

# Labor Epidural Analgesia and Breastfeeding: A Systematic Review

Cynthia A. French, MS, PhD, CRNA<sup>1,2</sup>, Xiaomei Cong, PhD, RN<sup>3</sup>,  
and Keun Sam Chung, MD<sup>4</sup>

Journal of Human Lactation  
2016, Vol. 32(3) 507–520  
© The Author(s) 2016  
Reprints and permissions:  
sagepub.com/journalsPermissions.nav  
DOI: 10.1177/0890334415623779  
jhl.sagepub.com



## Abstract

Despite widespread use of epidural analgesia during labor, no consensus has been reached among obstetric and anesthesia providers regarding its effects on breastfeeding. The purpose of this review was to examine the relationship between labor epidural analgesia and breastfeeding in the immediate postpartum period. PubMed, Cochrane Library, and Cumulative Index to Nursing and Allied Health Literature were searched for articles published in 1990 or thereafter, using the search term *breastfeeding* combined with *epidural*, *labor epidural analgesia*, *labor analgesia*, or *epidural analgesia*. Of 117 articles, 23 described empirical studies specific to labor epidural analgesia and measured a breastfeeding outcome. Results were conflicting: 12 studies showed negative associations between epidural analgesia and breastfeeding success, 10 studies showed no effect, and 1 study showed a positive association. Most studies were observational. Of 3 randomized controlled studies, randomization methods were inadequate in 2 and not evaluable in 1. Other limitations were related to small sample size or inadequate study power; variation and lack of information regarding type and dosage of analgesia or use of other intrapartum interventions; differences in timing, definition, and method of assessing breastfeeding success; or failure to consider factors such as mothers' intention to breastfeed, social support, siblings, or the mother's need to return to work or school. It is also unclear to what extent results are mediated through effects on infant neurobehavior, maternal fever, oxytocin release, duration of labor, and need for instrumental delivery. Clinician awareness of factors affecting breastfeeding can help identify women at risk for breastfeeding difficulties in order to target support and resources effectively.

## Keywords

breastfeeding, epidural analgesia, labor

## Background

The benefits of breastfeeding to mother and neonate in the short and long term are significant. Infants who are breastfed have a lower risk of respiratory tract infections and otitis media,<sup>1</sup> necrotizing enterocolitis,<sup>2</sup> sudden infant death,<sup>1</sup> asthma,<sup>1</sup> type 1 diabetes,<sup>1</sup> and childhood leukemia,<sup>3</sup> as well as improved neurodevelopmental outcomes.<sup>1,4</sup> Maternal benefits of breastfeeding in the short term include decreased postpartum blood loss and more rapid involution of the uterus.<sup>5</sup> Long-term maternal benefits are a decreased incidence in the development of hypertension,<sup>6</sup> type 2 diabetes,<sup>6</sup> and ovarian and breast cancer.<sup>1,3,7</sup>

The American Academy of Pediatrics recommends exclusive breastfeeding for about 6 months with continuation up to 1 year or more.<sup>5</sup> The American College of Obstetrics and Gynecologists also supports this recommendation.<sup>8</sup>

Various intrapartum interventions can potentially alter the course of labor and adversely affect the initiation and duration of breastfeeding.<sup>8</sup> Of these, epidural analgesia is one of the most common. Because it provides better pain relief than other types of pain medication,<sup>9</sup> epidural analgesia has been increasingly used over the past few decades and has become the standard method for pain relief during labor in the United States.<sup>10</sup>

Despite the widespread use of epidural analgesia during labor, no consensus has been reached among obstetric and anesthesia providers as to its effects on breastfeeding.<sup>11</sup> The overwhelming physiologic stress in labor experienced by the mother can cause physiologic stress to the fetus, which may delay the infant's initiation of breastfeeding at birth.<sup>11</sup> Epidural analgesia preserves the beneficial stress response of the fetus to labor and reverses the negative maternal physiological and biochemical changes of labor.<sup>12</sup> In this respect, epidural analgesia may exert a positive influence

**This article was accepted under the editorship of the former Editor-in-Chief, Anne Merewood.**

<sup>1</sup>Columbia University, Graduate Program in Nurse Anesthesia, New York, NY, USA

<sup>2</sup>Yale New Haven Hospital, New Haven, CT, USA

<sup>3</sup>University of Connecticut, School of Nursing, Storrs, CT, USA

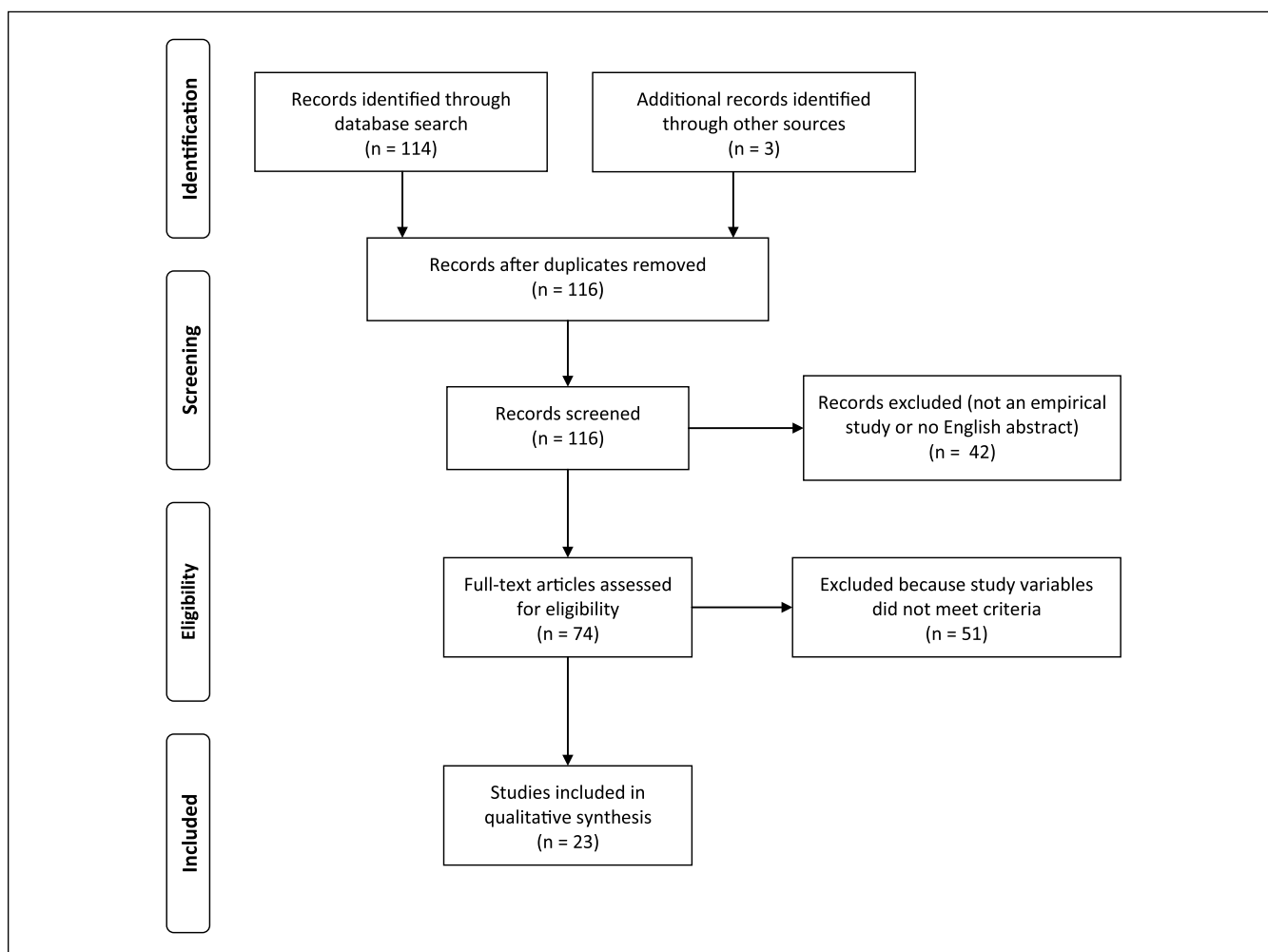
<sup>4</sup>Department of Anesthesiology, Yale University School of Medicine, New Haven, CT, USA

Date submitted: February 16, 2015; Date accepted: November 27, 2015.

## Corresponding Author:

Cynthia A. French, Assistant Professor of Nursing, Columbia University, Graduate Program in Nurse Anesthesia, 617 West 168th Street, New York, NY 10032, USA.

Email: cf2608@cumc.columbia.edu

**Figure 1.** Systematic Review: Selection of Studies.

on breastfeeding. In contrast, epidural analgesia may also negatively affect breastfeeding success, possibly through its effects on the labor process, maternal condition, or neonatal behavior.<sup>11</sup> A 2011 Cochrane review analyzed 38 of the most rigorous studies on epidural analgesia and concluded that, compared with other methods of pain relief, epidural analgesia was associated with significantly longer second stage of labor, higher rates of instrumental delivery, increased use of oxytocin to augment labor, lower maternal blood pressure, and increased risks of motor blockade and maternal fever.<sup>9</sup> However, of the 38 studies included in the review, only 1 study assessed breastfeeding as an outcome.

Given the benefits of breastfeeding and the recommendations for its promotion, the impact of epidural analgesia on breastfeeding needs to be clarified so that appropriate measures can be instituted to ameliorate or compensate for any negative effects. Thus, the purpose of this review was to comprehensively examine, appraise, and synthesize the results of studies in the current literature regarding the effects of labor epidural analgesia on breastfeeding outcomes and make recommendations for future research.

## Methods

To guide this review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were used.<sup>13</sup> The health science databases Cumulative Index to Nursing and Allied Health Literature, PubMed, and the Cochrane Database of Systematic Reviews were searched for articles published in 1990 or thereafter. The search terms used were *epidural* OR *labor epidural analgesia* OR *labor analgesia* OR *epidural analgesia* AND *breastfeeding*. In addition, reference lists of the articles retrieved were hand searched, and 4 systematic reviews from the Cochrane Database were examined.<sup>9,14-16</sup>

## Study Selection

The initial search resulted in 117 publications. The process of selecting publications for review is shown in Figure 1. Reports were eligible for review if they met the following criteria: (1) English language full text or an English language abstract, (2) report of an empirical

study (including nonrandomized observational studies), (3) the mother did not undergo cesarean section, (4) effects of epidural analgesia during labor were studied, and (5) breastfeeding outcomes were reported. Upon screening of titles and abstracts, 1 duplicate article was removed, and 42 articles were excluded because they were not published in English and had no English abstract or they were not empirical studies. After exclusion of these articles, 74 articles remained for full-text review. Of these, 51 articles were eliminated because breastfeeding was assessed after cesarean delivery, epidural analgesia was not used for labor but rather for postoperative pain, or effects of epidural analgesia on breastfeeding outcomes were not measured. The remaining 23 articles were specific to labor epidural analgesia and measured a breastfeeding outcome.

### Data Collection

All of the studies were examined in detail, and the following variables related to breastfeeding were examined: type of study (retrospective or prospective, controlled or uncontrolled, randomized or not randomized, etc), number of patients, type of epidural medication, assessment methods, and outcome variables. Study design and limitations were evaluated to assess strength of evidence and risk of bias on the basis of criteria described by Wright et al<sup>17</sup>: Level I, randomized trials with a significant difference or with no significant difference but narrow confidence intervals; Level II, prospective cohort studies and poor-quality randomized controlled trials (eg, < 80% follow-up); Level III, case-control studies and retrospective cohort studies; Level IV, case series with no control group or only historical controls.

All studies with breastfeeding outcomes were included in the review, regardless of definitions, duration of breastfeeding, or length of follow-up. Also, all studies pertaining to the effects of epidural analgesia were included, regardless of type of medication or failure to identify the medication.

### Results

Table 1 summarizes the methods, results, and level of evidence of the 23 studies included in this review.

#### *Studies Finding No Adverse Effects of Epidural Analgesia on Breastfeeding*

A total of 11 studies found that epidural analgesia was not implicated in adverse breastfeeding outcomes.<sup>18-28</sup> Of these, 1 study reported positive results on initiation of breastfeeding and quantity of milk in a comparison of continuous epidural analgesia versus no analgesia,<sup>25</sup> and the rest found no significant differences between women receiving epidural analgesia and those who did not. All the studies had a no-analgesia control group, except that Wilson et al<sup>24</sup> included a

subset of women in the nonepidural control group who also received pethidine. However, in the data analysis, the authors made a distinction between women who received nonepidural pethidine and those who received other forms of analgesia or none at all.

One study<sup>27</sup> recruited 87 multiparas who had previously breastfed and who delivered vaginally after receiving continuous labor epidural infusion with various doses of fentanyl. A telephone questionnaire was administered during the immediate postpartum period and at 1 week and 6 weeks postpartum by an investigator blinded to the total fentanyl dose. No dose-response relationship was found. However, because of the high rate of breastfeeding (95.4% at week 6), the study did not have sufficient power to detect a difference between high and low doses of fentanyl. Another study<sup>21</sup> evaluated breastfeeding behaviors using the Preterm Infant Breastfeeding Behavior Scale in 56 healthy mother-infant pairs and found no difference in neonatal rooting, latching, or sucking at 1 hour and at 24 hours after delivery between neonates born to mothers who received epidural analgesia and those whose mothers had no analgesia. They also measured the levels of bupivacaine and fentanyl in cord blood and found no significant effects on breastfeeding variables.

In addition, no dose-response effect was found in a secondary analysis of data from a randomized trial in the United Kingdom that assessed the effect of epidural analgesia on mode of delivery. A total of 1054 primiparas were randomized to receive high-dose epidural analgesia with bupivacaine alone or 1 of 2 mobile epidural techniques with low-dose bupivacaine and fentanyl, either a combined spinal epidural with a mean fentanyl dose of 107  $\mu$ g or a low-dose infusion with a mean fentanyl dose of 163  $\mu$ g.<sup>24</sup> A matched comparison group of women who did not receive regional analgesia was also recruited. The women were interviewed postpartum and mailed a postal questionnaire 12 months after delivery. The authors found no differences among the groups with regard to initiation rates or duration of breastfeeding. However, the breastfeeding initiation rate was significantly lower in a subset of women in the nonepidural group who received pethidine than in the other groups.

In a study reported in Chinese with an English abstract, 124 women with vaginal delivery were randomly divided into labor analgesia group ( $n = 75$ ) and control group ( $n = 49$ ). No significant differences were found in the initial time of lactation, the rate of abundant lactation, or newborn weight reduction between mothers receiving epidural analgesia and a control group.<sup>23</sup> In another study reported in Chinese with an English abstract, healthy women hospitalized for vaginal delivery without obstetric complications were observed, and 96 women who received continuous epidural anesthesia were compared with 74 women who did not.<sup>25</sup> The epidural group had a shorter starting time of lactation, a larger quantity of milk secretion, and higher prolactin level 48 hours after delivery. The women in the epidural group also reported better analgesia and postpartum mental state than the control

Table 1. Studies Evaluated.

	Type of Study	EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Rajan, 1994 <sup>18</sup>	Retrospective study—secondary analysis of UK survey of pain relief in labor (n = 1064)	Lignocaine (Lido)	No EDA	Questionnaire mailed at 6 weeks asked whether mother was breastfeeding	No negative effects of EDA, but breastfeeding rate decreased when mothers received pethidine	Retrospective study; not able to separate use of lignocaine in EDA from use as local anesthetic; doses unknown; pethidine used in some EDA patients	III
Albani et al, 1999 <sup>19</sup>	Prospective cohort study; vaginal delivery (n = 1920); mixed parity	Drugs unknown	No analgesia	Recorded feeding modality at discharge	No difference in breastfeeding rate between EDA and no analgesia in women with vaginal delivery	Article in Italian, only abstract in English; unknown medication and doses	II
Halpern et al, 1999 <sup>20</sup>	Prospective cohort study, mixed parity (n = 189)	Combined spinal/EDA (Bupi + Suf) (n = 79) or pure EDA (Lido or Bupi) (n = 34); maintained with Bupi or Fent if needed. Total EDA n = 113	No EDA (n = 76)	Breastfeeding assessment at 6 weeks by structured telephone interview (n = 171)	No significant effect of EDA or other types of labor analgesia on breastfeeding when leaving hospital or 6 weeks later; 74% were fully breastfeeding at 6 to 8 weeks	Study included only women intending to breastfeed; EDA was combined with spinal and/or IM opioid in some patients	II
Riordan et al, 2000 <sup>30</sup>	Prospective multisite cohort study; unknown parity	Assorted drugs, usually Bupi + Fent or Suf (n = 27) in varied doses	No medication (n = 37); IV opioids (n = 52); both IV opioids and EDA (n = 13)	Sucking (IBFAT) during hospital stay; duration of breastfeeding assessed by telephone at 6 weeks	Significant negative effect of medication vs no medication on IBFAT (suck scores, LATCH). No difference between EDA and IV opioids but mothers with both had significantly lower scores. Medication diminished sucking but not duration of breastfeeding, although duration shorter with low IBFAT scores	Multiple medication and doses; unclear whether IBFAT assessment was properly blinded; post hoc analysis of EDA vs IV opioids	II
Ransjö-Arvidson et al, 2001 <sup>31</sup>	Prospective cohort study; parity unknown	Bupi via EDA or parenteral pethidine or 2 to 3 types of analgesia (n = 12)	Pudendal block with mepivacaine (n = 6) or no analgesia (n = 10)	Video recordings of immediate PP skin-to-skin (assessed blindly)—rooting, latch on, sucking, swallowing, activity state, and neurobehavior. Age at and duration of first suck and number of sucks	Negative effect of EDA: Medicated babies had less frequent hand movements than nonmedicated babies. Nearly half of the medicated group did not feed in the first 2.5 hours of life, had higher temps (P = .03), and cried more (P = .05)	Small sample size; some patients with EDA had parenteral pethidine or multiple types of analgesia; only 2 patients had EDA alone	II

(continued)

Table 1. (continued)

	Type of Study	EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Radzysiminski, 2003, <sup>21</sup> 2005 <sup>45</sup>	Randomized trial	Bupri + Fent + epinephrine in an ultralow dose infusion (n = 28)	No analgesia (n = 28)	PIBBS/NACS at birth and 24 hours; high NACS = increased breastfeeding success. Measured duration of epidural infusion and amount of drug in cord blood at birth	No significant difference between EDA and no analgesia in PIBBS/NACS scores. No significant relation between levels of bupivacaine or fentanyl in cord blood and breastfeeding variables	Small sample size, randomization method not truly random	II
Henderson et al., 2003 <sup>32</sup>	Prospective observational (cohort) study; primiparas	CSE with PCEA Bupri + Fent (n = 690)	Continuous midwifery support group, N <sub>2</sub> O and/or pethidine (n = 302)	Time and quality of first breastfeed and self-report at 2 and 6 months	Negative effect of EDA: EDA associated with shorter duration of breastfeeding. Factors that favored longer breastfeeding were higher education, older mothers, nonsmokers, and no EDA	Intended as a randomized clinical trial but analyzed as a prospective observational study because of high crossover rates (43.4%), pethidine used in some EDA patients; self-report biased and unreliable	II
Baumgardner et al., 2003 <sup>33</sup>	Prospective cohort study (consecutive breastfeeding mothers receiving EDA compared with next breastfeeding mother without EDA); mixed parity	Drugs not specified (n = 115)	No analgesia (n = 116)	Two successful breastfeeding sessions in 24 hours as defined by LATCH	Negative effect of EDA, with 69.6% of mothers with EDA and 81% of nonmedicated mothers achieving successful breastfeeding in 24 hours; OR, 0.53; P = .04 by LATCH	Medications used not stated	II
Volmanen et al., 2004 <sup>29</sup>	Retrospective survey, primiparas, vaginal delivery	Bupri + occasional Fent (n = 30)	No EDA (n = 34)	Mailed questionnaire 2 to 3 years after delivery asking about breastfeeding success or failure in the first 12 weeks	Negative effect of EDA. Full breastfeeding: 33% with EDA, 71% with no EDA; "not enough milk" was reported as reason more often with EDA	Does not address breastfeeding in immediate PP, recall after 2 to 3 years may be faulty, failed to control for confounding variables after discharge	III

(continued)

Table 1. (continued)

	Type of Study	EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Chang and Heaman, 2005 <sup>22</sup>	Prospective cohort study; mixed parity	Bupri or Ropi with Fent or occasionally epinephrine; no other analgesia (n = 52)	No analgesia (n = 63)	Assessed at 8 to 12 hours PP LATCH and NACS telephone; phone interview at 4 weeks PP	No differences between EDA and no analgesia regarding LATCH and NACS. Positive correlation between infant neurobehavior and breastfeeding effectiveness ( $P = .01$ )	No mention of breastfeeding hospital practices, no definition of exclusive breastfeeding, no mention of total EDA infusion time	II
Jordan et al, 2005 <sup>39</sup>	Retrospective sample from birth register, primiparas	Neuraxial analgesia (n = 232) containing opioid (n = 158) or local anesthetic (n = 74)	Nitrous oxide or IM opioid (n = 570)	Infant feeding at discharge as recorded in case notes: proportion with exclusive bottle feeding or breastfeeding (total or partial)	Possible negative effect of EDA: bottle feed: $N_2O + O_2$ (32%); IM opioids + $N_2O + O_2$ (42%); neuraxial LA (44%); neuraxial + opioid (54%) with Fent (55%) and morphine (64%). Main determinants of bottle feed: maternal age, occupation, feed intention, cesarean, and Fent in a dose-response relationship	IM pethidine used in some EDA patients; no formal breastfeeding assessment in discharge summary; exclusive breastfeeding not separately analyzed, no neurobehavior assessment	III
Beilin et al, 2005 <sup>40</sup>	Randomized double-blinded study of different doses of Fent in EDA; multiparas who had previously breastfed	Bupri with intermediate-dose Fent (n = 59) or high-dose Fent (n = 58)	EDA with Bupri only (no Fent) (n = 60)	PP day 1, mother and lactation consultant each assessed breastfeeding separately using "B-R-E-A-S-T" feeding observation form, NACS, and 6-week PP telephone interview	Negative effect of high-dose Fent at 24 hours on NACS scores but no difference in consultant assessment. Negative effect of increasing Fent dose at 6 weeks, 17% of PP women in the high-dose Fent group, 5% with the interim dose, and 2% with no Fent reported stopping breastfeeding ( $P = .005$ ). High-dose Fent group reported significantly more difficulty with breastfeeding than other groups	No control group without EDA, breastfeeding assessed at 6 weeks	II (for dose comparison)
Wang et al, 2005 <sup>25</sup>	Prospective observational study; unknown parity	Continuous EDA, drug unknown (n = 96)	No EDA anesthesia or postpartum analgesia	Starting time of lactation, milk quantity, feeding times in 24 hours, prolactin level 48 hours after delivery	Positive effects of EDA: EDA group had earlier starting time of lactation, larger quantity of milk secretion, higher prolactin levels 48 hours after delivery, better analgesia and PP mental state than control	Article in Chinese—only abstract available in English	II

(continued)

Table 1. (continued)

	Type of Study	EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Torvaldsen et al, 2006 <sup>34</sup>	Prospective cohort, primiparas and multiparas either intending or not intending to breastfeed (not differentiated)	Bupr + Fent PCEA ± IM pethidine or N <sub>2</sub> O (n = 416)	No analgesia, N <sub>2</sub> O, pethidine (with or without N <sub>2</sub> O), or general anesthesia (n = 762)	Questionnaire on day 4 and mailed at 8, 16, and 24 weeks PP. Breastfeeding categorized as full, partial, or not breastfeeding	Possible negative effect of EDA: at week 1, EDA ± pethidine group had higher risk of partial instead of full breastfeeding compared with N <sub>2</sub> O, pethidine, and no analgesia groups. At 24 weeks, both EDA and pethidine groups had higher risk of breastfeeding cessation than the no-analgesia group ( $P < .0001$ )	Not possible to determine effects of EDA alone because no EDA patient had vaginal birth without pethidine (all EDA patients without pethidine had cesarean birth)	III
Chen et al, 2008 <sup>23</sup>	Randomized study	Ropi PCEA (n = 75)	No analgesia (n = 49)	Starting time of lactation, rate of abundant lactation, newborn weight reduction, and prolactin were recorded during first 24 hours	No differences between EDA and no analgesia in starting time of lactation, rate of abundant lactation, or newborn weight reduction	Article in Chinese—only abstract available in English	Not clear if I or II
Jordan et al, 2009 <sup>36</sup>	Retrospective analysis of survey data (n = 48,366)	EDA drugs not specified, with or without IM opioid or spinal	No analgesia	Breastfeeding or not at 48 hours PP; as recorded in maternal notes	Negative effect of EDA: regression analysis showed breastfeeding rate was significantly lower with EDA than with no EDA ( $P < .001$ ), even when adjusted for parity	Drugs and doses not specified; incomplete coding for social class. Retrospective design cannot separate effects of confounding variables	III
Wiklund et al, 2009 <sup>35</sup>	Retrospective matched case controlled study	Bupr + Suf ± pudendal or paracervical block (n = 351)	No analgesia ± pudendal or paracervical block (n = 351)	Breastfeeding assessed at 1 and 4 hours after birth, bottled in hospital, breastfeeding at discharge; as recorded in maternity record	Negative effect of EDA: fewer babies of mothers who received EDAs suckled breast within first 4 hours ( $P < .0004$ ); babies with EDAs were more likely to receive supplement ( $P < .0012$ ), and fewer had exclusive breastfeeding at discharge ( $P < .0430$ )	Retrospective study	III

(continued)

Table 1. (continued)

Type of Study		EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Wilson et al, 2010 <sup>24</sup>	Prospective cohort study—secondary outcome measure from randomized trial comparing different types of EDA (COMET trial)	High-dose Bupi (n = 353); CSE with low-dose Bupi + Fent (n = 351); low-dose Bupi and Fent infusion (n = 350)	Nonrandomized matched comparison group with no EDA (n = 351); pethidine (n = 151)	Interviewed 24 to 48 hours PP. Postal questionnaire 12 months PP asked duration of breastfeeding	No difference between EDA and non-EDA groups in breastfeeding initiation; women with pethidine in non-EDA group reported lower breastfeeding initiation rates ( $P = .002$ ). Older age ( $P < .001$ ) and nonwhite ethnicity ( $P < .026$ ) predicted breastfeeding. Duration of breastfeeding similar across all EDA groups	Maternal report of breastfeeding may not be accurate, sample size estimates not determined by breastfeeding initiation or duration, and no data on additional breastfeeding support women may have had	II
Bell et al, 2010 <sup>26</sup>	Prospective cohort study	EDA Bupi + Fent (n = 34)	No medication (n = 18)	Neonatal neurobehavior organization measured within 1 hour after birth with sucking apparatus	No difference in number of sucks; sucking pressure not related to EDA exposure overall, but unmedicated girls had more sucks ( $P = .027$ ) than girls in the EDA group. Overall girls had stronger suck pressure than boys ( $P = .042$ )	Groups were self-selected. Missing data on 4 neonates due to video recorder problems and 1 infant needing observation, no racial/ethnic diversity, and small sample size	II
Wieczorek et al, 2010 <sup>27</sup>	Prospective observational cohort study; multiparas who had previously breastfed successfully	Bupi + Fent (n = 87). Compared high-dose Fent ( $> 150 \mu\text{g}$ , n = 47) vs low-dose Fent ( $< 150 \mu\text{g}$ , n = 40)	No control without EDA	Immediate PP questionnaire and telephone interview at 1 and 6 weeks with degree of breastfeeding classified	No significant correlation between Fent dose and breastfeeding success. Breastfeeding success rate of $> 95\%$ PP; cessation rate at 6 weeks PP was much lower than in previously quoted literature	Comparison was only high vs low dose of Fent. High breastfeeding rates resulted in insufficient power to detect a true difference between doses if one existed	II (for dose comparison)
Gizzo et al, 2012 <sup>37</sup>	Prospective cohort study; primiparas	Bolus Fent + Ropi, booster boluses as need (n = 64)	No medication (n = 64). Controls randomly selected from larger group who met inclusion criteria but did not receive EDA	Within 2 hours of birth, midwife completed grid follow-up and recorded data	Negative effect of EDA: duration of first breastfeeding was significantly shorter in the EDA group than in the nonmedicated group ( $P < .001$ ), and length of labor was longer in EDA vs nonmedicated ( $P < .001$ )	Abstract states “randomized” but assignment to study group was not random; narrow patient selection (patients with potential confounding factors excluded)	II

(continued)

Table 1. (continued)

Type of Study	EDA (n)	Comparison Group (n)	Assessment Methods	Findings	Limitations	Evidence Level
Armani et al, 2013 <sup>28</sup> Retrospective case-control study	Bupri or Ropi combined with opiates administered as EDA top-up (n = 287)	No analgesia (n = 1676)	Gathered data on neonatal and obstetric outcomes, rates of breastfeeding, supplemental formula, and full formula	No difference between EDA and no analgesia in breastfeeding rate or supplementation. EDA had higher rates of instrument deliveries ( $P < .01$ ), occiput position ( $P < .05$ ), and neonatal cephalohematoma ( $P = .01$ ) and lower 1-minute Apgar ( $P = .016$ ); more women with EDA had fever ( $P = .003$ )	Retrospective design; not possible to draw conclusions about duration of breastfeeding	III
Dozier et al, 2013 <sup>36</sup> Retrospective analysis of data from 2 cohort studies of breastfeeding support: I prospective in-hospital and I retrospective perinatal; primiparas and multiparas	EDA (any type, drugs not specified, excluded local, spinal, or general anesthesia) (n = 437)	No EDA (n = 290)	Data abstracted from birth certificate + EMR; breastfeeding cessation within first month assessed by maternal self-report (mailed survey)	Negative effect of EDA: mothers with EDA more likely to discontinue breastfeeding during first 30 days (Kaplan-Meier analysis with log-rank test), even considering BFH status and other factors ( $P < .04$ for BFH; $P < .01$ for non-BFH) (Cox proportional hazards). Mothers with EDA + oxytocin most likely to stop	Medications not specified; breastfeeding data relied on maternal self-report; results applicable only to vaginal deliveries, full-term singleton infants; secondary analysis—data not available for certain relevant variables; different data sources may introduce bias	II-III

BFH, Baby-Friendly Hospital; Bupri, bupivacaine; COMET, Comparative Obstetric Mobile Epidural Trial; CSE, combined spinal epidural; EDA, epidural analgesia; EMR, electronic medical record; Fent, fentanyl; IBFAT, Infant Breastfeeding Assessment Tool; IM, intramuscular; IV, intravenous; LA, local anesthetic; LATCH, breastfeeding assessment tool measuring 5 key components of breastfeeding: Latching onto the breast, Audible swallowing, Type of nipple, Comfort of the mother, and amount of support the mother needs to hold the infant; Lido, lidocaine; NACS, Neonatal Neurologic and Adaptive Capacity Score; OR, odds ratio; PCEA, patient-controlled epidural analgesia; PIBBS, Preterm Infant Breastfeeding Behavior Scale; PP, postpartum; Ropi, ropivacaine; Suf, sufentanil.

group. However, the abstract failed to mention the dose and name of the epidural medications, any use of oxytocin, the availability of lactation support, or the hospital policy's that may be in place to support breastfeeding initiation in the immediate postpartum period.

### ***Studies Finding Adverse Effects of Epidural Analgesia on Breastfeeding***

Twelve studies found adverse effects of epidural analgesia on breastfeeding, either in comparisons of women with and those without epidural analgesia<sup>29,38</sup> or in analyses of dose-response relationships of epidural medications and breastfeeding.<sup>39,40</sup>

In contrast to the 3 studies finding no effects of fentanyl dose level, a retrospective cohort study in the United Kingdom, in which midwife and obstetric case notes were analyzed in a random sample of 425 healthy primiparas identified from a birth registry,<sup>39</sup> found a dose-response relationship between epidural fentanyl and bottle feeding. Three women received systemic fentanyl, and when they were added to the epidural group during data analysis, the association between bottle feeding and fentanyl increased. Higher fentanyl doses decreased breastfeeding rates even after demographic confounders of breastfeeding had been accounted for. However, women who had decided antenatally to bottle feed did so regardless of fentanyl dose. In addition, a randomized double-blind study<sup>40</sup> found an adverse effect of the epidural fentanyl dose on neurologic variables at 24 hours after birth but not on breastfeeding behavior observed by a lactation consultant. At 6 weeks, more women with high-dose than with low-dose fentanyl had discontinued breastfeeding.

In a prospective cohort study of 1280 women in Australia who responded to mailed questionnaires regarding breastfeeding at 1, 8, 16, and 24 weeks postpartum,<sup>34</sup> women with epidural analgesia had an increased likelihood of breastfeeding difficulties and partial breastfeeding in the first week postpartum and were more likely to stop breastfeeding in the first 24 weeks compared with women who had no analgesia. In another prospective observational study conducted in Australia,<sup>32</sup> 992 primiparas were enrolled to investigate effects of labor epidural analgesia ( $n = 690$ ) on breastfeeding duration by a self-reported postal questionnaire at 2 and 6 months. Women with labor epidural analgesia had a shorter breastfeeding duration and a 1.4 times greater risk of breastfeeding cessation in the first 6 months postpartum compared with women who had no analgesia. Similar results were found in a retrospective study of 164 primiparas with spontaneous vaginal delivery in Finland.<sup>29</sup> Questionnaires were mailed a median of 2.4 years after delivery. Women who had epidural analgesia were more likely to report problems of "not having enough milk" and reported more partial breastfeeding or formula feeding during the first 6 months postpartum than women who had no epidural.

A retrospective cohort study was performed in a large obstetric data set from Wales to investigate the associations

between drugs given routinely in labor and breastfeeding at 48 hours.<sup>36</sup> Regression analysis confirmed the association between epidural analgesia and lower breastfeeding rates, even after accounting for confounding variables such as age, parity, and social class. The authors did not name the epidural medications used.

A prospective study assessed the effects of different types of analgesia during labor on spontaneous breastfeeding movements and behavior.<sup>31</sup> The authors videotaped 28 neonates placed skin-to-skin with the mother immediately after birth. Analysis of the videotapes blinded to type of analgesia or no analgesia showed that neonates whose mothers had received labor analgesia had less frequent infant hand massage-like movements and sucking at the breast than infants whose mothers had received no analgesia, with almost half of the infants in the analgesia group not breastfeeding within the first 2.5 hours after birth. However, some patients receiving epidural analgesia also had parenteral pethidine or multiple types of analgesia, and only 2 patients had only epidural analgesia. Another prospective study of 129 women in the United States examined labor analgesia and its effect on neonatal sucking and breastfeeding duration.<sup>30</sup> The researchers measured suckling using the Infant Breastfeeding Assessment Tool (IBFAT) and found reduced neonatal suckling scores in women who had labor analgesia, although there was no difference in duration of breastfeeding through 6 weeks postpartum compared with women who had no analgesia. Similarly, a study in the United States of 52 mixed-parity healthy women with spontaneous vaginal delivery found that epidural analgesia ( $n = 34$ ) was associated with reduced sucking among the female neonates during their first feed compared with the nonmedicated group.<sup>26,28</sup>

In a retrospective comparative study carried out in Sweden,<sup>35</sup> all maternity records of women who received epidural analgesia for labor between January 2000 and April 2000 were assessed. After exclusions, 351 charts were included. Each epidural chart was matched to a control record similar in age, parity, and gestational age. Compared with matched controls, neonates born to mothers who had epidural analgesia during labor had significantly lower rates of suckling at the breast during the first 4 hours after delivery and were given formula more often while in the hospital, and fewer were fully breastfeeding at discharge.

## **Discussion**

Studies on the relationship between epidural analgesia and breastfeeding success yielded conflicting results, with 12 studies yielding negative associations and 11 studies finding either no effect of epidural analgesia on breastfeeding ( $n = 10$ ) or a positive association ( $n = 1$ ). The studies defined breastfeeding success differently, as discussed later in this section. The level of evidence<sup>17</sup> ranged from II to IV (Table 1). Only 2 randomized studies comparing epidural analgesia to no analgesia were found, and neither study justified classification at level I. One of these<sup>21</sup> showed no difference in

breastfeeding behaviors between infants of women who received epidural analgesia and those whose mothers received no analgesia, but the method of treatment allocation was not truly random. The second randomized trial<sup>23</sup> showed no difference between epidural analgesia and no pain-relieving measures. However, the number of patients in the 2 groups differed, and it was not possible to evaluate the study design because only the abstract was available in English. One problem with studies that find no differences between groups is that they are not always powered to detect a true difference, even if one did indeed exist.

Another study<sup>32</sup> was intended as a randomized trial, but breastfeeding outcomes were analyzed as a prospective observational study because of high crossover rates (43.4%). This study found an association between epidural analgesia and shortened duration of breastfeeding. A further randomized study compared different doses of epidural fentanyl without a nonepidural group and found a negative effect of increasing doses.<sup>40</sup>

If epidural medications have a physiological effect on breastfeeding, and the half-life of epidural fentanyl in the maternal circulation is 2 to 2.5 hours, then breastfeeding should be studied the first few hours after delivery, before the drugs are cleared. However, breastfeeding was measured at time points ranging from immediate postpartum to 6 months or assessed retrospectively through questionnaires mailed up to 2 or 3 years after delivery. Especially after so much time has elapsed, maternal self-report carries the risk of recall bias. After hospital discharge, many new factors may confound the picture of breastfeeding success, for example, lack of social support, presence of siblings, or the mother's need to return to work or school. In addition, studies did not always take into account maternal factors that may influence breastfeeding, such as the mother's intention to breastfeed, level of education, marital status, body mass index, and smoking behavior.

Numerous differences among studies make it difficult to draw conclusions. Different definitions of breastfeeding success were used. In some studies, breastfeeding was considered successful only if exclusive, whereas other studies grouped partial and full breastfeeding together. Many of the studies did not consider other factors that may influence breastfeeding success, such as hospital practices in regard to provision of breastfeeding support, availability of supplemental formula, and the timing of breastfeeding initiation after delivery. A hospital environment strongly supportive of breastfeeding (eg, using lactation consultants) may be able to at least partially offset the potential negative effects of epidurals on breastfeeding.<sup>20,27</sup>

To assess reflexes needed for rooting and swallowing, standardized breastfeeding assessment tools such as LATCH (a breastfeeding charting system measuring 5 key components of breastfeeding: Latching onto the breast, Audible swallowing, Type of nipple, Comfort of the mother, and amount of support the mother needs to Hold the infant),<sup>41</sup> the

IBFAT,<sup>42</sup> or the Preterm Infant Breastfeeding Behavior Scale<sup>43</sup> should be used. However, only a few studies reported such measures.<sup>21,22,30,33,40</sup>

The drugs and doses used in labor epidural analgesia varied among study sites, but all contained a local anesthetic (usually bupivacaine) and an opioid (generally fentanyl or sufentanil). However, some studies failed to mention the exact name and/or dose of the medications used in the epidural. Furthermore, in several studies, women in the epidural analgesia groups also received other medications, including pethidine, which has been shown to have an adverse effect on breastfeeding.<sup>18,24</sup> Administration of other medication makes it very difficult to determine whether the observed breastfeeding outcome was associated with the pharmacokinetics of a specific epidurally administered drug given at a specific dose at a certain time or with some other variable related to the epidural.

Whether and to what extent epidural medications exert a direct or indirect effect on breastfeeding remains uncertain. For example, epidurally administered local anesthetic and opioid drug combinations readily cross the placenta and fetal blood-brain barrier and may depress necessary neonatal reflexes needed for rooting, swallowing, or sucking.<sup>22</sup> A depressed neonate not responsive to sucking may prompt the mother to quit breastfeeding too soon. Because an intact and functioning central nervous system is necessary for an infant to latch on and feed, several studies have used the Neurologic Adaptive Capabilities Scale (NACS)<sup>44</sup> to address the association between epidural opioids and neonatal neurobehavior. Infants who score high on breastfeeding behaviors tend to have high NACS scores.<sup>22,45</sup> For example, Beilin et al<sup>40</sup> randomized 177 multiparas who had previously breastfed into 3 groups: with epidural bupivacaine and either no fentanyl or fentanyl at  $< 150 \mu\text{g}$  (intermediate dose) or  $> 150 \mu\text{g}$  (high dose). More than  $150 \mu\text{g}$  fentanyl was associated with significantly lower NACS scores compared with bupivacaine without fentanyl. At 6 weeks postpartum, significantly more women who were randomly assigned to high-dose epidural fentanyl were not breastfeeding than in either of the other groups. Thus, one can conclude that depression of the neonate's muscle tone by epidural opiates impedes the neonate's ability to latch on to the breast. Such factors may prevent good feeding behaviors in the first 24 hours of life, which may prompt the mother to quit breastfeeding too soon.

Epidural analgesia has been consistently associated with maternal fever<sup>3</sup> or temperature elevation. Curtin et al<sup>46</sup> reported that epidural analgesia was an independent predictor of intrapartum fever, with an odds ratio of 3.4 (confidence interval, 1.70-6.81). Maternal fever may also affect breastfeeding, because the transfer of heat can cause fetal hyperthermia. In one study,<sup>47</sup> when the temperature of all women who received epidural analgesia was evaluated, a significant linear correlation was found between maximum maternal temperature and the infant's Apgar scores, hypotonia, early-onset seizures, and need for assisted ventilation. Infants born to women with

maternal fever  $> 38.3^{\circ}\text{C}$  had a 2- to 6-fold increase in all the neonatal outcomes evaluated. To remove the possibility that fever might be due to maternal infection, the authors excluded study participants who had a sexually transmitted infection or fever at admission (temperature above  $37.5^{\circ}\text{C}$ ). Although no data are available on the specific effects of increased maternal temperature on breastfeeding, studies<sup>48,49</sup> show a negative effect of maternal fever on neonatal outcomes, which suggests a negative effect on breastfeeding.

Furthermore, the combination of epidural analgesia with other intrapartum interventions appears to have an indirect effect on breastfeeding, although the extent is unclear.<sup>11</sup> Recent emphasis has been placed on research involving the potential lowering effect of epidural analgesia on oxytocin levels in the maternal plasma during labor and birth and the relationship of epidural analgesia to the mother's endogenous release of oxytocin. Oxytocin use has been associated with delayed initiation of breastfeeding,<sup>35</sup> and combined administration of epidural analgesia and oxytocin during labor has been negatively associated with breastfeeding success. The shortened breastfeeding duration shown in women who received epidural analgesia<sup>32,34,40</sup> may be a result of decreased maternal milk production due to low levels of maternal oxytocin at birth, which may interfere with the pattern of oxytocin secretion for milk production and affect maternal-infant bonding at birth.<sup>36</sup> Although a shorter starting time of lactation and a larger quantity of milk secretion were found in the epidural group versus control group in 1 study,<sup>25</sup> it was difficult to know whether other factors led to these outcomes because the article was in Chinese. Further research in this area is needed to ascertain the effects of intrapartum oxytocin combined with epidural analgesia on breastfeeding success.

Epidural analgesia is also associated with a significantly higher rate of instrumental vaginal delivery.<sup>9,50</sup> Two large cohort studies found that the use of epidural analgesia in nulliparous women was associated with a 4-fold increase in instrumental vaginal deliveries.<sup>51,52</sup> Instrumental vaginal delivery can have serious ramifications for the neonate and mother. A retrospective case-control study was designed to evaluate the relationship between epidural analgesia, labor length, and perinatal outcomes in 350 women who received epidural analgesia compared with 1400 patients without epidural. Epidural analgesia was associated with longer labors and increased rates of vacuum deliveries due to dystocia, or fetal distress.<sup>53</sup>

The tissue damage caused by episiotomies and lacerations due to instrumental delivery can take time to repair, which can delay immediate skin-to-skin contact between the infant and mother. During early postpartum skin-to-skin contact, the neonate initiates breastfeeding, inducing the release of maternal oxytocin necessary for milk production. When delivery is difficult, the baby may need medical assessment, thereby delaying immediate skin-to-skin contact during the crucial time. Being in pain may prevent the mother from getting breastfeeding off to a good start. The baby may have pain from bruising and facial injury caused by the forceps or vacuum

delivery, which inhibits movements of the baby's head and neck, making it difficult for the baby to get into the breastfeeding position and to latch on effectively. Longer stage 2 labor caused by epidural analgesia may tire the mothers and stress babies, making breastfeeding even more difficult. Women who perceive breastfeeding as difficult, no matter the reason, are more likely to stop breastfeeding during the first week postpartum than are women who perceive no problems.<sup>54</sup> A delay in breastfeeding during the critical time immediately postpartum may require extra support and follow-up for the mother and neonate to establish successful breastfeeding.

As shown by this review, the relationship between epidural analgesia and breastfeeding remains inconclusive. Because the available studies varied in design, outcome definition, sample size, control group, inclusion of many potential confounders, and rigor, any statistical conclusions are difficult to make. Poor study design is common. Few studies are able to use randomized treatment allocation; most do not use a breastfeeding assessment tool. Some studies have not mentioned the names of medications that were used, at what dose or concentration of the epidural infusion, making it difficult to determine whether any effects are caused by the specific drugs in the epidural infusate or the condition that the epidural analgesia itself has created.<sup>55</sup>

Despite concern regarding adverse effects on breastfeeding, epidural analgesia and other intrapartum interventions are frequently used because of the benefits they confer. Therefore, it is important to find ways of ameliorating any adverse consequences. Hospital practices and providers can lend additional breastfeeding support to women who are at a higher risk of not initiating breastfeeding or for early cessation. Various strategies may be tried, but one promising way to achieve this goal is for hospitals to offer breastfeeding support by promoting unlimited skin-to-skin contact between mother and neonate. Skin-to-skin contact immediately postpartum allows development of innate neonatal behaviors such as temperature regulation, crying, respiration, and nursing. When this contact occurs, mothers are more likely to be breastfeeding at 1 and 4 months after delivery and for a longer duration.<sup>56-59</sup>

## Conclusions

Labor epidural analgesia provides women with excellent pain relief. Although epidural analgesia may sometimes lead to obstetric problems and breastfeeding difficulties, almost half of the studies reviewed here do not show adverse effects on breastfeeding. Furthermore, epidural analgesia is just one of the intrapartum interventions that can affect the course of labor and breastfeeding. The relationship of epidural analgesia with breastfeeding involves complex interactions among the various intrapartum interventions. One intervention may lead to another in a cascade that may either directly or indirectly affect breastfeeding.

Future studies on labor epidural analgesia and breastfeeding need to view labor, birth, and interventions as a

whole—in an integrated process that must be evaluated for potential adverse effects on the course of labor, neonatal and maternal behavior, and breastfeeding. Because random assignment of patients to receive no analgesia versus analgesia would be unethical, carefully planned prospective cohort studies with a control group should allow for comparisons of the interventions and interrelations. Studies should measure breastfeeding success using an objective breastfeeding scoring system and record the specific time point after delivery when the first breastfeeding attempt occurred. A breastfeeding analysis should be completed in the first 3 hours after delivery and then at discharge. Neurobehavior assessment with tools such as the NACS should be performed to account for the general neurological effects that analgesia may produce in the neonate. Evidence-based recommendations can then be made to change practice to improve labor outcomes and provide additional breastfeeding support to the women who will need it most postpartum.

### Acknowledgments

The corresponding author gratefully acknowledges Cheryl Beck, DNSc, CNM, FAAN, and E. Carol Polifroni, EdD, NEA-BC, CNE RN, ANEF, for their critical and insightful recommendations to the development of this manuscript and a special thank you to Holly Robins, DNAP, MBA, CRNA, for her continued support.

### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

### References

1. Ip S, Chung M, Raman G, et al; Tufts-New England Medical Center Evidence-based Practice Center. Breastfeeding and maternal and infant health outcomes in developed countries. *Evid Rep Technol Assess*. 2007;153(153):1-186.
2. Sullivan S, Schanler RJ, Kim JH, et al. An exclusively human milk-based diet is associated with a lower rate of necrotizing enterocolitis than a diet of human milk and bovine milk-based products. *J Pediatr*. 2010;156(4):562-567.
3. Ip S, Chung M, Raman G, Trikalinos TA, Lau J. A summary of the Agency for Healthcare Research and Quality's evidence report on breastfeeding in developed countries. *Breastfeed Med*. 2009;4(suppl 1):S17-S30.
4. Kramer MS, Aboud F, Mironova E, et al; Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group. Breastfeeding and child cognitive development: new evidence from a large randomized trial. *Arch Gen Psychiatry*. 2008;65(5):578-584.
5. Eidelman AI, Schanler RJ. Breastfeeding and the use of human milk: an analysis of the American Academy of Pediatrics 2012 Breastfeeding Policy Statement. *Breastfeed Med*. 2012;7(5):323-324.
6. Schwarz EB, Ray RM, Stuebe AM, et al. Duration of lactation and risk factors for maternal cardiovascular disease. *Obstet Gynecol*. 2009;113(5):974-982.
7. Stuebe AM, Willett WC, Xue F, Michels KB. Lactation and incidence of premenopausal breast cancer: a longitudinal study. *Arch Intern Med*. 2009;169(15):1364-1371.
8. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 361: Breastfeeding: maternal and infant aspects. *Obstet Gynecol*. 2007;109(2, pt 1):479-480.
9. Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. *Cochrane Database Syst Rev*. 2011;(12):CD000331.
10. Cambic CR, Wong CA. Labour analgesia and obstetric outcomes. *Br J Anaesth*. 2010;105(suppl 1):i50-i60.
11. Montgomery A, Hale TW; Academy of Breastfeeding Medicine. ABM clinical protocol #15: analgesia and anesthesia for the breastfeeding mother, revised 2012. *Breastfeed Med*. 2012;7(6):547-553.
12. Westgren M, Lindahl SG, Norden NE. Maternal and fetal endocrine stress response at vaginal delivery with and without an epidural block. *J Perinat Med*. 1986;14(4):235-241.
13. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009;62(10):e1-e34.
14. Anim-Somuah M, Smyth R, Howell C. Epidural versus non-epidural or no analgesia in labour. *Cochrane Database Syst Rev*. 2005;(4):CD000331.
15. Jones L, Othman M, Dowswell T, et al. Pain management for women in labour: an overview of systematic reviews. *Cochrane Database Syst Rev*. 2012;3:CD009234.
16. Sng BL, Leong WL, Zeng Y, et al. Early versus late initiation of epidural analgesia for labour. *Cochrane Database Syst Rev*. 2014;10:CD007238.
17. Wright JG, Swiontkowski MF, Heckman JD. Introducing levels of evidence to the journal. *J Bone Joint Surg Am*. 2003;85(1):1-3.
18. Rajan L. The impact of obstetric procedures and analgesia/anaesthesia during labour and delivery on breast feeding. *Midwifery*. 1994;10(2):87-103.
19. Albani A, Addamo P, Renghi A, Voltolin G, Peano L, Ivani G. The effect on breastfeeding rate of regional anesthesia technique for cesarean and vaginal childbirth [in Italian]. *Minerva Anestesiol*. 1999;65(9):625-630.
20. Halpern SH, Levine T, Wilson DB, MacDonell J, Katsiris SE, Leighton BL. Effect of labor analgesia on breastfeeding success. *Birth*. 1999;26(2):83-88.
21. Radzyminski S. The effect of ultra low dose epidural analgesia on newborn breastfeeding behaviors. *J Obstet Gynecol Neonatal Nurs*. 2003;32(3):322-331.
22. Chang ZM, Heaman MI. Epidural analgesia during labor and delivery: effects on the initiation and continuation of effective breastfeeding. *J Hum Lact*. 2005;21(3):305-314, quiz 315-319, 326.
23. Chen YM, Li Z, Wang AJ, Wang JM. Effect of labor analgesia with ropivacaine on the lactation of parturients [in Chinese]. *Zhonghua Fu Chan Ke Za Zhi*. 2008;43(7):502-505.
24. Wilson MJ, MacArthur C, Cooper GM, et al. Epidural analgesia and breastfeeding: a randomised controlled trial of epidural techniques with and without fentanyl and a non-epidural comparison group. *Anaesthesia*. 2010;65(2):145-153.

25. Wang BP, Li QL, Hu YF. Impact of epidural anesthesia during delivery on breast feeding [in Chinese]. *Di Yi Jun Yi Da Xue Xue Bao*. 2005;25(1):114-115, 118.
26. Bell AF, White-Traut R, Medoff-Cooper B. Neonatal neurobehavioral organization after exposure to maternal epidural analgesia in labor. *J Obstet Gynecol Neonatal Nurs*. 2010;39(2):178-190.
27. Wiecek PM, Guest S, Balki M, Shah V, Carvalho JC. Breastfeeding success rate after vaginal delivery can be high despite the use of epidural fentanyl: an observational cohort study. *Int J Obstet Anesth*. 2010;19(3):273-277.
28. Armani M, Gaggiano C, Dallaglio S, Romanini E, Sospiri C, Magnani C. Are there any strategies to improve neonatal outcomes associated with epidural analgesia in labor? *Act Biomed*. 2013;84(2):117-123.
29. Volmanen P, Valanne J, Alahuhta S. Breast-feeding problems after epidural analgesia for labour: a retrospective cohort study of pain, obstetrical procedures and breast-feeding practices. *Int J Obstet Anesth*. 2004;13(1):25-29.
30. Riordan J, Gross A, Angeron J, Krumwiede B, Melin J. The effect of labor pain relief medication on neonatal suckling and breastfeeding duration. *J Hum Lact*. 2000;16(1):7-12.
31. Ransjö-Arvidson AB, Matthiesen AS, Lilja G, Nissen E, Widstrom AM, Uvnas-Moberg K. Maternal analgesia during labor disturbs newborn behavior: effects on breastfeeding, temperature, and crying. *Birth*. 2001;28(1):5-12.
32. Henderson JJ, Dickinson JE, Evans SF, McDonald SJ, Paech MJ. Impact of intrapartum epidural analgesia on breast-feeding duration. *Aust N Z J Obstet Gynaecol*. 2003;43(5):372-377.
33. Baumgarder DJ, Muehl P, Fischer M, Pribbenow B. Effect of labor epidural anesthesia on breast-feeding of healthy full-term newborns delivered vaginally. *J Am Board Fam Pract*. 2003;16(1):7-13.
34. Torvaldsen S, Roberts CL, Simpson JM, Thompson JF, Ellwood DA. Intrapartum epidural analgesia and breast-feeding: a prospective cohort study. *Int Breastfeed J*. 2006;1:24.
35. Wiklund I, Norman M, Uvnas-Moberg K, Ransjö-Arvidson AB, Andolf E. Epidural analgesia: breast-feeding success and related factors. *Midwifery*. 2009;25(2):e31-e38.
36. Jordan S, Emery S, Watkins A, Evans JD, Storey M, Morgan G. Associations of drugs routinely given in labour with breast-feeding at 48 hours: analysis of the Cardiff Births Survey. *Bjog*. 2009;116(12):1622-1632.
37. Gizzo S, Di Gangi S, Saccardi C, et al. Epidural analgesia during labor: impact on delivery outcome, neonatal well-being, and early breastfeeding. *Breastfeed Med*. 2012;7:262-268.
38. Dozier AM, Howard CR, Brownell EA, et al. Labor epidural anesthesia, obstetric factors and breastfeeding cessation. *Matern Child Health J*. 2013;17(4):689-698.
39. Jordan S, Emery S, Bradshaw C, Watkins A, Friswell W. The impact of intrapartum analgesia on infant feeding. *Bjog*. 2005;112(7):927-934.
40. Beilin Y, Bodian CA, Weiser J, et al. Effect of labor epidural analgesia with and without fentanyl on infant breast-feeding: a prospective, randomized, double-blind study. *Anesthesiology*. 2005;103(6):1211-1217.
41. Jensen D, Wallace S, Kelsay P. LATCH: a breastfeeding charting system and documentation tool. *J Obstet Gynecol Neonatal Nurs*. 1994;23(1):27-32.
42. Matthews MK. Developing an instrument to assess infant breastfeeding behaviour in the early neonatal period. *Midwifery*. 1988;4(4):154-165.
43. Nyqvist KH, Rubertsson C, Ewald U, Sjoden PO. Development of the Preterm Infant Breastfeeding Behavior Scale (PIBBS): a study of nurse-mother agreement. *J Hum Lact*. 1996;12(3):207-219.
44. Amiel-Tison C, Barrier G, Shnider SM, Levinson G, Hughes SC, Stefani SJ. A new neurologic and adaptive capacity scoring system for evaluating obstetric medications in full-term newborns. *Anesthesiology*. 1982;56(5):340-350.
45. Radzysimski S. Neurobehavioral functioning and breastfeeding behavior in the newborn. *J Obstet Gynecol Neonatal Nurs*. 2005;34(3):335-341.
46. Curtin WM, Katzman PJ, Florescue H, Metlay LA, Ural SH. Intrapartum fever, epidural analgesia and histologic chorioamnionitis. *J Perinatol*. 2015;35(6):396-400.
47. Greenwell EA, Wyshak G, Ringer SA, Johnson LC, Rivkin MJ, Lieberman E. Intrapartum temperature elevation, epidural use, and adverse outcome in term infants. *Pediatrics*. 2012;129(2):e447-454.
48. Camann WR, Hortvet LA, Hughes N, Bader AM, Datta S. Maternal temperature regulation during extradural analgesia for labour. *Br J Anaesth*. 1991;67(5):565-568.
49. Lieberman E, Lang JM, Frigoletto F Jr, Richardson DK, Ringer SA, Cohen A. Epidural analgesia, intrapartum fever, and neonatal sepsis evaluation. *Pediatrics*. 1997;99(3):415-419.
50. Nguyen US, Rothman KJ, Demissie S, Jackson DJ, Lang JM, Ecker JL. Epidural analgesia and risks of cesarean and operative vaginal deliveries in nulliparous and multiparous women. *Matern Child Health J*. 2010;14(5):705-712.
51. Paterson CM, Saunders NS, Wadsworth J. The characteristics of the second stage of labour in 25,069 singleton deliveries in the North West Thames Health Region, 1988. *Br J Obstet Gynaecol*. 1992;99(5):377-380.
52. Hawkins JL, Hess KR, Kubicek MA, Joyce TH III, Morrow DH. A reevaluation of the association between instrument delivery and epidural analgesia. *Reg Anesth*. 1995;20(1):50-56.
53. Hasegawa J, Farina A, Turchi G, Hasegawa Y, Zanello M, Baroncini S. Effects of epidural analgesia on labor length, instrumental delivery, and neonatal short-term outcome. *J Anesth*. 2013;27(1):43-47.
54. Leff EW, Gagne MP, Jefferis SC. Maternal perceptions of successful breastfeeding. *J Hum Lact*. 1994;10(2):99-104.
55. Szabo AL. Review article: Intrapartum neuraxial analgesia and breastfeeding outcomes: limitations of current knowledge. *Anesth Analg*. 2013;116(2):399-405.
56. Salariya EM, Easton PM, Cater JJ. Duration of breast-feeding after early initiation and frequent feeding. *Lancet*. 1978;2(8100):1141-1143.
57. Wiberg B, Humble K, de Chateau P. Long-term effect on mother-infant behaviour of extra contact during the first hour post partum: V. Follow-up at three years. *Scand J Soc Med*. 1989;17(2):181-191.
58. Bystrova K, Ivanova V, Edhborg M, et al. Early contact versus separation: effects on mother-infant interaction one year later. *Birth*. 2009;36(2):97-109.
59. Moore ER, Anderson GC, Bergman N, Dowswell T. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database Syst Rev*. 2012;5:CD003519.