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Beake S, Bick D, Narracott C, Chang Y-S. **Interventions for women who have a planned or unplanned caesarean birth to increase uptake and duration of breastfeeding: a systematic review.** Maternal and Child Nutrition.

Abstract

Rates of breastfeeding uptake are lower after a caesarean birth than vaginal birth despite caesarean rates increasing globally over the past 30 years, and many high-income countries reporting overall caesarean rates of above 25%. A number of factors are likely to be associated with women's infant feeding decisions following a caesarean birth such as limited post-operative mobility, post-operative pain, and on-going management of medical complications which may have triggered the need for a caesarean birth. The aim of this systematic review was to evaluate evidence of interventions on the initiation and duration of any and exclusive breastfeeding among women who had a planned or unplanned caesarean birth. Seven studies, presenting quantitative and qualitative evidence, published in the English language from January 1994 to February 2016 were included.

A limited number of interventions were identified relevant to women who had had a caesarean birth. These included immediate or early skin-to-skin contact, parent education, the provision of sidecar bassinets when rooming-in, and use of breast pumps. Only one study, an intervention which included parent education and targeted breastfeeding support, increased initiation and continuation of breastfeeding, but due to methodological limitations, findings should be considered with caution. There is a need to better understand the impact of caesarean birth on maternal physiological, psychological and physical recovery, the process of establishing lactation and breastfeeding and infant feeding behaviours if effective interventions are to be implemented.

Keywords

Caesarean section, breastfeeding support, skin-to-skin, rooming-in, breast pumps, breastfeeding duration.

Introduction

The World Health Organisation (WHO) and United Nations Children's Fund recommends that infants are exclusively breastfed for a minimum of six months, with continued breastfeeding recommended until child age two years or over to optimise growth, development and health (WHO / UNICEF, 2003).

Breastfeeding has many health benefits for infant and later child health including reduced risk of gastrointestinal infection, otitis media, respiratory tract infection, asthma, allergies, obesity, type 1 and 2 diabetes and sudden infant death syndrome (Bowatte et al. 2015, Giugliani et al. 2015, Horta et

al. 2013, Horta et al. 2015, Lodge et al. 2015, Ip et al. 2009, Victora et al. 2016). Benefits for the woman include lower rates of ovarian cancer, breast cancer and type 2 diabetes (Aune et al. 2014, Chowdhury et al. 2015, Ip et al. 2009, Victora et al. 2016). Breastfeeding has been associated with improved maternal/infant bonding (MacGregor & Hughes 2010) and increased child intelligence (Victora et al. 2016). Despite breastfeeding being a priority public health intervention with robust evidence of benefit, duration of exclusive breast feeding is shorter in high income countries when compared with low income countries. Even so, in low and middle income countries only 37% of infants younger than six months are exclusively breastfed (Victora et al 2016).

Exclusive breastfeeding rates in European countries based on nationally collated data on infants at 6 months of age have been reported as 25% in Spain, 33% in Sweden and 37% in Hungary (Cattaneo et al. 2012), although different definitions and methods used to collate data from each country limit comparisons. In the UK breastfeeding initiation and duration to six months postnatally have increased during the last decade with an increase at six months from 25% in 2005 to 34% in 2010 although rates of exclusive breastfeeding remain persistently low compared to other European countries with only 1% exclusively breastfeeding at six months (McAndrew et al. 2012)

Decisions about infant feeding are informed by a range of complex factors including a woman's socio-demographic background, age, ethnicity and peer support network (McAndrew et al. 2012). It is also clear that medical interventions during labour and birth, including a caesarean section, impact on women's infant feeding decisions and are a cause for concern given increasing global caesarean birth rates, with women who have a planned caesarean birth reported as less likely to intend to breastfeed than women who did not have a planned caesarean birth or had a vaginal birth (Hobbs et al 2016, Prior et al. 2012). An overview of caesarean birth rates in 19 high income countries calculated an average rate of 27% in 2010 with rates in individual countries ranging from 14% to 33%, and rates have increased sharply in the majority of countries in the last 30 years (Ye et al. 2014). In England

during 2013-2014 (Health and Social Care Information Centre 2015) 26% of all births were by caesarean compared to 18% 16 years ago (Department of Health 2001).

There is a negative association between breastfeeding duration, birth complications and medical interventions (Bai et al. 2013, Brown & Jordan 2013, Kozhimannil et al. 2014). McInnis & Chambers' (2008) synthesis of qualitative research into mothers' and health professionals' experiences and perceptions of breastfeeding support noted that breastfeeding was adversely affected by interventions related to the birth or provision of inadequate postnatal pain relief. A critical review of qualitative data of women's and their supporters' perceptions of barriers and enablers to initiation and duration of breastfeeding included post-caesarean birth pain and post-operative recovery amongst the barriers (MacKean & Spragins 2012).

A systematic review and meta-analysis of breastfeeding outcomes after caesarean birth (Prior et al. 2012) which synthesized data from 53 studies from 33 countries found rates of breastfeeding initiation were significantly lower after caesarean birth (pooled OR: 0.78; 95%CI: 0.76, 0.79.). Moreover rates of any breastfeeding and exclusive breastfeeding at six months were lower among women who had a caesarean birth (either planned or unplanned) compared to vaginal birth (normal or instrumental) (pooled OR for any breastfeeding: 0.86; 95%CI: 0.82, 0.91, pooled OR for exclusive breastfeeding: 0.81; 95%CI: 0.67, 0.98). Based on sub-group analysis this review also concluded that although caesarean birth was associated with lower rates of initiation, those who initiated successfully were as likely to exclusively breastfeed at six months as women who had a vaginal birth, suggesting early interventions could be effective following caesarean birth.

A number of factors may influence breastfeeding experiences of women who have a caesarean birth, including maternal physical and emotional responses to surgery as well as infant health and behaviour. McFadden et al (2009) in a small qualitative study involving 10 women from one UK maternity unit noted that women underestimated the emotional and physical effects of surgery on commencing and continuing breastfeeding. Infrequent feeding (Tully & Ball 2014) and women's limited mobility in the

early days following surgery may impede efforts to provide basic infant care (Tully & Ball 2012). High levels of post-operative pain, particularly in the first 24 hours were also found to have a negative impact on women's breastfeeding experiences (Karlström et al. 2007, Tully & Ball 2014). Surgery could impact on postpartum prolactin levels (Wang et al. 2006) and delay lactation (Scott et al. 2007), with potential consequences for infant physiological behaviour (Jain & Eaton 2006). There is also potential for physical separation of mother and infant given higher risk of infant admission to neonatal intensive care as a consequence of respiratory disorders (Kolås et al. 2006). Physical, psychological and emotional support for women to breastfeed following caesarean birth was identified by McFadden et al (2009) as essential to enable women to initiate and establish successful breastfeeding. Of note in this small study was that women whose babies were admitted to neonatal care appeared to require more psychological support, whilst women whose babies accompanied them to the postnatal ward described the need for more physical support.

Reductions in in-patient stay, which in UK hospitals are being informed by the roll-out of 'Enhanced Recovery Pathways' for planned major surgery (NHS Institute for Innovation and Improvement 2008), including caesarean sections (Wrench et al. 2015) which comprise pre-operative assessment and standardised peri-operative and post-operative management to facilitate even earlier hospital discharge could further impact on breastfeeding support needs. Evidence is needed of how maternity service providers could promote interventions to support breastfeeding in this population of women, some of whom will also have had medically complex pregnancies.

No previous systematic reviews have focused on support for breastfeeding following caesarean birth (Schmied et al. 2009, Renfrew et al. 2012). Given the evidence gap the aim of this review was to evaluate evidence of interventions on the initiation and duration of any and exclusive breastfeeding among women who had a planned or unplanned caesarean birth. If appropriate data were available, the impact of such interventions on the views and experiences of women, their key supporters (e.g.

partners, close family members), healthcare professionals and healthcare resources were included. The review protocol was registered on the PROSPERO international prospective register of systematic reviews (PROSPERO 2015:CRD42015015555).

Methods

The review protocol was developed using the process described by The Joanna Briggs Institute to consider and appraise all forms of available evidence relevant to interventions to support breastfeeding outcomes following caesarean birth. The Joanna Briggs Institute is an international research and development organisation that encourages a broad, inclusive approach to evidence. This not only promotes systematic reviews of the meta-analysis of data from randomised controlled trials but also research that uses other approaches, particularly qualitative, economic and policy research (see www.joannabriggs.org). The Joanna Briggs Institute levels of evidence are shown in Box 1:

Box 1. The Joanna Briggs Institute levels of evidence

Levels of evidence for effectiveness

Level 1 Experimental designs (strongest evidence)

Level 1.a – Systematic review of Randomized Controlled Trials (RCTs)

Level 1.b – Systematic review of RCTs and other study designs

Level 1.c – RCT

Level 1.d – Pseudo-RCTs

Level 2 Quasi-experimental designs

Level 2.a – Systematic review of quasi-experimental studies

Level 2.b – Systematic review of quasi-experimental and other lower study designs

Level 2.c – Quasi-experimental prospectively controlled study

Level 2.d – Pre-test – post-test or historic/retrospective control group study

Level 3 Observational – analytical designs

Level 3.a – Systematic review of comparable cohort studies

Level 3.b – Systematic review of comparable cohort and other lower study designs

Level 3.c – Cohort study with control group

Level 3.d – Case – controlled study

Level 3.e – Observational study without a control group

Level 4 Observational – Descriptive studies

Level 4.a – Systematic review of descriptive studies

Level 4.b – Cross-sectional study

Level 4.c – Case series

Level 4.d – Case study

Level 5 – Expert Opinion and Bench Research

Level 5.a – Systematic review of expert opinion

Level 5.b – Expert consensus

Level 5.c – Bench research/ single expert opinion

Levels of evidence for meaningfulness

1. Qualitative or mixed-methods systematic review

2. Qualitative or mixed-methods synthesis

3. Single qualitative study

4. Systematic review of expert opinion

5. Expert opinion

Population / Participants

The review included studies involving women who had had a caesarean birth (planned or unplanned) and had healthy term babies. Participants also included those who provided breastfeeding interventions to these women, such as health professionals, breastfeeding specialists and significant supporters if their experiences and perceptions in relation to the breastfeeding intervention were recorded.

Interventions / Phenomena of interest

Studies included were those with interventions aimed at improving the initiation and continuation of any or exclusive breastfeeding targeted at women who had experienced a caesarean birth. Interventions commencing from the time of birth and/or postnatal period were included, but not those implemented in the antenatal period unless reported as part of a 'package' of care which included specific postnatal interventions. Interventions implemented by healthcare professionals, breastfeeding specialists or peer supporters which could include education, physical care or use of equipment (such as support for breast pumping), were included as were interventions that addressed training needs of supporters.

Comparison / Context

Studies undertaken in acute and/or primary care settings in high income countries as defined by the World Development Indicators (World Bank 2014) were included. For experimental studies, comparison could involve usual care or a control group that was designed as a comparison to a study's proposed intervention

Outcomes

Primary outcomes:

- Rates of initiation of breastfeeding
- Duration of exclusive breastfeeding
- Duration of any breastfeeding

Secondary outcomes:

- Maternal and infant physical and psychological health (e.g. re-admission to hospital)
- Women's confidence, knowledge, attitudes and skills
- Staff knowledge, attitudes and skills
- Women's experiences of support (professional and peer) for breastfeeding
- Impact on healthcare resources
- Breastfeeding problems
- Barriers to provision of interventions
- Views of women's key supporters, for example partners and close family members

To examine the evidence regarding interventions to support breastfeeding outcomes following caesarean birth, specific review questions were developed:

Primary question

What interventions support initiation and duration of exclusive or any breastfeeding following a planned or unplanned caesarean birth?

Secondary questions

1. Can interventions to support breastfeeding following a caesarean birth:
 - improve maternal and infant physical and psychological health including prevention of re-admission to hospital following initial postnatal discharge?
 - enhance women's confidence, knowledge, attitudes and skills in breastfeeding?
 - enhance staff knowledge, attitudes and skills in breastfeeding?
 - enhance women's experiences of support (professional and peer) for breastfeeding?
 - impact on healthcare resources?
 - reduce breastfeeding problems?

2. Are there specific barriers to implementation of interventions to support breastfeeding outcomes after a caesarean birth?

3. What are the views of women's key supporters, for example partners and close family members with respect to interventions to support breastfeeding following a caesarean birth?

Papers which incorporated evidence to address primary and /or secondary questions of interest were included in the review if they met all review criteria.

A search strategy was developed to identify published papers. Papers were restricted to those published in English. A three-step strategy was utilised. In the first stage optimal search terms were identified using CINAHL, MEDLINE and Maternity and Infant Care. Key words and index terms were

then searched using the following databases: CINAHL, MEDLINE, Cochrane Library, EMBASE, Maternal & Infant Care, Scopus, PsycINFO, British Nursing Index, Centre for Reviews and Dissemination database. The third stage involved searching the reference list of identified papers for additional papers and unpublished research and reports published in grey literature from sources including British Library EThOS, Opendoar, Open Grey, NHS Evidence, ProQuest and WorldCat. Websites of national breastfeeding organisations were also searched.

Initial keywords and index terms included breast feeding, lactation, infant feeding, breastmilk, caesarean/cesarean. Studies published in the English language from January 1994 following introduction of the global UNICEF Baby Friendly Initiative to February 2016 were searched. Papers representing quantitative, qualitative, mixed methods research and systematic/literature reviews were included. Studies contained within systematic reviews were not included separately as part of this review. Opinion pieces were excluded as were guidelines and policy papers as they were unlikely to report thoroughly the research design and/or outcomes of empirical research. Studies of breastfeeding support interventions for all women, irrespective of the mode of birth, were excluded unless outcomes for women who had a caesarean birth were reported separately. Studies that only focused on breastfeeding of babies who were premature or admitted to neonatal care were excluded. An example of an electronic search is shown in figure 2.

Insert figure 2

All identified papers were initially assessed for relevance based on the title and then further assessed from reading the abstract. Following the initial assessment, two reviewers (SB, Y-SC), independently assessed the papers against the inclusion criteria and for methodological validity using standardised critical appraisal instruments. Any disagreements that arose between the reviewers were resolved through discussion with a third reviewer (DB).

Critical appraisal tools developed by the Critical Appraisal Skills Programme (CASP) were used for quality assessment, using the appropriate checklist depending on the study methodology. There was no suitable CASP appraisal checklist for one paper, and in this case a checklist designed for quantitative observational studies based on the STROBE statement was used (Barley et al. 2011).

As papers which met the inclusion criteria used a range of research approaches, and only a small number of relevant papers were identified, a decision was made to not exclude any following quality assessment. However, the quality assessment score for each paper is presented (Table 1) to demonstrate the strength of the quality for each paper. Following the Joanna Briggs Institute review development guidance, papers were assigned levels of evidence, based on the study design to provide an estimate of 'trustworthiness' for the review (Joanna Briggs Institute 2014).

Only two included studies were randomised controlled trials (RCT), which considered different interventions meaning data could not be statistically combined for a meta-analysis. Data were therefore synthesised into a narrative summary, with main data extracted and presented in Table 1, by one reviewer (SB), and checked by a second (Y-SC).

Results

A total of 2346 papers were identified from the initial search. After removing duplicates, 1412 papers remained. The titles of these papers were assessed for relevance after which 289 papers were initially considered (Figure 1). Abstracts were independently assessed by two reviewers (SB, Y-SC) to see if they met review inclusion criteria. The full texts of 26 papers were retrieved and assessed further to confirm if they were eligible for inclusion, following which 19 papers were excluded which did not address any of the primary or secondary questions or were incorporated in an included review paper (n=3) (Stevens et al. 2014). The reference lists of retrieved papers were searched for possible further

relevant papers, however no further papers were identified. The remaining seven papers were appraised using the appropriate checklist for the type of study under consideration. The number of possible criteria to meet varied depending on the study design checklist, with most scoring 8 or 9 out of a possible 10 or 11 criteria (table 1).

The seven papers included one narrative literature review (Stevens et al. 2014), four primary research papers (Chertock 2006, Chetock & Shoham-Vardi 2004, Tully & Ball 2012, Chapman et al. 2001) and two quality improvement projects (Brady et al. 2014, Moran-Peters et al. 2014). All referred to care in high-income country settings.

The papers were assessed for levels of evidence (Box 1) to consider the effectiveness of interventions or meaningfulness of qualitative studies based on the study design rather than the quality which was assessed during the critical appraisal process. Three of the papers (Chapman et al. 2001, Stevens et al. 2014, Tully & Ball 2012) were assessed as level one studies (the highest level of evidence) although one (Chapman et al. 2001) scored poorly during the critical appraisal process and in another paper (Tully & Ball 2012) the results were underpowered as a substantial number of women were excluded following recruitment. Three further papers (Chertock 2006, Chetock & Shoham-Vardi 2004, Moran-Peters et al. 2014) were assessed as level three and one as level four (Brady et al. 2014) (table 1).

Few postnatal interventions specifically targeted women who had a caesarean birth with the primary aim of increasing breastfeeding and/or duration of any or exclusive breastfeeding. Interventions identified included immediate or early skin-to-skin contact (Brady et al. 2014, Moran-Peters et al. 2014, Stevens et al. 2014), education and breastfeeding support (Chertock 2006, Chetock & Shoham-Vardi 2004), the use of sidecar bassinets when rooming-in (Tully & Ball 2012) and use of breast pumps (Chapman et al. 2001). A summary of included papers is included in Table 1.

The results presented below reflect interventions investigated in each included paper relevant to the primary and/or secondary questions of this review.

Immediate or early skin-to-skin contact (SSC) after a caesarean birth

A narrative literature review (Stevens et al. 2014) and two quality improvement (QI) projects (Brady et al. 2014 and Moran-Peters et al. 2014), both implemented in North American settings considered immediate or early SSC after a caesarean birth. The main focus of these papers was the feasibility of introducing immediate or early SSC following surgery with data on breastfeeding outcomes also included.

Stevens et al.'s (2014) narrative literature review included seven papers published from 2003 to 2013 (Gouchon et al. 2010, Nolan & Lawrence 2009, Velandia et al. 2010a, 2010b, Crenshaw et al. 2012, Finigan & Davies 2004 and Hung & Berg 2011). Three of these studies were from the USA and the remaining four from Europe. There was wide study heterogeneity. Individual studies were methodologically poor and most had small sample sizes (ranging from six to 50). Although the majority of papers provided some data on breastfeeding and formula feeding outcomes (which generally showed an increase in breastfeeding initiation and reduced formula supplementation) evidence of benefit was inconclusive. There was some evidence that it was possible to commence SSC immediately following a caesarean section, but limited evidence that SSC increased bonding and maternal satisfaction, maintained the temperature of new born babies, or reduced infant stress.

Brady et al.'s QI project (2014) was conducted in a community teaching and referral unit in the USA which provided care for around 1,200 women and their babies each year. It was unclear from the data presented what percentage of these women had a caesarean birth. Prior to the QI project usual practice at the study site was for SSC to be initiated in a post anaesthesia care unit. The plan, do, study, act (PDSA) approach was used to implement an intervention to assess the introduction of SSC in the

operating theatre during the surgery. SSC was successfully implemented with an increase from the first month of full implementation from 43% of women to over 70% of women 10 months later. The increase in exclusive breastfeeding rates during the same period varied month by month from under 10% to just over 20%. In the year before implementation of SSC the exclusive breastfeeding rate on discharge from hospital was 9%.

Moran-Peters et al (2014) carried out a QI project also in the USA, in a 400 bed general community hospital with approximately 1500 births a year and a high caesarean rate (42%). This project focused on women's perceptions of the benefits of SSC and included a purposive sample of six women who had at least one previous caesarean birth who were asked to compare their previous caesarean birth experience with their index pregnancy and birth by caesarean which included early SSC (defined as contact within two hours of birth). Previous standard practice at this hospital had been for babies born by caesarean to be separated from their mothers and taken to the nursery for assessment and bathing, following which they were transferred back to their mothers on the postnatal ward. Two main themes were identified: women's relationships with their infants and women's experiences with breastfeeding. Overall the women reported a more positive breastfeeding experience due to earlier contact with their baby and a calmer, more relaxed approach to breastfeeding enabling the baby to 'latch' better. Study limitations, included potential recall bias in terms of comparison of previous experiences, reasons for having a first caesarean birth, timing of questions and the very small sample size. The authors also acknowledged the limitations of only including women who had had two caesarean births meaning that few women met the study inclusion criteria, although they reported that data saturation was achieved.

Education and breastfeeding support in the early postnatal period

Two papers presented data from the same study on initiation and duration of breastfeeding to four months postnatally following caesarean birth (Chertock 2006, Chertock & Shoham-Vardi 2004). The

intervention implemented included four components: (1) antenatal education on breastfeeding where possible prior to a planned caesarean, (2) early contact and /or breastfeeding in the recovery room (during the first four hours), (3) support and assistance with positioning and attachment of the infant on the breast, and (4) continued follow-up breastfeeding support throughout the hospital stay. The study, a prospective non-randomised evaluation, took place in a university medical centre in Israel with approximately 12,000 births a year and included 306 women in the intervention (101 Muslim, 205 Jewish) and 264 in the control group (93 Muslim, 171 Jewish). Due to the difference in availability of research assistants from the two communities a higher number of Jewish women were approached on the ward than Muslim women, potentially explaining why a higher number of Jewish women were included although the overall refusal rate was actually higher for Jewish women (12%) than Muslim women (1%). As breastfeeding practices are influenced by social and cultural influences, outcomes among these two groups were presented separately. Interviews were conducted in hospital prior to inpatient discharge and follow up phone calls were made at 10 and 16 weeks postnatally.

Most Muslim women (94%) had a general anaesthetic for their caesarean birth compared to just over half (59%) of the Jewish women. A third (28%) of caesarean births among Muslim women were planned, compared with just under half (46%) for Jewish women. Reasons for these differences were not described. Breastfeeding initiation rates (initiation was described as 'ever breastfed the infant') were statistically significantly higher in the intervention groups than control groups (Muslim women $p < 0.05$ [100% vs 95%], Jewish women $p < 0.01$ [98% vs 90%]). The overall breastfeeding rates at 10 and 16 weeks for Jewish women in the intervention group were significantly higher than in the control group ($p = 0.04$ [68% vs 57%] and $p = 0.002$ [59% vs 42%] respectively), with no differences in overall breastfeeding rates found between Muslim women in the intervention and control groups at either follow up time, probably due to the high percentage of women in the control group who continued to breastfeed (97% and 96% respectively). There were statistically significant differences in exclusive breastfeeding rates at 10 and 16 weeks in the intervention groups; Jewish women ($p = 0.001$ [49% vs

32%] at 10 and $p=0.001$ [34% vs 18%] at 16 weeks) and in Muslim women ($p=0.046$ [49% vs 31%] at 10 weeks and $p=0.001$ [31% vs 7%] at 16 weeks). Muslim women in the control group introduced formula supplements significantly earlier than the other groups. Of note was the higher study drop-out rate among Muslim women (56% were followed up to 16 weeks compared to 94% of Jewish women). Reasons postulated for this included women's lack of access to a telephone, phone disconnected or not answered.

The use of sidecar bassinets during in-patient rooming-in

Tully and Ball (2012) in a randomised trial looked at the use of sidecars (3-sided bassinets that locked onto the woman's bed) after a planned caesarean birth. The trial took place in a tertiary maternity unit in the north of England with approximately 5400 births a year. Mother and baby interactions were filmed on the second postpartum night and semi-structured interviews with women conducted before and after the filming. Main outcome measures included infant location, acceptability of the bassinet to women and breastfeeding frequency. Women were recruited antenatally and randomised into either a side-car or stand-alone bassinet, with a sample size of 72 required to detect a group difference in breastfeeding frequency. A total of 86 women were recruited but sufficient video observations to analyse were only collected from 35 maternal and baby interactions. There was no significant difference between breastfeeding frequency, maternal-infant sleep over and midwifery presence, although more women allocated to the side-car bassinet group expressed a preference for this model of bassinet than the women allocated to the stand alone bassinet. Reasons included that it was easier to get to and visualise their infants and they would not have managed to breastfeed without it.

Use of breast pumping

A small trial from the USA (Chapman et al. 2001) investigated the impact of breast pumping between 24 and 72 hours after a planned or unplanned caesarean birth using a double electric breast pump three times a day, for 10 to 15 minutes after a breast feed, over two days. Study objectives were to

measure the impact of increased breast stimulation on milk transfer during the first 72 hours and investigate the potentially dormant effects of breast pumping prior to the onset of lactation on milk transfer during the first two weeks postnatally and duration of subsequent breastfeeding. To assess if there was additional milk transfer as a result of breast pumping babies were test weighed before and after three breastfeeds each day.

Sixty women were randomly assigned to either the pumping intervention group or the control group. Those in the control group (n=30) held the pump to their breasts, without the suction under the constant supervision of research staff, for the same amount of time as the intervention group (n=30). Randomisation was stratified by parity and planned or unplanned caesarean to ensure an even distribution between the two groups. Breast pumping did not improve milk transfer with women in the pumping group tending to have lower milk transfer than those in the control group, and no significant difference in exclusive or any breastfeeding outcomes at seven to 10 days or at five months. The authors proposed several hypotheses for this, including a possible increase in stress hormones for those pumping and a lack of evidence of whether the hormonal response to breast pumping resembles breastfeeding stimulation during first 72 hours postnatally. Other hypothesis considered included that pumping could reduce the frequency and duration of breastfeeding, although the authors did not report that this was a finding in their sample. Given the small amounts of milk 're-fed' and that test weighing for consecutive feeds was avoided, it was considered unlikely that this could have decreased later milk intake. Another possibility considered by the authors was whether by delaying pumping until 24 hours postnatally they had missed a crucial time for breast stimulation, although evidence of this was not collected as part of the study. .

Discussion

Breastfeeding initiation and rates of exclusive or any breastfeeding at six months are lower in women who have a caesarean birth, indicating the importance of robustly evaluated interventions to support women who want to breastfeed (Prior et al. 2012). This review identified very few interventions to specifically support breastfeeding among women who had a caesarean birth, despite this being a population with a potentially greater risk of poorer longer-term maternal and infant health outcomes. The lack of evidence was particularly surprising given the high proportion of women in high income countries who have a caesarean birth and availability of international and national policy and guidance on interventions to support successful breastfeeding (WHO 2003, NICE 2006, Kramer and Kukuma 2012). Apart from early SSC, few other interventions were identified. Most studies were small with data collected from a single study site and none included longer-term follow up beyond four months of the birth. Only two studies were randomised trials, neither of which was of high quality. One (Chapman et al. 2001) had a small sample size and the other (Tully & Ball 2012) was not powered to detect differences in outcomes of interest.

Three of the four interventions considered in this review comprised studies that included findings on initiation *or* duration of breastfeeding. Most studies showed no statistically significant increase in the outcomes of interest. Only Chertock's study (2004, 2006), which compared a 'package' of interventions with usual care, showed any significant improvement in breastfeeding outcomes but was limited by methodological issues. Nevertheless plans for infant feeding women may make during pregnancy (if a planned caesarean birth) and after giving birth are likely to be influenced by a range of complex factors (McAndrew et al. 2012). As such intervention 'packages' which reflect planned or unplanned caesarean birth (Hobbs et al 2016) may be more likely to have an influence on breastfeeding outcomes following a caesarean birth rather than a single intervention.

Stevens et al's narrative review (2014) and Brady et al's QI project (2014) found limited evidence that immediate or early SSC after a caesarean birth increased breastfeeding initiation. The main aim of the review by Stevens' et al was facilitation of immediate or early SSC, with some evidence from the

included studies to support the value of SSC, with findings supported by Brady et al's (2014) QI project. The women in Moran-Peter et al's (2014) QI project reported better breastfeeding experiences following an intervention to support SSC although the study was very small (n=6) and patient inclusion criteria restrictive, limiting the generalisability of the findings.

In terms of a supportive physical environment to enable women to breastfeed, despite the women in the study by Tully and Ball (2012) reporting that they liked the side-car attached to their beds, impacts on breastfeeding frequency outcomes were not statistically significant. The use of breast pumping (Chapman et al. 2001) did not impact on outcomes of exclusive or any breastfeeding, and although not statistically significant at five months postnatally fewer primiparous women in the pumping group were still breastfeeding compared with the control group. The study authors suggested that better understanding of the hormonal impact of breast pumping on milk transfer was needed. However these studies lacked power to show any statistically significant difference in outcomes, and further research is needed.

Robust evidence of the impact of a caesarean birth on lactogenesis and on women's post-operative physical and psychological recovery and ability to care for their infants is also urgently needed. There is a move now for women to be discharged earlier from in-patient care, with an in-patient duration of around 48 hours following a caesarean birth among women in the UK not uncommon (Wrench et al. 2015), following policy recommendations for management of planned surgery (NHS Institute for Innovation and Improvement 2008). The impacts of earlier hospital discharge following caesarean birth on women's ability to breastfeed especially with the increased use of routine medication to expedite post-operative recovery in an environment where support for breastfeeding in hospital and during any home contacts may not be offered consistently is as yet unknown.

In conclusion despite increases in caesarean birth rates in high income countries, very few interventions were identified which specifically targeted additional support for women who wished to breast feed. Of interventions which were assessed, poor study methods, small sample sizes and lack of longer-term follow-up, limit the generalisability of findings. Given the lack of robust evidence there is a need for large scale randomised controlled trials of interventions to support this group of women. However before future trials are conducted, we need evidence of what interventions or package of interventions could potentially provide the most benefit for women undergoing planned or unplanned caesarean birth.

Limitations

Limitations of the review process include exclusion of non-English language studies and studies from low and middle income countries, which could have introduced selection bias. The poor quality of studies and lack of 'gold standard' randomised controlled trials also means that potential risk of bias with particular respect to selection, attrition and reporting of outcomes cannot be excluded. . The paucity of well conducted, large primary studies, with planned longer-term follow up and assessment, limits the generalisability of the review findings. Strengths of the review include a comprehensive search strategy which was developed and implemented to identify all relevant evidence to address our primary and secondary questions. Relevant studies were included which used quantitative and qualitative approaches to data capture, which were subject to rigorous critical review and appraisal in order to meet planned aims and objectives.

Key messages (3-5 key messages)

- Few interventions to increase the uptake / duration of breastfeeding have been specifically considered following planned or unplanned caesarean birth
- The only intervention associated with higher breastfeeding rates following caesarean birth was a multi component intervention, however methodological issues limit the generalizability of findings
- There is a need to better understand the impact of planned and unplanned caesarean birth on women's physiological, physical and emotional health to better inform interventions to improve uptake and duration of exclusive breastfeeding.
- Future research into the effectiveness of interventions should include sufficiently large sample sizes, clear definitions of breastfeeding uptake and duration, take account of planned and unplanned caesarean birth, and include appropriate longer-term follow up
- Policy makers in settings with high rates of caesarean birth need to consider shorter and longer-term consequences for maternal and infant health if breastfeeding support is not addressed as a priority, particularly for women giving birth who have physical and/or psychological co-morbidity

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Figure 1: Flow chart of stages of searching

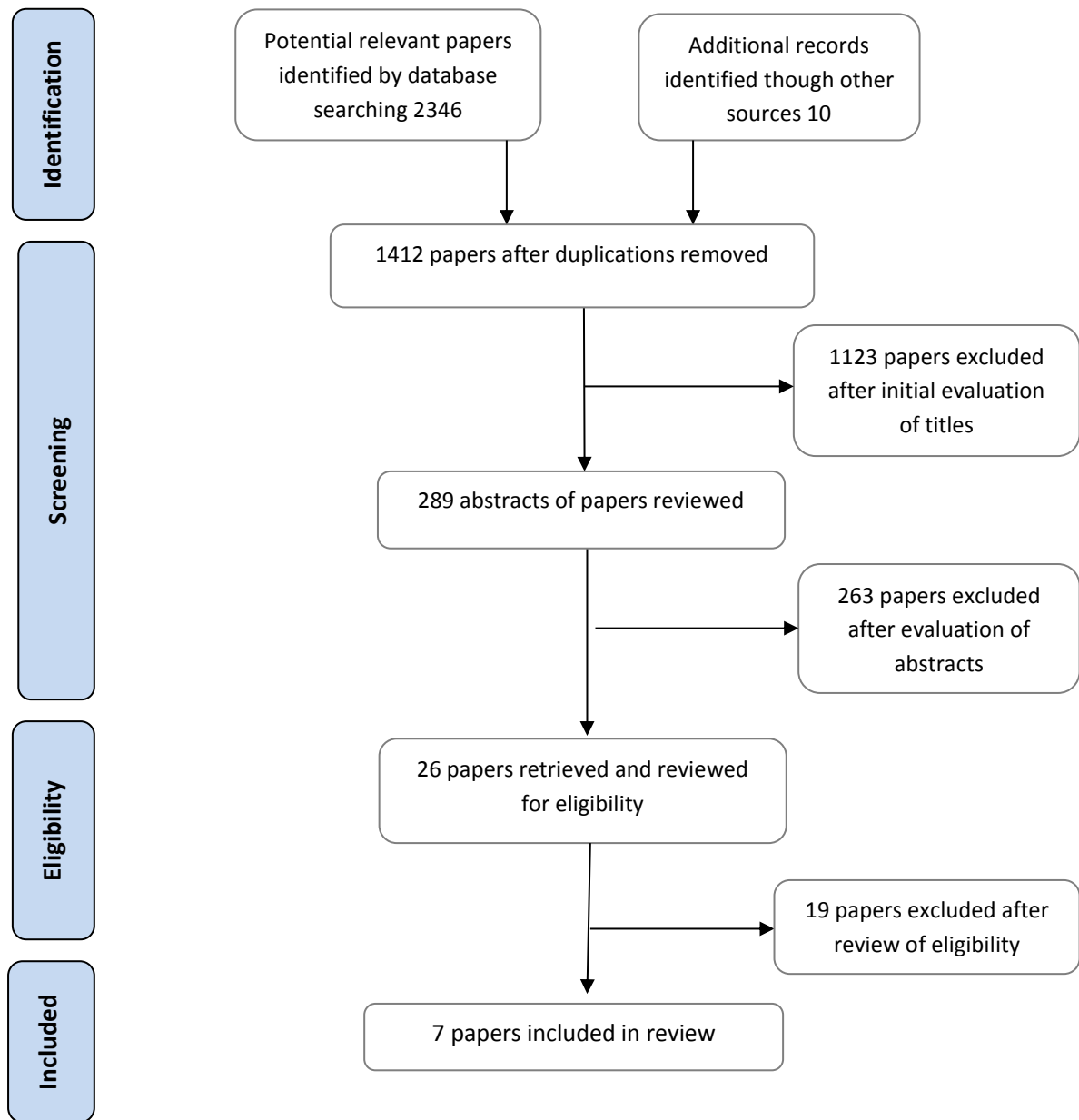


Figure 2: Electronic search strategy (Medline)

1. exp Breast Feeding/
2. *Lactation/
3. breastfe?d*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
4. breast-fe?d*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5. infant feeding.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
6. 1 or 2 or 3 or 4 or 5
7. exp Cesarean Section/
8. c?esarean.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
9. 7 or 8
10. 6 and 9
11. limit 10 to (english language and humans and yr="1994 - 2014")

Table 1: summary of papers included in the review

Study	Intervention type	Study Sample	Aims of study	Methodology	Outcome measures	Important results	Critical appraisal score§ & level of evidence
Brady et al. 2014 (USA)	Early skin-to-skin contact	All staff / eligible mother/infant couplets in a maternity unit of approx. 1,200 women/infants couplets	To implement SSC for all eligible mother/infant couplets after CS in the operating room	Quality Improvement project	SSC implemented in the operating room. Increase exclusive breastfeeding rates at discharge	In first month 43% of women undergoing a CS experienced SSC in the operating room, after 10 months >70% experienced this. In the year prior to implementation 9% of infants born by CS were exclusively breastfeeding on discharge. After 10 months 19% were exclusively breastfed on discharge	Observational check list (7 questions , Barley et al 2011): 5/7 = Yes 1/7 = N/A 1 /7 = No Level of evidence for effectiveness: 4d
Chapman et al. 2001 (USA)	Breast pumping; electric pump for x6 sessions each 10-15mins	Intervention group 30 women, Control group 30 women	1. To measure impact of increased breast stimulation via breast pumping on breast milk transfer during the first 72 hours after CS 2. To investigate potentially dormant effects of breast pumping before onset of lactation, including effects on milk transfer during first 2 weeks after birth and subsequent breastfeeding duration	RCT	Milk transfer (by test weighing)	Breast pumping between 24 and 72 hours after CS did not improve milk transfer. Participants in the pumping group tended to have lower milk transfer than control group. Primipara in pumping group breastfed for 5 months less than their counterparts in the control group; however, this difference was not statistically significant	*CASP RCT checklist of 11 questions: 5/11 = Yes 2/11 = Can't tell 4/11 = No Level of evidence for effectiveness: 1c
Chertok 2006 (Israel)	Post CS breast-feeding assistance and guidance along with early post-CS maternal-infant contact.	Intervention group 306 women (Muslim 101, Jewish 205) Control group 264 women (93 Muslim, 171 Jewish)	1. To examine post CS breastfeeding rates at discharge, 10 weeks & 16 weeks postpartum 2. To decrease the time lapsing from CS to maternal-infant contact, thereby increasing early post CS infant holding and breastfeeding initiation in the intervention group as compared with the control group 3. To increase post CS breastfeeding rates in the	Prospective population based, none randomised, evaluation	Hold infant early post CS period (0-4hrs). Breastfeeding initiation. Breast feeding early post CS period (0-4hrs)	Timing of post CS maternal-infant contact and breastfeeding initiation outcomes for Jewish and Muslim women statistically significantly improved following the intervention	CASP cohort study checklist of 10 questions: 4/10 = Yes 4/10 = Can't tell 2/10 = No Level of evidence for effectiveness: 3c

			intervention group as compared with the control group				
Chertok & Shoham-Vardi 2004 (Israel)	<p>1. Breastfeeding education prior to elective CS when possible</p> <p>2. Bringing the infant to interested and non-sedated mother in the post CS recovery room for immediate post CS holding and/or breastfeeding</p> <p>3. Providing support and assistance with positioning and latching</p> <p>4. Continuing follow-up breastfeeding support throughout the hospital stay. A goal for the intervention was to bring infants to their mothers during the first 4 hours</p>	<p>Intervention group 306 women (Muslim 101, Jewish 205)</p> <p>Control group 264 women (93 Muslim, 171 Jewish)</p>	<p>1. To examine post CS breastfeeding rates at discharge, 10 weeks & 16 weeks postpartum</p> <p>2. To decrease time lapsing from CS to maternal–infant contact, thereby increasing early post CS infant holding and breastfeeding initiation in the intervention group as compared with the control group,</p> <p>3. To increase post CS breastfeeding rates in the intervention group as compared with the control group</p>	Prospective population based, none randomised, evaluation	<p>Overall and exclusive breastfeeding at 10 weeks.</p> <p>Overall and exclusive breastfeeding at 16 weeks</p>	<p>Overall and exclusive 4-month breastfeeding duration rates were statistical significantly higher for the intervention group as compared to the control group for the Jewish women at 10 and 16 weeks postpartum. Since few Muslim women ceased breastfeeding, only exclusive breastfeeding rates were evaluated. At 10 and 16 weeks, significantly more Muslim women in the intervention group were exclusively breastfeeding as compared to the control group, although rates dramatically declined by 16 weeks.</p>	<p>CASP cohort study checklist of 10 questions: 7/10 = Yes 3/10 = No</p> <p>Level of evidence for effectiveness: 3c</p>
Moran-Peters et al. 2014 (USA)	Skin-to-skin contact	6 women	To evaluate the implications of unavailability of SSC following a CS and to identify perceptions of women who performed SSC after their second CS, particularly related to facilitation of breastfeeding in	A Quality Improvement project. (Qualitative)	Not applicable	<p>2 main themes from analysis:</p> <p>1. Mothers’ relationships with their newborns</p> <p>2. Mothers’ experiences with breastfeeding</p> <p>Overall the women reported a better experience with the most</p>	<p>CASP qualitative research checklist of 10 questions : 9/10 = Yes 1/10 = Can’t tell</p>

			order to compare CS experiences in which SSC was and was not present			recent CS because of contact with the baby. They also had a better breastfeeding experience.	Level of evidence for meaningfulness: 3
Stevens et al. 2014 (USA & Europe)	Early skin-to-skin contact	7 papers included, small sample sizes in individual papers	To evaluate existing evidence on the facilitation of immediate or early (within 1 hr) SSC following CS for healthy term newborns and identify facilitators, barriers and associated maternal and newborn outcomes	Literature review	Implementation of immediate or early SSC in operating theatre, mother / newborn emotional well-being, parent / newborn communication, maternal pain, newborn feeding outcomes.	With appropriate collaboration SSC during CS surgery can be implemented. Limited evidence that immediate or early SSC after CS may increase breastfeeding initiation, decrease time to the 1st breastfeed, reduce formula supplement in hospital, increase bonding and maternal satisfaction, maintain the temperature of newborns and reduce newborn stress.	CASP systematic review checklist of 10 questions: 9/10 = Yes 1/10 = Can't tell Level of evidence for effectiveness: 1b
Tully & Ball 2012 (UK)	Side-car bassinet on postnatal unit	20 dyads allocated to side-car bassinet, 15 dyads allocated stand alone.	To test the effect of the side-car bassinet on postnatal unit breastfeeding frequency and other maternal-infant behaviours compared to a stand-alone bassinet following CS	Randomised trial with a parallel design	Infant location, bassinet acceptability, breastfeeding frequency, breastfeeding effort, maternal-infant contact, sleep states, midwife presence, and infant risk	Differences in breastfeeding frequency, maternal-infant sleep overlap, and midwife presence not statistically significant. The 20 dyads allocated to side-car bassinets breastfed a median of 0.6 bouts/ hour compared to 0.4 bouts/hour for the 15 stand-alone bassinet dyads. Participants in the intervention group expressed overwhelming preference for the side-car bassinets. Bed sharing was equivalent between the groups, although the motivation for this practice may have differed. Infant handling was compromised with stand-alone bassinet use, including infants positioned on pillows while bed sharing with their sleeping mothers.	CASP RCT checklist of 11 questions 6/11 = Yes 2/11 = Can't tell 3/11 = No Level of evidence for effectiveness: 1c
<p>*caesarean birth = CS * skin to skin contact = SSC *CASP = Critical Appraisal Skills Programme § Highest level of quality met when 'Yes' answered for all included questions</p>							

