


Quantitative parameters of skin-to-skin contact and infant interactive behavior in very preterm infants: a systematic review


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Abstract

Objectives: to summarize evidence on the quantitative parameters of skin-to-skin contact during hospitalization in newborns ≤ 32 weeks of gestational age that are associated with infant interactive skills.

Methods: a systematic review was conducted, consulting databases in August 2024: BVS, Pubmed, CINAHL, Scopus, APA PsycNET, and Web of Science. Eligible studies were those focusing on mother-preterm infant interaction, evaluated by behavioral observation, that performed skin-to-skin contact during hospitalization, and analyzed infant interactive skills. Studies with indirect evaluation or those including children born above 32 weeks of gestational age were excluded. Data extraction and evaluation of methodological quality were performed independently by three reviewers using the QUIPS Tool and Quality Assessment Tool scales.

Results: eight studies were included. The minimum time for the initiation of skin-to-skin contact was found to be 15 minutes of life for stable preterm infants. The duration varied from 1 to 2 hours/day, for approximately 15 days. Skin-to-skin contact was associated with improving contact initiative, responsiveness, reciprocity, gaze, vocalization, positive affect, and the infant's negative mood.

Conclusion: skin-to-skin contact needs to be included in the routines of neonatal units, as a tool to promote initial interaction between mother and infant.

key words Mother-infant relations, Mother-child interaction, Skin-to-skin contact, Kangaroo care, Preterm infant, Systematic review



Introduction

For assistance to preterm newborns (PTNBs), Skin-to-skin contact (SSC) has advantages over the traditional method of care.¹⁻³ However, the literature could be more precise about the timing of SSC⁴ and its benefits for the interaction within the mother-infant dyad.^{5,6} Additionally, studies on SSC and mother-child relationships have different methodologies, which hinders evidence-based conclusions. Most studies focus only on maternal behavior,^{7,8} such as the meta-analysis conducted by Karimi *et al.*⁹ These authors found a statistically significant association between the SSC and the mother-infant relationship. However, the studies included in the review considered only maternal reports and maternal interactive behavior.

The SSC, also known as Kangaroo Position or Kangaroo Mother Care, is defined as the maintenance of the PTNB, dressed only in a diaper, under the breast of one of the parents, in direct contact, and covered by a blanket.¹⁰ Due to the inaccuracy of timing, the current consensus is for both to remain in this position for as long as they feel comfortable.¹¹ Thus, during clinical practice, the time of permanence in this position is often random or non-standardized.

SSC was proposed in Colombia in 1978 by the doctor and Professor Edgar Rey to solve the issue of overcrowding of neonatal units, a lack of incubators for PTNBs, and neonatal cross-infection, since many incubators were shared by more than one newborn.¹² Faced with the public health problem and the finding that the practice of SSC resulted in improved breastfeeding rates, a decrease in infant mortality rates, and reduced maternal abandonment, many studies were initiated after these findings.¹³ In 1983, the United Nations Children's Fund (UNICEF) recognized SSC as one of the best practices in neonatal care, emphasizing the survival of newborns weighing less than 1500 grams.¹² In 2000, Brazil proposed SSC as a National Policy with broad coverage as a care method for low birth weight newborns.¹¹

Studies have advanced and increasingly proved how SSC is an excellent strategy for promoting and maintaining breastfeeding,¹⁴ weight gain and shorter hospital stay,¹⁵ stabilization of maternal mental health,¹⁶ extended child survival,¹⁷ and favoring maternal approximation to the PTNB.^{7,18} However, studies that analyze the infant's results concerning the mother-child interaction lack a robust methodological design. It is known so far that there are benefits to the mother-child dyad relationship. Nevertheless, little has been investigated about the characteristics of an infant interactive behavior, and there still needs to be a consensus on the time to perform SSC.¹¹ Due to the lack of methodological robustness, clinical practice sometimes becomes abstract and is not

consistently integrated into the routine when the objective is to promote the relationship between the dyad.

Thus, this review aimed to summarize evidence on the quantitative parameters of skin-to-skin contact during hospitalization in newborns ≤ 32 weeks of gestational age that are associated with infant interactive skills.

Methods

This paper is a systematic review conducted and presented following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA).¹⁹ The protocol of this systematic review was registered in PROSPERO with registration number: CRD42020222006.

The research question was structured according to the PICO acronym: Population (P) was defined as all preterm infants born at ≤ 32 weeks of gestational age and evaluated the mother-child interaction between birth and 18 months of corrected age. The Intervention (I) was the quantitative parameter of SSC, either the onset time, duration, or frequency of SSC during hospitalization. The Control (C) was usual neonatal care. The outcome (O) was the infant's interactive skill with their mother.

Thus, we aimed to identify which SSC quantitative parameters (onset, duration, and frequency of SSC, among others) are measured in the literature in order to compare the results between experimental and observational studies. We also categorized the outcomes of SSC quantitative parameters and infant interactive developmental milestones up to eighteen months corrected age.

Furthermore, this review aims to support health practice, prevent harmful practices (such as unnecessary handling of a PTNB, as well as maternal fatigue in prolonged static positions), provide health professionals with updates, and promote alignment among hospitals that adopt this policy; to improve the understanding of the development of interactive skills in infants born preterm, thus favoring careful follow-up of infants born preterm at risk for child development disorders.

Source of information

The following electronic databases were consulted: BVS (254 retrieved articles), Pubmed (397), CINAHL (282), Scopus (247), APA PsycNET (3), and Web of Science (103). The final search date for all databases was August 2024. The keywords and search terms combined in the investigation are described in the Supplementary Table 1.

Eligibility Criteria

Original scientific articles published on mother-preterm infant interaction between birth and 18 months corrected age were included, using a quantitative methodology

Table 1

Author (year) country	Study objective	Study design	Sample size (sampling power %)	Comparison group	Results	Study limitations
**Lillieskold <i>et al.</i> ³¹ (2023) Sweden	To determine the effect of immediate SSC at birth on mother-infant interaction at 4 months of corrected infant age in very preterm infants.	Randomized clinical trial	71 infants and 56 mothers (if 100, 90% power)	Control (conventional care) vs. SSC group	Infant positive affect, communicative and social skills score were higher at 4 months during mother-child interaction in the SSC group whose SSC was onset at 6 hours of life. Results were adjusted for the child sex, primiparity and observation setting ($p=0.02$).	The authors consider the sample size was small. The randomization of the groups was not blinded by the researchers.
**Nunes <i>et al.</i> ³² (2021) Brazil	To compare the difference in socio-emotional development between hospital discharge and at six months corrected age in infants ≤ 32 weeks and assess the impact of maternal and infantile factors on socioemotional development rate within six months.	Observational, prospective	72 preterm mother-child dyads (98%)	NA	The onset of SSC (≤ 3 days) had a statistically significant association with the onset of contact ($p=0.013$) and vocalization ($p=0.016$). The number of days of SSC performance during hospitalization showed a statistically significant association with the response to communication ($p=0.039$).	It was not possible to propose an experimental study design (ethical issues). Difficulty comparing pioneering methodology with pre-existing literature.
Buil <i>et al.</i> ³⁵ (2020) France	Further investigation of the immediate benefits of the Supported Diagonal Flexion position during SSC on the quality of mother-infant communication in very preterm newborns.	Case control, prospective	34 preterm mother-child dyads	Vertical vs. Diagonal SSC	Infant vocalization frequency was higher in the diagonal kangaroo position group (3.68 times/min) vs. control group (1.06 times/min), with a statistically significant difference ($p<0.001$). In addition, infant vocalizations occupy more space in the dialogue (1.9% x 0.7%; $p=0.01$).	The authors consider the sample size, the dyads from only one level three unit and non-blinding of the kangaroo group, the type of allocation of the case and control groups.
**Mehler <i>et al.</i> ²⁵ (2020) Germany	To investigate the effects of 60 minutes of skin-to-skin contact in the delivery room compared to 5 minutes of eye contact on mother-child interaction, salivary cortisol, maternal depression, stress and bonding at six months corrected age.	Randomized Clinical Trial	77 preterm mother-child dyads (if 88, 80% power)	Visual contact versus skin-to-skin contact in the delivery room	In the SSC group, infant's vocal and motor responses were higher and statistically significant. Vocal = 7 (± 6) vs 5 (± 5) 0.044 and motor = 20 (± 9) vs 15 (± 7) 0.032.	Psychological and neurodevelopmental aspects were not evaluated. These results are limited to primiparous mothers.
Nunes <i>et al.</i> ³³ (2017) Brazil	To analyze the influence of the skin-to-skin contact duration in the initial interactions between mothers and preterm infants.	Observational, prospective	32 preterm mother-child dyads	NA	The longer the time in SSC, the more newborns made attempts at physical contact with their mothers during breastfeeding ($r=0.37$; $p=0.03$).	The reduced sample size was considered, in addition to environmental issues during filming, such as noise and the presence of the camera.
Buil <i>et al.</i> ³⁴ (2016) France	Assess the safety of SDF kangaroo positioning compared to usual upright positioning. To assess the position of the SDF in early mother-infant communication and in improving their well-being.	Observational prospective	15 preterm mother-child dyads	SSC vertical vs. Diagonal	The tenth session revealed that the children's vocalizations and smiles were more frequent in the diagonal kangaroo position groups but statistically non-significant.	The authors consider a small sample and the use of elastic wrap in the diagonal SSC.
Bigelow <i>et al.</i> ³⁰ (2010) South Africa	To investigate the relationship between early mother-infant skin-to-skin contact and maternal sensitivity with low birth weight infants	Randomized Clinical Trial	12 preterm mother-child dyads	SSC vs. incubator	Scores on the NCATS Child Behavior Subscale correlated significantly only with the age of the infants at the time of the follow-up visit.	It was considered a small sample size and a wide age range for child care. The mothers performed the recording of home SSC time in an abstract way. A high-risk mother-child dyad sample limited the generalizability of the results.

**Feldman et al.²¹ (2003) Israel	To examine the effects of dyadic and triadic interactions.	Cohort study	146 preterm mother-child dyads	Control (conventional care) vs. SSC group	In the SSC group, the level of dyadic reciprocity was higher (3.71 ±1.02 vs 3.24 ±1.10), and children showed fewer negative emotions (1.38 ±0.65 vs 1.51± 0.70) during social play $p<0.01$. Univariate tests showed that the SSC group had less time in blurred gaze compared to controls (0.55 ±0.21 vs 0.71±0.33).	Local ethical constraints limited randomization criteria. SSC initiation occurred at varying times during the study
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with no restriction on language or publication period. For studies that used SSC as a synonym for skin-to-skin contact, studies that included performing SSC during hospitalization were considered eligible. For studies that analyzed infant interactive skills, the criterion was direct analysis through observation of infant behavior (e.g., videos or on-site evaluation), due to the possibility of detailing the collected data.

Studies based on interviews or questionnaires (indirect analysis), case report studies, expert opinions, animal experiments, reviews, theoretical essays, and research protocols were excluded. In addition, we excluded theses and dissertations, as well as those in which SSC was performed exclusively at home or in children born above 33 weeks of gestational age.

When multiple publications originated from the same cohort,²⁰⁻²⁷ we opted for that publication that focused its results on the interaction.^{21,25} In the case of clinical trials, unpublished results were sought. When necessary, the authors were contacted to clarify any doubts about the study.

Selection process

After manually excluding duplicate publications, the initial screening was performed by reading titles, abstracts, and keywords. Three independent researchers completed the screening of the selected papers according to the eligibility criteria. A 98% inter-researcher agreement was reached. Disagreements were resolved in a consensus meeting with a fourth author.

Assessment of methodological quality

The quality of the articles was analyzed using instruments validated in the scientific literature. The methodological quality of the included experimental studies was assessed using the QUIPS Tool scale.²⁸ This tool comprises six domains (study participation, study attrition, prognostic factor measurement, outcome measurement, study confounding, statistical analysis, and reporting). Each domain is classified as having a high, moderate, or low risk of bias. No experimental studies were excluded, as all had a predominantly low or medium risk of bias.

The methodological quality of the included observational studies was assessed using the Quality Assessment Tool for Observation Cohort and Cross-Sectional Studies.²⁹ This tool provides for items to determine potential flaws in study or implementation methods, including sources of bias (e.g., patient selection, performance, attrition, and detection), confounding, study power, and the causal strength in the association between interventions and outcomes. Quality reviewers can select “Yes”, “No” or “cannot be determined / not reported / not applicable” in response to each item. Two independent reviewers performed these analyses. In cases of disagreement, a third reviewer was consulted to assist in decision-making. No observational studies were excluded, as they presented a final score greater than 50%.

Data extraction process

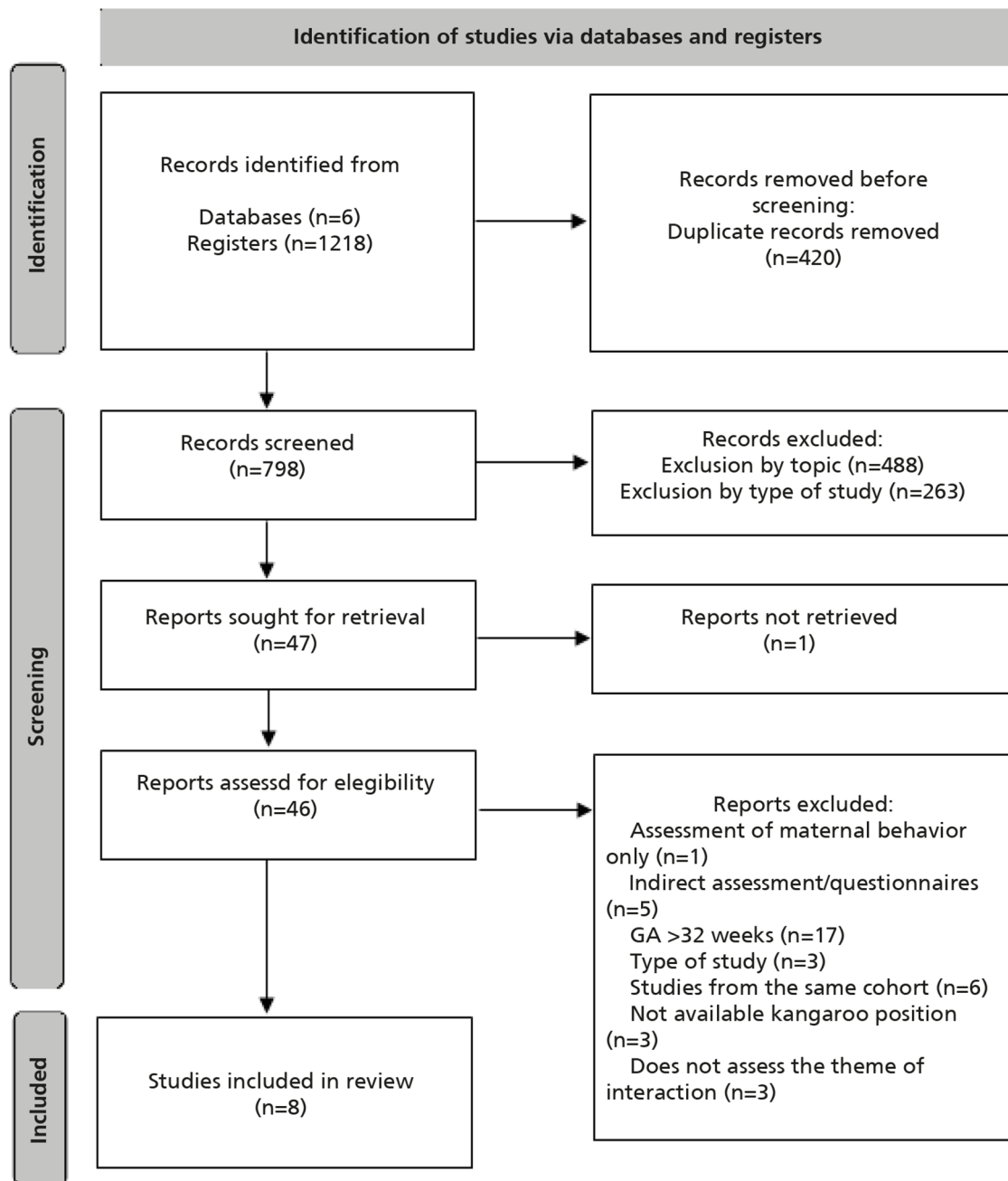
For the data screening stage, a pre-defined form was used. This form collected the following information: author, year of publication, country, study objective, study type, mean birth weight and gestational age at birth, corrected age at which the interaction was evaluated, duration of the interaction video, interaction assessment instrument, sample size (sampling power), comparison group, SSC quantitative parameters (onset, duration, frequency), other measures of SSC, the inclusion of the Kangaroo Method, interaction constructs appreciated, primary results, study funding, conflicting interest, blinded observers, and limitations stated by authors.

The data extraction process was carried out by two authors and validated by the research team. Finally, the results were presented in table format. When data of interest were unavailable, the corresponding author of the selected study was contacted by email for further clarification.

Results

Among the 1,218 articles retrieved using search terms, 798 abstracts were reviewed after duplicate records were removed. Of these, eight studies met the eligibility criteria and demonstrated adequate methodological quality (Figure 1).

Figure 1

Flowchart of the selection of articles found from the combination descriptors in the different databases. PRISMA (2020).¹⁹

Of the articles that remained in this review, three utilized an experimental study design,^{25,30,31} and five utilized an observational design.^{21,32-35} All included articles evaluated the mother-child relationship. Only the Lilliesköld *et al.*³¹ study included the father in skin-to-skin contact, in addition to the mother. Mehler *et al.*,²⁵ Bigelow *et al.*,³⁰ Feldman *et al.*,²¹ Buil *et al.*,³⁵ Lilliesköld *et al.*³¹ studies declared receiving financial support, unlike the other three.³²⁻³⁴ Only six of these studies presented a clear and precise statement of the absence of author conflict of interest.^{25,31-35}

The gestational age at birth of the newborns included in the studies ranged from 29 to 32 weeks. The mean birth weight ranged from 1,245.8±2.7 to 1,807.9±250.5. Most studies presented non-probabilistic samples, with the exception of three: Mehler *et al.*,²⁵ which presented a sample calculation based on maternal sensitivity. However, the final sample collected was below the number of participants required for 80% power. Lilliesköld *et al.*³¹ which presented a sample calculation based on the main outcome variable of infant cardiorespiratory stability.³⁶ However, the initial sample with 90% power would require

100 participants, while the final sample was 71 mother-child dyads. Finally, Nunes *et al.*,³² presented a sampling power of 98% for a sample with 72 participants.

The age at which the mother-child interaction was assessed ranged from hospital admission to 12 months of corrected age. Additionally, SSC was compared to standard care (incubator), maternal eye contact at birth, and diagonal SSC. More details, such as objectives, populations, main results, and limitations, can be seen in Table 1.

The studies varied in terms of the criteria for SSC onset. Lilliesköld *et al.*,³¹ Mehler *et al.*,²⁵ e Bigelow *et al.*³⁰ considered the first hours of life. Buil *et al.*³⁵ started on the third day of life, and Nunes *et al.*^{32,33} started SSC when the newborns were clinically stable. Buil *et al.*³⁴ adopted the weight criteria, and Feldman *et al.*²¹ gestational age (Table 2). Among the studies that reported the duration and frequency of SSC, this relationship varied between approximately 1 and 7 hours/day of SSC.

Regarding the constructs analyzed during the interaction, it is possible to categorize them as macro-analytic (infant state, positive and negative mood, dyadic conflict, and infant behavior such as responsiveness and

the initiation of physical/verbal contact, reciprocity, mutuality and attunement between the dyad) And micro-analytic (which observes the gaze, smile, cry, and vocalization) (Table 3).

Among the constructs evaluated in this review, those that were repeated throughout the articles include responsiveness,^{25,30,33} positive mood,^{21,25,31,33} negative mood,^{21,25,31} reciprocity,^{21,31,33} initiation of physical/eye contact,^{21,30,33} smile, gaze and vocalization.³²⁻³⁵ The constructs that showed a statistically significant association with SSC were the onset of physical contact at hospital discharge,³³ infant positive affect at four months of corrected age,³¹ infant vocalization,^{25,32} responsiveness,^{21,25,32} reciprocity, negative mood, and gaze at six months corrected age^{21,25} (Table 3). Table 4 compares the methodological quality of experimental and observational studies.

In this review, it was impossible to conduct a meta-analysis and heterogeneity analysis due to the variability of criteria for measuring SSC, the operationalization of mother-child interaction instruments, and the diversification of the ages addressed in the studies.

Table 2

Description of skin-to-skin contact quantitative parameters in included studies.

Studies/country	Skin-to-skin contact quantitative parameters		
	Onset	Duration	Frequency
Lilliesköld <i>et al.</i> ³¹ (2023) Sweden	Median 15 (0-62) minutes vs. 5.25 (4.5-5.5) hours	Median 68 (10-70) hours vs. 46 (5-44) hours	8 days of life
Nunes <i>et al.</i> ³² (2021) Brazil	Median 7.00 (5–10) days	23.55 (10.72-44.75) hours during hospitalization	12.00 (7–20) days
Buil <i>et al.</i> ³⁵ (2020) France	3 ^o day of life	Unreported	Unreported
Mehler <i>et al.</i> ²⁵ (2020) Germany	45 min of life in the exposure group	Duration/day=1.6 hours vs. 1.7 hours.	Unreported
Nunes <i>et al.</i> ³³ (2017) Brazil	Median 9.04 ± 5.42 days	Median 14.7 ± (0.2) hours during hospitalization	Median 6 days during hospitalization (1 – 9)
Buil <i>et al.</i> ³⁴ (2016) France	Average weight 1330 ±419 grams	Unreported	10 sessions
Bigelow <i>et al.</i> ³⁰ (2010) South Africa	6 hours of life in the exposure group	Average SSC in the first 24h = 7.8 (±4.8) hours.	15.00 (±9) days*
Feldman <i>et al.</i> ²¹ (2003) Israel	PTNB with a mean GA of 32 weeks	1 hour/day - average 26.62 (±12.14) hours	14 consecutive days

**Studies with significant results between the SSC quantitative parameters and the infant construct of the mother-child relationship. *Information provided by the author by email. Unreported information was queried by email from the corresponding author.

Table 3

Characterization of the instruments used in the studies.						
Studies	Interaction assessment tool	Nature of the variable	Age of assessment	Infant's constructs	Recording duration	
Lillieskold <i>et al.</i> ³¹ (2023)	Parent-Child Early Relational Assessment (PCERA) ³⁷	Likert scale	4 months (± 2 weeks) of corrected infant age	Infant Positive Affect; Communicative and Social Skills; Infant Dysregulation and Irritability and Dyadic Emotional Tone; Reciprocity and Regulation.	5 minutes	
Nunes <i>et al.</i> ³² (2021)	Observation Protocol of Mother-Infant Interaction 0-6 ³⁸	Likert scale/difference between two phases (median)	Close to hospital discharge and at 6 months CA	Gaze; Response to communications Intensity of positive response; Verbal and/or physical contact; smile; Good mood; vocalization; cry; Interaction Tuning	3 minutes	
Buil <i>et al.</i> ³⁵ (2020)	Author Developed Instrument	Microanalysis (frequency of occurrence)	18 days of life	Visual attention, smile, and vocalization	5 minutes	
Mehler <i>et al.</i> ²⁵ (2020)	Mannheim Rating System	Microanalysis (frequency of occurrence)	6 months	Motor, vocal and facial responsiveness. Positive mood and negative mood	4 minutes	
Nunes <i>et al.</i> ³³ (2017)	Observation Protocol of Mother-Infant Interaction 0-6 ³⁸	Likert Scale (median)	Close to hospital discharge (mean 31.88 ± 12.61 days of life)	Gaze; Response to communications Intensity of positive response; Verbal and/or physical contact; smile; Positive mood; vocalization; cry; Interaction Tuning	3 minutes	
Buil <i>et al.</i> ³⁴ (2016)	Author Developed Instrument	Microanalysis (frequency of occurrence)	Weight in the intervention: 1605 \pm 349	Visual attention, smile, and vocalization	10 minutes	
Bigelow <i>et al.</i> ³⁰ (2010)	Nursing Child Assessment Scale(NCATS) ³⁹	23-item checklist	<12 (3.1 to 11.9) months	Clarity of signals and responsiveness to the mother	Direct observation of the trained evaluator	
Feldman <i>et al.</i> ²¹ (2003)	Global Codes of Dyadic and Triadic Interactions ⁴⁰	Likert scale (averages)	6 months	Positive affect, negative emotional affect, child initiation and involvement, and infant reciprocity.	5 minutes	

Table 4

Classification of the methodological quality analysis of articles with experimental methodological design using the QUIPS ^a tool and Quality Assessment Tool ^b .																				
Author (year)	Methodological design ^a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	%	Classification		
**Nunes <i>et al.</i> ³² (2021)	Prospective Cohort	+	+	+	+	+	/	+	+	+	+	+	+	+	+	13/14	92.85	Good		
Buil <i>et al.</i> ³⁵ (2020)	Prospective case-control	+	+	+	+	-	/	+	/	+	?	+	-	-	+	8/14	57.14	Regular		
Nunes <i>et al.</i> ³³ (2017)	Prospective observational	+	+	+	+	-	/	+	+	+	+	+	+	+	-	11/14	78.57	Good		
Buil <i>et al.</i> ³⁴ (2016)	Prospective observational	+	+	+	+	-	/	+	/	+	?	+	+	/	-	8/14	57.14	Regular		
Feldman <i>et al.</i> ²¹ (2003)	Prospective Cohort	+	+	?	+	-	/	+	-	+	+	+	+	?	+	9/14	64.28	Regular		

Randomized Clinical Trial ^b	Study participation	Study attrition	PF measurement	Outcome measurement	Study confounding	Statistical analysis and Reporting
Lillieskold <i>et al.</i> ³¹ (2023)	Medium*	Low*	Low*	Low*	Medium*	Low*
Mehler <i>et al.</i> ²⁵ (2020)	Low*	Low*	Low*	Low*	Medium*	Low*
Bigelow <i>et al.</i> ³⁰ (2010)	High*	High*	Medium*	Low*	Medium*	Low*

+ Yes; - No; / Not applied; ? not reported; Bad: <50; Regular: 51-74; Good: 75-100%; PF= *prognostic factor* * Risk of Bias.

Discussion

This study selected articles that associated SSC quantitative parameters and child interaction. We observed the early onset of SSC was possible from the first minutes of life to the first week, provided that the PTNBs were stable from a respiratory and hemodynamic point of view.

Regarding the quantitative parameters of SSC, the study by Nunes *et al.*,³² found high collinearity between the duration and frequency of SSC. However, these variables were not always reported or controlled in the other studies. Another issue was the randomization of the groups, as a control group not exposed to SSC would be ethically limited, given that SSC is a consolidated practice in many countries.

In summary, SSC was generally performed between 1 and 2 hours per day. We verified favorable associations with children's interactive behavior was possible as long as it was performed frequently for at least two weeks. However, there are facilitators and obstacles to realizing the SSC.⁴¹ Among the facilitators, the most effective approach would be for the neonatal team to be trained and proactive in proposing and ensuring conditions for performing SSC with the mother and newborn.⁴² On the other hand, some authors of the included studies cited the maternal absence during the hospital stay as a hindrance to controlling SSC performance after its initiation. Furthermore, Smith *et al.*⁴³ also pointed out, in a systematic review, the difficulty of maternal permanence after her clinical discharge to ensure continuity of care for the PTNB in the neonatal unit. Thus, it is essential to emphasize the importance of infrastructure that facilitates skin-to-skin contact and socio-emotional support for the PTNB's family.¹¹

However, PTNBs are at risk for neurodevelopmental challenges, particularly interactive,⁴⁴ linguistic,⁴⁵ and socioemotional development.⁴⁶ This risk is due to social reasons, such as parents' removal during prolonged hospitalization in neonatal units,⁴⁷ biological factors, such as preterm birth itself, and environmental factors, such as exposure to excessive noise and light that can impair the PTNB's circadian cycle and, consequently, brain development.⁴⁸ This is in addition to exposure to medications, respirators, and painful and routine stimuli.⁴⁹

Thus, this review found studies that associated SSC with improved contact initiative, responsiveness, reciprocity, gaze, vocalization, positive affect and children's negative mood. These behaviors should be well-established to ensure typical child development⁵⁰ in several areas, such as linguistic, psychological, socio-emotional, and motor skills.

Thereby, the contact initiative is the child's ability to act to engage the adult through vocalizations, smiles, looks, and physical approaches. Responsiveness, in turn, is the child's ability to be responsive and provide rewarding feedback to the adult. However, reciprocity refers to the coordinated interaction with behavioral and physiological signals that reflect the bidirectional attunement of one partner with the psychophysiological, cognitive, emotional, and behavioral state of the other.^{51,52} These behaviors can occur through trans-modal communicative acts such as the look, vocalizations, smiles, and physical contact.

Interactive gaze has been present since birth.⁵³ Newborns already prefer to focus on human faces⁵³ and may be favored by physical proximity (30 cm from the mother's lap during breastfeeding, SSC^{34,35}). During social interaction, the gaze is part of the shared attention skill.⁵⁴ The absence of interactive gaze is one of the markers for the early investigation of pervasive developmental disorders.⁵⁵

Vocalization is also present since birth, with a less complex structure when the newborn is on active alert.⁵⁶ Initially, as cooing, it will move on to vocalizations until babbling in this pre-linguistic phase. Success in the linguistic phase is determined by the number of positive auditory and proprioceptive experiences the newborn has had in the pre-linguistic phase.⁵⁷

Negative mood is defined as crying, whimpering, negative vocalizations, and when the child demonstrates anger, restlessness, or discontent, and is measured by the number of episodes that occur during the observation of the infant's interactive behavior. Bruce *et al.*⁵⁸ observed that negative mood predicts children's expressive language. Therefore, despite causing discomfort in the caregiver responsible for the child, it is a necessary behavior and mediator of child satisfaction. Negative mood, with duration and punctual frequencies, will help

the younger child to demonstrate discomfort. Thus, it will be up to the caregiver's sensitivity to interpret, attribute meaning and respond appropriately to the situation.⁵⁹ In this way, the negative mood is also considered a means of communication, especially for newborns, as it can mobilize people around them, resulting in actions.⁶⁰ Furthermore, negative mood participates in the capacity for emotion regulation, which consists of modulating the occurrence, duration, and intensity of internal feeling states.⁶¹

Limitations and future directions

The main limitation for deeper comparative analysis lies in the methodological heterogeneity of the studies, specifically the use of diverse and non-standardized assessment tools for mother-infant interaction, many of which also lack cultural validation. There is also a clear knowledge gap regarding outcomes between 12 and 18 months of corrected age. To address this, future research should enhance methodological rigor, using representative samples and probabilistic models to reduce selection bias. Standardized measurement of SSC onset, duration, and frequency is essential to explore potential dose-response relationships. Comparative analyses between SSC subgroups (e.g., early vs. late initiation, longer vs. shorter duration) are recommended, along with adequate statistical control of confounding variables.

Clinical implications

Despite methodological variability, evidence strongly suggests that SSC parameters—especially early initiation, frequency, and duration—positively influence mother-infant interaction in preterm infants. Improvements have been observed in key interactive behaviors, including contact initiation, vocalization, responsiveness, reciprocity, affect, and gaze. These findings underscore the importance of integrating SSC into neonatal care routines as a cost-effective strategy to promote early social development and bonding.

Final considerations

The reviewed studies indicate that SSC can begin as early as 15 minutes post-birth in stable very preterm newborns, with typical sessions lasting two hours per day for approximately 15 days. Crucially, while only a few studies evaluated timing quantitatively, SSC was consistently associated with enhanced mother-infant interactive behaviors up to 12 months of corrected age. A significant knowledge gap remains in understanding outcomes between 12 and 18 months. Overall, SSC emerges as a promising, low-cost intervention to foster

social interaction in preterm infants and warrants reinforcement as standard practice in neonatal care.

Acknowledgment

We would like to thank J. Baeta Vianna Library - Health Campus of UFMG for their assistance with the bibliographic search.

Author's contribution

Nunes CRN: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, software, validation, visualization, writing – original draft, writing - review and editing.

Freitas NF: Formal analysis, data curation, validation, visualization, writing - review and editing.

Prates ABC and Silva CA: Data curation, investigation, validation, visualization, writing - review and editing.

Lemos SMA: Conceptualization, investigation, methodology, visualization, writing – review and editing.

Bouzada MCF: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, validation, visualization, writing – review & editing.

All authors approved the final version of the article and declared no conflict of interests.

Data Availability

All datasets supporting the study are included in the article.

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Received on September 7, 2024

Final version presented on September 13, 2025

Approved on September 16, 2025

Associated Editor: Kelly Abud

Supplementary Table 1

Results of the search strategy according to the database.		
Database	Search Strategy	Retrieved references
BVS	("Mother-Child Relations" OR "Relaciones Madre-Hijo" OR "Relações Mãe-Filho" OR "Interação Mãe-Criança" OR "Interação Mãe-Filho" OR "Relacionamento Filho-Mãe" OR "Relacionamento Materno-Filial" OR "Relacionamento Mãe-Filho" OR "Relação Filho-Mãe" OR "Relação Materno-Filial" OR "Relação Mãe-Filho" OR "Relações Criança-Mãe" OR "Relações Filho-Mãe" OR "Relações Materno-Filiais" OR "Relações Mãe-Criança" OR infant OR lactante OR lactente OR lactentes) AND ("Kangaroo-Mother Care Method" OR "Método Madre-Canguru" OR "Método Canguru" OR "Mãe Canguru" OR "Método Mãe Canguru" OR "Método Mãe-Canguru" OR "Posição Canguru" OR "Kangaroo Position" OR "Posição Canguru" OR "Kangaroo Position" OR "Skin to skin contact") AND ("Infant, Premature" OR "Recien Nacido Prematuro" OR "Recém-Nascido Prematuro" OR "Bebê Prematuro" OR "Bebês Prematuros" OR "Lactente Nascido Prematuramente" OR "Lactente Nascido Pré-Termo" OR "Lactente Prematuro" OR "Lactente Pré-Termo" OR "Lactentes Nascidos Prematuramente" OR "Lactentes Nascidos Prematuros" OR "Lactentes Nascidos Pré-Termo" OR "Lactentes Prematuros" OR "Lactentes Pré-Termo" OR "Neonato Prematuro" OR "Neonato Pré-Termo" OR "Neonatos Prematuros" OR "Neonatos Pré-Termo" OR prematuro OR prematuros OR "Pré-Termo" OR "Recém-Nascido Pré-Termo" OR "Recém-Nascidos Prematuros" OR "Recém-Nascidos Pré-Termo") AND (instance:"regional") AND (db:("LILACS" OR "BDENF" OR "SES-SP" OR "IBICS" OR "INDEXPSI" OR "LIS" OR "CUMED" OR "coleccionaSUS" OR "PAHOIRIS" OR "PERNAL"))	254
MEDLINE via PubMed	("Mother-Child Relations"[All Fields] OR "Holding"[All Fields] OR "Bonding"[All Fields] OR "Attachment Theory"[All Fields]) AND ("Kangaroo-Mother Care Method"[All Fields] OR "Skin to skin contact"[All Fields] OR "Kangaroo position"[All Fields]) AND ("Infant, Premature"[All Fields] OR "infant"[MeSH Terms] OR "infant"[All Fields])	397
CINAHL	("Mother-Child Relations" OR "Holding" OR "Bonding" OR "Attachment Theory") AND ("Kangaroo-Mother Care Method" OR "Skin to skin contact" OR "Kangaroo position") AND ("Infant, Premature" OR Infant)	282
Scopus	("Mother-Child Relations" OR "Holding" OR "Bonding" OR "Attachment Theory") AND ("Kangaroo-Mother Care Method" OR "Skin to skin contact" OR "Kangaroo position") AND ("Infant, Premature" OR Infant)	242
Web of Science	("Mother-Child Relations" OR "Holding" OR "Bonding" OR "Attachment Theory") AND ("Kangaroo-Mother Care Method" OR "Skin to skin contact" OR "Kangaroo position") AND ("Infant, Premature" OR Infant)	103
APA PsycNET	(Any Field: "Mother-Child Relations" OR Any Field: "Holding" OR Any Field: "Bonding" OR Any Field: "Attachment Theory") AND (Any Field: "Kangaroo-Mother Care Method" OR Any Field: "Skin to skin contact" OR Any Field: "Kangaroo position") AND (Any Field: "Infant, Premature" OR Any Field: Infant)	3