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REVIEW ARTICLE

Systematic review shows the benefits of involving the fathers of preterm infants in early interventions in neonatal intensive care units

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Abstract

Aim: This review identifies interventions involving the fathers of preterm infants that have been tested in neonatal intensive care units (NICU). It examines their effects on the fathers and infants and highlights any differences between fathers and mothers who took part in the same interventions.

Methods: A systematic search was performed in English from 1995 to 1 September 2020, using the CINAHL, Cochrane Central Register of Controlled Trials, Embase, PubMed and PsycINFO databases. We examined 14 peer-reviewed studies that investigated NICU interventions involving 478 fathers, whose 511 infants were born before 37 weeks of gestation. These included empirical studies with clinical outcomes.

Results: Studies on fathers' interventions in NICUs were limited and mainly restricted to basic skin-to-skin contact or tactile interventions. The interventions had similar general positive effects on mothers and fathers when it came to infant physiological and behavioural reactions. There was also evidence of a positive effect on the fathers, including their mental health.

Conclusion: Including fathers as active partners in the care of their preterm newborn infants produced good outcomes for both of them. Further research is needed to

Abbreviations: NICU, neonatal intensive care unit; SSC, skin-to-skin contact.

Manuela Filippa and Sahar Saliba share the first authorship of the manuscript.

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develop new, multimodal and interactive interventions that provide fathers with positive contact with their preterm infants.

KEYWORDS
early intervention, father, neonatal intensive care unit, preterm infants, systematic review

1 | INTRODUCTION

The role that fathers play in the early care of their preterm babies in the neonatal intensive care unit (NICU) continues to be highly debated.[1,2] In the first days after preterm births, fathers often play a crucial role if the mothers are absent due to medical complications. By reducing parent–infant separation, timely paternal involvement after birth increases fathers' knowledge of infant behaviour and boosts their confidence.[3] A very preterm birth is a traumatic event and a major disruption in the life of parents who experience the early and unexpected birth of their child. They have to face the uncertainty of the infant's health outcomes[4] and are themselves exposed to a stressful NICU environment. Several studies have specifically evaluated fathers' perspectives on becoming a parent of a preterm newborn infant.[5,6] Fathers were shown to experience lack of control when faced with their infant's conditions.[7,8] Compared to fathers of full-term healthy infants, they found the physical and social hospital environment highly stressful.[8,9]

Fathers of premature babies experience parenthood differently from the fathers of term babies.[10] This means that specific nursing support and interventions are needed to sustain caregiving engagement and the fathers' transition to parenthood.[11]

In the last decade, a few preliminary studies have shown that the contribution made by fathers to the overall parental presence has been highly variable between medical institutions. These include one study conducted in six European countries.[12] Infant- and family-centred developmental care strategies have been developed to overcome the complications related to prematurity and to meet the special needs of infants and their families in this context. One corner stone of this approach is to support the early and continuous involvement of both mothers and fathers as primary caregivers of their infant.[13,14] Continuous parental support and access and high parental involvement is recommended at national[14] and European[15] levels, although policies vary widely between European countries, as well as between medical establishments within the same country.[16] Overall, the presence of fathers in the NICU has been acknowledged as a source of support for the well-being of mothers and, thereby, of infants.[17,18] Despite this, the vast majority of the early interventions involving parents in NICUs have been performed by mothers,[19] also in individualized care contexts.[20] The lack of systematic studies that have investigated the effects of paternal-driven interventions does not encourage health practitioners to involve fathers in the early care of their preterm infants. Only skin-to-skin contact (SCC) with fathers has been systematically evaluated as an optimal alternative, in the absence of mothers, and this has enhanced the outcomes of both newborn infants and their parents.[21]

Key Notes

- Most early interventions in neonatal intensive care units have been aimed at, or driven by, mothers.
- Our review showed that early paternal interventions had positive physiological and behavioural effects on infants and good outcomes for fathers.
- Fathers should be encouraged to get involved in caring for their preterm infants and further research should focus on developing and evaluating early paternal interactive and multimodal interventions.

This review had three main aims. First, we wanted to determine the types of paternal interventions that had been tested in NICUs, before hospital discharge. Second, we examined whether early paternal interventions after a preterm birth had positive impacts on several dimensions, notably the infants' outcomes and the fathers' mental health. The third aim was to highlight any differences between maternal and paternal interventions in the NICU, with the focus on interventions driven by fathers.

2 | METHODS

2.1 | Search strategy

A systematic review of the literature was undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. We included peer-reviewed studies published in English between 1995 and 1 September 2020. Studies before 1995 were not included, to reduce heterogeneity.

The Population, Intervention, Comparison, Outcomes and Study approach was used to search the literature. The population was preterm infants in NICUs, the intervention focused on fathers and the comparisons were no intervention, standard care or mothers' interventions. The outcomes of interest were any physiological measures, behavioural responses, biochemical, psychological and subjective feelings of the infants and, or, fathers. The study design included experimental studies.

The CINAHL, Cochrane Central Register of Controlled Trials, Embase, PubMed and PsycINFO electronic databases were used.

TABLE 1 Search terms and strategy to identify the studies from electronic databases

1.	Preterm.mp
2.	NICU.mp
3.	Father.mp
4.	#1 and #2 and #3
5.	Intervention.mp
6.	Auditory.mp
7.	Gustatory.mp
8.	Olfactory.mp
9.	Kinesthetic.mp
10.	Tactile.mp
11.	Vestibular.mp
12.	Vision.mp
13.	Multimodal
14.	Pain.mp
15.	#5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14
16.	#4 and #15
17.	Limit 16 to (English language and humans and year = "1995 to Current")

Note: mp, Multipurpose search across the subject headings.

Searches were undertaken using the same medical subject heading terms and combinations of keywords. The search terms and strategies used for the electronic searches are detailed in Table 1.

2.2 | Study selection

Studies were included if the infants were born preterm, before 37 weeks of gestational age, and the interventions were delivered by fathers during hospitalisation. Studies that did not report outcomes on infants or on fathers were not included. If studies had resulted in multiple papers, the data from the most complete report were used. Discussion papers, qualitative papers, theses, dissertations and reviews were excluded.

The searches identified 1604 papers and the titles and abstracts were used to check whether they fell within the remit of this review. Then, the full texts of 36 studies were evaluated by two reviewers (MF, SS) to determine whether they fitted the inclusion criteria. A third reviewer (PK) was involved if their views differed. The studies were excluded if the intervention was not delivered by fathers or there was insufficient information (Figure 1).

2.3 | Data extraction

The main data were extracted and included the author, year of publication and where the study was conducted. The studies comprised randomised controlled trials, crossover trials, quasi-experimental and retrospective studies. We extracted the setting descriptions, the population and the intervention characteristics, in terms of types and dosage. The control conditions were described. Outcomes were clustered in five domains, namely physiological, behavioural, nutritional, biochemical and psychological.

2.4 | Analysis

A meta-analysis was planned, but was not feasible due to inconsistent reporting or marked clinical heterogeneity in the study populations, interventions and outcomes studied.

These limitations did not permit any formal quality assessment. However, the study quality was addressed by the authors during the session on limitations.

3 | RESULTS

3.1 | Study design and characteristics

We selected 14 studies, with a total population of 511 preterm infants and 478 fathers. Studies were not limited to high-income countries, as they were performed in Canada, Colombia, Germany, Iran, Italy, Lebanon, Norway, South Korea, Sweden and the United States.

All the preterm infants were born at 28–37 weeks of gestation and the paternal interventions started during the infants' hospitalisation, at three to 48 days of post-natal age.

Of the 14 studies, five were defined by the authors as randomised controlled trials,[22-26] seven were crossover trials,[27-33] one was quasi-experimental[13] and one had a retrospective design.[34] The main characteristics of the study designs are summarised in Table 2.

The setting descriptors were not reported in eight of the 14 studies. The NICU levels were III or IV and the infants' state at the onset of the intervention was only reported in two studies.[27,29]

3.2 | Types of paternal interventions

We found that 10 of the 14 interventions were paternal SCC. Of these, two[28,33] related to 30-min sessions with three collected measures, before, during and after SSC. In one study the duration of the intervention was 45 min[24] and in two[27,30] it was 60 min. In two studies the session lasted 60 min over 3 days.[31,32] In one case continuous paternal SSC began in the delivery room and continued for almost 24 h a day.[25]

In two studies, tactile[13] and massage stimulation[23] were performed. The tactile stimulation consisted of 10-min periods each day, for 5 consecutive days, whereas the massage stimulation consisted of eight sessions of 60 min each and was preceded by a period of observation.

One intervention aimed to improve parental participation, and consisted of individualised interactions between fathers and

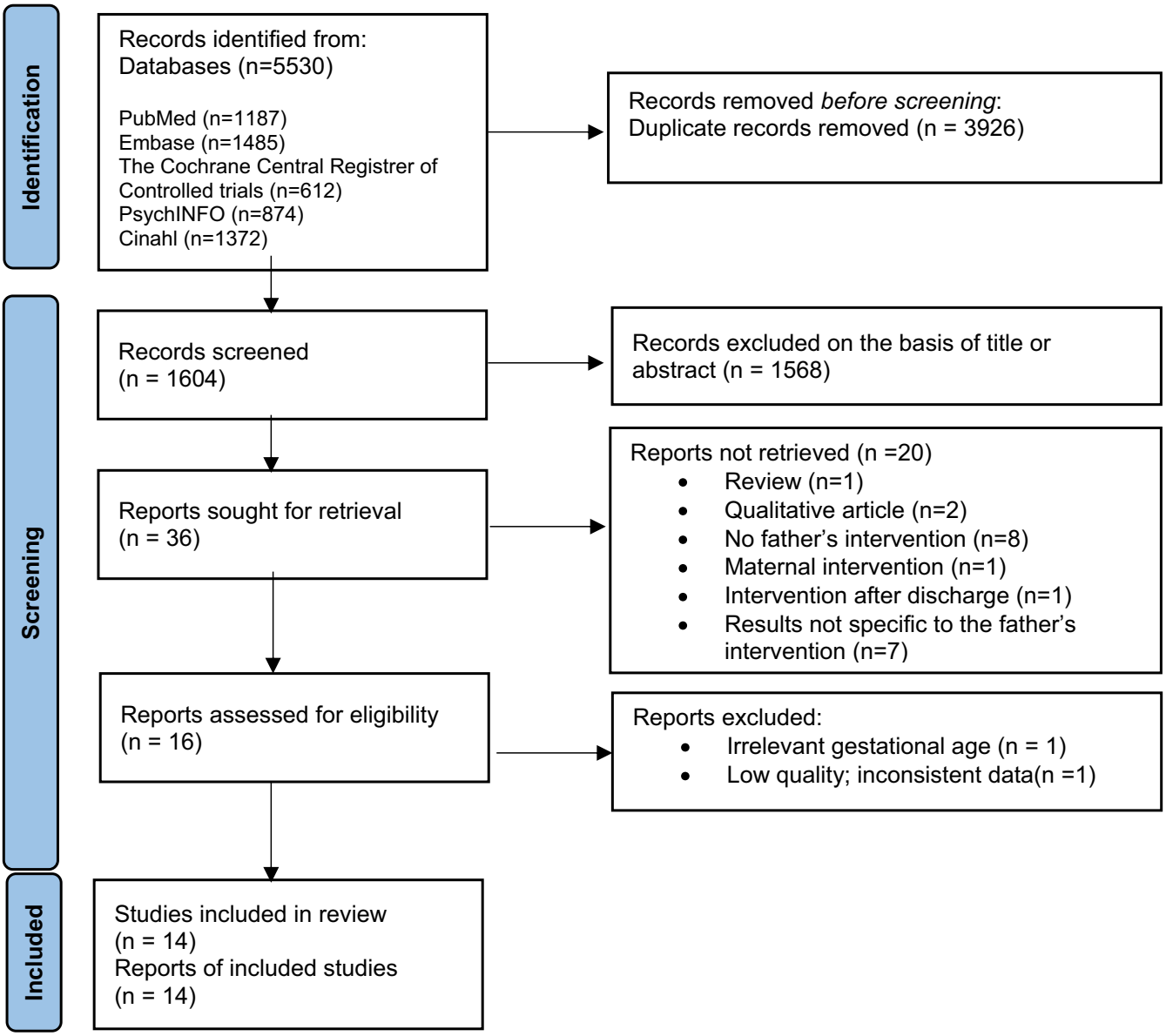

FIGURE 1 Flow diagram of review process

preterm infants that lasted 50–60 min each.[22] In the final study[29] preterm infants were exposed to their fathers' live and interactive directed speech for 5 min on 2 consecutive days.

3.3 | Control conditions

In eight studies[27-34] the control condition was the same intervention performed by mothers. In the remaining studies the control condition was standard care.

3.4 | Outcome measures, domains and results

Various outcome measures were identified and clustered in five main outcome domains. The physiological domain comprised the heart rate, respiration rate, oxygen consumption, temperature and blood pressure. The behavioural domain comprised the cluster of state, stress, stability and infant affect, which is the emotional tone an individual express. The nutritional domain comprised breastfeeding and infant body weight and the biochemical domain comprised oxytocin and cortisol. Finally, the psychological domain incorporated the father's psychological and subjective feelings, such as anxiety, stress, attachment and interaction scores. The main outcomes are summarised in Table 3.

In five studies, the authors reported measures in the physiological domain.[13,26,27,30,33] More specifically, they observed an increase in skin temperature during both maternal and paternal SSC.[27] In one study,[30] the authors found no significant differences in the change in mean heart rate, temperature, oxygen, systolic blood pressure and mean blood pressure when maternal and paternal SSC were compared in newborn infants. One study showed that paternal tactile

TABLE 2 Description of study design, setting, population, intervention and control

Author, reference Place of study	Study design	Setting description NICU level Infant state at test	Population Number GA - PNA (mean ± standard deviation; range)	Intervention		Control
				Type	Details	
Bauer et al.[27] Germany	Randomised order, crossover	NR Steady-state	11 PI GA: 28–31 weeks PNA: 8–48 days	P-SSC	60 min Each period (before, during and after SSC) began 60 min after feeding	M-SSC
Cong et al.[28] USA	Randomised order, crossover	Level IV NR	28 PI GA: 32.7 ± 2.1 weeks PNA: 3–10 days	P-SSC	30 min Phases: pre-SSC, during-SSC and post-SSC. Study procedures and data collection occurred in the early afternoon on each study day.	M-SSC
Gloppestad[34] Norway	Retrospective	NR NR	63 PI GA: 29 ± 2.73 weeks	P-SSC	NR	M-SSC
Heo and Oh[22] South Korea	Parallel, two-group RCT	NR NR	66 PI GA I: 28.42 ± 2.67 weeks GA C: 29.75 ± 3.19 weeks	Parent participation Improvement program	A 2-week program on three stages: an individualised interaction stage, a pre-participation stage and an active participation stage (50–60 min each).	Standard care routine visits
Johnston et al.[33] Canada	Randomised order, crossover	Level III NR	62 PI GA: 28–36 weeks	P-SSC	Infants were held in SSC 30 min before and during the painful procedure with the mother or with the father, and with the other parent in the subsequent session.	M-SSC
Kim et al.[13] South Korea	Quasi-experimental	NR NR	40 PI GA I: 34.71 ± 2.67 weeks GA C: 35.18 ± 2.57 weeks	Tactile stimulation	One 10-min period per day, for 5 consecutive days. The tactile stimulation consisted of gentle stroking with moderate pressure on various parts of the body using the palm of the hand or bottom of the fingers.	Standard care
Matricardi et al.[23] Italy	RCT	NR NR	42 PI GA I: 29.10 ± 1.87 weeks GA C: 29.35 ± 1.99 weeks	Joint observation and infant massage (by both parents)	8 sessions, 60 min each. Joint observations, massage with oil; moderate massage pressure stroking and kinaesthetic stimulation in two separate phases each 10-min long.	Standard care
Mirnia et al.[24] Iran	RCT	NR NR	45 PI GA I: 32 ± 2.73 weeks PNA I: 15.39 ± 14.7 days GA C: 31.35 ± 2.31 weeks PNA C: 17.09 ± 13.6 days	P-SSC	45 min of SSC Infants were placed in the foetal position or flexion on the fathers' chest. The fathers cuddled the infants and gave them supportive care.	Standard care
Mörelius et al.[25] Sweden	RCT	Level II-III NR	37 PI GA I: 34.4 ± 6.2 weeks GA C: 34.6 ± 4.8 weeks	Continuous P-SSC	Continuous SSC, beginning in the delivery room and continuing almost 24 h a day with the parents alternating until hospital discharge.	Standard care

(Continued)

TABLE 2 (Continued)

Author, reference Place of study	Study design	Setting description NICU level Infant state at test	Population Number GA - PNA (mean ± standard deviation; range)	Intervention		Control
				Type	Details	
Saliba et al.[29] Lebanon	Randomised order, crossover	Level III Active sleep state	14 PI GA: 31.7 ± 1.99 weeks PNA: 34.7 ± 1.03 weeks	Fathers' infant-directed speech	Father and mother's live speech, for 5 min on 2 consecutive days in a random order. Pre and post intervention: 5 min of parental absence	Mother's infant-directed speech
Srinath et al.[30] Canada	Randomised order, crossover	Level III NR	26 PI GA: 28 ± 2 weeks PNA: 32 ± 2 weeks	P-SSC	M-SSC and P-SSC for 60-min on consecutive days in a random order. Parents interact with their neonate by touch, talk or sing as they pleased and based on the response from the neonate	M-SSC
Varela et al.[26] Colombia	RCT	NR NR	49 PI GA: 29.2 ± 2.5 weeks PNA: 31.6 ± 1.5 weeks	P-SSC	60-min SSC session	Standard care
Vittner et al.[31] USA	Randomised order, crossover	NR NR	28 PI GA: 33 ± 1.57 weeks PNA: 3–10 days	P-SSC	60-min SSC session, over 3-days	M-SSC and Standard care
Vittner et al.[32] USA	Randomised order, crossover	NR NR	28 PI GA: 33 ± 1.57 weeks PNA: 3–10 days	P-SSC	60-min SSC session, over 3 days	M-SSC and Standard care

Abbreviations: GA, gestational age at birth; M-SSC, maternal skin-to-skin; NICU, neonatal intensive care unit; NR, not reported; PI, preterm infant; PNA, post-natal age at the time of intervention; P-SSC, paternal skin-to-skin; RCT, randomised controlled trial; SSC, skin-to-skin.

TABLE 3 Description of outcome domains, measures and results

Author, reference	Outcome domain	Outcome measures	Coding (Blinded)	Significant results
Bauer et al.[27]	Physiological	Oxygen consumption, carbon dioxide production, energy expenditure, skin and rectal temperatures, heart rate, respiratory rate and arterial saturation.	NR	Skin temperature (lower leg) increased significantly during both maternal and paternal SSC. No other significant effect.
	Behavioural	Behavioural states		No significant differences were found between M and P-SSC
Cong et al.[28]	Biochemical	Parental salivary oxytocin and cortisol levels	NR	Maternal and paternal oxytocin levels were significantly increased during-SSC from baseline. Maternal oxytocin dropped post-M-SSC, but paternal oxytocin continued to be maintained at a higher level during post-P-SSC. Both maternal and paternal cortisol levels significantly decreased during SSC from baseline. Maternal cortisol dropped post-M-SSC, but paternal cortisol increased post-P-SSC.
	Psychological (father)	Parental anxiety score		Both mothers' and fathers' anxiety levels decreased during SSC from baseline, and then increased post-SSC. Mother–father dyads also showed correlated or synchronised stress and anxiety.
Gloppestad[34]	Behavioural (father)	Initial time for SSC	NR	Fathers held their infants later than did mothers
Heo and Oh[22]	Psychological (father)	Paediatric Nurse–Parent Partnership Score Parental Attachment Score	NR	In the intervention group, the fathers' attachment scores increased more than the mothers. The fathers' partnership scores with nurses in the intervention group increased less than the mothers' scores, but it was a significant increase compared with the fathers' scores in the control group.
	Nutritional	Infants body weight		No difference in infants' weight between the intervention and control groups.
Johnston et al.[33]	Physiological	Time for heart rate to return to baseline	Blinded	The difference in time to return to SSC heart rate before the heel lance was significantly lower for M-SSC.
	Behavioural	Pain level		At 30 and 60 s after the heel lance, infants in M-SSC = lower scores on the Premature Infant Pain Profile than when in P-SSC. At 90 and 120 s = no differences.
Kim et al.[13]	Physiological	Oxygen saturation levels, heart rate, respiratory rate	NR	Tactile stimulation by fathers stabilised infants' physiological status, including oxygen saturation levels, heart rate and respiratory rate
	Psychological (father)	Attachment level		Increased paternal attachment levels
Matricardi et al.[23]	Psychological (father)	Parental stress level	NR	Parents of the intervention group reported lower post-intervention stress levels than parents of standard support group. Mothers showed higher levels of stress than fathers. The intervention was effective in reducing the stress-role alteration in mothers (stress levels associated with parents' feeling about the parental role and the relationship with their infant), but not in fathers.
Mirnia et al.[24]	Biochemical	Infant salivary cortisol level	Blinded	Control and intervention groups showed decreasing cortisol levels during the study, the reduction in the P-SSC group was more than the control group, with no significant difference. The intervention showed no significant statistical difference at any time interval of the study.

(Continued)

TABLE 2 (Continued)

Author, reference	Outcome domain	Outcome measures	Coding (Blinded)	Significant results
Mörelius et al.[25]	Biochemical	Infant and maternal salivary cortisol level	Blinded	Infants in SSC = lower salivary cortisol reactivity at 1 month. Correlation between the mothers' and the preterm infants' salivary cortisol levels at 4 months in the SSC group, but not in the standard care group.
	Psychological (father)	Parental stress level and depression		Fathers in SSC = lower scores on the Swedish Parenthood Stress Questionnaire compared to fathers in standard care. At 4 months = no difference in the Edinburgh Postnatal Depression Scale between these 2 groups
	Nutritional	Breastfeeding		No difference for breastfeeding.
Saliba et al.[29]	Behavioural	Infant behavioural states	Blinded	Both maternal and paternal speech modified infant behavioural state, but no significant difference in the behavioural state distribution between mother's and father's voice presentation. Infants spent more time in a quiet alert state when they heard both voices compared to no vocalisation baseline.
Srinath et al.[30]	Physiological	Heart rate, oxygen saturation, temperature, blood pressure (in infant and parents)	NR	No significant differences in the changes in mean heart rate, temperature, oxygen saturation, systolic blood pressure, mean blood pressure and salivary cortisol before and after M-SSC versus P-SSC in the neonates.
	Biochemical	Infant salivary cortisol level Parental salivary cortisol level		Changes in mean heart rate, temperature and salivary cortisol before and after kangaroo care were similar between mothers and fathers.
Varela et al.[26]	Physiological	Blood pressure	Blinded	Decrease in fathers' cortisol levels and systolic blood pressure as a reduction in physiological stress response
	Biochemical	Cortisol levels		
Vittner et al.[31]	Biochemical	Infant and parent salivary oxytocin and cortisol levels.	NR	Salivary oxytocin levels increased significantly during SSC in mothers, fathers and infants. Infant salivary cortisol levels decreased during SSC, both for M-SSC and P-SSC conditions.
	Psychological (father)	Parental stress Parent-infant interaction		Parents with higher oxytocin levels exhibited more synchrony and responsiveness during interaction with newborns
Vittner et al.[32]	Biochemical	Parental salivary oxytocin and cortisol levels	NR	Significant negative correlation between paternal engagement and paternal oxytocin and cortisol levels (as paternal oxytocin or cortisol levels increased, there was a significant decrease in paternal engagement)
	Psychological (father)	Parental engagement		Significant negative correlation between infant oxytocin levels and maternal engagement (as infant oxytocin levels increased during SSC, maternal engagement scores significantly decreased at discharge).

Abbreviations: M-SSC, maternal skin-to-skin; NICU, neonatal intensive care unit; OXT, oxytocin; P-SSC, paternal skin-to-skin; SSC, skin-to-skin.

stimulation[13] stabilised the infants' physiological status, including oxygen saturation levels, heart and respiration rates, when compared to standard care. Only one study showed that it took a long time for the heart rate to return to baseline after a painful procedure when paternal, rather than maternal, SSC was provided.[33]

In the behavioural domain, no significant differences in the infant's states were found between maternal and paternal SSC[27] and no significant differences in the behavioural state distribution were found between the voice presentation of fathers and mothers.[29] In this last study, infants spent more time in a quiet alert state when they heard either the father's and mother's voices, compared to a no vocalisation baseline.[29] The time from birth until the father held their premature infant was significantly different compared to the mothers and the fathers began SSC later than the mothers.[34] After a painful procedure, namely 30 and 60 s after a heel lance, one study showed that infants with maternal, rather than paternal, SSC had lower scores on the Premature Infant Pain Profile.[33] However, these differences disappeared 90 and 120 s after the intervention.

One study found no differences in the nutritional domain weight when they compared the intervention and control groups.[22] The intervention involved both parents in the care of their preterm infants and consisted of three stages: an individualised interaction stage, a pre-participation stage and an active participation stage.

Another study of biochemical levels found that maternal and paternal oxytocin levels significantly increased, and cortisol levels decreased, when SSC was compared to baseline. There were also differences between maternal SSC and paternal SSC in the post SSC phase.[28] No significant differences were found in a study[41] that compared a paternal SSC and standard care control group. Another,[25] reported similar biochemical level findings between mothers and fathers when they provided continuous SSC. Infants in both SSC intervention groups had lower salivary cortisol reactivity at 1 month. A study that focused on decreased paternal cortisol levels found that they were associated with lower systolic blood pressure and this indicated that SCC reduced their physiological stress response.[26] Similar decreases in cortisol levels and increased oxytocin levels were found in mothers and fathers when SCC was compared to standard care.[31] Finally, a significant negative correlation between paternal engagement and paternal oxytocin and cortisol levels was reported by one study.[32] Another study[31] noted that significant decreases in paternal engagement were associated with increased oxytocin or cortisol levels. Similarly, when infant oxytocin levels increased during SSC, maternal engagement scores significantly decreased at discharge. Finally, fathers with higher oxytocin levels exhibited more synchrony and responsiveness during interactions with their newborn infants.[31]

Authors reported the psychological effects on the fathers' affective involvement in interventions in seven out of the 14 studies. During interventions, anxiety[28] and stress[23] levels decreased among fathers, while attachment scores increased,[13] sometimes by even more than for mothers. Partnership scores with nurses increased as well.[22] Finally, mother–father dyads showed correlated or synchronised stress and anxiety.[15]

3.5 | Differences between maternal and paternal interventions

Several studies reported similar effects for interventions driven by fathers and mothers. Physiological responses during SSC were similar between both interventions,[27] even if fathers began SSC later than mothers.[34] Biochemical responses during SSC were similar and mother–father dyads showed correlated or synchronised levels of stress and anxiety.[15] Finally, infants showed similar behavioural states when their mothers and fathers spoke to them.[29]

Few studies reported differences between mothers and fathers who took part in interventions. During painful procedures, newborn infants showed lower pain scores when they were held in SCC by their mothers and their pain scores took longer to return to baseline when they were held in SCC by their fathers.[34] In another study, there were post-SSC phase differences between the parents, with higher levels of oxytocin and cortisol in the fathers.[28]

4 | DISCUSSION

Parent participation in the early phases of an infant's development in the NICU has been shown to predict better neurodevelopmental outcomes.[35] To the best of our knowledge, this was the first systematic review to evaluate the specific effects of fathers' early active intervention with preterm infants.

The main results indicate that studies on paternal-driven interventions in the NICU were limited and mainly restricted to basic SCC, with few exceptions. Interventions that involved mothers and fathers showed similar general positive effects in the infants' physiological and behavioural domains, with additional beneficial effects on paternal affective and mental health. Few differential effects were seen between maternal and paternal interventions.

4.1 | The predominance of SSC and tactile interventions

Our results indicated that SSC and tactile initiatives were the main paternal intervention types that were evaluated, with limited systematic assessment of other types of active paternal involvement. This finding makes sense as SSC is a multisensory experience for the infant and is one of the most effective and well-evaluated early parental interventions, with well-evidenced benefits for the infants and the parents.[36] However, SSC can also be included in multisensory interventions that involve the tactile SCC experience, together with face-to-face vocal communication and affectionate touching with reciprocal gazing. These interventions can help fathers intuitively and progressively co-regulate and interact with their preterm newborn infants.

As reported in a previous study,[37] fathers of preterm infants show intuitive abilities to communicate with their preterm infants. However, only one study to date has provided evidence on the

characteristics of maternal versus paternal face-to-face vocal interactions with preterm infants in the NICU.[29]

4.2 | The beneficial effects of paternal interventions

What is particularly interesting is that the vast majority of the studies we included showed a general beneficial effect of paternal interventions on fathers. Actively intervening in the early care of the infant supported the early acquisition of parental skills by fathers. It was associated with lower stress and anxiety levels and with a significant increase in attachment scores, which underlined the importance of the affective aspects of early father–infant interactions. Early fathering experiences also affected them at a biochemical level,[31] laying the ground for a long-term positive effect on father–infant interaction.[38] It is also likely that such early involvement allowed fathers to develop a more intense affective bond, which promoted their long-term affective relationships with their children.

4.3 | Paternal versus maternal interventions

Several of the studies in this review confirmed that both paternal and maternal interventions showed similar general effects on infants, at physiological, behavioural and biochemical levels. However, minor differences were found between mothers and fathers, especially at the biochemical level and with regard to the great effect that mothers had on pain protection.[33] Finally, stress treatment should recognise that mothers generally report more stress than fathers.[23]

Despite the fact that fathers had different experiences in the NICU than mothers, as assessed with tests or ad hoc interviews,[6,23] most of the studies on prematurity had mainly concentrated on mother–infant dyads.[39] There are a number of possible reasons for this. One important reason, from a social and political perspective, is that in most countries fathers do not have the same rights as mothers in terms of parental leave. Fathers also tend to be included in infant care less frequently, due to cultural attitudes to parenting roles and social networks. Other factors that limit fathers from being present in the NICU include neonatal services that enable mothers to stay with their babies while they are hospitalised. The studies included a wide variety of geographical areas, with heterogeneous cultural backgrounds, and issues with transport and access meant that fathers could not always be present. The combination of these factors has provided great obstacles for fathers being present in the NICU and evaluating their active intervention.

The last few decades have seen major changes in the affective and social perceptions of maternal and paternal roles and in the acceptation of major theoretical frameworks. These include attachment theory, which is largely based on the mother–infant dyad. In the 1990s there was a dramatic increase in heterogeneous studies that emphasised the role of fathers in children's development.[40] This led to widespread recognition that the care provided by fathers and mothers was complementary, important and different.[41] Today, this issue is at the heart of the debate on NICU use and experiences. Fathers have reported lower self-confidence ratings than mothers when their infant was in the NICU. This lack of confidence can be linked to the size and apparent fragility of the premature newborn infant and the medical technology used in the NICU.[2,3,7,9] One study that covered the first days after a premature birth provided a striking contrast between the parents and suggested that fathers were more able to get involved immediately after the birth.[5]

Despite these difficulties, several studies have shown that the fathers of preterm infants are keen to play an active caring role.[2,5,7,17] Others have reported that reluctant fathers felt they were forced into caring for their infants.[6,9] Finally, the progressive development of fathers' skills, and their increasing involvement in infant care, have been shown to support father–infant affective bonding.[17,18]

4.4 | The importance of fathers' early intervention in the NICU

In the last decades, studies on the effect of early father–infant interaction on the child's development have gained much interest. This has led to multiple techniques for analysis,[42] including cross-cultural perspectives.[43] These studies show that engaging fathers in the early phases of development affect children's affective, social, behavioural, psychological and cognitive outcomes.[44] It also has positive benefits on early mother–infant interaction.[18]

In fact, a timely paternal presence during the early and crucial periods of an infant's development can also have indirect impacts on specific maternal domains. Father–infant SCC improves breastfeeding rates,[45] including exclusive breastfeeding in the first 3 months.[20] Involving fathers has also been associated with increasing mothers' caregiving-related hormones, such as oxytocin and prolactin.[46]

4.5 | Supporting early paternal involvement with preterm infants

This review demonstrates the benefits that early interventions had on both fathers and their infants. This, in turn, underlines the importance of providing fathers with better support so that they can increase their early presence and involvement while their preterm infant is hospitalised in the NICU. Practical recommendations for neonatal teams have been drafted by the Family Initiative's International Neonatal Fathers Working Group. These aim to support the development of father–infant affective bonding and enable fathers to experience more complementary co-parenting.[47] Other studies have recommended that their presence and involvement should be encouraged and they should receive the support they need on their journey to fatherhood.[24-28] Despite a number of programmes that support fathers being actively present in the NICU, the average frequency and duration of presence per day remain consistently lower

for fathers than for mothers.[48] This suggests the need to test and adopt measures to increase paternal involvement in NICUs.

Individual and non-transferable parental leave rights have been developed in order to encourage more men to spend time with their new infant.[49] Studies on paternal leave have shown that fathers who took leave were more involved in childcare and housework.[50] It is important to recognise the impact that the presence of fathers has on both infant development and parental bonding. In addition, governments and societies should make it easier for fathers to get more involved in the early care of their infants, for example by developing or reinforcing paternity leave.

Most European Union member states now provide statutory parental leave,[51] but the Nordic countries were forerunners in parental leave in the 1970s.[52] The main aim of developments in Nordic parental support has been to promote gender equality, by creating a social environment where women and men have the same access to vocational, family and personal fulfilment.[53]

It is essential that societies provide greater support for fatherhood if they are to endorse gender equality and to emphasise the need for co-parenting policies. As paternal leave and benefit policies continue to evolve, there might be an increased interest in examining the short and long-term impacts that actively involved fathers have on child and family health.

5 | CONCLUSION

We are now increasingly aware of the importance that the active and timely involvement of fathers have on the cognitive, affective and social development of infants and children. Despite this, limited studies on paternal involvement indicate that fathers are only partially involved in early developmental interventions in NICUs. These interventions appeared to be limited to SSC or tactile domains. Other types of interventions that actively involve fathers in face-to-face vocal communication and affectionate touching are recommended.

In general, interventions involving fathers and mothers showed similar positive effects, which suggests that they should be included as active partners in the care of their preterm newborn infants. Our review shows that when fathers were present in the NICU it was beneficial for them as well as their infant. Early involvement was important for the fathers' own affective and mental health, for acquiring their paternal role and for their attachment and responsiveness during interactions.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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