Factors Associated with Breastfeeding Initiation and Continuation: A Meta-Analysis

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Objective To use a quantitative approach to evaluate the literature for quantity, quality, and consistency of studies of maternal and infant characteristics in association with breastfeeding initiation and continuation, and to conduct a meta-analysis to produce summary relative risks (RRs) for selected factors.

Study design A systematic review using PubMed and CINAHL through March 2016 was conducted to identify relevant observational studies in developed nations, reporting a measure of risk for 1 or more of 6 quantitatively derived, high impact factors in relation to either breastfeeding initiation or continuation. One author abstracted data using a predesigned database, which was reviewed by a second independent author; data evaluation and interpretation included all co-authors. These factors were summarized using standard meta-analysis techniques.

Results Six high impact factors were identified (smoking [39 papers], mode of delivery [47 papers], parity [31 papers], dyad separation [17 papers], maternal education [62 papers], and maternal breastfeeding education [32 papers]). Summary RR from random-effects models for breastfeeding initiation were highest for high vs low maternal education (RR 2.28 [95% CI 1.92-2.70]), dyad connection vs not (RR 2.01 [95% CI 1.38-2.92]), and maternal nonsmoking vs smoking (RR = 1.76 [95% CI 1.59-1.95]); results were similar for breastfeeding continuation.

Conclusions Despite methodological heterogeneity across studies, relatively consistent results were observed for these perinatally identifiable factors associated with breastfeeding initiation and continuation, which may be informative in developing targeted interventions to provide education and support for successful breastfeeding in more families. *(J Pediatr 2018;203:190-6).*

Breastfeeding and human breast milk are the normative standards for ideal feeding and nutrition for infants[1] with many established short- and long-term benefits.[2-19] Exclusive breastfeeding through the first 6 months of age with continued breastfeeding through 12 months is universally recommended, but despite the known health benefits, breastfeeding rates drop precipitously soon after birth. In 2013 in the US, 81% of infants were breastfed at birth, but by age 3 months, only 44% were exclusively breastfed.[20] Worldwide from 2007 to 2014, approximately 36% of infants ages 0-6 months were exclusively breastfed.[21]

To develop interventions that help more women breastfeed, an understanding of the many factors affecting choice of feeding modality is critical. Many maternal and infant factors have been examined in relation to breastfeeding; in particular, maternal obesity has been well-established as a risk factor for poorer breastfeeding outcomes.[22] For other factors, however, numerous studies with small sample sizes, diverse populations, and heterogeneity in study design and definitions of outcomes and exposures make it difficult to discern patterns that can inform successful interventions. Therefore, in this study, we performed a comprehensive literature review and quantitative meta-analysis of 6 select factors in relation to breastfeeding initiation and continuation. The factors chosen had not been examined collectively in prior studies and were suitable for meta-analysis: smoking, mode of delivery, parity, dyad separation, maternal education, and maternal breastfeeding education. Methodologic limitations prevented the examination of some potentially important factors in a meta-analytic context, such as socioeconomic status (SES), and this review is

P-h	*P* value for heterogeneity
RR	Relative risk
SES	Socioeconomic status
WIC	Women, infants, and children

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not intended to discuss all potentially relevant factors that influence breastfeeding behaviors. This study was conducted according to the PRISMA guidelines for systematic reviews and meta-analyses.[23]

Methods

An initial search of the literature (PUBMED and CINAHL) was conducted to broadly identify characteristics that have been studied in relation to early breastfeeding (Search strings shown in **Table I** [available at www.jpeds.com]). We focused on factors identifiable during the perinatal period and attainable by history at birth or during the early lactation period. Postnatal changes in family, social, or work-related events were not included. The search was conducted from January to May 2015 with no lower date truncation and included over 2600 titles and abstracts and 183 full text papers. After data abstraction of the 183 papers (including study design, year and location of study, maternal and/or infant cohort details, predictor(s) of breastfeeding, breastfeeding outcome(s) assessed, and statistical techniques including model form and covariate adjustment), all independent variables predicting breastfeeding outcomes were grouped into distinct categories that were reviewed by practicing pediatricians and a Certified Lactation Counselor for clinical relevance and refined to contain the most homogeneous groupings. For all categories that had statistically significant predictors of breastfeeding outcomes in at least 5 publications, an evidence score from 1 to 9 was assigned for each factor-outcome relationship. This score was based on volume of supportive studies (up to 3 points), magnitude of association (up to 3 points), and relative consistency of associations (up to 3 points). **Tables II** and **III** (available at www.jpeds.com) include all initial factors considered as well as the associated evidence scores.

After evaluation of the evidence scores in combination with clinical input, 6 factors were identified for full systematic quantitative evaluation: maternal smoking, mode of delivery (vaginal vs cesarean delivery), parity, infant-mother (hereafter called dyad) separation (including both early skin-to-skin contact and rooming-in of infants in the hospital), maternal educational attainment, and breastfeeding education received by the mother or parents. Smoking and parity had lower evidence scores than other factors but were included based on perceived importance in clinical practice. Conversely, external/environmental characteristics and internal/dyad characteristics of the mother as well as breastfeeding intent were not included despite relatively high evidence scores because the measures were too heterogeneous to be used in a meta-analysis. After careful consideration, SES was not included due to methodologic challenges. In US studies, the effects of the women, infants, and children (WIC) program on breastfeeding vs formula use are complex and the true relationship between breastfeeding and SES is difficult to tease out in meta-analysis; there is also lack of generalizability of WIC globally. Further, in accordance with recommended protocol for the conduct of systematic reviews and meta-analyses, such as the PRISMA guidelines, the measures of SES were deemed too heterogeneous to be combined in a meta-analysis (factors are described in **Table IV** [available at www.jpeds.com]). Maternal obesity initially did not emerge as a high-impact factor in our broad searches but after adding specific search terms related to maternal body size, a 2014 meta-analysis that reviewed 19 articles (6 obtained via literature search and 13 obtained via review of references or the snowball method)[22] was identified; as few new articles on this topic were published since 2014, our review did not include an update of maternal obesity in relation to breastfeeding. Also, of note, factors including maternal age, race/ethnicity, gestational age, and pacifier use did not reach minimal evidence scores in terms of volume, strength, or consistency.

Current Literature Review

For the current systematic review, each of the 6 factors identified in the initial search was examined in a separate, comprehensive literature search using PUBMED limited to papers published between January 1, 2005 and March 12, 2016 (search terms shown in **Table V**). A 10-year search history was deemed a suitable representation of the current standard of care. Papers were included if they were written in English, included a study population in a developed nation, presented original data, and reported a relevant exposure (1 or more of the 6 factors of interest) and relevant outcome (either breastfeeding initiation, defined as in the birth hospitalization period or up to 1 week after birth, or breastfeeding continuation, defined as breastfeeding from 1 month of age up to the end of the first year). Relevant data from the papers selected for inclusion were abstracted by 1 epidemiologist and reviewed by a second. No data were sought from original investigators, and studies were not formally assessed for quality or potential sources of bias.

Statistical Analyses

For analysis, papers were included in 1 or both categories (initiation or continuation) for breastfeeding outcomes depending on available results. Exposures and outcomes were harmonized across studies so that all comparisons were in the same direction. When results for multiple time windows were provided, the earlier or shorter time window was used in the analysis. For exposures with multiple categories, the highest value (eg, the highest level of multiple categories of educational attainment) was compared with the lowest.

Estimates of relative risk (RR) and CIs from each study were combined in separate meta-analysis models for each combination of the 6 factors and 2 outcomes (initiation and continuation) using Comprehensive Meta-Analysis software (v 3.2.00089; Bio stat, Englewood, New Jersey). Random-effects meta-analysis models were used to generate summary RR estimates, 95% CIs, and corresponding *P* values for heterogeneity (*P*-h). Study weights were equal to the inverse of the variance of each study's effect estimate.[24] Statistical heterogeneity was assessed with Cochran Q, which tests for between-study statistical variation, and I^2, which indicates percentage of variation attributable to between-study

Table V. Search terms and results for each factor

Factors	Search terms	Articles identified	Full text reviewed	Selected for Inclusion	Added after Identification from other factor reviews	Total included papers
All searches	(((breastfeeding[MeSH Terms]) OR breastfeeding[Title/Abstract]) AND((duration[Title/Abstract]) OR initiat*[Title/Abstract] OR establish*[Title/Abstract] OR continu*[Title/Abstract])) AND					
Smoking	("Smoking"[MeSH Terms] OR "Tobacco Products"[MeSH Terms] OR smok*[All fields] OR tobacco[All fields])	396	131	31	8	39
Mode of delivery	((("Cesarean Section"[MeSH Terms] OR "Extraction, Obstetric"[MeSH Terms] OR "Delivery, Obstetric" OR "Labor Presentation"[MeSH Terms] OR Cesarean[All fields] OR caesarean[All fields] OR "Vaginal Delivery"[All fields] OR "vaginally delivered"[All fields])))))) AND ("2005/01/05"[PDat] : "2016/02/12"[PDat] AND English[lang]))))	325	128	28	19	47
Parity	(Parity[MeSH Terms] OR "Reproductive History"[MeSH Terms] OR parity[All fields] OR "first birth"[All fields] OR nullipar*[All fields] OR primipar*[All fields] OR multipar*[All fields])	477	177	22	9	31
Dyad separation	("Time to first"[All fields] OR "Separation of dyad" [All fields] OR "Dyad separation"[All fields] OR Skin-to-skin [All fields] OR Rooming-in[All fields] OR Rooming[All fields])	146	56	9	8	17
Maternal education	((Education[MeSH Terms] OR Schooling[MeSH Terms] OR education[All fields] OR college[All fields] OR high school[All Fields] OR educ*[All fields]))	1859	508	54	8	62
Breastfeeding education	Health Knowledge, Attitudes, Practice[MeSH Terms] OR Patient Education as Topic[MeSH Terms] OR Health Education[MeSH Terms] OR "breastfeeding information"[All fields] OR "breastfeeding education"[All fields] OR "lactation counseling"[All fields] OR "lactation consultant"[All Fields] OR "prenatal class"[All fields] OR "childbirth class"[All fields]	702	223	20	12	32

heterogeneity. Formal tests of publication bias were not conducted.

Results

Table V shows the number of studies screened for each factor as well as the number that went on to full-text review and abstraction. Most papers were excluded at the abstract level due to lack of relevant exposure or outcome data, inappropriate study design (review or case study), or duplication. Figures 1-6 (available at www.jpeds.com) show flow diagrams for each factor under study and Tables VI-XI (available at www.jpeds.com) list each paper selected for abstraction.

For breastfeeding initiation, the time frame was consistent across studies with initiation being evaluated within the birth hospitalization period or up to 1 week after birth. For breastfeeding continuation, the time frame for evaluation varied considerably across studies from 1 month up to 1 year although most studies focused on the first 2-4 months of the postpartum period (Tables VI-XI).

For maternal smoking, papers were harmonized according to smoking during pregnancy vs not. Results (Table XII, Figure 7, A, and Figure 8, A [available at www.jpeds.com]) were

Table XII. Summary RRs and 95% CIs for 6 factors in relation to breastfeeding) initiation and continuation, overall, and limited to studies with follow-up of 4 months or less (continuation only)

	Breastfeeding initiation		Breastfeeding continuation		Breastfeeding continuation with follow-up <4 mo	
Factors	Included studies*	(RR, 95% CI)	Included studies*	(RR, 95% CI)	Included studies*	(RR, 95% CI)
Smoking: nonsmoking vs smoking	17	1.76 (1.59-1.95)	25	1.91 (1.68-2.16)	12	2.11 (1.76-2.53)
Mode of delivery: vaginal vs cesarean	31	1.38 (1.27-1.50)	16	1.23 (1.15-1.32)	9	1.34 (1.17-1.55)
Parity: multiparous vs primiparous	20	1.04 (0.84-1.29)	13	1.36 (1.24-1.50)	6	1.34 (1.11-1.62)
Dyad connections: skin-to-skin/rooming-in vs no skin-to-skin/rooming-in	10	2.01 (1.38-2.92)	8	1.23 (1.02-1.47)	5	1.49 (0.93-2.40)
Maternal educational attainment: highest category vs lowest category	36	2.28 (1.92-2.70)	27	1.68 (1.35-2.08)	17	1.86 (1.33-2.61)
Breastfeeding education: yes vs no	19	1.41 (1.29-1.54)	14	1.37 (1.14-1.65)	8	1.27 (1.06-1.52)

*Some studies identified in the systematic review (Table XII) may not have been included in the meta-analysis if key information such as variance or CIs were unavailable.

relatively consistent in showing increased breastfeeding initiation (P-h < 0.01, I^2 = 67.37)) and continuation (P-h < 0.001, I^2 = 80.16) for nonsmokers compared with smokers. One study included paternal smoking in relation to continuation; when removed in a sensitivity analysis, results were similar (summary RR 1.96; 95% CI 1.72-2.23; P-h < 0.001, I^2 = 79.48).

Papers examining delivery mode most often compared vaginal to cesarean delivery, but there was heterogeneity in more subtle groupings within vaginal (spontaneous vs induced, or forceps or vacuum assistance vs no assistance) and cesarean delivery (elective/not in labor vs nonselective/in labor). Whenever available, we used RRs with spontaneous vaginal delivery as the independent variable in the meta-analyses. Summary RRs for breastfeeding initiation (P-h < .01, I^2 = 93.11) and continuation (P-h < 0.01, I^2 = 55.46) were higher for vaginal compared with cesarean delivery (**Table XII**, **Figure 7**, B, and **Figure 8**, B).

For papers examining parity in relation to breastfeeding initiation, there was a great deal of heterogeneity in results between the individual studies, and the summary RR for multiparous woman vs primiparous woman was nonsignificant (**Table XII**, **Figure 7**, C; P-h < 0.01, I^2 = 97.25). There was more consistency for breastfeeding continuation with most studies showing a positive relationship between continuation of breastfeeding and multiparity (**Table XII**, **Figure 8**, C; P-h < 0.01, I^2 = 68.69).

Mother-infant dyad separation generally focused on 2 outcomes: early skin-to-skin contact or rooming-in during the birth hospitalization. Taken together as a single metric, positive dyad connections (skin-to-skin vs not or rooming-in vs not) were associated with increased initiation (**Table XII**, **Figure 7**, D; P-h < 0.001, I^2 = 95.54) and continuation (**Table XII**, **Figure 8**, D; P-h < 0.01, I^2 = 76.59) of breastfeeding. Sensitivity analyses of studies examining skin-to-skin and rooming-in separately similarly found that the association was stronger for initiation. For skin-to-skin alone, the summary RR was 1.79 (95% CI 1.30-3.11; P-h < .001; I^2 = 93.1) for initiation (7 studies) and 1.14 (95% CI 1.07-1.86; P-h = 0.001; I^2 = 75.62) for continuation (6 studies). Models limited to rooming-in had a summary RR for initiation of 2.20 (95% CI 1.44-3.36; P-h < 0.001; I^2 = 87.05) in 7 studies and 1.04 (95% CI 0.93-1.16; P-h 0.93; I^2 < 0.01) for continuation in 3 studies.

Measurement and categorization of maternal education was variable and often dependent on the country in which the study was conducted. For analysis, the highest education level vs the lowest was used. Although the magnitude of effect varied across studies, the direction was consistent with nearly all individual studies showing a higher likelihood of breastfeeding initiation and continuation among women with higher vs lower levels of education. The summary RRs for breastfeeding initiation (**Table XII**, **Figure 7**, E; P-h < 0.01, I^2 = 92.27) and continuation (**Table XII**, **Figure 8**, E; P-h < 0.001, I^2 = 97.06) were higher for women with the highest level of education vs the lowest.

We grouped interventions directed specifically at mothers or parents to increase knowledge and confidence around breastfeeding into the factor "breastfeeding education." These included attendance at prenatal breastfeeding classes, peer counseling on breastfeeding, and lactation consultation before or after delivery (full listing of measurements shown in **Table XI**). Interventions at the clinic or hospital-level or those directed at clinicians were excluded. Receiving some type of breastfeeding education or support was positively associated with increased likelihood of either breastfeeding initiation (**Table XII**, **Figure 7**, F; P-h < 0.01, I^2 = 80.45) or continuation (**Table XII**, **Figure 8**, F; P-h < 0.001, I^2 = 69.67).

A set of sensitivity analyses were conducted for breastfeeding continuation that limited the follow-up time to less than 4 months to reduce potential biases related to the introduction of foods other than breastmilk or formula that may begin after 4 months. The summary RRs for breastfeeding continuation in studies limited to 4 months or less of follow-up are summarized in **Table XII**. The patterns were similar as in the analysis of all time periods for continuation as reported by the individual studies.

Discussion

In this systematic review and meta-analysis, 6 factors were examined in association with breastfeeding initiation and continuation: maternal smoking, vaginal delivery, multiparity, dyad separation and connection, maternal education level, and breastfeeding education/support.

Smoking was one of the strongest and most consistent factors associated with early breastfeeding. Approximately 11% of women in the US smoke during pregnancy and the numbers are even higher in Europe,[25,26] indicating an efficient potential target for increased breastfeeding interventions. In addition to women who smoke throughout pregnancy, 50%-80% of women who quit during pregnancy will relapse to smoking within the first 6 months after birth,[27,28] and smoking among breastfeeding women is associated with both shorter duration and reduced milk production.[29-34] Smoking may be serving, at least in part, as a surrogate measure for SES (and the associated challenges related to breastfeeding), but nonetheless, its strong association indicates that it may be a useful characteristic in identifying women who would benefit from additional support in establishing and maintaining breastfeeding.

A large volume of literature was available to examine delivery mode in relation to breastfeeding. Despite some heterogeneity in the categorization of delivery types, vaginal delivery was consistently associated with significant increases in both breastfeeding initiation and continuation. Maternal body size is an important confounder between delivery mode and breastfeeding, but out of 34 studies of breastfeeding initiation, only 7 controlled for maternal body mass index, and in 19 studies of breastfeeding continuation, only 3 controlled for maternal body mass index. Thus, a portion of the effect size of the relationship between delivery mode and breastfeeding outcomes is likely attributable to underlying confounding by maternal body size. Cesarean deliveries might also lead to less breastfeeding initiation because of a disruption of the infant/mother dyad. Lactogenesis may be disrupted in women who have cesarean deliveries as a result of decreased oxytocin secretion or maternal stress, which may result in decreased milk

production.[35-38] Although we did not distinguish between the 2 in our analyses, the type of cesarean delivery (planned or emergency) has been found to influence breastfeeding initiation and duration. Although mothers who underwent emergency cesarean deliveries had greater difficulty initiating breastfeeding compared with vaginal deliveries,[36,39] several studies have shown that planned cesarean delivery in particular is associated with a significant decrease in breastfeeding initiation.[39-41] Women undergoing a planned cesarean delivery were less likely to intend to breastfeed, initiate breastfeeding, or seek lactation support.[39] Infants born by planned cesarean deliveries are more likely to suffer from factors associated with lower gestational age that impact breastfeeding initiation, such as poor sucking skills and decreased alertness.[35,39,42]

A large degree of heterogeneity was noted in the individual studies examining the effect of multiparity on breastfeeding initiation. Some studies showed a positive association with multiparity and others showed a negative effect, and the summary RR for breastfeeding initiation was nonsignificant. However, multiparity was positively related to continuation of breastfeeding. Prior work has shown that challenging breastfeeding experiences, unsuccessful attempts, and failure to initiate breastfeeding with the first child have been associated with failure to initiate breastfeeding with subsequent births.[39,43]

A composite metric for positive dyad connections (skin-to-skin vs not or rooming-in vs not) was associated most strongly with increased breastfeeding initiation but also with breastfeeding continuation. Keeping the mother and infant dyad together during their hospital stay promotes attachment within the dyad, which is a likely mechanism to improve breast feeding initiation and duration.[44] A delay in breastfeeding initiation can result in reduced suckling ability and receptivity of the infant resulting in reduced or insufficient milk supply.[45-53] These results are consistent with the World Health Organization's Baby-friendly Hospital Initiative that recommends that the mothers are supported and encouraged to initiate breastfeeding with the first hour after birth (step 4) and that infants and mothers remain together 24 hours a day (step 7).[35,42,54]

Despite measurement differences between study populations from different countries, the highest level of education vs the lowest was consistently associated with a higher likelihood of both breastfeeding initiation and continuation. Other sociodemographic characteristics such as lower maternal age and household income were similarly associated with decreased probability of breastfeeding initiation and continuation in another study.[55] These factors are likely to be at least partially accounted for within our factor of maternal education. More highly educated mothers may have more control over their schedule or work environment, which may provide the support needed to breastfeed for a longer time.[56]

Mothers who received education on breastfeeding were 41% more likely to initiate and continue breastfeeding than women who received no such educational opportunities. Attendance at prenatal breastfeeding classes likely provides women with strategies to cope with the challenges associated with the first few weeks of breastfeeding (eg, perception of insufficient milk supply, breast engorgement, and cracked nipples)[57-60] as well as longer term strategies such as establishing breastfeeding or pumping routines.[61,62] Our grouping of breastfeeding education generally aligns with steps 3 (inform all pregnant women about the benefits and management of breastfeeding) and 10 (foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or birth center) of the Baby-friendly Hospital Initiative. The studies we included in our review are more recent than the original research cited by the Baby-friendly Hospital Initiative 10 steps,[54] but our meta-analysis comes to the same conclusion as the World Health Organization; there is significant evidence that increased education and support for mothers or parents during pregnancy or soon after birth improve breastfeeding initiation and continuation.

A recent systematic review employed stringent inclusion and exclusion factors to examine a large number of sociodemographic, physical, maternal, and social factors in relation to breastfeeding in the first 6 months but did not include a quantitative analysis.[63] Although our review and meta-analysis focused on a more limited number of factors that had a relatively large volume of high-quality literature, many factors were not included. In our initial search, we expected to identify infant birth factors such as hypoglycemia, jaundice, birth weight, and gestational age, but found very little published data meeting our inclusion criteria. These factors are often considered clinically important predictors of a successful early breastfeeding relationship but additional well-designed studies to substantiate this assumption appear warranted based on the lack of peer-reviewed evidence.

We also did not examine associations between breastfeeding and formula discharge packs provided to mothers leaving the hospital; this practice was shown in a 2000 Cochrane review to be associated with a reduction in exclusive breastfeeding but had no significant effect on the earlier termination of nonexclusive breastfeeding.[64] Although still relatively common, this practice declined 41% from 2007 to 2013[65]; further contemporary research is needed to evaluate the effects on breastfeeding initiation and continuation.

As noted in the Methods section, a comprehensive and relatively recent systematic review of the literature related to maternal obesity and breastfeeding was identified,[22] and, thus, maternal obesity was not included in the current meta-analysis. The authors applied rigorous inclusion criteria and provided an assessment of the methodological quality of the studies they included in their review. Their overall conclusion that obese women are less likely to initiate and to continue breastfeeding than women of a healthy weight should be considered alongside the conclusions of the current meta-analysis in developing comprehensive breastfeeding education and support programs.

Limitations of our analysis include heterogeneity in measurement and categorization of the factors, particularly maternal education and breastfeeding education. There is additional heterogeneity in the study populations included as well in the timeframes examined for breastfeeding continuation. Not all studies presented RRs or appropriately adjusted

for confounders nor adjusted results using the same sets of confounders. Another limitation of this study is that these factors were studied in parallel, but in actual clinical practice, they are most certainly related in complex ways that were not considered in this analysis. Furthermore, some of the factors are not dichotomous but may be present in gradations (eg, rooming in, educational interventions). The ability to assess for a dose-response would have strengthened this analysis; however, most studies do not quantify, for example, the amount of time rooming-in or the intensity of educational interventions. Also, this review did not include community-level factors such as hospital policy initiatives, clinician training, or interventions designed to increase breastfeeding rates. Finally, as noted in the Methods section, we did not include SES as one of our select factors. SES is certainly a potentially important factor in relation to breastfeeding initiation and continuation and is more readily collected in clinical settings (such as by payer identification or WIC status) than some other factors presented in this meta-analysis; however, SES as a construct in the literature published to date is quite heterogeneous, and, thus, SES was not included in this meta-analysis due to these methodologic limitations.

In summary, we found scant quality empirical evidence for some factors commonly believed to be important influences of the breastfeeding experience, and there were limitations in methodology for others (such as SES). For the 6 factors included in this review, despite differences in study design, measurement of exposures and outcomes, and underlying demographics of the populations studied, the literature provides relatively consistent indicators as to which factors influence breastfeeding decisions, particularly maternal smoking, maternal educational attainment, and dyad separation. Although some factors are not modifiable, these results may be informative in developing targeted, multifactorial interventions to provide the education and support needed to allow breastfeeding to be successful for more families. ■

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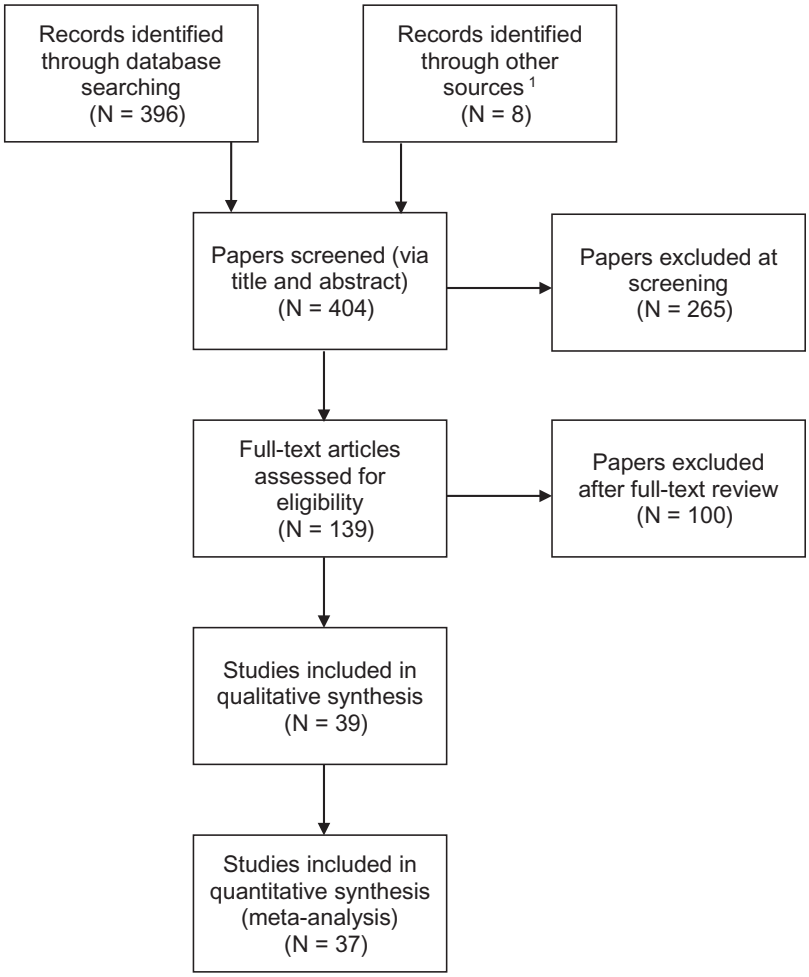


Figure 1. PRISMA flow diagram for studies examining smoking and breastfeeding initiation and/or continuation.

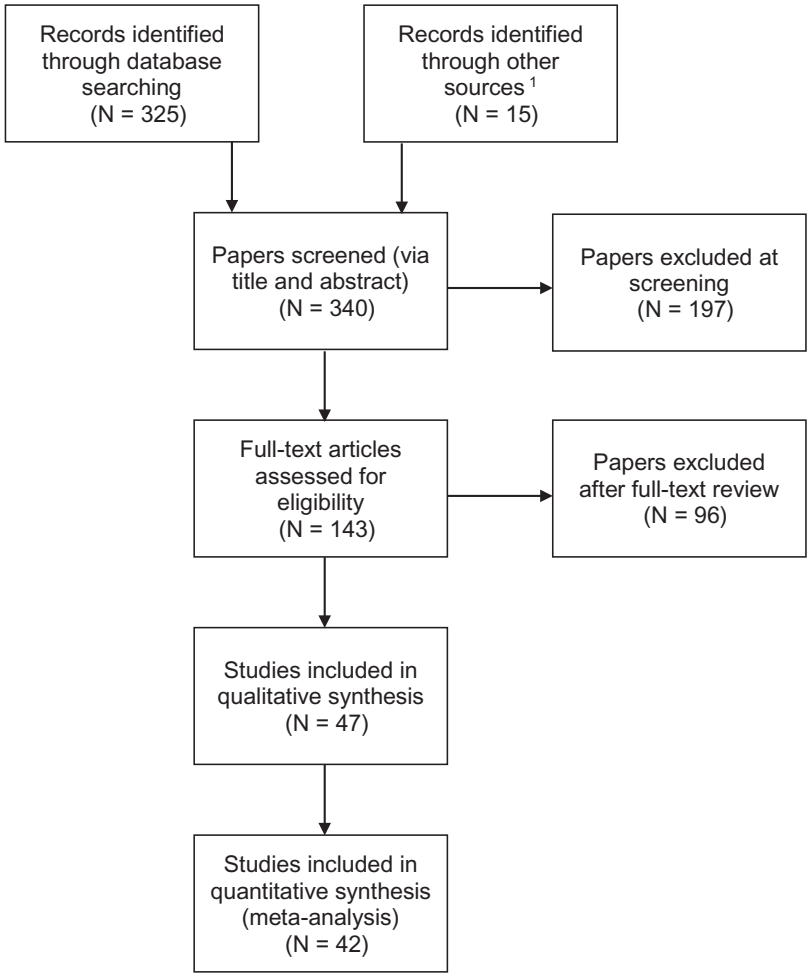


Figure 2. PRISMA flow diagram for studies examining mode of delivery and breastfeeding initiation and/or continuation.

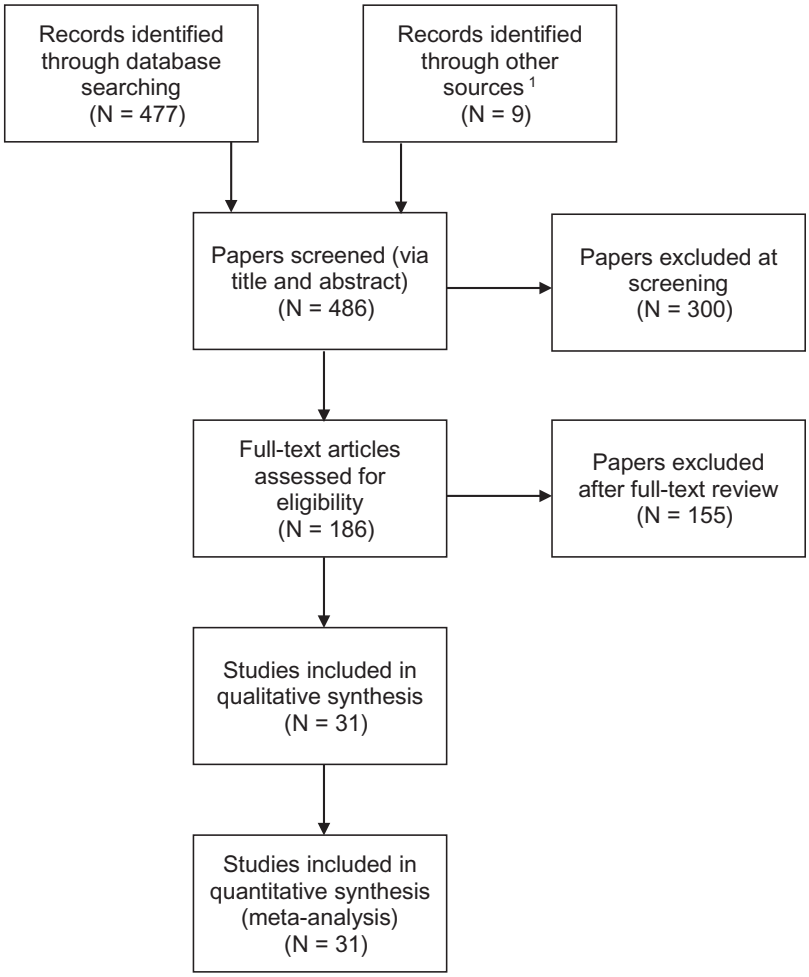


Figure 3. PRISMA flow diagram for studies examining parity and breastfeeding initiation and/or continuation.

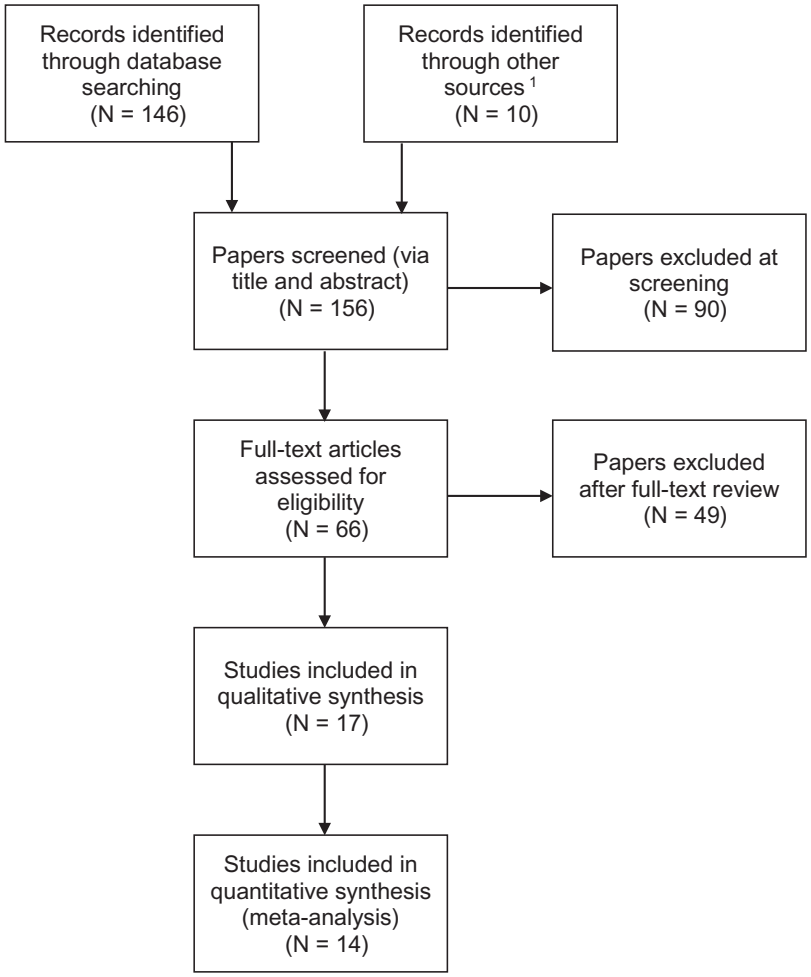


Figure 4. PRISMA flow diagram for studies examining dyad separation and breastfeeding initiation and/or continuation.

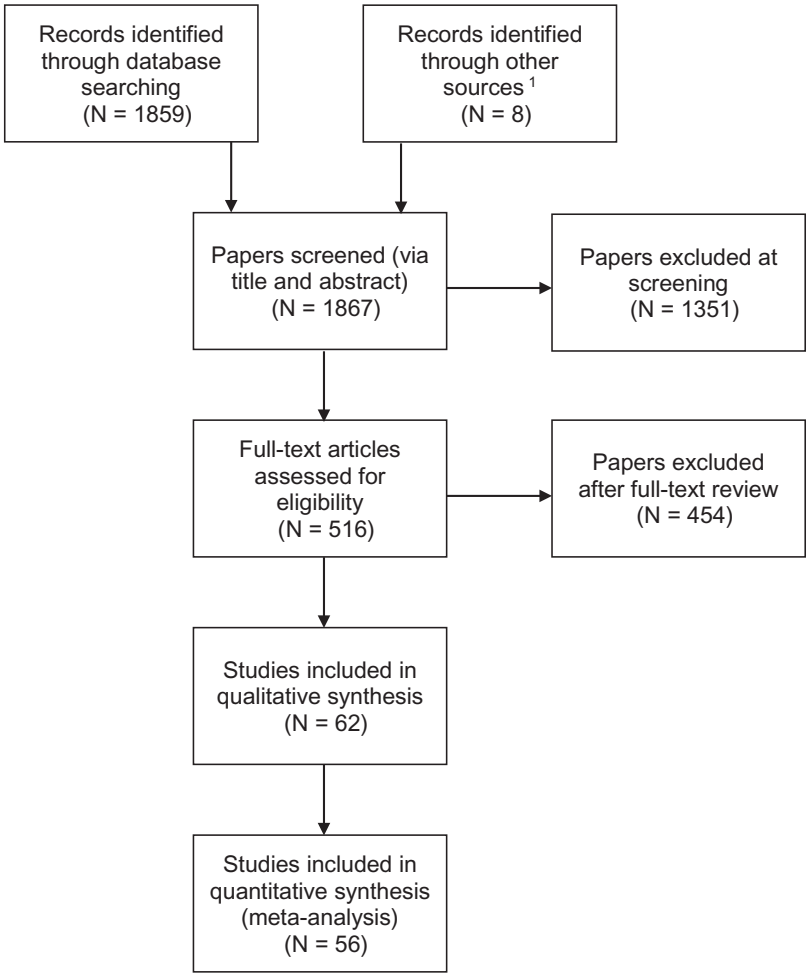


Figure 5. PRISMA flow diagram for studies examining maternal education and breastfeeding initiation and/or continuation.

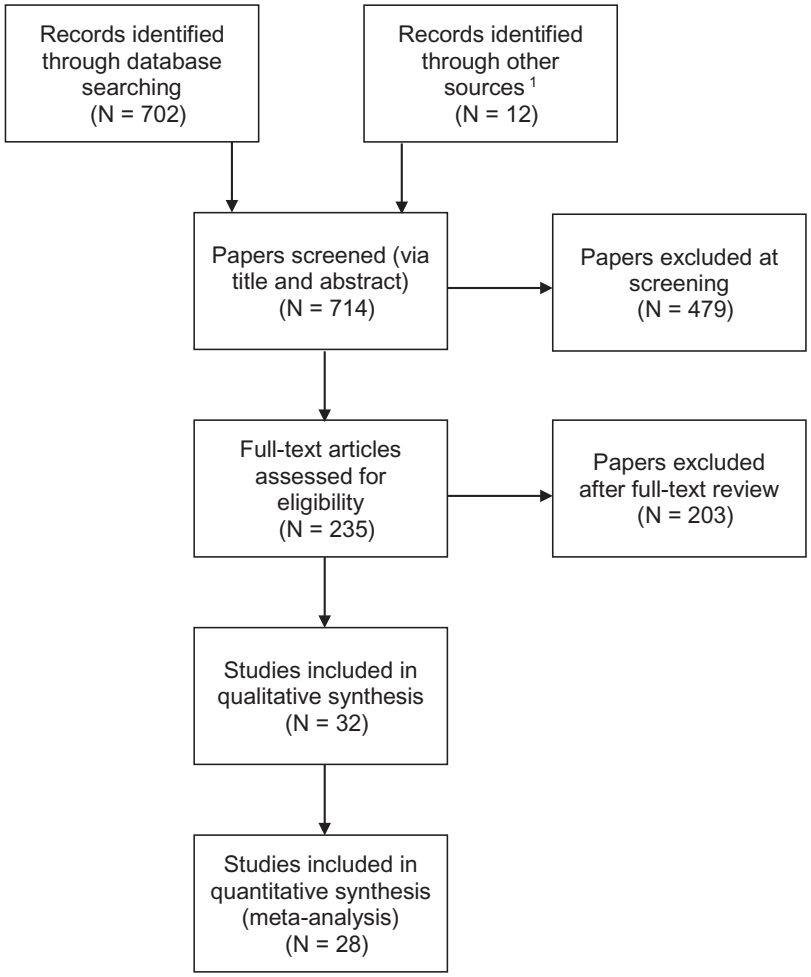
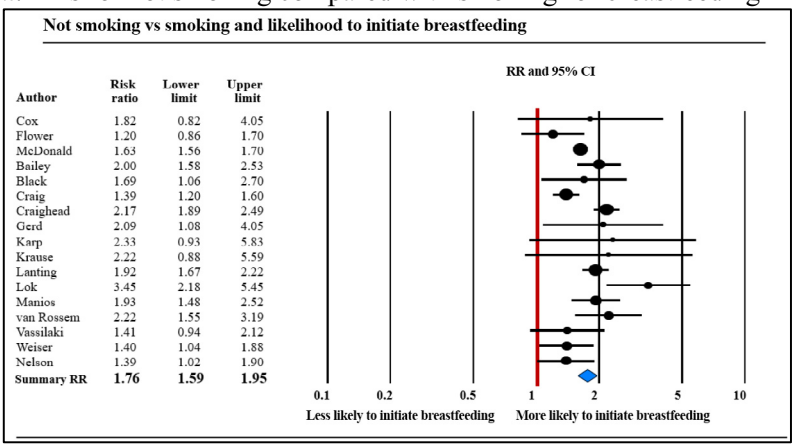
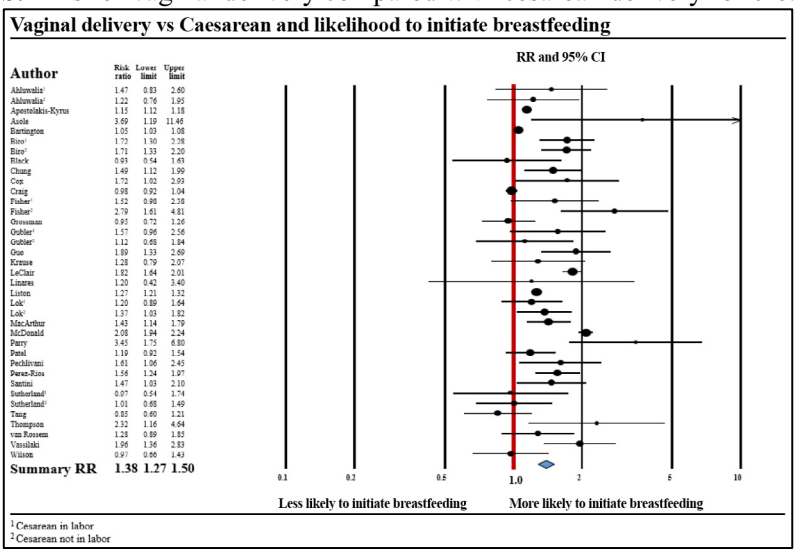


Figure 6. PRISMA flow diagram for studies examining breastfeeding education and breastfeeding initiation and/or continuation.

a. RRs for not smoking compared with smoking for breastfeeding initiation



b. RRs for vaginal delivery compared with cesarean delivery for breastfeeding initiation



c. RRs for multiparous vs primiparous women for breastfeeding initiation

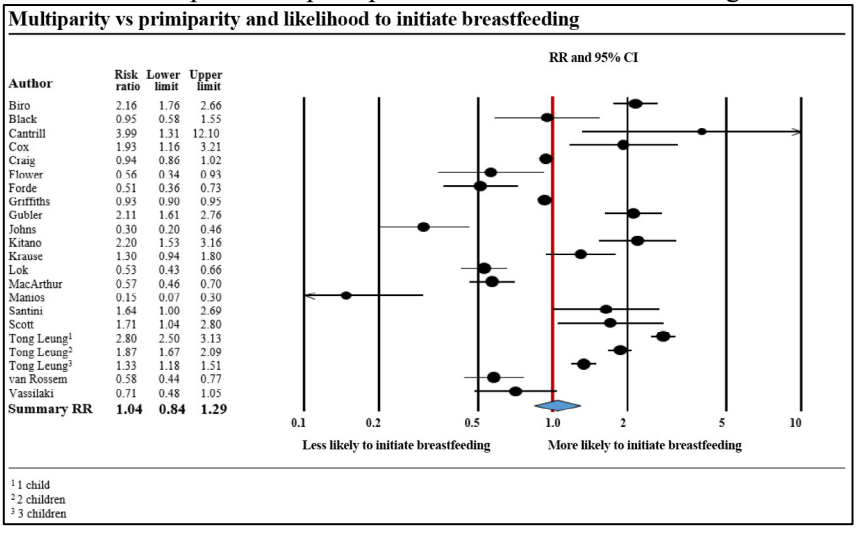
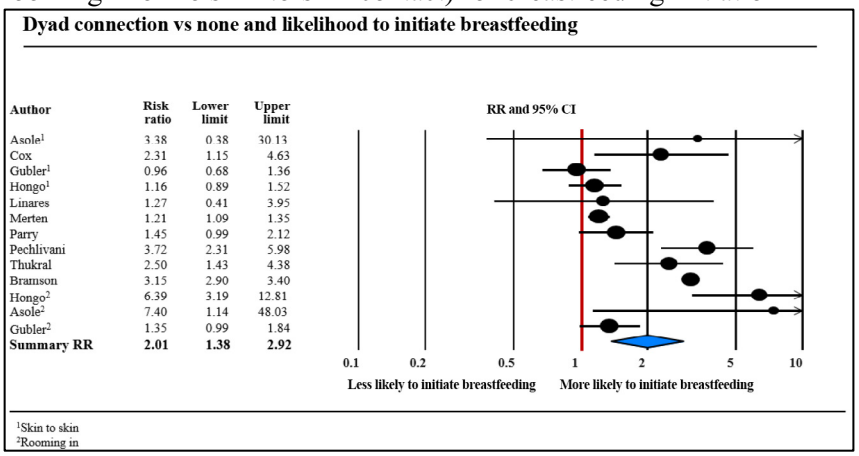
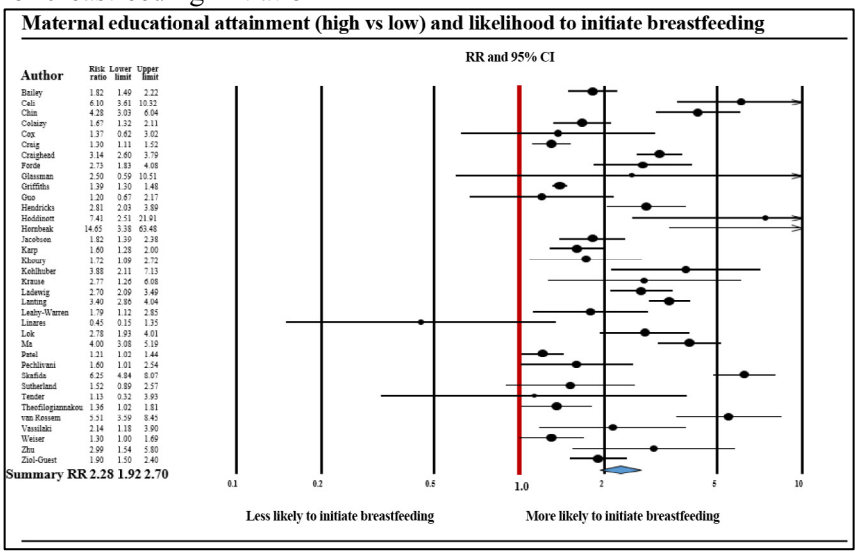


Figure 7. Individual study results and summary RR for factors in relation to breastfeeding initiation. *(Continues)*

d. RRs for dyad non-separation (ie rooming in or skin-to-skin contact) vs separation (ie not rooming in or no skin-to-skin contact) for breastfeeding initiation



e. RRs for higher maternal educational attainment compared with lower educational attainment for breastfeeding initiation



f. RRs for receiving breastfeeding education (classes, support groups) vs not receiving such education for breastfeeding initiation

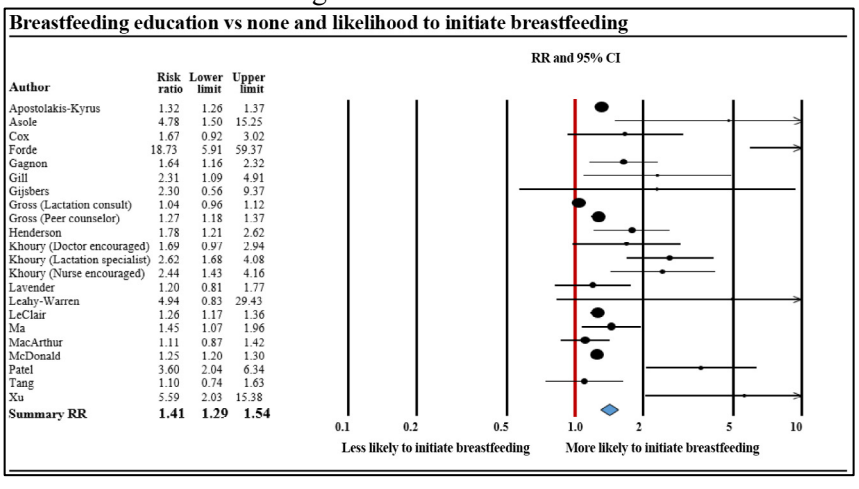
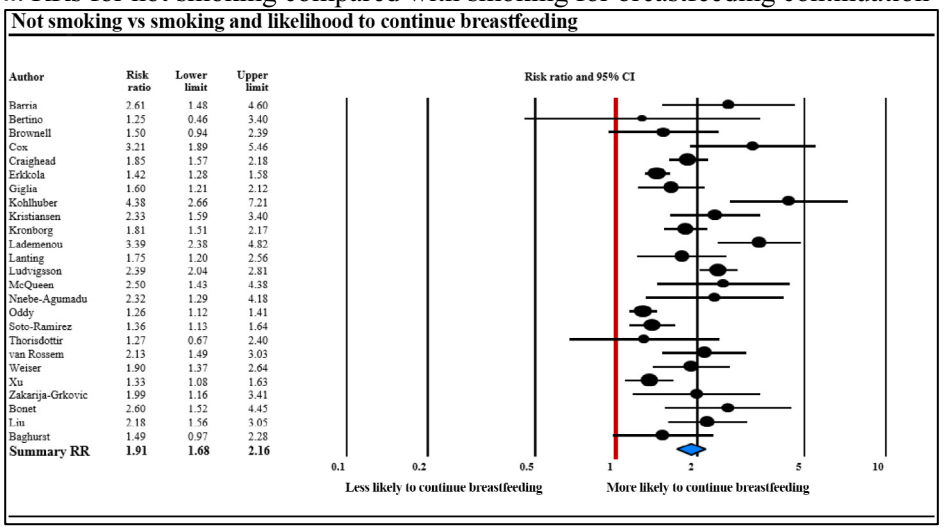
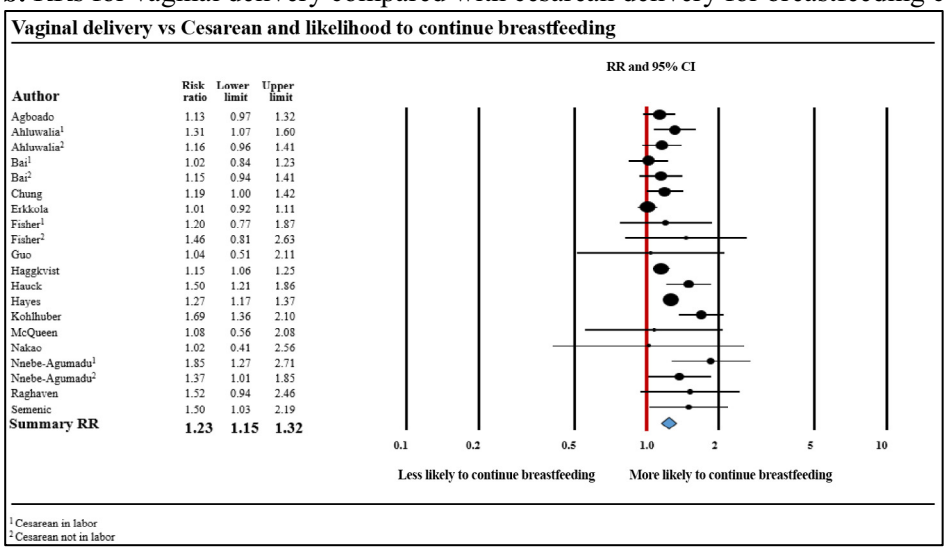


Figure 7. Continued.

a. RRs for not smoking compared with smoking for breastfeeding continuation



b. RRs for vaginal delivery compared with cesarean delivery for breastfeeding continuation



c. RRs for multiparous vs primiparous women for breastfeeding continuation

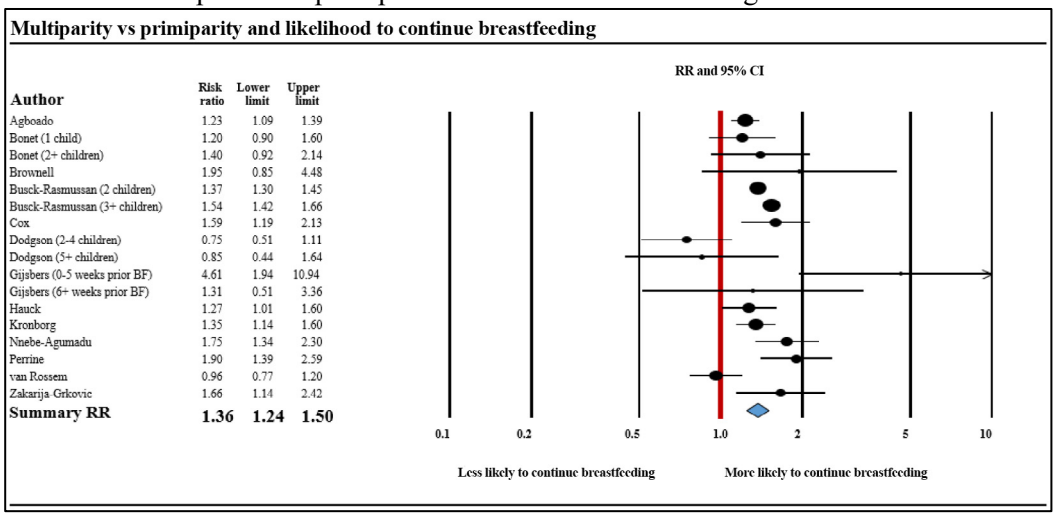
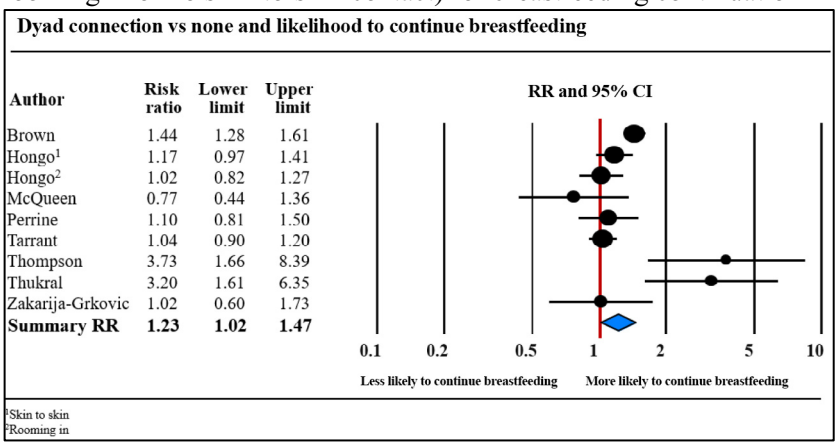
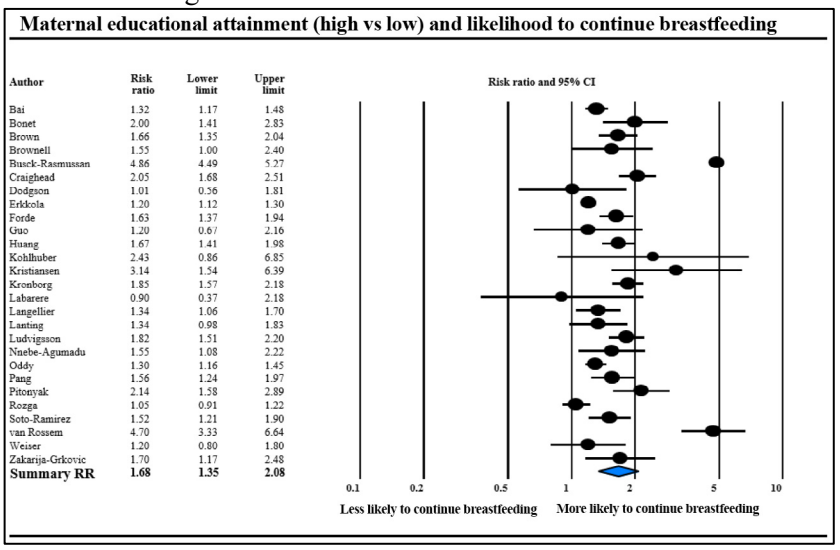


Figure 8. Individual study results and summary RR for factors in relation to breastfeeding continuation. *(Continues)*

d. RRs for non-separation (ie rooming in or skin-to-skin contact) vs separation (ie not rooming in or no skin-to-skin contact) for breastfeeding continuation



e. RRs for higher maternal educational attainment compared with lower educational attainment for breastfeeding continuation



f. RRs for receiving breastfeeding education (classes, support groups) vs not receiving such education for breastfeeding continuation

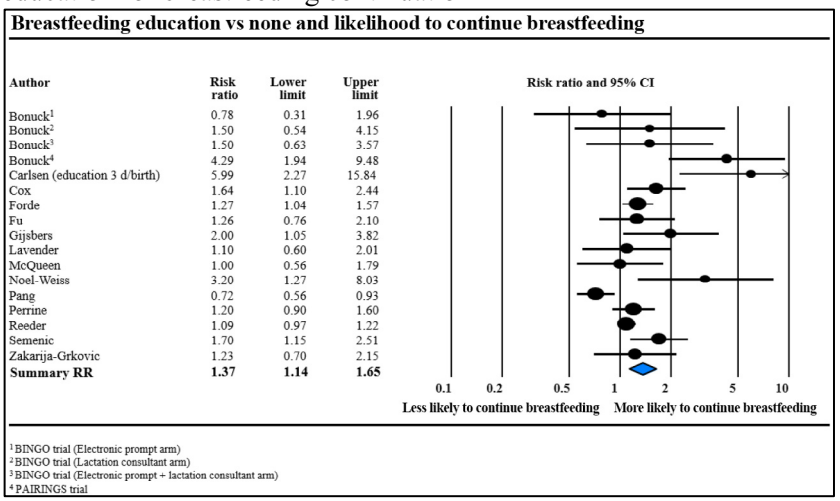


Figure 8. Continued.

Table I. Initial literature search to identify list of factors that have been studied in relation to early breastfeeding including database searched, search strings, and date of search

Databases	Search date	Topic	Search string
Medline	02Jan2015	Intent (last 10 y)	("infant, newborn"[MeSH Terms] AND "breast feeding"[MeSH Terms]) AND (((intent*[All Fields] OR intend*[All Fields])) AND "2005/01/05"[PDat] : "2015/01/02"[PDat] AND English[lang]) AND ("2005/01/05"[PDat] : "2015/01/02"[PDat] AND English[lang])
Medline	09Feb2015	Supply, maternal	((((((low[Title/Abstract] OR insufficient[Title/Abstract]) OR enough[Title/Abstract]) AND ((((supply[Title/Abstract] OR milk[Title/Abstract]) OR colostrum[Title/Abstract]) OR lactation[Title/Abstract]) OR lactogenesis[Title/Abstract])) AND term[Title/Abstract]) AND "Infant, Newborn"[Mesh]) AND "Breast Feeding"[Mesh]
Medline	18Feb2015	Nipple pain, maternal	((((("Breast Feeding"[Mesh]) AND "Infant, Newborn"[Mesh]) AND term[Title/Abstract] AND English[lang])) AND (((((((breast*[Title/Abstract]) OR nipple[Title/Abstract])) AND (((pain[Title/Abstract]) OR trauma[Title/Abstract]) OR sore*[Title/Abstract]))) OR (("Breast/abnormalities"[Mesh] OR "Breast/injuries"[Mesh]))) AND English[lang])
Medline	18Feb2015	Fatigue, maternal	((((("Fatigue"[Mesh]) OR (((((fatigue[Title/Abstract]) OR rest[Title/Abstract]) OR tired*[Title/Abstract]) OR energy[Title/Abstract]) AND English[lang])) AND English[lang])) AND ((("Breast Feeding"[Mesh]) AND "Infant, Newborn"[Mesh]) AND term[Title/Abstract] AND English[lang])
Medline	18Feb2015	Illness, maternal	((((("Breast Feeding"[Mesh]) AND "Infant, Newborn"[Mesh]) AND term[Title/Abstract] AND English[lang])) AND ((((((((((((((medication*[Title/Abstract]) OR prescription[Title/Abstract]) OR incapacitat*[Title/Abstract]) OR unavailable[Title/Abstract]) OR distress[Title/Abstract]) OR Cesar*[Title/Abstract]) OR Caesar*[Title/Abstract]) AND English[lang])) OR sick[Title/Abstract]) OR unwell[Title/Abstract]) AND English[lang])) OR ill[Title/Abstract]) OR illness[Title/Abstract]) AND English[lang])
Medline	25Feb2015	Beliefs, Maternal	(("Infant, Newborn"[Mesh] AND "Breast Feeding"[Mesh]) AND term[Title/Abstract]) AND ((((((((((culture[Title/Abstract] OR country[Title/Abstract]) OR background[Title/Abstract]) OR ethnicity[Title/Abstract]) OR race[Title/Abstract]) OR religion[Title/Abstract]) OR practice[Title/Abstract]) OR custom[Title/Abstract]) OR tradition[Title/Abstract]) OR habit[Title/Abstract]) OR convention[Title/Abstract]) OR (((((((attitude[Title/Abstract] OR opinion[Title/Abstract]) OR belief[Title/Abstract]) OR opinion[Title/Abstract]) OR view[Title/Abstract]) OR demeanor[Title/Abstract]) OR psychosocial[Title/Abstract]) OR temperament[Title/Abstract])) AND English[lang]
Medline	02Mar2015	Infants	(((((("Infant, Newborn"[Mesh]) AND "Breast Feeding"[Mesh])) AND "term"[Title/Abstract]) AND ((((((((((hypoglycaemia[Title/Abstract]) OR hypoglycemia[Title/Abstract]) OR "low blood sugar"[Title/Abstract]) OR "low blood glucose"[Title/Abstract])) OR ((weight[Title/Abstract]) OR growth[Title/Abstract])) OR (((((latch*[Title/Abstract]) OR attach*[Title/Abstract]) OR position[Title/Abstract]) OR suck*[Title/Abstract]) OR "nipple confusion"[Title/Abstract])) OR (((jaundice[Title/Abstract]) OR bilirubin[Title/Abstract]) OR dehydration[Title/Abstract])) OR (((((((fuss*[Title/Abstract]) OR cry[Title/Abstract])OR crying[Title/Abstract]) OR unsettled[Title/Abstract]) OR sleep*[Title/Abstract]) OR wake[Title/Abstract]) OR hungry[Title/Abstract]) OR hunger[Title/Abstract]))) AND English[lang]
Medline	05Mar2015	Pacifier use	(((((("Infant, Newborn"[Mesh]) AND "Breast Feeding"[Mesh])) AND term[Title/Abstract])) AND ((((((("Health Promotion"[Mesh]) OR "Health Education"[Mesh]) OR "Delivery of Health Care"[Mesh])))) OR "Health Personnel"[Mesh]) AND English[lang]
Medline	21Apr2015	Obesity, maternal	(("Breast Feeding"[Mesh] AND "Infant, Newborn"[Mesh]) AND ((((((((weight[Title/Abstract] OR overweight[Title/Abstract]) OR obesity[Title/Abstract]) OR BMI[Title/Abstract]) OR size[Title/Abstract]) OR "body weight"[MeSH Terms]) OR "body mass index"[MeSH Terms]) OR "overweight"[MeSH Terms]) OR "obesity"[MeSH Terms])) AND term[Title/Abstract] AND English[lang]
Medline	08May2015	Hypoglycemia, Infant—expanded search	((breastfeeding[MeSH Terms]) AND (((((duration[Title/Abstract]) OR continu*[Title/Abstract]) OR initiat*[Title/Abstract]) OR establish*[Title/Abstract]) OR supplement*[Title/Abstract])) AND (((((hypoglycemia[MeSH Terms]) OR hypoglycemia[Title/Abstract]) OR hypoglycaemia[Title/Abstract]) OR low blood sugar[Title/Abstract]) OR low blood glucose[Title/Abstract]) AND English[lang]
CINAHL	11Mar2015	All factors	SU: Breast Feeding Limiters—Exclude MEDLINE records; Language: English; Publication Type: Journal Article; Age Groups: Infant, Newborn: birth-1 month Search modes—Boolean/Phrase

Table II. Initial literature search results, grouped into factor categories for breastfeeding initiation with evidence scores

Factor categories	Instances of significant findings for factor category	Volume score	Strength score	Consistency score	Total score
Maternal education	10	3	2	2	*7*
Maternal factors—external/environmental characteristics	9	3	3	2	*8*
SES	9	3	1	1	*5*
Delivery mode	8	2	1	1	*4*
Maternal factors—internal/dyad characteristics	6	1	2	3	*6*
Intent	6	1	1	3	*5*
Breast and nipple complications	5	1	1	1	*3*
Dyad separation	5	1	2	2	*5*
Infant birthweight	5	1	2	1	*4*
Breastfeeding history	4				
Maternal age	4				
Maternal culture	4				
Maternal race / ethnicity	4				
Delivery medication	3				
Infant gestational age	3				
Maternal emotional state	3				
Parity	3				
Provider breastfeeding support and education	3				
Delivery complications	2				
Infant health	2				
Maternal body mass index	2				
Multiple birth	2				
Pacifier	2				
Pregnancy complications	2				
Social support	2				
Time of birth	2				
Infant sex	1				
Location	1				
Marital status	1				
Maternal diabetes	1				
Maternal employment	1				
Smoking status	1				

Each instance of a significant finding for a factor grouping comes from a single statistical model. Multiple statistical models were reported in many papers. Evidence scores range from 1 to 9 based on the sum of: volume of supportive studies (up to 3 points), the magnitude of association (up to 3 points), and the relative consistency of associations (up to 3 points). Only factor categories with at least 5 significant findings in the literature were given an evidence grade.

Table III. Initial literature search results, grouped into factor categories for breastfeeding continuation with evidence scores

Factor categories	Instances of significant findings for factor categories	Volume score	Strength score	Consistency score	Total score
Provider breastfeeding support and education	20	3	1	2	6
Delivery mode	12	3	1	3	7
Maternal factors—internal/dyad characteristics	10	3	2	1	6
SES	10	3	1	2	6
Maternal factors—external/environmental characteristics	9	3	2	2	7
Dyad separation	9	3	1	1	5
Intent	8	2	3	2	7
Maternal age	8	2	1	2	5
Maternal education	8	2	1	2	5
Maternal race /ethnicity	6	1	1	2	4
Smoking status	6	1	2	2	5
Maternal culture	5	1	NA	NA	NA
Parity	5	1	1	2	4
Maternal emotional state	4				
Maternal employment	4				
Pacifier	4				
Social support	4				
Infant health	3				
Advertising	2				
Breast and nipple complications	2				
Breastfeeding history	2				
Lactation	2				
Maternal birth history	2				
Maternal body mass index	2				
Maternal health	2				
Maternal medication	2				
Multiple birth	2				
Recall bias adjustment	2				
Delivery complications	1				
Hospital size	1				
Infant birthweight	1				
Infant gestational age	1				
Marital status	1				
Maternal drug use	1				
Maternal gestational age	1				
Pregnancy complications	1				
Prenatal care	1				

Each instance of a significant finding for a factor grouping comes from a single statistical model. Multiple statistical models were reported in many papers. Evidence scores range from 1 to 9 based on the sum of: volume of supportive studies (up to 3 points), the magnitude of association (up to 3 points), and the relative consistency of associations (up to 3 points). Only factor categories with at least 5 significant findings in the literature were given an evidence grade.

Table IV. Measures of SES identified in initial literature search

Measures examined in relation to breastfeeding	Country
Breastfeeding continuation	
Median neighborhood family income ($20 000 increments)	Canada
Median proportion of labor force employed in neighborhood (above/below)	Canada
Median proportion in labor force in neighborhood (above/below)	Canada
Federal poverty limit (<185%, 185%-350%, >350%)	US
Postnatal WIC enrollment (yes/no)	US
Categories of household income in 1995	US
New food package receipt (y) *(2 studies)	US
Number of y mother in WIC	US
WIC participation (yes/no)	US
Breastfeeding initiation	
Townsend deprivation score quintile	United Kingdom
WIC participation (yes/no)	US
WIC*mother employed interaction	US
Disadvantage index quintiles	Australia
New food package (yes/no)	US
Health insurance status (Medi-Cal vs private)	US
Birth hospital (government vs public)	Australia
Insurance status (public vs private)	US
SES (affluent vs deprived)	United Kingdom

*Measured as year of survey participation (2005 or 2008 = old food package; 2011 = after new food package); in 2011 WIC implemented a new food package with the goal to provide stronger incentives to breastfeed and reduce the amount of formula given to partially breastfed infants.

Table VI. Included studies examining smoking and breastfeeding initiation and/or continuation

Authors	Study year	Study design	Nation	n, Mother	n, Infants	Time-frame	Exposure measure	Adjusted RR
Breastfeeding initiation								
Apostolakis-Kyrus	2006-2007	Retrospective cohort	US	288 242	288 242	Hospital discharge	Maternal smoking vs non	Y
Bailey	2006-2007	Retrospective cohort	US	2323	2323	Hospital discharge	Maternal smoking vs non	Y
Black	1997-2003	Cross-sectional	Canada	297	NR	Hospital discharge	Maternal smoking vs non	N
Bramson	2005-2006	Prospective cohort	US	21 842	21 842	Hospital discharge	Maternal smoking vs non	Y
Cox	2010-2011	Prospective cohort	Australia	427	427	Hospital discharge	Maternal smoking vs non	N
Craig	2005-2007	Prospective cohort	Australia	1928	1928	Hospital discharge	Maternal smoking vs non	Y
Craighead	2009	Retrospective cohort	US	10 877	10 877	NR	Maternal smoking vs non	Y
Flower	2003-2004	Prospective cohort	US	1287	1287	Hospital discharge	Maternal smoking vs non	Y
Gerd	2007-2008	Prospective cohort	Sweden	2666	NR	NR	Maternal smoking vs non	Y
Karp	2007-2010	Clinical trial	US	130	130	48 h	Maternal smoking vs non	N
Krause	2004-2006	Clinical trial	US	450	450	Up to 6 mo	Maternal smoking vs non	Y
Lanting	2000-2003	Cross-sectional	Netherlands	8739	8739	Birth	Maternal smoking vs non	Y
Lok	2011	Cross-sectional	China	2761	NR	Hospital discharge	Maternal smoking vs non	Y
Manios	2003-2004	Cross-sectional	Greece	1897	1897	NR	Maternal smoking vs non	Y
McDonald	2009-2010	Retrospective cohort	Canada	~92 000	92 364	Hospital discharge	Maternal smoking vs non	Y
Nelson	1995-1997	Prospective cohort	Multicountry	2844	NR	NR	Maternal smoking vs non	N
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	Birth	Maternal smoking vs non	Y
Vassilaki	2007	Prospective cohort	Greece	1181	1208	NR	Maternal smoking vs non	Y
Weiser	2005	Cross-sectional	US	1748	NR	NR	Moderate/heavy smoker vs non	Y
Breastfeeding continuation								
Baghurst	2003	Prospective cohort	Australia	317	317	6 mo	Maternal smoking vs non	Y
Barria	2005-2006	Prospective cohort	Chile	315	315	3 mo	Maternal smoking vs non	Y
Bertino	2009	Prospective cohort	Italy	562	562	Varied	Maternal smoking to 3 mo of pregnancy vs non	Y
Bonet	2003-2006	Prospective cohort	France	1339	NR	4 mo	Maternal smoking vs non	Y
Brownell	2005-2007	Prospective cohort	US	2491	2491	4 wk	Maternal tobacco use vs non	Y
Cox	2010-2011	Prospective cohort	Australia	427	427	26 wk	Maternal smoking vs non	Y
Craighead	2009	Retrospective cohort	US	10 877	10 877	4 wk	Maternal smoking vs non	Y
Erkkola	1996-2004	Prospective cohort	Finland	5993	5993	4 mo	Maternal smoking vs non	N
Giglia	2002-2003	Prospective cohort	Australia	580	580	6 mo	Maternal smoking vs non	Y
Kohlhuber	2005	Prospective cohort	Germany	3822	3822	4 mo	Maternal smoking vs non	Y
Kristiansen	2006	Prospective cohort	Norway	1490	1490	4 mo	Maternal smoking vs non	Y
Kronborg	2004	Clinical trial	Denmark	1375	1375	17 wk	Maternal smoking vs non	N
Lademenou	2005	Prospective cohort	Greece	1049	1049	NR	Maternal smoking vs non	Y
Lanting	2000-2003	Cross-sectional	Netherlands	8739	8739	1 mo	Maternal smoking vs non	Y
Liu	2001-2002	Prospective cohort	US	3047	3047	10 wk	Maternal smoking vs non	Y
Ludvigsson	1997-1999	Prospective cohort	Sweden	10 205	NR	4 mo	Maternal smoking vs non	Y
McQueen	2010-2011	Prospective cohort	Canada	130	132	8 wk	Maternal smoking vs non	N
Nnebe-Agumadu	2005-2007	Prospective cohort	US	1799	1799	3 mo	Maternal smoking vs non	Y
Oddy	1989-1991	Prospective cohort	Australia	1803	1803	6 mo	Maternal smoking vs non	N
Soto-Ramirez	1994-1995	Cross-sectional	Germany	575	575	NR	Maternal smoking vs non	Y
Thorisdottir	2005	Prospective cohort	Iceland	200	200	12 mo	Smoking in home vs non	Y
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	2 mo	Maternal smoking vs non	Y
Weiser	2005	Cross-sectional	US	1748	NR	NR	Moderate/heavy smoker vs non	Y
Xu	2003-2004	Prospective cohort	China	617	NR	6 mo	Paternal smoking vs non	Y
Zakarija-Grkovic	2008-2009	Prospective cohort	Croatia	773	773	3 mo	Maternal smoking vs non	Y

N, no; *NR*, not reported; *Y*, yes.

Table VII. Included studies examining mode of delivery and breastfeeding initiation and/or continuation

Authors	Year	Study design	Nation	n, mother	n, infants	Time-frame	Exposure measure	Adjusted RR
Breastfeeding initiation								
Ahluwalia	2005-2006	Prospective cohort	US	3026	3026	NR	Vaginal vs elective cesarean vs emergency cesarean	Y
Apostolakis-Kyrus	2006-2007	Retrospective cohort	US	28 8242	28 8242 births	Hospital discharge	Vaginal vs cesarean	Y
Asole	2005	Cross-sectional	Italy	153	153	Hospital discharge	Vaginal vs cesarean	Y
Banapurmath	2011-2012	Cross-sectional	India	1793	1793	1 h	Vaginal vs cesarean	N
Bartington	2000-2002	Prospective cohort	United Kingdom	17 359	17 359	NR	Vaginal vs cesarean	Y
Biro	2007	Cross-sectional	Australia	3352	4085	Hospital discharge	Vaginal vs elective cesarean vs emergency cesarean	Y
Black	1997-2003	Cross-sectional	Canada	297	NR	Hospital discharge	Cesarean vs not cesarean	N
Chalmers	2006	Cross-sectional	Canada	6421	NR	NR	Vaginal vs cesarean	N
Chung	2007	Cross-sectional	South Korea	865	NR	NR	Vaginal vs cesarean	Y
Cox	2010-2011	Prospective cohort	Australia	427	427	Hospital discharge	Vaginal vs cesarean	N
Craig	2005-2007	Prospective cohort	Australia	1928	1928	Hospital discharge	Vaginal vs cesarean	N
Fisher	NR	Prospective cohort	Australia	549	549	Hospital discharge	Vaginal vs elective cesarean vs emergency cesarean	Y
Grossman	2005-2006	Clinical trial	US	1347	1347	Hospital discharge	Vaginal vs cesarean	Y
Gubler	2008-2009	Retrospective cohort	Switzerland	1893	1893	Hospital discharge	Vaginal vs elective cesarean vs emergency cesarean	Y
Guo	2010	Cross-sectional	China	2158	2354	1 h	Vaginal vs cesarean	Y
Krause	2004-2006	Clinical trial	US	450	450	Up to 6 mo	Vaginal vs cesarean	Y
LeClair	2009-2011	Retrospective cohort	Canada	22 023	22 023	Hospital discharge	Vaginal vs cesarean	Y
Linares	NR	Prospective cohort	US	97	NR	Hospital discharge	Vaginal vs cesarean	Y
Liston	1988-2002	Cross-sectional	Canada	142 929	142 971	Hospital discharge	Vaginal vs cesarean in labor	Y
Lok	2011	Cross-sectional	China	2761	NR	Hospital discharge	Vaginal vs elective cesarean vs emergency cesarean	Y
MacArthur	2007	Clinical trial	United Kingdom	2398	NR	Hospital discharge	Vaginal vs cesarean	Y
McDonald	2009-2010	Retrospective cohort	Canada	~92 000 (after accounting for twins)	92 364	Hospital discharge	Vaginal vs unplanned cesarean	Y
Parry	2006-2007	Prospective cohort	Hong Kong	1246	1246	Hospital discharge	Vaginal vs cesarean	Y
Patel	2005-6	Cross-sectional	India	20108	NR	NR	Cesarean vs not cesarean	N
Pechlivani	2001	Cross-sectional	Greece	1591	1600	NR	Vaginal vs cesarean	Y
Perez-Rios	1995-1996	Cross-sectional	US (Puerto Rico)	1695	1695	NR	Vaginal vs cesarean	Y
Santini	2008	Prospective cohort	Italy	757	757	Hospital discharge	Vaginal vs cesarean	N
Sutherland	2012	Prospective cohort	US	712	1574	NR	Vaginal vs elective cesarean vs emergency cesarean	Y
Tang	2010-2011	Prospective cohort	China	693	693	Hospital discharge	Vaginal vs cesarean	N
Theofilogiannakou	2003-2004	Prospective cohort	Greece	312	NR	1 h	Vaginal vs cesarean	N
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	Birth	Cesarean vs not cesarean	Y
Vassilaki	2007	Prospective cohort	Greece	1181	1208	NR	Vaginal vs cesarean	Y
Wilson	NR	Randomized controlled trial	United Kingdom	1405	NR	NR	Vaginal vs cesarean	Y

(*continued*)

Table VII. Continued

Authors	Year	Study design	Nation	n, mother	n, infants	Time-frame	Exposure measure	Adjusted RR
Breastfeeding continuation								
Agboado	2004-2006	Retrospective cohort	United Kingdom	2107	NR	Up to 6 mo	Vaginal vs cesarean	N
Ahluwalia	2005-2006	Prospective cohort	US	3026	3026	NR	Vaginal vs elective cesarean vs emergency cesarean	N
Bai	2006-2007	Prospective cohort	Hong Kong	1280	1280	Up to 1 y	Vaginal vs elective cesarean vs emergency cesarean	Y
Chalmers	2006	Cross-sectional	Canada	6421	NR	NR	Vaginal vs cesarean	N
Chung	2007	Cross-sectional	South Korea	546	NR	NR	Vaginal vs cesarean	Y
Erkkola	1996-2004	Prospective cohort	Finland	5993	5993	4 mo	Vaginal vs cesarean	N
Fisher	NR	Prospective cohort	Australia	549	549	4 mo	Vaginal vs elective cesarean vs emergency cesarean	Y
Guo	2010	Cross-sectional	China	2158	2354	6 mo	Vaginal vs cesarean	N
Haggkvist	1999-2008	Prospective cohort	Norway	29 621	29 621	NR	Vaginal vs cesarean	Y
Hauck	2006	Cross-sectional	Australia	2669	2669	9 wk	Vaginal vs cesarean	Y
Hayes	2004-2008	Cross-sectional	US	8508	NR	8 wk	Vaginal vs cesarean	Y
Kohlhuber	2005	Prospective cohort	Germany	3822	3822	4 mo	Vaginal vs cesarean	Y
McQueen	2010-2011	Prospective cohort	Canada	130	132	8 wk	Vaginal vs cesarean	N
Nakao	2003	Cross-sectional	Japan	318	318	4 mo	Cesarean vs not cesarean	Y
Nnebe-Agumadu	2005-2007	Prospective cohort	US	1799	1799	3 mo	Vaginal vs elective cesarean vs emergency cesarean	Y
Raghaven	2009	Prospective cohort	India	400	400	6 wk	Vaginal vs cesarean	Y
Semenic	2003	Cross-sectional	Canada	189	189	6 mo	Vaginal vs cesarean	Y
Thompson	2006-2007	Prospective cohort	Australia, NZ	206		1 wk	Vaginal vs cesarean	N
Wiklund	2003-2005	Prospective cohort	Sweden	357	357	3 mo	Vaginal vs cesarean	N

Table VIII. Included studies examining parity and breastfeeding initiation and/or continuation

Authors	Year	Study design	Nation	n, Mother	n, Infants	Time-frame	Measure of association	Adjusted RR
Breastfeeding initiation								
Flower	2003-2004	Prospective cohort	US	1287	Same	Hospital discharge	First born vs not	Y
Biro	2007	Cross-sectional	Australia	3352	4085	Hospital discharge	Primiparous vs multiparous	Y
Black	1997-2003	Cross-sectional	Canada	297	NR	Hospital discharge	Primiparous vs multiparous	N
Cantrill	2004	Prospective cohort	Australia	78	78	60 min	Primiparous vs multiparous	Y
Cox	2010-2011	Prospective cohort	Australia	427	427	Hospital discharge	Primiparous vs multiparous	Y
Craig	2005-2007	Prospective cohort	Australia	1928	1928	Hospital discharge	Primiparous vs multiparous	N
Forde	2006	Prospective cohort	Australia	3828	NR	Hospital discharge	Primiparous vs multiparous	Y
Griffiths	2000-2002	Prospective cohort	United Kingdom	11 286	11 286	NR	Primiparous vs multiparous	Y
Gubler	2008-2009	Retrospective cohort	Switzerland	1893	1893	Hospital discharge	Primiparous vs multiparous	Y
Johns	NR	Cross-sectional	Australia	1003	1003	First feed	Primiparous vs multiparous	N
Kitano	2011	Cross-sectional	Japan	1193	1193	Hospital discharge	Primiparous vs multiparous	Y
Krause	2004-2006	Clinical trial	US	450	450	6 mo	Primiparous vs multiparous	Y
Krause	2004-2006	Clinical trial	US	450	450	6 mo	Primiparous vs multiparous	Y
Lok	2011	Cross-sectional	China	2761	NR	Hospital discharge	Primiparous vs multiparous	Y
MacArthur	2007	Clinical trial	United Kingdom	2398	NR	Hospital discharge	Primiparous vs multiparous	Y
Manios	2003-2004	Cross-sectional	Greece	1897	1897	NR	Primiparous vs multiparous	Y
Santini	2008	Prospective cohort	Italy	757	757	Hospital discharge	Primiparous vs multiparous	N
Scott	NR	Cross-sectional	Australia	587	587	Hospital discharge	Primiparous vs multiparous	Y
Tong Leung	1997-2008	Retrospective cohort	China	63 885	NR	First feed	Parity 1, 2, 3, vs primiparous	Y
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914		Primiparous vs multiparous	Y
Vassilaki	2007	Prospective cohort	Greece	1181	1208	NR	Primiparous vs multiparous	Y
Breastfeeding continuation								
Agboado	2004-2006	Retrospective cohort	United Kingdom	2107	NR	6 mo	Primiparous vs multiparous	Y
Bonet	2003-2006	Prospective cohort	France	1339	NR	4 mo	Parity 1, 2 + v Primiparous	Y
Brownell	2005-2007	Prospective cohort	US	2491	2491	4 wk	Primiparous vs multiparous (with previous breastfeeding)	Y
Busck-Rasmussan	2002-2009	Prospective cohort	Denmark	36 899	36 899	4 mo	Parity 2, 3 + v 1	N
Cox	2010-2011	Prospective cohort	Australia	427	427	26 wk	Primiparous vs multiparous	Y
Dodgson	2003-2005	Prospective cohort	US	200	NR	6 mo	Parity 2-4, 5 + vs 1	Y
Forde	2006	Prospective cohort	Australia	3828	NR	Hospital discharge	Primiparous vs multiparous	Y
Gijsbers	2002-2003	Clinical trial	Netherlands	89	89	6 mo	Primiparous vs multiparous	Y
Hauck	2006	Cross-sectional	Australia	2669	2669	9 wk	Primiparous vs multiparous	Y
Kronborg	2004	Clinical trial	Denmark	1375	1375	17 wk	Primiparous vs multiparous	N
Manios	2003-2004	Cross-sectional	Greece	1897	853	NR	Primiparous vs multiparous	Y
Nnebe-Agumadu	2005-2007	Prospective cohort	US	1799	1799	3 mo	Primiparous vs multiparous	Y
Perrine	2005-2007	Prospective cohort	US	1457	NR	12 mo	Primiparous vs multiparous	Y
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	2 mo	Primiparous vs multiparous	Y
Zakarija-Grkovic	2008-2009	Prospective cohort	Croatia	773	773	3 mo	Primiparous vs multiparous	Y

Table IX. Included studies examining dyad separation and breastfeeding initiation and/or continuation

Authors	Year	Study design	Nation	n, Mother	n, Infants	Time-Frame	Measure of association	Adjusted RR
Breastfeeding initiation								
Asole	2005	Cross-sectional	Italy	153	153	Hospital discharge	Rooming in; time to first mother–baby contact	Y
Bramson	2005-2006	Prospective cohort	US	21 842	same	Hospital discharge	Skin-to-skin at birth	N
Cox	2010-2011	Prospective cohort	Australia	427	427	Hospital discharge	Early breast contact (<30 min); Rooming-in	N
Gubler	2008-2009	Retrospective cohort	Switzerland	1893	1893	Hospital discharge	First skin-to-skin contact >5 min first suckling > 60 min rooming-in <24 h/d	Y
Hongo	NR	Cross-sectional	Japan	363	NR	Hospital discharge	Early skin-to-skin contact; timely rooming-in	Y
Linares	NR	Prospective cohort	US	97	NR	Hospital discharge	Skin-to-skin at birth	Y
Merten	2003	Cross-sectional	Switzerland	2812	2861	NR	Rooming in	Y
Parry	2006-2007	Prospective cohort	Hong Kong	1246	same	Hospital discharge	Breastfed in delivery room; newborn rooming-in	Y
Pechlivani	2001	Cross-sectional	Greece	1591	1600	NR	Rooming-in	Y
Thukral	2008-2009	Clinical trial	India	41	41	48 h	Skin-to-skin (intervention)	N
Zuppa	2006	Prospective cohort	Italy	903	903	Hospital discharge	Rooming in	N
Breastfeeding continuation								
Brown	2006-2009	Retrospective cohort	Canada	2907	2907	6 mo	Early breast contact (<1 h after birth)	Y
Hongo	NR	Cross-sectional	Japan	363	NR	4 mo	Early skin-to-skin contact; timely rooming-in	Y
McQueen	2010-2011	Prospective cohort	Canada	130	132	8 wk	Skin-to-skin at birth	N
Perrine	2005-2007	Prospective cohort	US	1457	NR	12 mo	Rooming-in	Y
Tarrant	2006-2007, 2011-2012	Prospective cohort	Hong Kong	2470	2470	1 y	Rooming-in	Y
Thompson	2006-2007	Prospective cohort	Australia, NZ	206	206	1 wk	Time to first suckle	N
Thukral	2008-2009	Clinical trial	India	41	41	6 wk	Skin-to-skin (intervention)	N
Zakarija-Grkovic	2008-2009	Prospective cohort	Croatia	773	773	3 mo	Skin-to-skin at birth	Y

Table X. Included studies examining maternal education and breastfeeding initiation and/or continuation

Authors	Year	Study type	Nation	n, Mother	n, Infants	Time-frame	Measure of association	Adjusted RR
Breastfeeding initiation								
Artieta-Pinedo	2005-2007	Prospective cohort	Spain	614	NR	Hospital discharge	No formal education, primary or early secondary school, secondary school, occupational training, university diploma or degree	N
Bailey	2006-2007	Retrospective cohort	US	2323	2323	Hospital discharge	≥Some college vs ≤high school	Y
Celi	1999-2002	Prospective cohort	US	1829	1829	Hospital discharge	Postgraduate degree vs high school	Y
Chin	2000-2004	Cross-sectional	US	3515	3515	Hospital discharge	13 + v < 12 y	Y
Colaizy	2000-2003	Cross-sectional	US	16 839	16 839	Hospital discharge	>12 vs <12 y	Y
Cox	2010-2011	Prospective cohort	Australia	427	427	Hospital discharge	Bachelor degree or higher vs <high school	N
Craig	2005-2007	Prospective cohort	Australia	1928	1928	Hospital discharge	≥10 vs < 10 y	Y
Craighead	2009	Retrospective cohort	US	10 877	10 877	NR	16 + vs <12 y	Y
Forde	2006	Prospective cohort	Australia	3828	NR	Ever	Tertiary degree vs no tertiary degree	Y
Glassman	NR	Prospective cohort	US	209	209	NR	Graduate school vs less than high school	Y
Griffiths	2000-2002	Prospective cohort	United Kingdom	11 286	11 286	NR	Degree/higher degree vs <GCSE grades D–G	Y
Guo	2010	cross-sectional	China	2158	2354	1 h	Senior high school or above vs none or primary school	N
Hendricks	2002	Cross-sectional	US	2515	2515	NR	11th grade education or less vs completed high school	Y
Hoddinott	2001-2002	Clinical trial	Scotland	259	NR	Not specified	Age at completion of full-time education Age 19 + vs age 16	Y
Hornbeak	2000-2008	Cross-sectional	China	3009	NR	Not specified	University vs none	Y
Jacobson	NR	Cross-sectional	US	14 268	17 067	any time	>High school vs <high school	Y
Jacobson	NR	Cross-sectional	US	2799	17 067	any time	>High school vs <high school	Y
Karp	2007-2010	Clinical trial	US	130	130	48 h	Continuous y of education	N
Khoury	2000	Cross-sectional	US	733	NR	Hospital discharge	College education vs not	Y
Kohlhuber	2005	Prospective cohort	Germany	3822	3822	NR	>11 y vs < 10 y	Y
Krause	2004-2006	Clinical trial	US	450	450	6 mo	Postgraduate degree vs high school graduate or less	Y
Krause	2004-2006	Clinical trial	US	450	450	6 mo	Postgraduate degree vs high school graduate or less	Y
Ladewig	2007-2008	Cross-sectional	Ireland	11 092	11 092	NR	High vs low	Y
Lanting	2000-2003	Cross-sectional	Netherlands	8739	8739	Birth	High vs low	Y
Leahy-Warren	2009	Cross-sectional	Ireland	1715	NR	NR	3rd level education vs not	Y
Linares	NR	Prospective cohort	US	97	NR	Hospital discharge	Post-secondary ed vs not	Y
Lok	2011	cross-sectional	China	2761	NR	Hospital discharge	University degree or above vs compulsory secondary or below	Y
Ma	2000-2004	Cross-sectional	US	2036	2036	NR	≥13 vs <12 y	Y
Nelson	1995-1997	Prospective cohort	multicountry	2844	NR	NR	Continuous mother's age finished full-time education	N
Patel	2005-6	Cross-sectional	India	20108	NR	NR	Secondary or above vs none	N
Pechlivani	2001	Cross-sectional	Greece	1591	1600	NR	>15 v ≤9 y	Y
Qiu	2004-2005	Prospective cohort	China	1520	1520	Hospital discharge	>12 v ≤9 y	N
Skafida	2005-2005 and 2010-2011	Prospective cohort	Scotland	10 862	10 862	NR	Degree or equivalent vs no qualifications	Y
Sutherland	2012	Prospective cohort	US	705	1329	NR	Graduate degree vs <college degree	Y
Tender	2004	Cross-sectional	US	150	150	Hospital discharge	> High school vs high school or less	Y
Theofilogiannakou	2003-2004	Prospective cohort	Greece	312	NR	24 h	Academic education vs not	N
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	Birth	Graduate degree vs no education, or primary school	Y
Vassilaki	2007	Prospective cohort	Greece	1181	1208	NR	High vs low	Y
Vassilaki	2007	Prospective cohort	Greece	1181	1208	NR	High vs low	Y
Weiser	2005	Cross-sectional	US	1748	NR	NR	≥12 y vs <12 y	Y
Zhu	2011-2012	Cross-sectional	US	1471	1471	Hospital discharge	≥High school vs <high school	Y
Ziol-Guest	2001	Prospective cohort	US	4450	4450	NR	High school diploma vs < high school diploma	N

(*continued*)

Table X. Continued

Authors	Year	Study type	Nation	n, Mother	n, Infants	Time-frame	Measure of association	Adjusted RR
Breastfeeding continuation								
Bai	2006-2007, 2011-2012	Prospective cohort	Hong Kong	1738	1907	NR	University degree or above secondary or below	Y
Bonet	2003-2006	Prospective cohort	France	1339	NR	4 mo	University degree vs <high school	Y
Brown	2006-2009	Retrospective cohort	Canada	2907	NR	6 mo	University degree vs less than high school	Y
Brownell	2005-2007	Prospective cohort	US	2491	2491	4 wk	College vs < High school	Y
Busck-Rasmussan	2002-2009	Prospective cohort	Denmark	36 899	36 899	4 mo	>12 vs < 10 y	N
Craighead	2009	Retrospective cohort	US	10 877	10 877	4 wk	16 + vs <12 y	Y
Dodgson	2003-2005	Prospective cohort	US	200	NR	6 mo	Any college vs <high school	Y
Erkkola	1996-2004	Prospective cohort	Finland	5993	5993	4 mo	High-school graduate vs <high school	N
Forde	2006	Prospective cohort	Australia	2581	NR	3 mo	Tertiary degree vs no tertiary degree	Y
Guo	2010	cross-sectional	China	2158	2354	6 mo	Senior high school or above vs none or primary school	Y
Howard	NR	Clinical trial	US	700	700	12 mo	Mother's education (y) 0.93 0.89-0.96 $P < .0001$	Y
Huang	NR	Prospective cohort	US	1846	1846	6 mo	College graduate or more vs <high school	Y
Kohlhuber	2005	Prospective cohort	Germany	3822	3822	4 mo	>11 y vs < 10 y	Y
Kristiansen	2006	Prospective cohort	Norway	1490	1490	4 mo	Academy/college/university (≥4 y) vs Primary and secondary schools	Y
Kronborg	2004	Clinical trial	Denmark	1375	1375	17 wk	>10 y vs 7-10 y	N
Labarere	2001-2002	Clinical trial	France	231	331	4 wk	> High school graduate vs ≤high school	Y
Langellier	2005-2011	Cross-sectional	US	5020	5020	3 mo	> High school vs <high school	Y
Lanting	2000-2003	Cross-sectional	Netherlands	8739	8739	1 month	High vs low	Y
Ludvigsson	1997-1999	Prospective cohort	Sweden	10 205	NR	8 mo	University vs elementary school	N
Ludvigsson	1997-1999	Prospective cohort	Sweden	10 205	NR	4 mo	University vs elementary school	Y
Nnebe-Agumadu	2005-2007	Prospective cohort	US	1799	1799	3 mo	College graduate or more vs high school/ less	Y
Oddy	1989-1991	Prospective cohort	Australia	1803	1803	6 mo	>12 y vs < =12	N
Pang	2009-2010	Prospective cohort	Singapore	1030	NR	6 mo	University vs no education/primary/secondary	Y
Pitonyak	2005-2007	Prospective cohort	US	1226	1226	4 mo	College vs some college	Y
Rozga	2005-2011	Clinical trial	US	5389	5389	3 mo	High-school diploma or equivalent vs <High-school diploma	Y
Soto-Ramirez	1994-1995	Cross-sectional	Germany	575	575	NR	≥ College graduate vs some college	Y
Thorisdottir	2005	Prospective cohort	Iceland	200	200	12 mo	University vs high school or vocational school vs elementary school	Y
van Rossem	2002-2006	Prospective cohort	Netherlands	2914	2914	2 mo	Graduate degree vs no education, or primary school	Y
Weiser	2005	Cross-sectional	US	1748	NR	NR	≥12 y vs <12 y	Y
Xu	2003-2004	Prospective cohort	China	1256	1256	6 mo	≥13 y vs < 9 y	N
Zakarija-Grkovic	2008-2009	Prospective cohort	Croatia	773	773	3 mo	>12 vs ≤12 y	Y

GCSE, General Certificate of Secondary Education.

Table XI. Included studies examining breastfeeding education and breastfeeding initiation and/or continuation

Authors	Study design	Nation	n, Mother	n, Infants	Time-frame	Measure of association	Adjusted RR
Breastfeeding initiation							
Apostolakis-Kyrus	Retrospective cohort	US	288 242	288 242	Hospital discharge	Limited prenatal care (<5 visits)	Y
Artieta-Pinedo	Prospective cohort	Spain	614	NR	Hospital discharge	Prenatal education classes	N
Asole	Cross-sectional	Italy	153	153	Hospital discharge	Information about the advantages of breastfeeding given; mothers instructed how to latch for breastfeeding; explanations about feeding on demand given	Y
Cox	Prospective cohort	Australia	427	427	Hospital discharge	Mother attended antenatal classes, yes vs no; Staff encouragement to breastfeed at birth, yes vs no	N
Forde	Prospective cohort	Australia	3828	NR	Hospital discharge	Antenatal breastfeeding educ, yes vs no	Y
Gagnon	Clinical trial, analyzed as cohort	Canada	564	564	Hospital discharge	Attended childbirth education class	Y
Gijsbers	Clinical trial	Netherlands	89	89	NR	Pre and postnatal breastfeeding education one-on-one (intervention)	Y
Gill	Quasi-experimental	US	158	NR	NR	Prenatal education and postnatal support	N
Gross	Cross-sectional	US	NR	18789	NR	Lactation consultant support available; peer counselling	Y
Henderson	Cross-sectional	United Kingdom	2966	NR	First few days	Attended antenatal class	Y
Khoury	Cross-sectional	US	733	NR	Hospital discharge	Doctor encouraged breastfeeding; hospital nurse encouraged breastfeeding; lactation specialist/peer counselor encouraged breastfeeding; family encouraged formula	Y
Lavender	Clinical trial	United Kingdom	1312	NR	Hospital discharge	breastfeeding education intervention	N
Leahy-Warren	Cross-sectional	Ireland	1715	NR	NR	Time to first PHN visit; number of PHN visits	Y
LeClair	Retrospective cohort	Canada	22023	22023	Hospital discharge	Prenatal classes	Y
Ma	Cross-sectional	US	2036	2036	NR	Prenatal care in the first trimester; health clinic workers offered info on breastfeeding during pregnancy	N
MacArthur	Clinical trial	United Kingdom	2398	NR	Hospital discharge	Prenatal peer support for breastfeeding (intervention)	Y
McDonald	Retrospective cohort	Canada	92 000	92 364	Hospital discharge	Attended prenatal classes	Y
Patel	Cross-sectional	India	500	504	1 h	Counseling on breastfeeding during antenatal clinic checkup	Y
Tang	Prospective cohort	China	693	693	Hospital discharge	Attendance at antenatal classes	N
Xu	Cross-sectional	China	1118	1177	Hospital discharge	Perception of breastfeeding information given by hospital	Y
Breastfeeding continuation							
Abbas-Dick	Clinical trial	Canada	214	NR	6 wk	Co-parenting breastfeeding support video and contact (intervention)	N
Artieta-Pinedo	Prospective cohort	Spain	614	NR	3 mo	Prenatal education classes	N
Bonuck	Clinical trial	US	628/262	NR	NR	Electronic prompt in EMR to discuss breastfeeding, Lactation counselor meetings, or both (intervention)	N
Carlsen	Clinical trial	Denmark	207	207	Varied	Postpartum telephone support from lactation consultant (intervention)	Y
Cox	Prospective cohort	US	427	427	26 wk	Attended antenatal classes, yes vs no	Y
Forde	Prospective cohort	Australia	2581	NR	3 mo	Antenatal breastfeeding educ, yes vs no	Y
Fu	Clinical trial	Hong Kong	722	722	3 mo	Postpartum in-hospital support sessions for breastfeeding; postpartum telephone support for breastfeeding (intervention)	Y
Gijsbers	Clinical trial	Netherlands	89	89	6 mo	Pre and postnatal breastfeeding education one-on-one (intervention)	Y
Lavender	Clinical trial	United Kingdom	1312	NR	4 mo	breastfeeding education intervention	N
McQueen	Prospective cohort	Canada	130	132	8 wk	Attended prenatal classes	N
McQueen	Clinical trial	Canada	150	NR	4 wk	Postpartum self-efficacy training (intervention)	N
Noel-Weiss	Clinical trial	Canada	92	NR	8 wk	Prenatal breastfeeding workshop attendance (intervention)	N
Pang	Prospective cohort	Singapore	1030	NR	6 mo	Shown how to breastfeeding	Y
Perrine	Prospective cohort	US	1457	NR	12 mo	Information on breastfeeding support provided	Y
Reeder	Clinical trial	US	1884	NR	3 mo	Prenatal and postpartum peer counseling	Y
Semenic	cross-sectional	Canada	189	189	6 mo	Attended prenatal classes	Y
Wong	Clinical trial	China (Hong Kong)	469	NR	3 mo	One-on-one prenatal breastfeeding support and education	N
Zakarija-Grkovic	Prospective cohort	Croatia	773	773	3 mo	Attended prenatal class	Y

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