals in Cape Town, South Africa.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Bystrova 2003

Methods	Open randomized controlled trial (envelope with group assignment).
Participants	176 healthy fullterm infants and their mothers.
Interventions	All infants were immediately placed under a radiant warmer, dried, washed, weighed, given eye prophylaxis and cord care during the first 20 min postbirth. 1) SSC group = babies were placed prone and SSC on mother's chest for 90 min. 2) Mother's arms group = babies were clothed (swaddled or dressed) and placed prone on their mother's chest. 3) Nursery group = babies were clothed and taken to the nursery.
Outcomes	Mean difference in axillary, interscapular, thigh temperatures and foot temperature change from 30 to 120 min postbirth.
Notes	Study was done in St Petersburg, Russia.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Carfoot 2004

Methods	Open randomized controlled trial (sealed envelopes).
Participants	26 healthy fullterm infants > 36 weeks' gestation and their mothers.
Interventions	1) SSC group = mothers given infants to hold prone between their breasts and covered with a warm blanket as soon as possible postbirth. Midwives assisted with the 1st breastfeeding. 2) Control group = babies dried, wrapped in a towel and handed to mom or dad. Midwives assisted with the 1st breastfeeding.
Outcomes	Success of the 1st breastfeeding (BAT score 8-12), type of feeding at 4 months postbirth (exclusive breastfeeding, mixed feedings, artificial feedings).
Notes	Study was done in Cheshire, UK.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Carfoot 2005

Methods	Open randomized controlled trial (sequence of sealed envelopes containing next allocation from a computer-generated randomization list).
Participants	204 healthy fullterm infants > 36 weeks' gestation and their mothers.
Interventions	1) SSC group = mothers given naked infants to hold prone between their breasts and covered with a warm blanket as soon as possible postbirth. Midwives assisted with the 1st breastfeeding. 2) Control group = babies dried, wrapped in a towel and handed to mom or dad. Midwives assisted with the 1st breastfeeding.
Outcomes	Success of the 1st breastfeeding (BAT score 8-12), success of a subsequent breastfeeding, mean temperature 1 hour postbirth, maternal satisfaction with care, preference for same postdelivery care in the future, type of feeding at 4 months (exclusive, partial breast, formula feeding).
Notes	Study was done in Cheshire, UK.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Carlsson 1978

Methods	Open randomized controlled trial.
Participants	62 healthy, fullterm infants. The mothers were randomized into 1 of 3 groups before delivery.
Interventions	1) Extended contact-new routine group = kept their naked infants for 1 hour immediately postbirth, mothers cared for infants. 2) Extended contact-old routine = kept their naked infants immediately postbirth for 1 hour, staff cared for infants. 3) Limited contact-old routine group = held their infants for 5 min immediately postbirth, staff cared for infants.
Outcomes	Observation of maternal behavior (contact behavior and behavior not implying contact with baby) by videotape during breastfeeding on day 2 and 4 postbirth.
Notes	Study was done with middle-income primipara in Sweden.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Christensson 1992

Methods	Open randomized controlled trial.
Participants	50 fullterm infants and their mothers randomized after the delivery.
Interventions	a) 80 min of SSC with the mother, b) 80 min in a cot.
Outcomes	Axillary, thigh, and interscapular temperatures. Duration of crying. Blood glucose, base excess, respiratory rate, heart rate after 90 min.
Notes	Study was done in Madrid, Spain.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Christensson 1995

Methods	Open randomized controlled trial.
Participants	44 fullterm infants and their mothers immediately postbirth.
Interventions	Group a) 76-85 min of SSC with the mother, b) infant in a cot for 76-85 min, c) infant in a cot for 35 min then SSC for 45 min.

Christensson 1995 (*Continued*)

Outcomes	Duration of crying, axillary temperature 90 min postbirth.
Notes	Study was done in Madrid, Spain.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Chwo 1999

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	34 healthy late preterm infants 34-36 weeks' gestation and their mothers.
Interventions	1) SSC group = SSC and on cue self-regulatory feedings during 6 1-hour feeding periods beginning M = 21 hours postbirth. The infant, in a small diaper, was placed on the ventral surface of their mother's torso. 2) Control group = infants held wrapped in blankets during 6 1-hour feeding periods beginning M = 23 hours postbirth.
Outcomes	Infant body weight change day 14 and 28 postbirth, length of stay in the hospital, tympanic temperature change and variability, behavioral state inactive awake, drowsy, crying during feedings.
Notes	Study was done in a teaching hospital near Taipei, Taiwan.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Craig 1982

Methods	Open randomized controlled trial (sealed envelopes prepared using a table of random numbers by gender).
Participants	60 healthy fullterm infants and their mothers.
Interventions	1) Control group = mothers held their wrapped infants for 3 min then contact at feedings every 4 hours. 2) Early SSC group = infants were placed in SSC on their mother's chests for 54 min then contact at feedings every 4 hours.
Outcomes	1) Neonatal perception inventory. 2) Interview of mother's experiences during pregnancy, delivery, 1st postpartum month. 3) Questions about infant behavior during a home visit at 1 month postbirth.
Notes	Study was done with low-income primapara in the USA.

Craig 1982 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Curry 1982

Methods	Open randomized controlled trial (sealed envelopes).
Participants	20 healthy fullterm infants randomized during the first hour postbirth.
Interventions	1) Control group = held their wrapped infants for 36 min during the first hour postbirth. 2) SSC group = held their infants in SSC for 35 min during the first hour postbirth. Both groups had 12 hours of rooming-in during the day.
Outcomes	1) 7 maternal attachment behaviors (en face, kiss, hold, encompass, close contact and smile at) measured at 36 hours and 3 months postbirth during breastfeeding. 2) The Tennessee Self Concept measured at 2 months postbirth.
Notes	Study was done with well-educated, married, middle-income, caucasian, breastfeeding primipara in the USA.

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

De Chateau 1977

Methods	Open randomized controlled trial (open random numbers table).
Participants	62 healthy fullterm infants and their mothers. Group 1 primiparous mothers and their infants n = 22. Group 2 primiparous mothers and their infants n = 20. Group 3 multiparous mothers and their infants n = 20.
Interventions	Group 1: 15-20 min of SSC during the first hour postbirth. The infants were placed on the breast at 10 min postbirth and assisted by the midwives with breastfeeding. Groups 2 and 3 = routine care. The dressed babies were placed in a crib at the mother's bedside or in her bed at 10 min postbirth.
Outcomes	Observation of mother's behavior during breastfeeding at 36 hours postbirth. Mother's and infant's behavior at 3 months during free play. Breastfeeding at 3 months, 1 year postbirth. Mother's and infant's behavior during a physical exam and infant development at 12 months.
Notes	Study was done with middle-income women in Sweden.

De Chateau 1977 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	No	C - Inadequate

Fardig 1980

Methods	Open randomized controlled trial (blind drawing of 1 of 3 numbers with replacement).
Participants	51 uncomplicated infants with gestation 38-42 weeks, birthweight of at least 2500 g, normal labor and delivery and normal Apgar score.
Interventions	Group 1 infants were suctioned, dried under a radiant heater for 5 min and then placed naked on the mother's bare chest for 25 min. The infant's back was then covered with 2 cotton blankets. Group 2 infants were placed naked directly on the mother's chest for 28 min after the umbilical cord was cut. Group 3 infants were placed under a radiant warmer without being placed on the mother's chest.
Outcomes	Skin temperature measured on the infant's left side every 3 min for 45 min. Rectal temperature at 21 and 45 min. Outcomes were the numbers of infants with skin or rectal temperature in the neutral range at 21 or 45 min.
Notes	Study was done in the USA.

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Ferber 2004

Methods	Open randomized controlled trial (table of random numbers).
Participants	42 healthy full-term infants 38-42 weeks' gestation and their mothers.
Interventions	All newborns were placed on mom's chest for 5-10 min, then dried, weighed and dressed. 1) SSC group = infants brought back to mom 15-20 min postbirth, undressed, placed SSC between the mother's breasts and covered with blankets for 60 min. Then the infants were taken to the newborn nursery for 4 hours of observation. 2) Control infants were taken to the newborn nursery, placed under a warmer for 5-10 min, swaddled and laid in a bassinette. They were brought back to their mothers at 5 hours postbirth.
Outcomes	Optimal respirations, motor disorganization, visceral stress response, optimal flexed movements, extension movements, facial movements, sleep state, drowsy, fussy and crying states, positive attention signs, negative attention signs.

Ferber 2004 (*Continued*)

Notes	Study was done in Haifa, Israel with primarily middle- to upper-middle class European, African and Arab mothers.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Hales 1977

Methods	Open randomized controlled trial.
Participants	60 healthy fullterm infants randomized into 3 groups.
Interventions	1) Control group = glance at babies immediately after delivery, swaddled infants brought to bedside at 12 hours postbirth, then daytime rooming-in. 2) Early contact group = 45 min of SSC immediately postbirth, daytime rooming-in. 3) Delayed contact group = 45 min of SSC at 12 hours postbirth, daytime rooming-in.
Outcomes	Observation of maternal affectionate, proximity maintaining and caretaking behavior at 36 hours post-birth.
Notes	Study was done with low-income, urban, breastfeeding primipara in Guatemala city.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Mazurek 1999

Methods	Open randomized controlled trial.
Participants	66 healthy full-term infants and their mothers (mean gestational age 39 weeks).
Interventions	After birth all infants were dried, cord blood PH was drawn and measurements were taken. 1) SSC group = the infant was placed in their mother's arms SSC 6-8 min postbirth and both were covered with a sheet. SSC continued for 75 min. 2) Mother's arms group = the infant was wrapped in a blanket and given to the mother to hold for 75 min. 3) Control group = the infant was wrapped and kept at a distance from their mother in the same room.
Outcomes	Crying time, blood glucose, heart rate and respiratory rate at 75 min postbirth, blood PH, skin thigh temperature.
Notes	Study was done in Warsaw, Poland.

Mazurek 1999 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

McClellan 1980

Methods	Open randomized controlled trial (table of random numbers).
Participants	40 healthy full-term infants born by repeat cesarean section (spinal anesthesia).
Interventions	1) Control group = visual contact < 5 min, holding the swaddled infant for 10-20 min in the nursery during the first 12 hours postbirth, then rooming-in. 2) Early contact group = visual contact for 5 to 15 min, SSC for the first hour in the recovery room, then rooming-in.
Outcomes	1) Neonatal perception inventory. 2) Postnatal research inventory. 3) Observation of maternal behavior. All variables measured on postpartum day 1 or 2 and 28-32 days postbirth.
Notes	Study was done with middle-income, multipara in the USA.

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	No	C - Inadequate

Mizuno 2004

Methods	Open randomized controlled trial.
Participants	60 healthy full-term infants >37 weeks' gestation and their mothers.
Interventions	1) SSC group = extensive SSC (M = 63.7 min) immediately postbirth with effective suckling. Then mothers and infants were separated for 24 hours and infants were fed formula. After 24 hours rooming-in with q3hr breastfeedings 2) Control group = first mother-infant contact 24 hours postbirth then rooming-in and q3hr breastfeedings. Midwives assisted both groups with the first breastfeeding.
Outcomes	Frequency of mouthing movements with exposure to own mother's milk, another mother's milk, formula, orange juice, distilled water at 1 and 4 days of age. Difference in frequency of mouthing movements between mother's milk and another mother's milk at 1 and 4 days of age, duration of breastfeeding.
Notes	Study was done in Chiba, Japan.

Risk of bias

Mizuno 2004 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Moore 2005

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	20 healthy full-term infants > 37 weeks' gestation and their mothers.
Interventions	1) SSC group = infant placed prone SSC on mothers abdomen. Baby moved to warmer after cord cut. Then infant placed prone on mother's bare chest between breasts. Moved to cross cradle nursing position when infant displayed early hunger cues (M = 99.5 min of SSC) Breastfeeding assistance provided by researcher. 2) Control group = infant shown briefly to mother and moved to warmer. Then infant swaddled in blankets and held by mother. Moved to cross cradle nursing position when infant displayed early hunger cues. Breastfeeding assistance provided by researcher.
Outcomes	Success of the 1st breastfeeding, time of effective breastfeeding, body weight change day 14 postbirth, number of breastfeeding problems in the 1st postpartum month, mother's perception of the adequacy of her milk supply, maternal parenting confidence, breastfeeding status 1 month postbirth.
Notes	Study was done in the USA with primarily Caucasian, married, college-educated primipara.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Punthmatharith 2001

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	196 healthy full-term 37-42 weeks' gestation infants and their mothers.
Interventions	All infants received standard care for the 1st 30-60 min postbirth. After the cord was clamped they were shown briefly to mom and moved to a warmer. 1) SSC group = beginning 60 min postbirth infants received (M = 30 min) of SSC. Mothers were encouraged to breastfeed on infant demand. Infants and mothers transferred to the postpartum unit at 120 min postbirth for 24 hour rooming-in. Moms encouraged to provide SSC 15-30 min before each breastfeeding. No other fluids given to infants. 2) Control group = swaddled infant given to mom after episiotomy repair and they were transferred together to the recovery room for 2 hours, then to postpartum for 24 hour rooming-in. Mothers encouraged to breastfeed on infant demand. Cup feeding was encouraged if the infant required supplementation.
Outcomes	Observation of maternal affectionate behaviors during a breastfeeding at 36-48 hours postbirth, 4 sub-scales of the maternal-infant bonding questionnaire (attention/connection to the infant, preparation for nurturing the infant, role of mother, breastfeeding the infant) at 36-48 hours and week 4 postbirth,

Punthmatharith 2001 (*Continued*)

	Mother's perception of the adequacy of her milk supply, and breastfeeding status 36-48 hours and week 4 postbirth, infant weight day 2 and 1 month postbirth.
Notes	Study was done in a Baby Friendly Hospital in Songkhla, Thailand.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Shiau 1997

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	58 healthy full-term infants and their mothers randomized into 1 of 2 groups 0-4 hours postvaginal or cesarean birth.
Interventions	1) KC group = mothers began SSC at 4 hours postbirth and held their infants in SSC 8 hours daily for 3 days. Breastfeeding based on infant hunger cues during the day and every 4 hours at night. 2) Control group = began breastfeeding 24 hours postbirth. Mothers fed their infants every 4 hours in the nursery.
Outcomes	1) Mean maternal state anxiety. 2) Mean score on 6 point breast engorgement scale. 3) Chest circumference. 4) Breastfeeding status day 3 and 28 postbirth. 5) Breast milk maturation. 6) Breastfeeding duration.
Notes	Study was done with married primipara and multipara in Taiwan. The researcher provided all nursing care to the SSC group during the day.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Sosa 1976a

Methods	Open randomized controlled trial (random numbers in sealed envelopes).
Participants	60 healthy full-term infants and their mothers randomized immediately after delivery.
Interventions	1) Experimental group = mothers held their infants in SSC for 45 min after the episiotomy repair. They were encouraged to breastfeed. 2) Control group = infants were separated from their mothers for 12 hours.
Outcomes	1) Mean duration of breastfeeding. 2) Episodes of illness, growth and development, mortality.
Notes	Study was done with poor, urban primipara from the marginal area of Guatemala city.

Sosa 1976a (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Sosa 1976b

Methods	Open randomized controlled trial (random numbers in sealed envelopes).
Participants	68 healthy full-term infants and their mothers randomized immediately after delivery.
Interventions	1) Experimental group = mothers held their infants in SSC for 45 min after the episiotomy repair. They were encouraged to breastfeed. 2) Control group = infants were separated from their mothers for 12 hours.
Outcomes	1) Mean duration of breastfeeding. 2) Episodes of illness, growth and development, mortality.
Notes	Study was done with poor, urban primipara from the marginal area of Guatemala city.

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Sosa 1976c

Methods	Open randomized controlled trial (random numbers in sealed envelopes).
Participants	40 healthy full-term infants and their mothers randomized immediately after delivery.
Interventions	1) Experimental group = mothers held their infants in SSC for 45 min after the episiotomy repair. They were encouraged to breastfeed. 2) Control group = infants were separated from their mothers for 24 hours.
Outcomes	1) Mean duration of breastfeeding. 2) Episodes of illness, growth and development, mortality.
Notes	Study was done with poor, urban primipara from the marginal area of Guatemala city.

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Svejda 1980

Methods	Open randomized controlled trial.
Participants	30 healthy full-term infants and their mothers.
Interventions	1) Control group = held their wrapped infants briefly (< 5 min) during transfer, then 30 min of contact at feedings every 4 hours. 2) Extra contact group = SSC for 15 min beginning 25 min postbirth, then the gowned mothers held their nude infants for 45 min in their rooms, 90 min of contact every 4 hours for feedings.
Outcomes	Videotaped affectionate and proximity - maintaining behavior in interaction with the infant, affectionate and caretaking behavior during breastfeeding 36 hours postbirth.
Notes	Study was done with middle-income, primipara in the USA.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Syfrett 1996

Methods	Open randomized controlled trial (computerized minimization technique).
Participants	8 healthy late preterm infants 34-36 weeks' gestation, average for gestational age, Apgars 7 or more, and their mothers.
Interventions	1) Control group = 24 min of SSC during the first hour postbirth before randomization to radiant warmer for 3 hours, double wrapped in open bassinette for 3 hours then demand feeding and continuous rooming-in if stable. 2) KC group = 40 min of SSC during the first hour postbirth, transferred to nursery for admission procedures, then continuous SSC (mean 37 hours) and breastfeeding on demand.
Outcomes	Temperature, temperature variability, breastfeedings/day bottle-feedings (ml/day), IV fluids (ml/day), weight loss (g/hr), birthweight lost (%), number of heel sticks, length of stay (total days), breastfeeding duration.
Notes	Study was done in the USA. All nursing care in the KC group was done by the researchers.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Thomson 1979

Methods	Open randomized controlled trial.
Participants	34 healthy full-term infants and their mothers.
Interventions	1) Control group = held their wrapped infants briefly (< 5 min), subsequent contact at 12-24 hours postbirth, then contact every 4 hours for feedings during the day. 2) Early contact group = held infant in SSC for 15-20 min starting 15-30 min postbirth. Mothers were encouraged to breastfeed, subsequent contact at 12-24 hours postbirth, then contact every 4 hours for feedings during the day.
Outcomes	1) Happy maternal reaction to birth. 2) Breastfeeding at hospital discharge. 3) Successful breastfeeding 2 months postbirth.
Notes	Study was done with married, primipara in Canada.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Vaidya 2005

Methods	Open randomized controlled trial.
Participants	110 healthy full-term infants and their mothers.
Interventions	1) SSC group = the naked infant was placed on the mother's naked chest for 10-15 min within 1 hour of birth. 2) Control group = after immediate newborn care the infants were dressed and given to their mothers or visitors. Both groups were encouraged to initiate breastfeeding.
Outcomes	Exclusive breastfeeding up to 2-4 and 4-6 months postbirth, started other feedings before 2 months of age.
Notes	Study was done in Kathmandu, Nepal.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Villalon 1993

Methods	Open randomized controlled trial.
Participants	119 healthy full-term infants and their mothers.

Villalon 1993 (*Continued*)

Interventions	SSC Group = babies were placed SSC on their mothers immediately postbirth, then dried and given medications. Diapered infants were then placed between their mother's breasts and covered with a blanket. Breastfeeding was initiated or attempted. Babies stayed in contact with their mothers for most of the following 4 hours. Control group = babies were dried, given medications, clothed and taken to the nursery for 4 hours.
Outcomes	Breastfeeding at 24 hours, hospital discharge, and 14 days postbirth, maternal parenting confidence, temperature, heart rate, respiratory rate at 1,2,3 and 4 hours postbirth in a subset of 92 infants.
Notes	Study was done in Coyhaique, Chile. All mothers were Hispanic with mixed parity and education. Temperature, heart rate and respiratory rate data were obtained from a subset of 96 infants.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

BAT: Breastfeeding Assessment Tool
BPM: beats per minute
GA: gestational age
HR: heart rate
IV: intravenous
KC: kangaroo care
min: minutes
NICU: neonatal intensive care unit
q3hr: every 3 hours
SAT: saturation
SCRIP: stability of the cardio-respiratory system
SSC: skin-to-skin contact

Characteristics of excluded studies *[ordered by study ID]*

Ali 1981	No mention was made regarding whether the early maternal-infant contact was skin-to-skin.
Cattaneo 1998	This was not a study of early KMC. The median age of enrollment in the study was 10 days postbirth for KMC infants and 8 days postbirth for CMC infants.
Christensson 1998	Infants in the control and intervention groups were hypothermic and admitted to the NICU before the study began.
Durand 1997	Not a randomized trial, subjects self-selected into the experimental or control group based on their desire to breast or bottle feed.

(*Continued*)

Feldman 2003	Study was not an RCT. KC infants were recruited at 1 hospital and control infants from another hospital. Infants were cared for concurrently at the 2 hospitals. Families were recruited to participate several days to several weeks postbirth. All infants were in the NICU. Mean gestational age - 30.65 weeks.
Gardner 1979	No information was provided about whether infants were randomized to SSC (group 1) or standard care in a Kreisselman warmer bed (group 2). No means and standard deviations were provided for the outcome variable rectal temperature at 17 min postbirth.
Gomes-Pedro 1984	The early contact in the intervention group was not skin-to-skin.
Gray 2000	This was not a study of early SSC. Infants were between 33 and 55 hours postnatal age at study entry.
Gray 2002	Infants were between 40 and 44 hours postnatal age at study entry
Grossman 1981	A questionable quasi-randomization procedure was used - the experimental treatment and time are confounded. No mention was made regarding whether the early contact was skin-to-skin.
Hill 1979	The study was described as "experimental" with 50 infants per group but the author does not state that infants were randomized to groups. Study compared swaddled holding (not SSC) by the mother or father to a heated transporter.
Ibe 2004	In the KMC group, infants were dressed in cotton vests and caps and placed between their mother's breasts. The study was not an RCT - infants served as their own controls and alternated between KMC and incubator care. Infants were recruited between 24 hours to 30 days of age.
Johanson 1992	In the KC group "the baby was placed under the mother's clothes on her chest. If the clothing alone was considered insufficient, the baby was swaddled in one of the labor room blankets and then kept immediately against the mother" (p 860). The full-term data were not reported separately; instead they were combined with preterm data in the analyses.
Johnson 1976	No mention was made regarding whether the early maternal-infant contact was skin-to-skin.
Kadam 2005	Study was conducted in a level 3 NICU in Mumbai, mean age of the infants at enrollment was 3.2 days, range 1-8 days, mean GA of the KC infants was 33.3 weeks.
Karlsson 1996	Not a randomized trial; a descriptive study.
Klaus 1972	The early contact in the intervention group was not skin-to-skin.
Kontos 1978	This study was not a randomized trial. Mothers who chose to room in and those who did not were alternately assigned to early SSC or usual care. No means or standard deviations were provided for the attachment summary score or individual attachment behaviors.
Lindenberg 1990	No mention was made regarding whether the early maternal-infant contact was skin-to-skin.
Ludington-Hoe 2004	This was not a study of early SSC. SSC began M =17.82 days postbirth. All infants were in the NICU.

(*Continued*)

Mikiel-Kostyra 2002	In this study infants were not randomly assigned to groups. Information on the care of 11,973 newborn infants from birth to hospital discharge was collected in 427 maternity wards using a standardized questionnaire. Then a subset of 9612 newborns was created. Then 1923 participants (20% of the subset) were randomly selected by systematic sampling of every 5th case to complete a follow-up questionnaire.
Ohgi 2002	This was a nonrandomized intervention study of infants who received KC compared to a historical comparison group of infants who did not receive KC. Also KC was initiated 1-3 days postbirth.
Ottaviano 1979	No mention was made regarding whether the early maternal-infant contact was skin-to-skin.
Ramanathan 2001	This study took place in the NICU. Mean gestational age of the infants was 31.5 weeks.
Roberts 2000	This was not a study of early KMC. SSC was started median = 11.8 days postbirth. Median gestational age was 30.4 weeks in the KMC group; 30.9 weeks in the control group.
Salariya 1978	No mention was made regarding whether the early maternal-infant contact was skin-to-skin.
Taylor 1979	The early contact in the intervention group was not skin-to-skin.
Taylor 1985	The early contact in the intervention groups was not skin-to-skin.
Taylor 1986	Not a randomized trial, a descriptive study. The early contact in the intervention group was not skin-to-skin.
Wimmer 1982	No standard deviations provided for breastfeeding duration.
Worku 2005	This was not a study of late preterm infants. The mean gestational age was 32.45 weeks KMC and 31.59 weeks CMC infants. The mean birth weight was 1514.8 g (range 1000-1900 g) for KMC and 1471.8 g (range 930-1900 g) for CMC infants. 58% of the KMC and 52% of CMC infants were on IV fluids and 34% of the KMC and 37% of the CMC infants were on oxygen through nasopharyngeal catheter. In addition, these infants experienced significant morbidity; 22.5% of the KMC infants and 38% of the CMC infants died during the study period. Infants were randomly assigned using a list of random numbers to conventional care (n=61, overhead lamp warmers or a heated room, oxygen therapy, breast, tube, cup or mixed feedings) or early KMC (n = 62) starting during the first 24 hours of life (mean age 10 h KMC, 9.8 CMC).

CMC: conventional method of care
GA: gestational age
h: hour
KC: kangaroo care
KMC: kangaroo mother care
min: minutes
NICU: neonatal intensive care unit
RCT: randomized controlled trial
SSC: skin-to-skin contact

DATA AND ANALYSES

Comparison 1. Skin-to-skin versus standard contact healthy infants

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Breastfeeding at hospital discharge	2	149	Odds Ratio (M-H, Fixed, 95% CI)	6.35 [2.15, 18.71]
2 Breastfeeding status day 3 postbirth	1	56	Mean Difference (IV, Fixed, 95% CI)	1.6 [0.91, 2.29]
3 Breastfeeding status day 28 to 1 month postbirth	3	245	Mean Difference (IV, Random, 95% CI)	0.86 [-0.73, 2.44]
4 Breastfeeding 1 month to 4 months postbirth	10	552	Odds Ratio (M-H, Random, 95% CI)	1.82 [1.08, 3.07]
5 Started other feeds before 2 months of age	1	92	Odds Ratio (M-H, Fixed, 95% CI)	0.14 [0.03, 0.68]
6 Exclusive breastfeeding up to 4-6 months postbirth	1	92	Odds Ratio (M-H, Fixed, 95% CI)	5.67 [2.27, 14.16]
7 Breastfeeding 1 year postbirth	2	62	Odds Ratio (M-H, Fixed, 95% CI)	7.62 [0.89, 65.23]
8 Duration of breastfeeding in days	7	324	Mean Difference (IV, Random, 95% CI)	42.55 [-1.69, 86.79]
9 Successful first breastfeeding (BAT score 8-12)	2	223	Odds Ratio (M-H, Fixed, 95% CI)	2.65 [1.19, 5.91]
10 Success of the first breastfeeding (IBFAT score)	1	20	Mean Difference (IV, Fixed, 95% CI)	2.40 [0.33, 4.47]
11 Time to effective breastfeeding in hours postbirth	1	17	Mean Difference (IV, Fixed, 95% CI)	-13.37 [-27.34, 0.60]
12 Frequency of mouthing movements with exposure to own mother's milk day 4 postbirth	1	58	Mean Difference (IV, Fixed, 95% CI)	0.70 [0.45, 0.95]
13 Difference in frequency of mouthing movements between own mother's milk and another woman's milk	1	58	Mean Difference (IV, Fixed, 95% CI)	1.70 [0.76, 2.64]
14 Breast engorgement - chest circumference day 3 postbirth	1	56	Mean Difference (IV, Fixed, 95% CI)	-0.80 [-3.95, 2.35]
15 Breast milk maturation - early transitional milk on day 3	1	56	Odds Ratio (M-H, Fixed, 95% CI)	1.0 [0.35, 2.86]
16 Infant body weight change (grams) day 14 postbirth	2	43	Mean Difference (IV, Fixed, 95% CI)	-6.00 [-175.60, 159.61]
17 Breast engorgement - pain 3 days postbirth	1	56	Mean Difference (IV, Fixed, 95% CI)	-0.80 [-1.46, -0.14]

18 Mother's most certain preference for same postdelivery care in the future	1	199	Odds Ratio (M-H, Fixed, 95% CI)	13.58 [6.70, 27.51]
19 Maternal state anxiety day 3 postbirth	1	56	Mean Difference (IV, Fixed, 95% CI)	-5.00 [-9.00, 1.00]
20 Mother self-confident about her child care ability at hospital discharge	1	119	Odds Ratio (M-H, Fixed, 95% CI)	7.73 [2.89, 20.69]
21 Mother's perception of the adequacy of her milk supply at 1 month postbirth	2	189	Mean Difference (IV, Fixed, 95% CI)	0.21 [-1.65, 2.07]
22 Number of breastfeeding problems in the first postpartum month	1	20	Mean Difference (IV, Fixed, 95% CI)	-1.79 [-6.77, 3.19]
23 Maternal parenting confidence at 1 month postbirth	1	20	Mean Difference (IV, Fixed, 95% CI)	5.60 [-6.24, 17.44]
24 Abdominal skin temp in neutral range after 21 minutes	1	51	Odds Ratio (M-H, Fixed, 95% CI)	23.1 [2.53, 210.89]
25 Abdominal skin temp in neutral range after 45 minutes	1	51	Odds Ratio (M-H, Fixed, 95% CI)	13.75 [1.45, 129.99]
26 Axillary temperature 90 minutes to 2 hours postbirth	3	168	Mean Difference (IV, Random, 95% CI)	0.25 [-0.15, 0.65]
27 Interscapular temp 90 minutes postbirth	1	50	Mean Difference (IV, Fixed, 95% CI)	0.5 [0.21, 0.79]
28 Axillary temperature change 30-120 minutes postbirth	1	88	Mean Difference (IV, Fixed, 95% CI)	0.81 [0.31, 1.31]
29 Mean axillary temperature	1	8	Mean Difference (IV, Fixed, 95% CI)	0.30 [0.22, 0.38]
30 Heart rate 75 minutes to 2 hours postbirth	3	183	Mean Difference (IV, Random, 95% CI)	-3.05 [-7.84, 1.75]
31 Respiratory rate 75 minutes - 2 hours postbirth	3	183	Mean Difference (IV, Random, 95% CI)	-2.76 [-7.29, 1.77]
32 Blood glucose mg/dl at 75-90 minutes postbirth	2	94	Mean Difference (IV, Fixed, 95% CI)	10.56 [8.40, 12.72]
33 Base excess at 90 minutes postbirth	1	50	Mean Difference (IV, Fixed, 95% CI)	1.60 [0.13, 3.07]
34 SCRIP score first 6 hours postbirth	1	31	Mean Difference (IV, Fixed, 95% CI)	2.88 [0.53, 5.23]
35 SCRIP score first 6 hours in newborns below 1800 g birthweight	1	13	Mean Difference (IV, Fixed, 95% CI)	4.92 [-1.67, 11.51]
36 Did not exceed parameters	1	31	Odds Ratio (M-H, Fixed, 95% CI)	60.0 [5.51, 652.90]
37 Transferred to the neonatal intensive care unit	1	31	Odds Ratio (M-H, Fixed, 95% CI)	1.5 [0.12, 18.54]
38 Hospital length of stay in hours	2	42	Mean Difference (IV, Random, 95% CI)	-95.30 [-368.50, 177.89]
39 Number babies not crying at 60 minutes postbirth	1	36	Odds Ratio (M-H, Fixed, 95% CI)	29.95 [1.57, 572.84]
40 Not crying for > 1 minute during 90 minutes	1	29	Peto Odds Ratio (Peto, Fixed, 95% CI)	21.89 [5.19, 92.29]

41 Amount of crying in minutes during a 75-minute observation period	1	44	Mean Difference (IV, Fixed, 95% CI)	-8.01 [-8.98, -7.04]
42 Drowsey, fussy, crying states during a 1 hour observation starting 4 hours postbirth	1	47	Mean Difference (IV, Fixed, 95% CI)	-0.74 [-3.82, 2.34]
43 Optimal flexed movements during a 1-hour observation starting 4 hours postbirth	1	47	Mean Difference (IV, Fixed, 95% CI)	0.05 [0.01, 0.09]
44 Affectionate love/touch during breastfeeding 36-48 hours postbirth	4	314	Std. Mean Difference (IV, Random, 95% CI)	0.52 [0.07, 0.98]
45 Holds infant during breastfeeding 36 hours/2nd day postbirth	2	62	Mean Difference (IV, Fixed, 95% CI)	6.17 [2.70, 9.64]
46 Encompassing during breastfeeding 36 hours/2nd day postbirth	2	62	Mean Difference (IV, Fixed, 95% CI)	3.83 [0.24, 7.43]
47 Maternal enface behavior during breastfeeding 36 hours postbirth	1	40	Mean Difference (IV, Fixed, 95% CI)	3.8 [2.17, 5.43]
48 Maternal proximity-maintaining behavior during breastfeeding 36 hours postbirth	1	40	Mean Difference (IV, Fixed, 95% CI)	9.5 [-0.25, 19.25]
49 Maternal caretaking behavior during breastfeeding 36 hours postbirth	1	40	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-4.01, 3.61]
50 Maternal contact time (mean %) during hours 0-48 postbirth	1	31	Mean Difference (IV, Fixed, 95% CI)	19.68 [11.93, 27.43]
51 Maternal contact behavior during breastfeeding day 2 postbirth	1	42	Mean Difference (IV, Fixed, 95% CI)	47.04 [7.65, 86.43]
52 Maternal noncontact behavior during a breastfeeding day 2 postbirth	1	42	Mean Difference (IV, Fixed, 95% CI)	-33.52 [-61.35, -5.69]
53 Maternal contact behavior during a breastfeeding day 4 postbirth	1	42	Mean Difference (IV, Fixed, 95% CI)	59.23 [21.72, 96.74]
54 Maternal noncontact behavior during a breastfeeding day 4 postbirth	1	42	Mean Difference (IV, Fixed, 95% CI)	-37.17 [-60.64, -13.70]
55 Maternal-infant behavior during a feeding postpartum day 1 or 2	1	40	Mean Difference (IV, Fixed, 95% CI)	28.40 [9.25, 47.55]
56 Maternal-infant behavior during a feeding 28-32 days postbirth	1	40	Mean Difference (IV, Fixed, 95% CI)	19.90 [10.87, 28.93]
57 Maternal attachment behaviors during a feeding postpartum day 1-2	6	396	Std. Mean Difference (IV, Fixed, 95% CI)	0.52 [0.31, 0.72]

58 Maternal enface behavior during a play observation 3 months postbirth	2	60	Std. Mean Difference (IV, Random, 95% CI)	2.07 [-1.34, 5.48]
59 Mother kisses infant during a play observation 3 months postbirth	2	60	Std. Mean Difference (IV, Random, 95% CI)	0.28 [-0.93, 1.48]
60 Mother affectionate touching during a physical exam at 1 year	1	31	Mean Difference (IV, Fixed, 95% CI)	0.85 [0.09, 1.61]
61 Mother holds infant positively during a physical exam at 1 year	1	31	Mean Difference (IV, Fixed, 95% CI)	1.50 [0.51, 2.49]
62 Maternal scores on the Neonatal Perception Inventory day 1 or 2 postbirth	1	40	Mean Difference (IV, Fixed, 95% CI)	1.90 [0.15, 3.65]
63 Maternal scores on the Neonatal Perception Inventory day 25 to 32 postbirth	2	89	Mean Difference (IV, Fixed, 95% CI)	0.40 [-1.25, 2.04]
64 Mother's perception of bonding/connection to the infant week 4 postbirth	1	169	Mean Difference (IV, Fixed, 95% CI)	0.08 [-0.01, 0.17]

WHAT'S NEW

Last assessed as up-to-date: 2 April 2007.

8 May 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 1, 2002

Review first published: Issue 2, 2003

3 April 2007	New citation required but conclusions have not changed	This review has been substantially updated.
3 April 2007	New search has been performed	The search was updated to August 2006, as a result of which 17 studies have been added to the review along with 23 clinical outcomes. Additional breastfeeding outcomes include: exclusive breastfeeding up to four to six months postbirth; starting other feedings before the infant is two months of age; success of the first breastfeeding; time to effective breastfeeding; number of breastfeeding problems; frequency of infant mouthing movements with exposure to mother's own milk; and infant body weight change. New outcomes related to maternal feelings and attitudes

(*Continued*)

		include: preference for the same postdelivery care in the future; perceptions of the adequacy of her milk supply; self-confidence about her child care ability; and parenting confidence. Three studies with late preterm infants who are healthy enough to remain with their mothers on the postpartum unit and between 34 to 37 weeks' gestational age have been added to this review. Additional outcomes related to these infants include: SCRIP scores; number of infants who did not exceed physiological parameters; transfers to the neonatal intensive care unit; and hospital length of stay. A new outcome related to infant behavior is optimal flexed movements. Two outcomes have also been added evaluating maternal attachment: mean % of maternal contact time and maternal perceptions of bonding/connection to her infant. Although 23 outcomes have been added, there are no significant changes from the conclusions of the previous review.

CONTRIBUTIONS OF AUTHORS

For this update, Dr Elizabeth Moore wrote the first draft of the review and revised subsequent drafts in response to extensive feedback. Dr Gene Anderson and Dr Nils Bergman commented on the first draft of the updated review and contributed to the writing of the final draft.

DECLARATIONS OF INTEREST

All of the review authors have been active trialists in this area and have personal contact with many groups in this field, including the International Network for Kangaroo Mother Care based in Trieste, Italy; Bogota, Colombia; and Cleveland, Ohio.

INDEX TERMS

Medical Subject Headings (MeSH)

*Breast Feeding; *Mother-Child Relations; *Object Attachment; Infant, Newborn; Mothers; Randomized Controlled Trials as Topic; Skin; Touch [*physiology]

MeSH check words

Female; Humans; Infant