A scoping review of mother–child separation in clinical paediatric settings

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Abstract
There is increasing evidence to suggest that autonomic regulation of hospitalised infants is affected by separation from their mother. This review explored the extent of the evidence relating to the impact of separation on infants and children and aimed to identify suitable measures of the impact of mother–child separation. We conducted a scoping review of seven databases using the main search terms ‘physiological’, ‘psychological’, ‘infant/child’, ‘maternal separation’ and ‘hospital’. Thirty-four articles containing data relevant to the effects of mother–child separation on either member of the pair were included. Findings highlight the central importance of the mother’s presence in mediating the stressful effects of hospitalisation on her child. The majority of articles reported on psychological effects of separation on mothers of infants or on younger children. We identified no articles reporting on physiological effects on the older child or mothers of older children or psychological effects on mothers of older children. Only nine articles used validated tools to measure the effects of separation. There is a need for more evidence, based on validated measurement, about the psychological effects of separation on the child, particularly the older child, and on the physiological effects of separation on the mother–child pair during hospitalisation.

Keywords
Child, hospital, infant, mother–child, separation, stress physiological, stress psychological

Introduction
Hospitalisation during childhood is recognised as a stressful healthcare event (Schore, 2000). While maternal presence has long been valued in many paediatric care settings (Davies, 2010), evidence
suggests that the presence of the mother is highly relevant to the autonomic regulation of hospitalised infants and possibly older babies and children (Bergman, 2014).

In recent years, new knowledge from the fields of developmental psychology and infant mental health has confirmed the important regulatory function of maternal presence (Schore, 2005). In the neurosciences, advanced imaging and validated measures of autonomic nervous system (ANS) responses have enhanced understanding of the interrelationships between the ANS of the mother and the child (Bergman et al., 2004; Morgan et al., 2011). These emerging knowledge bases are contributing important new understandings which have not yet changed the way that children are cared for or the way that research into paediatric care is conducted.

Our unit focuses on training children’s nurses and understanding and developing the clinical practice of children’s nurses in Africa. One such recent exploration of clinical practice investigated the impact of maternal presence on infants at a tertiary care facility in southern Africa by measuring the infant’s heart rate variability (HRV) and cardiac impedance (Ssenyonga et al., 2014). The sample was under-powered and researchers were unable to control for the many variables in a clinical practice setting but cautiously concluded that the results pointed towards ameliorating effects of maternal presence on infant autonomic dysregulation. Researchers inferred that infants experience separation intensely and that this can be detected through objective measurement of observable ANS parameters. To make further progress with research into this phenomenon, it was determined that further suitable measures of the impact of mother–child separation needed to be identified. We also wanted to scope existing evidence relating to the impact of maternal separation on older babies and children.

A preliminary search for previous reviews on this topic in the Joanna Briggs Institute (JBI) database of systematic reviews and implementation reports and the Cochrane Database of Systematic Reviews identified a small number of reviews which addressed related topics but none that exactly addressed the questions of interest to us. Our preliminary searching identified a number of discussion/review articles looking at various aspects of mother–child separation and these have been included in the results. We did not find any reviews focusing on the separation of the mother and her older infant/child and none that focused on the possible ameliorating effect of the mother’s presence on the child’s physiology, particularly during illness. Our review extends the summary of evidence beyond the newborn period, focusing on the degree of separation of the mother–child pair in the context of hospitalisation and the reported physiological and psychological effects of the separation on the pair.

**Aim**

The aim of this article was to identify existing evidence in relation to separation of the mother–child pair in clinical paediatric settings. Our specific questions were (1) What are the contexts in which the mother–child pair is described as being separated? (2) What are the reported physiological and psychological effects of separation on the mother and child? (3) What tools are being used to measure the effects of separation? (4) What are the gaps in the knowledge base?

**Method**

A scoping review was performed to identify, select and combine the results of multiple articles. Scoping reviews offer particular strengths as an exploratory review method when it is suspected that
substantial gaps in both research and general knowledge exist (Peters et al., 2015), and can be a helpful first step in investigating what research has been done in a field and what other knowledge exists (Colquhoun et al., 2014).

The Preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement, endorsed by the JBI, was consulted as a rigour guide to ensure transparency and replicability of the process while limiting bias – see Figure 1 (Moher et al., 2009; Peters et al., 2017). The inclusion criteria were based on the elements of population (mothers and infants/children), concept (separation) and context (in hospital). Limits applied to the search were publication date (January 2003 to June 2018), publications in English, age of child (infants: 0–23 months, children: 2–12 years, as per MeSH term definitions) and publications about humans. A 15-year period was defined to ensure inclusion of the most recent research on this topic, informed by researchers’ knowledge of relevant sources exploring impact measurement of mother–child separation (Peters et al., 2017). Following consultation with a health sciences librarian, a search was conducted across seven databases: PubMed, Web of Science, Scopus, CINAHL, PsychInfo, Africa wide and Psych articles. The five main areas searched were ‘physiological’, ‘psychological’, ‘infant/child’, ‘maternal separation’ and ‘hospital’. Google Scholar was searched for any grey literature on the topic. A limitation to this search strategy was the large amount of irrelevant articles that were retrieved due to the broad search terms and the time-consuming process involved in screening these. Articles were first screened by title, then abstract. The full texts were retrieved for all potentially relevant articles and each was read by any two of the authors. Discrepancies regarding the inclusion of an article were discussed among the authors and resolved. Only results relevant to the effects of separation on the mother–child pair were extracted. Data were not limited to any type of variable or study methodology. Articles were only excluded if they did not report on the effects of separation in hospital. A qualitative approach to synthesis was followed to allow for variations in samples and methodologies. The reporting guidelines for scoping reviews produced by the JBI were adhered to (Peters et al., 2017).

We did not identify a consistent definition of separation in the articles we reviewed. We therefore defined the concept of separation a priori as the mother–child pair not being together. We defined the physiological effects on the child and mother as outcomes that relate to the body, relating to tangible, concrete entities that are perceived through the senses and measurable through empirical tools. Psychological effects were defined as outcomes that arise in the mind and that are related to the emotional state of the pair.

Results

The search strategy revealed 1473 articles of which a high proportion (n = 1342) were irrelevant because they dealt with separation outside hospital. Abstracts were retrieved for 131 articles, and an additional 32 irrelevant articles were identified, resulting in the retrieval of 73 full texts. Following a co-review process, a further 37 articles were excluded, resulting in a sample of 36. A Cochrane review written by Moore et al. (2016) included two intervention studies that were found in the database search (Bergman et al., 2004; Nolan and Lawrence, 2009), and the results from these studies are therefore not discussed further. The final sample therefore comprised 34 articles. See PRISMA diagram (Figure 1) for search results. Relevant data were extracted and tabulated according to descriptive studies, intervention studies and review/discussion-type articles (Supplementary Tables 1–3). Study participants included mothers, infants and children. Five articles included parents and not mothers only. Two of these articles (Koller et al., 2006; Kerr et al., 2017)
Figure 1. Preferred reporting items for systematic reviews and meta-analyses flow diagram.
report results of interviews with parents and one review article (Boykova, 2016) included parents collectively. Reported results did not separate mother results from fathers; hence, they were not excluded. The remaining two studies (Alves et al., 2016; Sankar et al., 2017) explored the effects of separation on breastfeeding and these extracted results therefore relate to mothers only. Reference lists of included articles were scanned for any additional sources of evidence. No additional articles were added. Results are reported under the main contributions made to the knowledge on the effects of separation on the mother–child pair. Findings related to the fourth review question (What are the gaps in the knowledge base?) are reported in the summary section under each category and are later discussed collectively prior to the conclusion.

**Contexts of separation**

Analysis resulted in the identification of three main contextual categories:

1. Separation of newborn infants and their mothers\(^n=7\).  
2. Separation due to either the mother or the infant being admitted to intensive/special care\(^n=25\).  
3. Separation due to care practices\(^n=2\).

Many different forms of mother–child separation were described, spanning a variety of healthcare settings, and we found little consistency in the way that the concepts of ‘separation’ or ‘presence’ were applied.

The contexts of separation are used to structure presentation of the remaining results. For each contextual category, findings are presented in relation to the next two review questions, that is (2) What are the reported physiological and psychological effects of separation on the child and the mother? and (3) What tools are being used to measure the effects of separation? Question (4) What are the gaps in the knowledge base? is discussed at the end of the results.

**Separation of newborn infants and their mothers**

The extent of separation reported in this context varied between zero separation due to continuous skin-to-skin contact or breastfeeding and brief separation of the mother–child pair.

**Effects of separation (child, physiological).** Moore et al. (2016) published a Cochrane systematic review of trials to assess the effects of immediate or early skin-to-skin contact on healthy newborn infants and their mothers compared to standard contact, that is infants held swaddled or dressed in their mother’s arms, placed in open cribs or under radiant warmers. The infants in skin-to-skin contact had better stabilisation on three physiological parameters as measured by the SCRIP tool, a validated measure of stability of the cardiorespiratory system in preterm infants, higher blood glucose levels and similar temperatures to infants in standard care (Moore et al., 2016).

Four other intervention studies were identified that reported on the physiological effects of separation on the infant. In two of these studies (Mörelius et al., 2005; Morgan et al., 2011), the subjects served as their own controls, with comparison of infants’ physiological outcomes in skin-to-skin contact with their mothers and sleeping alone. In Mörelius et al.’s (2005), study infants’ salivary cortisol, heart rate, oxygen saturations and pain levels were measured during and after skin-to-skin contact on two out of four occasions (first and fourth skin-to-skin contact). The infants’
physiological response showed a decrease in pain scores and heart rate during skin-to-skin contact; cortisol levels were higher at the first skin-to-skin contact than at the fourth indicating clinical stabilisation; they were more relaxed and had a deeper sleep as reflected by their heart rate and behavioural state (Mörelius et al., 2005). Morgan et al. (2011) measured infants’ level of arousal and HRV. Results revealed that separation, that is no skin-to-skin contact, was associated with a dramatic increase in HRV power and had a negative impact on quiet sleep duration (Morgan et al., 2011). Chi Luong et al. (2016) compared the effects of skin-to-skin contact and the conventional method of care in Vietnam which involves separation of the mother and her low birth weight infant. In a large cohort \((n = 100)\), measures of the infants’ physiological stabilisation were the SCRIP score and blood glucose levels (Chi Luong et al., 2016). Results revealed a significantly greater SCRIP score in the skin-to-skin contact group at 120 min \((5.66 \pm 0.72 \text{ vs } 4.72 \pm 0.83, p < 0.0001)\) and 360 min \((5.82 \pm 0.66 \text{ vs } 5.24 \pm 0.72, p = 0.0001)\). Infants in skin-to-skin contact required significantly less IV fluids \((9/50 \text{ vs } 26/50, p < 0.001)\) and antibiotics \((9/50 \text{ vs } 26/50, p = 0.004)\), while separated infants experienced bradycardia, decreased respiratory rates, lower temperatures and blood glucose levels (Chi Luong et al., 2016).

Other infant physiological outcomes reported in the intervention studies were pain scores during heel lance (infants breastfed and in skin-to-skin contact, infants given sucrose and in skin-to-skin contact, infants in skin-to-skin contact and infants given sucrose) (Gabriel et al., 2013). Gabriel et al. (2013) found that breastfed infants in skin-to-skin contact were associated with significantly lower pain scores than other forms of non-pharmaceutical analgesia tested.

In a review article by Groer et al. (2015), the authors described current understandings of the nature of the microbiome of the very low birth weight infant. Factors that influence the infant’s microbiome include caesarean section delivery, antibiotic use, breastfeeding and skin-to-skin contact (Groer et al., 2015). The authors recommend that use of the mother’s own milk should be a priority, antibiotics should be used only when essential and separation from the mother should be avoided as skin-to-skin contact is essential to microbial transfer (Groer et al., 2015).

### Effects of separation (mother, physiological)

Only one study (Mörelius et al., 2005) reported physiological effects on the mother. Mörelius et al. (2005) reported a decrease in maternal salivary cortisol and heart rate during skin-to-skin contact.

### Effects of separation (mother, psychological)

Mörelius et al. (2005) also investigated how skin-to-skin contact influenced the stress of the mothers \((n = 17)\) measured by a visual analogue scale. The results showed the highest stress score immediately prior to the first skin-to-skin contact which decreased by 89% following the mothers contact with her infant.

Another context in which the psychological benefits of skin-to-skin contact and not being separated have been highlighted as important is for mothers of stillborn infants (Lindgren et al., 2014). When mothers were interviewed, they expressed that leaving the infant at the hospital goes against a mother’s biological instinct to care for and protect her infant and described their identity as mothers being demolished at the time of separation (Lindgren et al., 2014).

### Measures of effects

Five studies reported on the physiological effects of separation, as measured through empirical tools (Chi Luong et al., 2016; Gabriel et al., 2013; Moore et al., 2016; Mörelius et al., 2005; Morgan et al., 2011), including infant heart rate, respiratory rate, oxygen saturations, blood glucose, level of arousal, cardiac inter-beat intervals, salivary cortisol and HRV.
physiological measures included cortisol level and heart rate. Maternal psychological measures of mood and stress were measured by validated tools (Mörelius et al., 2005).

One study used interviews to elicit mothers’ reports of the effects of separation (Lindgren et al., 2014).

Summary. The results of infant physiological outcomes presented by validated measures indicate better overall physiological outcomes when infants are in skin-to-skin contact. The psychological effects on the mother reported through validated tools, and interviews highlight a better mood state when mothers are in skin-to-skin contact with their infants. The results highlight the importance of skin-to-skin contact for the health and welfare of the pair.

Separation due to either the mother or the infant being admitted to intensive/special care

Articles related to this context involved the greatest extent of separation of the mother–child pair. Most (25/34) of the articles included in the review are reported here.

Effects of separation (child, physiological). D’Agata et al. (2016) published a research synthesis of Infant Medical Trauma in neonatal intensive care units (NICU). The authors describe how the combination of parental separation, stress and pain contribute negatively to the infant’s allostatic load, increasing vulnerability and the risk for poorer outcomes subsequently (D’Agata et al., 2016).

In a repeated measures randomised controlled trial conducted by Dearn and Shoemark (2014), infants’ behavioural state, oxygen saturation and heart rate were measured during exposure to lullaby music with and without their mothers. Infants’ physiological and behavioural regulation were affected by the presence and departure of their mothers, displaying an increase in oxygen saturations when mothers were present (CI 0.12–1.40), despite mothers not interacting with the infant for most of the time when present. Infants spent less time in quiet sleep when separated from their mothers. There was no significant independent effect of music on the infants (Dearn and Shoemark, 2014).

Effects of separation (child, psychological). Only one study (Pennestri et al., 2015) explored the psychological effects of separation on the infant. Pennestri et al. (2015) measured the difference in attachment security at 36 months between children who received special care in the NICU or in an incubator at birth and children who did not. Logistic regression revealed an odds ratio of 6.1 for developing disorganised attachment after a stay in the NICU, when controlling for confounding variables (CI 1.76–21.02). However, the degree of separation of the mother–child pair during the NICU is not clear (Pennestri et al., 2015).

Effects of separation (mother, physiological). Several articles which reported on the effect of separation on breastfeeding are included here as the physiological process of breast milk production and demand are linked to the effects of separation. Mylod (2015) discussed current understandings in relation to breastfeeding hospitalised children, highlighting the links between exclusive breastfeeding, aided by the presence of the mother, and the prevention and reduction of myriad infections and conditions (Mylod, 2015). Skin-to-skin contact facilitates breastfeeding, yet the separation of the mother–child pair for assessment, stabilisation and transfer to specialist care impedes the initiation of breastfeeding (Mylod, 2015).
Mothers described ambivalent attitudes towards expressing breast milk (Hurst et al., 2013; Sankar et al., 2017). Mothers felt that expressing breast milk was therapeutic and represented a practical act of caring for their infants (Hurst et al., 2013; Ikonen et al., 2016). The majority of mothers felt separation from their infant hindered milk supply (Alves et al., 2016; Chaplin et al., 2016; Ikonen et al., 2016). The determination of mothers to breastfeed their infants was evident in a study by Mukwenda et al. (2017) where mothers who had been admitted to the ICU to recover from eclampsia negotiated stairs every 3 hours in order to reach the nursery (Mukwenda et al., 2017).

**Effects of separation (mother, psychological).** Negative impacts of separation on mothers’ emotional states were widely reported. De Macedo et al. (2007) measured mothers’ mood variation before and after visiting their infants in the NICU. Mothers who engaged in kangaroo mother care reported more positive mood states than mothers whose infants were nursed in incubators, and these differences were accounted for by prolonged contact with the infant (De Macedo et al., 2007).

The separation of the mother–child pair was associated with emotional chaos, anxiety, stress, distress, deep loss, sadness and a yearning to be together (Bayes et al., 2012; Chaplin et al., 2016; Elmir et al., 2012; Flacking et al., 2006; Gulla et al., 2017; Lindberg and Öhrling, 2008; Mukwenda et al., 2017; Wigert et al., 2006). Mothers of preterm infants reported a sense of loss for their full-term infant (Flacking et al., 2006), emptiness at no longer being pregnant (Baum et al., 2012) and unprepared for the NICU experience (Wigert et al., 2006). Mothers felt uncertainty with regard to who was looking after their infant (Hammarlund et al., 2012; Elmir et al., 2012; Mukwenda et al., 2017; Wigert et al., 2006) and worry over their infant’s health (Akbarbegloo et al., 2013; Lindberg and Öhrling, 2008). Mothers were stressed about separation and not being able to help or protect their infant from painful procedures (Akbarbegloo et al., 2013).

In an intervention study by Kerr et al. (2017), real-time images of the infant were transmitted via webcam from the neonatal unit to the mother’s bedside. Parents reported an enhanced feeling of closeness and emotional well-being with technology bridging the gap of separation by providing visual proximity to their infant (Kerr et al., 2017).

Nelson’s (2003) meta-synthesis identified the basic process of maternal transition as centring on mothers experiencing the presence of their child and being involved in their care. Mothers found the transition to motherhood a struggle when their infants were admitted to the NICU (Akbarbegloo et al., 2013; Baum et al., 2012; Flacking et al., 2006; Hurst et al., 2013; Lindberg and Öhrling, 2008; Shin and White-Traut, 2007) and when separated from their infants due to their own incapacitation following surgery (Bayes et al., 2012; Chaplin et al., 2016; Elmir et al., 2012). Mothers lamented lost bonding time with their infant and the interruption to their new mothering role (Baum et al., 2012; Bayes et al., 2012; Chaplin et al., 2016; Elmir et al., 2012; Flacking et al., 2006; Hurst et al., 2013; Lindberg and Öhrling, 2008; Shin and White-Traut, 2007). Greater time spent with their infant and higher levels of involvement in their care contributed to more secure parenting identities for mothers (Flacking et al., 2006; Lindberg and Öhrling, 2008). The results of Akbarbegloo et al.’s (2013) parent stressor scale (PSS) administered to 300 mothers revealed that the subscale of ‘relationship with the baby and parental role’ scored significantly higher than the subscales of ‘NICU environment’ and ‘how the baby looks, behaves and treatment’ as a source of maternal stress (mean rank 2.11 vs 1.98 and 1.91, \( p = 0.047 \)).

Separation of a mother from her newborn baby due to NICU admission affects neurobiology associated with the initial bonding period (Boykova, 2016; Olza-Fernández et al., 2014). In Olza-Fernández et al.’s (2014) review, the authors discuss the hormonal cascade in the maternal and infant...
brain at parturition, the early post-partum period and lactation which prime the mother for initial-
ation and consolidation of attachment. Elicitation of neuroendocrine changes associated with
mother–infant synchrony essential to the initial bonding process is impaired by separation, with
long-term effects on the mother–child interaction and patterns of mothering (Olza-Fernández et al.,
2014). Boykova’s (2016) review highlights lost initial bonding time, mothers not feeling like a
mother and the risk for the mother–child pair developing strained relationships (Boykova, 2016).

Measures of effects. Very few articles (n = 9) reported physiological effects of separation, and only
one study (Dearn and Shoemark, 2014) used validated tools to record infants’ physiological
measures of separation. Two studies (Akbarbegloo et al., 2013; De Macedo et al., 2007) used
validated measures of mothers’ psychological effects of separation. Mothers’ psychological effects
of separation were elicited through structured questionnaires (Ikonen et al., 2016), semi-/structured
interviews (Baum et al., 2012; Bayes et al., 2012; Elmir et al., 2012; Flacking et al., 2006; Hurst
et al., 2013; Lindberg and Öhring, 2008; Mukwenda et al., 2017; Wigert et al., 2006), interviews
and journal writing (Chaplin et al., 2016), protocol writing (Hammarlund et al., 2012) and focus
groups (Gulla et al., 2017). Three studies interviewed mothers and fathers (Alves et al., 2016; Kerr
et al., 2017; Sankar et al., 2017), two of which explored the effects of separation on mothers’
breastfeeding (Alves et al., 2016; Sankar et al., 2017) and one explored the effects of video
technology bridging the gap of separation on parents.

Summary. The effects of intermittent or prolonged separation of the mother–child pair due to either
of them requiring intensive/specialist care are widely reported. However, only one article reported
the positive physiological effects on the infant if the mother is present, with or without skin-to-skin
contact, and only one article reported on the longer-term negative psychological effect on the infant
due to separation during this time. The effects on the mother are vastly reported and include the
battle to establish and maintain breastfeeding and the emotional struggles regarding negative mood
states and transitioning to motherhood.

Separation due to care practices

In this context, separation of the mother–child pair occurred because mothers could not/did not
room in with their hospitalised children (Coyne, 2006) or children were nursed in isolation (Koller
et al., 2006). Only results relating to the psychological effects of separation were found and reported.

Effects of separation. Older children (ages 7 to 14, n = 11) voiced concerns when separated from their
families and indicated that their parents played an important role in ameliorating the negative
aspects of hospitalisation (Coyne, 2006). This was echoed by children in a study by Koller et al.
(2006) who were nursed in isolation. The children in this study were lonely, worried about other
family members and felt they were being punished (Koller et al., 2006).

Mothers and fathers separated from their hospitalised children have reported feelings of
helplessness at not being able to look after their children and felt frustrated by their lack of control
(Koller et al., 2006).

Measures of effect. Only interviews were used in this context and no validated tools. These included
semi-structured interviews with children (Coyne, 2006) and in-depth interviews with children and
their parents (Koller et al., 2006).
The two studies identified reported on the negative psychological effects of separation. As highlighted in Table 1, 9/34 articles reported on the use of validated tools to measure the physiological and/or psychological effects of mother–child separation. The majority (7/9) of these investigated physiological effects. All seven reported on physiological effects on infants, with one also reporting on physiological effects on mothers of infants. Only 4/23 articles which reported on psychological effects used validated measures, one measuring effects on infants and three measuring effects on mothers.

### Table 1. Summary of validated measures.

| Child physiological effect | Child psychological effect | Mother physiological effect | Mother psychological effect |
|----------------------------|----------------------------|-----------------------------|-----------------------------|
| **Moore et al. (2016)** (Cochrane systematic review) | • SCRIP stability of cardiorespiratory system in preterm infants | **Mörelius et al. (2005)** | • Mood scale |
| **Mörelius et al. (2005)** | • Salivary cortisol | | • Stress visual analogue scale |
| | • Heart rate | | • PSS-NICU parent stressor scale |
| | • NIPP | | • Visual analogue mood scale |
| | • NIPS | | |
| **Morgan et al. (2011)** | • Anderson behavioural state scale | **Akbarbegloo et al. (2013)** | |
| | • Inter-beat intervals | | |
| | • Heart rate variability | **De Macedo et al. (2007)** | |
| **Gabriel et al. (2013)** | • NIPS | | |
| **Dearn and Shoemark (2014)** | • Thoman’s primary states taxonomy for behavioural state | | |
| | • SPO2 | | |
| | • Heart rate | | |
| **Chi Luong et al. (2016)** | • SCRIP | | |
| | • Blood glucose | | |

Note: Only nine out of 34 items reported on the use of validated tools to measure the physiological and/or psychological effects of mother–child separation. NIPP: neonatal infant pain profile; NIPS: neonatal infant pain scale; PSS: parent stressor scale; NICU: neonatal intensive care units.

**Summary.** The two studies identified reported on the negative psychological effects of separation. As highlighted in Table 1, 9/34 articles reported on the use of validated tools to measure the physiological and/or psychological effects of mother–child separation. The majority (7/9) of these investigated physiological effects. All seven reported on physiological effects on infants, with one also reporting on physiological effects on mothers of infants. Only 4/23 articles which reported on psychological effects used validated measures, one measuring effects on infants and three measuring effects on mothers.

**Discussion**

All the evidence reported in this review indicates negative effects of separating the mother–child pair. As this is a scoping review, no formal appraisal of quality or bias was conducted. It is possible that design bias, selective reporting or publication bias may be distorting the literature on this topic. However, when considered in the context of long-established research into the attachment theory (Ainsworth, 1978; Bowlby, 1979) and the new knowledge emerging from the rapidly expanding fields of social neuroscience and interpersonal neurobiology (Blakemore et al., 2004; Siegel, 2001), the evidence identified is consistent with current understandings.
The familiar attachment patterns of protest, despair and detachment that are visible in young children separated from their mothers are now understood to result from the loss of regulatory functions that would otherwise be provided through the mother’s presence (Schore, 2000). There is evidence that children and caregivers physiologically regulate one another through social interaction, affecting both immediate physiological status and longer-term brain structure (Carpendale and Lewis, 2004). The principle that separation of the mother–child pair during stressful healthcare events results in harmful effects of dysregulation and subsequent epigenetic changes underlies the clinical practice models of zero separation (Bergman, 2014), kangaroo mother care (World Health Organisation, 2003) and skin-to-skin contact (Moore et al., 2016).

The profile of publications from the previous 15 years suggests that practices resulting in separation persist in many forms and across a full range of healthcare settings. Our review did not aim to identify factors which contributed to mother–child separation. However, we noted that organisational and environmental factors which prevented mothers from being close to their children were widely and consistently documented (Baum et al., 2012; Gulla et al., 2017; Mukwenda et al., 2017; Wigert et al., 2006). These descriptions align with the wider literature on this topic, which suggests that despite an increasingly consistent evidence base, facilitation of parental presence remains an inconsistent and hesitant practice (Suresh and Crowe, 2012; Farah et al., 2007; Gillis and Rennick, 2006).

**What are the gaps in the knowledge base?**

Our review suggests that the evidence base regarding physiological effects of separation on the mother–child pair during hospitalisation is far from comprehensive. We did find recent contributions which suggest that separation of the mother–child pair would negatively impact the beneficial process of microbial transfer from mother to child (Groer et al., 2015; Mylod, 2015), which is an interesting research direction. The absence of any articles reporting on physiological effects of children older than infants suggests that further research into the physiological effects of separation on the mother and hospitalised child, especially older children, is required.

Based on our findings, we consider that saturation of the psychological effects on mothers has been achieved. There is a need for more evidence about the psychological effects of separation on the child, particularly the older child, obtained through the use of validated tools.

Just over half of the studies investigating physiological effects (8/15) used non-validated measures. The majority of the psychological effects were obtained through observational studies and qualitative research. We believe that these effects are indicative of the physiological state and ANS response of the mother–child pair, but this has not been demonstrated in the literature.

**Implications for practice**

Practitioners delivering health services for children should ensure that the increasingly consistent evidence of harmful effects of separation of the mother–child pair informs institutional policies and healthcare practices. Practitioners should actively identify institutional barriers and practices that prevent the pair from being together, particularly during stressful healthcare events.

**Recommendations for future research**

Published outputs from the previous 15 years reveal a lack of integration between research into the psychology and physiology of separation. We suggest that research which integrates these two areas
of inquiry through the application of social neuroscience and interpersonal neurobiology, and which uses appropriate validated empirical measures of ANS response to presence and separation, will be of value.

**Conclusion**

Highlights of this scope review include a comprehensive search strategy and the inclusion of different study designs that spanned 15 years of research. It synthesised the results of 34 articles that reported on the effects of mother–child separation on the mother and child in the context of paediatric clinical settings. We conclude that the current literature consistently underlines the central importance of the mother’s presence in mediating the stressful effects of hospitalisation on her child. Separation of the mother–child pair in hospital constitutes a harmful event and should be avoided as much as possible.

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**Supplemental Material**

Supplemental material for this article is available online.

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