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Full-term induction of labor vs expectant management and cesarean delivery in women with obesity: systematic review and meta-analysis

Lise Qvirin Krogh, MD; Julie Glavind, MD; Tine Brink Henriksen, MD; Jim Thornton, MD; Jens Fuglsang, MD; Sidsel Boie, MD, PhD

OBJECTIVE: This study aimed to review the literature comparing full-term induction of labor with expectant management in women with obesity on the risk of cesarean delivery and other adverse outcomes.

DATA SOURCES: A literature search was performed on PubMed, EMBASE, Scopus, ClinicalTrials.gov, and the Cochrane Library. This study had no time, language, or geographic restriction.

STUDY ELIGIBILITY CRITERIA: Studies were eligible if (1) they were cohort or randomized controlled trials, (2) they compared induction of labor at early or late term with expectant management, and (3) they included women with a body mass index of ≥30 kg/m^2. Studies restricted to women with multiple pregnancy, premature rupture of membranes, or noncephalic presentation were excluded. The primary outcome was cesarean delivery. The secondary outcomes included maternal and neonatal mortality and morbidities and were evaluated.

METHODS: The risk of bias was assessed by 2 authors using the Risk of Bias In Non-Randomized Studies of Interventions tool. Only studies assessed with low or moderate risk of bias contributed to the meta-analysis. Data were combined to pooled relative risks and 95% confidence intervals using random effects models. The quality of evidence was assessed for selected outcomes.

RESULTS: Of the 232 studies identified, 13 were aligned with the inclusion criteria, and 4 cohort studies, including 216,318 women with induction of labor and 1,122,769 women managed expectantly, were included in the meta-analysis for the primary outcome. In women with obesity, full-term induction of labor was associated with a lower risk of cesarean delivery than expectant management (19.7% vs 24.5%; relative risk, 0.71; 95% confidence interval, 0.63–0.81). Moreover, this study found the same direction of the association for other selected outcomes: severe perineal lacerations (relative risk, 0.65; 95% confidence interval, 0.48–0.89), maternal infection (relative risk, 0.42; 95% confidence interval, 0.21–0.84), perinatal mortality (relative risk, 0.41; 95% confidence interval, 0.18–0.90), low Apgar score (relative risk, 0.48; 95% confidence interval, 0.26–0.91), meconium aspiration syndrome (relative risk, 0.40; 95% confidence interval, 0.28–0.56), and macrosomia (relative risk, 0.57; 95% confidence interval, 0.43–0.75). Conversely, induction of labor was associated with an increased risk of instrumental vaginal delivery (relative risk, 1.12; 95% confidence interval, 1.02–1.22). The quality of evidence ranged from low to very low.

CONCLUSION: Full-term induction of labor in women with obesity may reduce the risk of cesarean delivery compared with expectant management, but the quality of the evidence is low.

Key words: cesarean delivery, complications, delivery, induced, labor, maternal, maternal complications, meta-analysis, obesity, observational studies, obstetrics, perinatal complications, systematic review

Introduction

The prevalence of obesity defined as a body mass index (BMI) of ≥30 kg/m^2 is a significant health issue worldwide.[1] Among women of reproductive age, the prevalence is 33% in the United States, 20% in the United Kingdom, and between 8% and 26% in the European countries.[2,3]

The risk of complications in pregnancy and labor is higher in women with obesity than in women with a BMI

EDITOR'S CHOICE

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The primary outcome of this study was presented in an electronic poster at the Birth Congress December 8th 2022, Milano, Italy.

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AJOG MFM at a Glance

Why was this study conducted?

This study aimed to review the literature comparing full-term induction of labor (IOL) with expectant management in women with obesity on the risk of cesarean delivery and other maternal and neonatal outcomes.

Key findings

In our meta-analysis of observational studies, IOL was associated with a reduced risk of cesarean delivery and selected adverse maternal and neonatal outcomes compared with expectant management. Moreover, we found no completed randomized controlled studies.

What does this add to what is known?

This study synthesized the evidence on IOL vs expectant management in women with obesity.

of <25 kg/m^2 and increases with increasing BMI.[2,4,5] The complications include gestational diabetes mellitus, preeclampsia, macrosomia, shoulder dystocia, postpartum hemorrhage, cesarean delivery, and stillbirth.[4–7] Compared with women of normal weight, the risk of cesarean delivery is doubled in women with obesity.[2] The risk of wound infection or other infectious morbidities after cesarean delivery is increased.[8] In addition, cesarean delivery adds risk to future deliveries.[9] Hence, it is crucial to find strategies to lower the risk of maternal and neonatal morbidities in women with obesity.

Nevertheless, a systematic evaluation of the current evidence on how induction of labor (IOL) compared with expectant management affects cesarean delivery in women with obesity remains incomplete. Some randomized studies on IOL vs expectant management in a general low-risk population demonstrated lower rates of cesarean delivery with IOL and no difference in neonatal outcomes between groups,[10,11] whereas a study in an advanced maternal age population found no difference in cesarean delivery rates.[12] No randomized study on IOL vs expectant management has had women with obesity as the target population. However, recent observational studies suggested lower cesarean delivery rates with IOL than expectant management among women with obesity.[13–15]

Objective

This study aimed to compare full-term IOL with expectant management in women with obesity on the risk of cesarean delivery and other adverse maternal and neonatal outcomes.

Methods

This review was conducted following the Preferred Items for Reporting Systematic Reviews and Meta-analyses Protocols and Cochrane Handbook for Systematic Reviews of Interventions.[16,17] The study protocol was published on July 23, 2021, in the International Prospective Register of Systematic Reviews (registration number: CRD42021287310).

Search strategy

A literature search was performed by 1 author (L.Q.K.) on PubMed, EMBASE, Scopus, ClinicalTrials.gov, and the Cochrane Library with assistance from a university librarian. Search terms or Medical Subject Heading terms related closely to "induction of labor," "expectant management," "watchful waiting," "obesity," and "BMI." A detailed search strategy is shown in Appendix. The first search was performed on October 5, 2021, and the search was updated on September 9, 2022. Reference lists from each included article were further reviewed to identify other relevant articles not retrieved by the database search. The identification of full-text articles from conference abstracts was pursued by searching the databases and by contacting the corresponding authors.

Eligibility criteria

The eligible study population was pregnant women with a BMI of ≥30 kg/m^2. Studies restricted to women with multiple pregnancy, premature rupture of membranes, or noncephalic presentation were excluded. For the intervention, studies comparing women undergoing IOL at or beyond 37 to 40 weeks of gestation (early term and full term) with women undergoing expectant management beyond that gestational age were included. No restriction of methods used for IOL was applied. Moreover, studies with any of the outcomes from the core outcome set for trials on IOL were included.[18] Eligible study designs were randomized controlled trials (RCTs) and cohort studies. No time, language, or geographic restriction was imposed.

Studies that only included accepted medical indications for IOL were excluded. This was a posthoc decision. Conference abstracts, ongoing randomized trials, and studies with no full text were excluded from the meta-analyses.

Study selection

Identified studies were managed by the reference management package Covidence.[19] Duplicates were removed before the screening. Of note, 2 authors (L.Q.K. and S.B.) independently examined the titles and abstracts for all references and subsequently reviewed all full texts of potentially eligible studies. Disagreements during the process were resolved by discussion and consensus between the 2 authors without the need to consult a third author. Corresponding authors were contacted via e-mail to clarify potential identical studies (eg, conference abstract and corresponding full-text publications).

Data extraction

Data from studies included in the final analysis were extracted by 1 author (L.Q.K.) and checked for accuracy by another author (S.B.). Discrepancies were resolved by discussion and consensus. Data were entered into Review

Manager (RevMan) software (version 5.4; Cochrane Collaboration, Copenhagen, Denmark).[20] When possible, data extracted were unadjusted. In studies stratified by gestational age, data were only extracted on IOL at 39 weeks of gestation, to avoid a woman appearing more than once in the analysis and/or potentially in both intervention and control groups. This was not prespecified in the protocol. A gestational age of 39 weeks is consistent with clinical practice for the timing of IOL in the United States based on the balance of neonatal and maternal risks.[10,21–24]

Outcome measures

The predefined primary outcome was cesarean delivery. The maternal and perinatal secondary outcomes were based on the core outcome set for trials on IOL.[18] The secondary maternal outcomes were indication for cesarean delivery; instrumental vaginal delivery; duration from IOL to delivery; number of induction agents or methods required; oxytocin augmentation, uterine hyperstimulation; use of analgesia, including epidural during labor; shoulder dystocia (as defined in the specific article); perineal third- or fourth-degree laceration; damage to internal organs (the bladder, bowel, or ureters), uterine scar dehiscence or rupture; postpartum hemorrhage; hysterectomy for any complication resulting from birth; infection; intensive care unit (ICU) admission; pulmonary embolus; stroke; cardiopulmonary arrest; death; postnatal depression; satisfaction; breastfeeding (as defined in the specific article); and length of hospital stay. The secondary perinatal outcomes included perinatal death, neonatal ICU (NICU) admission, 5-minute Apgar score of <7, umbilical artery pH of <7 at birth, need for respiratory support, neonatal seizures, birth trauma, hypoxic-ischemic encephalopathy or the need for therapeutic hypothermia, infection, and meconium aspiration syndrome. Long-term outcomes included the need for maternal operative pelvic floor repair and long-term disability in the offspring, including neurodevelopmental delay.

Assessment of risk of bias

The risk of bias was assessed by 2 authors (L.Q.K. and S.B.) using the Risk of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool.[25] Following the ROBINS-I tool, predefined confounding domains were identified on the basis of discussions among authors (L.Q.K., T.B.H., J.G., J.F., and S. B.). These were subsequently used for the risk of bias assessment. The confounding domains included medical indication for IOL, previous cesarean delivery, Bishop score (a modified Bishop score was accepted), maternal BMI, gestational age at the time of IOL, and maternal age. Any disagreement in the risk of bias assessment was resolved by discussion. As recommended by the Cochrane handbook, studies at low or moderate risk of bias were included in the final meta-analysis, whereas studies with serious and critical risk of bias were excluded.[26]

Data synthesis

Outcome data from included studies were combined to estimate pooled relative risks (RRs) with 95% confidence intervals (CIs). The RevMan software (version 5.4) was used for statistical analyses.[20] There was a significant risk of clinical and methodological heterogeneity as a result of variability in both participants and interventions. This heterogeneity was explored by predefined subgroup analyses by parity (0 vs 1+), BMI (<35 or ≥35 kg/m^2), prepregnancy BMI, previous cesarean delivery or not, and gestational age at 39 0/7 to 39 6/7 weeks of gestation. The statistical heterogeneity was assessed and defined as substantial if I^2 was more than 50%.[27] Heterogeneity was addressed in the analyses by using a random effect assessment.

Summary of findings

Outcomes for the "Summary of findings" table were selected and described a priori in the review protocol.[28] However, none of the included studies reported data on 2 of the outcomes ("maternal satisfaction" and "umbilical artery pH of <7 at birth'"). Of note, 2 outcomes, "instrumental vaginal delivery" and "perinatal death," were added to the "Summary of findings" table posthoc.

Quality of evidence

The quality of evidence was assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE approach).[29] The initial level of quality was defined by study design, and reasons for downgrading or upgrading were assessed. Of note, 2 authors (L.Q.K. and S.B.) assessed the quality and listed arguments for downgrading or upgrading.

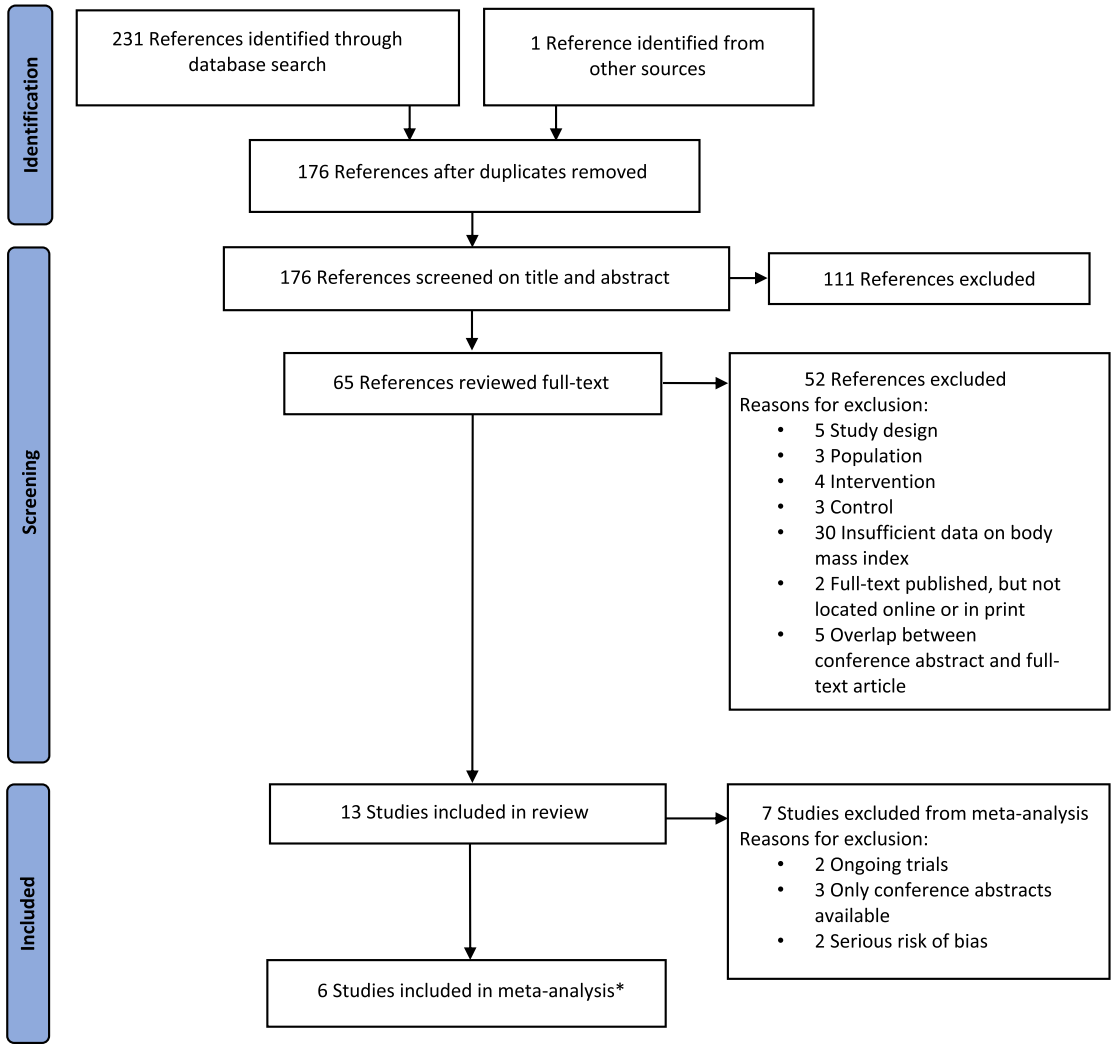
Results

Study selection

Of 232 references identified in the literature search, 65 references were eligible for full-text scrutiny. A total of 13 studies were included in this review. The selection process is shown in detail in Figure 1. Of note, 7 studies were excluded from the meta-analyses. Of these studies, 2 were ongoing RCTs,[30,31] and 3 were cohort studies published only as conference abstracts. Unsuccessful attempts to obtain full-text articles were made, and subsequently, the studies were excluded from the meta-analyses.[32–34] Moreover, 2 studies were excluded from meta-analyses as they were at serious risk of bias.[35,36] Hence, 6 studies were available for the meta-analyses.

In addition, 4 studies (in pairs of 2) had overlapping study populations. Of these studies, 1 evaluated[13] the same study population, but with a shorter inclusion period than another.[15] Furthermore, the outcomes of the 2 studies differed. Therefore, when an outcome was reported in both studies, only data from the largest study was included in the meta-analyses. When an outcome was only reported in the smallest study, these data were included. For the other pair of studies overlapping, 1 study[37] evaluated the same study population, but only in women with a BMI of ≥40 kg/m^2, in contrast to the paired study in women with a BMI of ≥30 kg/m^2.[14] Hence, all outcomes of the study on women with a BMI of ≥40 kg/m^2 were also reported in the study on women

FIGURE 1
Flow diagram of the study selection process



Asterisk denote overlapping study populations in some studies are included. (see text for details).

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with a BMI of ≥30 kg/m^2, and only data from the study on women with a BMI of ≥30 kg/m^2 were included in the meta-analyses. Data for the subgroup analysis on BMI were included from the study on women with a BMI of ≥40 kg/m^2, as the study on women with a BMI of ≥30 kg/m^2 did not stratify results by BMI.

Study characteristics

All the included articles were in English. Of note, 10 studies were from the United States, 1 study was from Australia, and 2 studies were from Europe. The studies were published between 2014 and 2021. All studies excluded accepted medical-indicated IOL. Table 1 provides further characteristics of the included studies.

Risk of bias assessment

The risk of bias assessment of the included studies showed moderate to critical risk according to the ROBINS-I tool. Detailed assessments are outlined in Figure 2.

Primary outcome

Of note, 4 studies that included 1,339,087 women contributed to the meta-analysis for the primary outcome of cesarean delivery.[14,15,38,39] Full-term IOL was associated with a reduced risk of cesarean delivery compared with expectant management in women with obesity (19.7% vs 24.5%; risk ratio [RR], 0.71; 95% confidence interval [CI], 0.63−0.81; low level of certainty). Pooled RR and 95% CI are presented for this estimate with a forest plot in Figure 3. We found a similar risk estimate for

TABLE 1
Characteristics of all 14 included studies

Authors, y	Study design, no. of participants	Data source or setting	Year of deliveries investigated and country of conduct	Restriction to study population	Time of body mass index assessment	Outcomes stratified by gestational age
Wolfe et al,[35] 2014	Cohort, n=470	MedStar Washington Hospital Center (single center)	2007–2012 United States	Nulliparous	At delivery	No
Lee et al,[33] 2015	Cohort, n=63,056	California, data source unknown	2008 United States	None	Not reported	Yes 38, 39, and 40 wk
Lee et al,[34] 2015	Cohort, n=25,964	California-linked hospital data	2008 United States	Nulliparous	Not reported	Yes 38, 39, and 40 wk
Lee et al,[13] 2016	Cohort, n=74,725	California-linked birth data	2007 United States	None	Prepregnancy	Yes 37, 38, 39, and 40 wk
Kawakita et al,[37] 2017	Cohort, n=4,349	Consortium on Safe Labor	2002–2008 (87% between 2005 and 2007) United States	BMI≥40 kg/m^2	At delivery	Yes 37 0/7 to 38 6/7 wk of gestation and 39 0/7 to 40 6/7 wk of gestation
Nugent et al,[36] 2017	Cohort, n=623	Matrix database from Townsville Hospital and Health Service	2011–2015 Australia	BMI≥35 kg/m^2	Not reported	Yes 37, 38, 39, and 40 wk
Gibbs Pickens et a,[15] 2018	Cohort, n=165,975	California-linked birth data	2007–2011 United States	None	Prepregnancy	Yes 39, 40, and 41 wk
Glazer et al,[38] 2022	Cohort, n=66,280	New York City Department of Health and Mental Hygiene	2008–2013 (except from 2010) United States	None	Prepregnancy	Yes 39 and 40 wk
Krogh,[31] 2020	RCT	Danish delivery departments	2020, recruitment ongoing Denmark	None	Prepregnancy	No
Palatnik et al,[14] 2020	Cohort, n=17,087	Consortium on Safe Labor	2002–2008 United States	None	Prepregnancy	Yes 39, 40, and 41 wk
Eberle et al, [39] 2021	Cohort (propensity score matched), n=1,184,058	Center for Disease Control and Preventions	2013–2017 United States	Live births	Not reported	No
Schmidt et al,[32] 2021	Cohort, n=572,113	California, data source unknown	2007–2011 United States	None	Not reported	No
Sentilhes,[30] 2021	RCT	French delivery departments	2021, recruitment ongoing France	Nulliparous	Not reported	Not reported

BMI, body mass index; *RCT*, randomized controlled trial.

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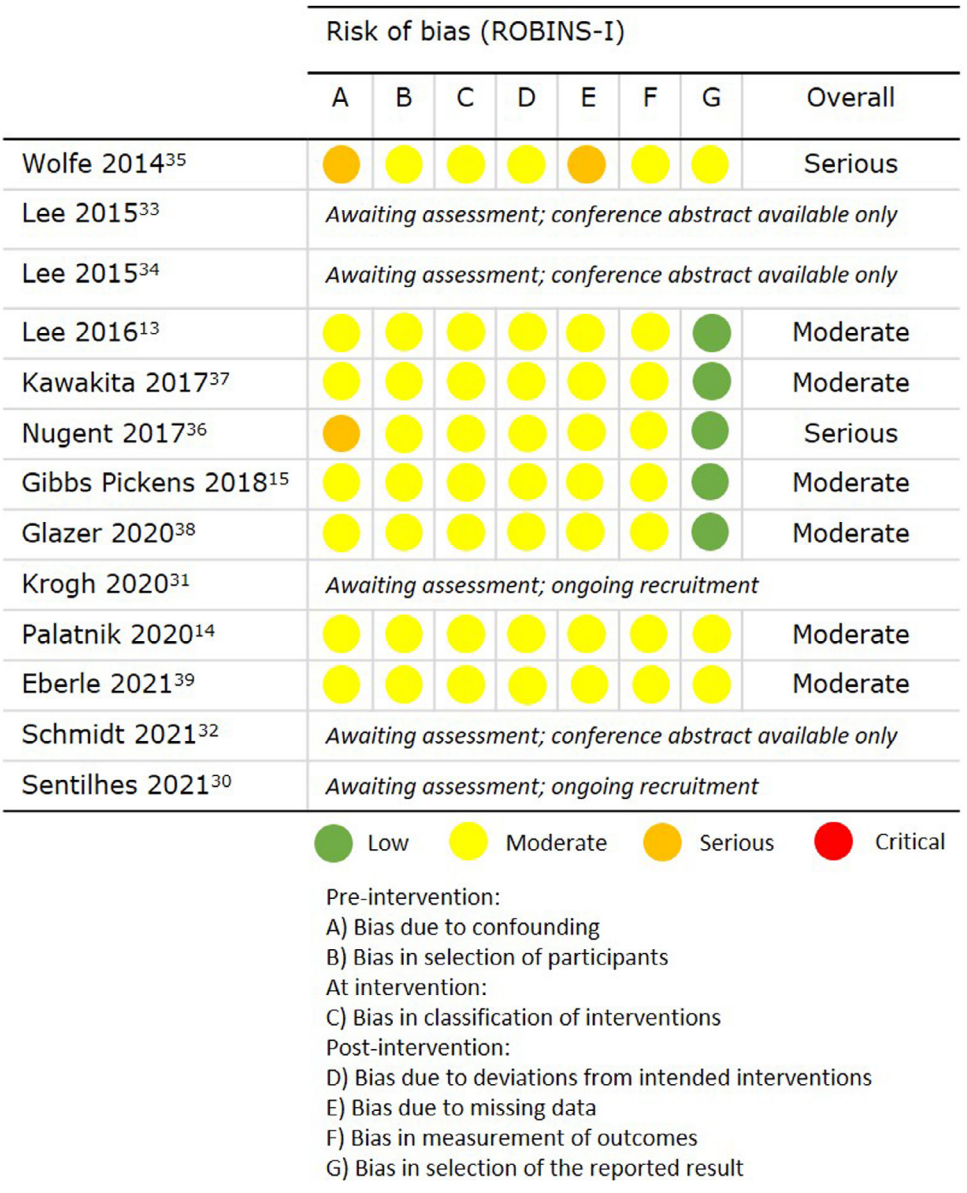
FIGURE 2
Results of the risk of bias assessment



ROBINS-I, Risk of Bias In Non-Randomized Studies of Interventions.

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cesarean delivery in a sensitivity analysis, including studies with critical and serious risks of bias (data not shown). There was considerable heterogeneity (I^2=97%) among studies in the meta-analysis. The evidence was downgraded from a high to a low level of certainty because of the risk of bias and heterogeneity. The results from the quality of evidence assessment are shown in Table 2.

Subgroup analyses

The results from the planned subgroup analyses are presented in Figure 4. In women with obesity, IOL compared with expectant management showed a more pronounced association between cesarean delivery rates in parous women (RR, 0.66; 95% CI, 0.55−0.80; I^2=95%) than in nulliparous women (RR, 0.91; 95% CI, 0.83−1.00; I^2=94%). When stratified by BMI, the estimated risk reductions of cesarean delivery with IOL compared with expectant management were similar in women with a BMI of 30.0 to 34.9 kg/m^2 (RR, 0.81; 95% CI, 0.80−0.82; I^2 = not applicable [NA]) and in women with a BMI of ≥35 kg/m^2 (RR, 0.82; 95% CI, 0.81−0.83; I^2=0%). For women with a pre-pregnancy BMI of ≥30 kg/m^2 as opposed to those with a BMI of ≥30 kg/m^2 at delivery or unknown time of

TABLE 2
Summary of findings table

IOL at 39 wk of gestation compared with expectant management in women with obesity

Patient or population: Low-risk women with a body mass index of ≥30 kg/m^2
Setting: Outpatient IOL when deemed safe. Laboring in hospital settings
Intervention: IOL at 39 wk of gestation
Comparison: Expectant management

Outcomes	Illustrative comparative risks (95% CI)[a]		Relative effect (95% CI)	No. of participants (studies)	Quality of the evidence (GRADE)	Comments
	Corresponding risk	Assumed risk				
	IOL	Expectant management				
Cesarean delivery	174 per 1000 (154–198)	245 per 1000	0.71 (0.63–0.81)	1,339,087 (n=4)	⊕⊕⊖⊖ Low[b,c]	
Instrumental vaginal delivery	36 per 1000 (33–39)	32 per 1000	1.12 (1.02–1.22)	1,302,095 (n=3)	⊕⊕⊖⊖ Low[b,d]	Exploratory outcome
Perineal third- or fourth-degree laceration	14 per 1000 (10–19)	21 per 1000	0.65 (0.48–0.89)	47,098 (n=2)	⊕⊕⊖⊖ Low[b,e]	
Postpartum hemorrhage	27 per 1000 (16–44)	31 per 1000	0.86 (0.52–1.42)	44,599 (n=2)	⊕⊖⊖⊖ Very low[b,d,e]	
Neonatal intensive care admission	80 per 1000 (43–145)	83 per 1000	0.96 (0.52–1.75)	118,037 (n=2)	⊕⊕⊖⊖ Low[b,c]	
Perinatal death	0.4 per 1000 (0.18–0.90)	1 per 1000	0.41 (0.18–0.90)	118,037 (n=2)	⊕⊕⊖⊖ Low[b,e]	Exploratory outcome

CI, confidence interval; *GRADE*, Grading of Recommendations Assessment, Development, and Evaluation; *IOL*, induction of labor; *RR*, risk ratio.

[a] The basis for the "assumed risk" (eg, the median control group risk across studies) is provided in footnotes. The "corresponding risk" (and its 95% CI) is based on the assumed risk in the comparison group and the "relative effect" of the intervention (and its 95% CI).; [b] Downgraded for study limitations. Studies were with moderate risk of bias.; [c] Downgraded for considerable heterogeneity.; [d] Downgraded for substantial heterogeneity.; [e] Downgraded for imprecision (wide CIs and few events).

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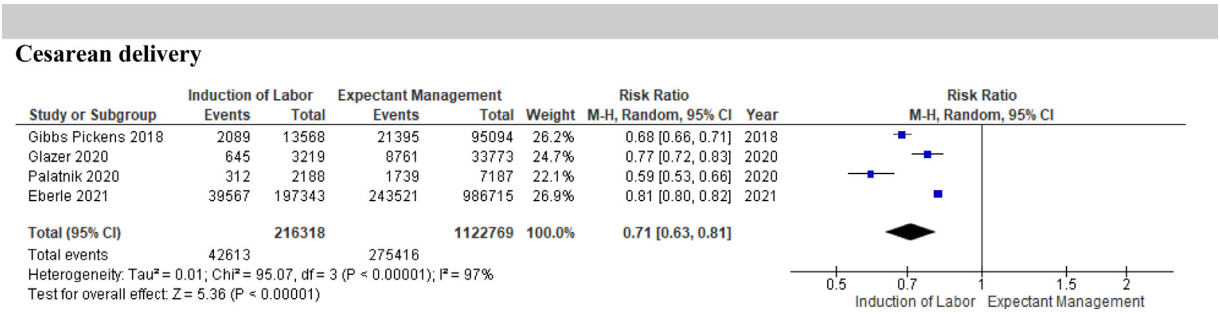
FIGURE 3
Forrest plot of the primary outcome



CI, confidence interval.

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weight and height assessment, IOL was also associated with a significantly lower frequency of cesarean delivery than expectant management (RR, 0.68; 95% CI, 0.61−0.77; I^2=89%). In general, heterogeneity for these estimates was substantial with high I^2 values. As none of the studies included women with previous cesarean delivery, the planned subgroup analysis in women with previous cesarean delivery was impossible. Because of the posthoc decision on extracting data only from women at 39 weeks of gestation, the planned subgroup analysis on gestational age at 39 0/7 to 39 6/7 weeks was not undertaken as data were identical with data from the main analysis of the primary outcome.

Secondary outcomes

The results for the maternal secondary outcomes are shown in Figure 5. Compared with expectant management, IOL was associated with a significantly lower risk of perineal third- or fourth-degree lacerations (RR, 0.65; 95% CI, 0.48−0.89; I^2=0%; 2 studies, 47,098 women, low certainty evidence) and maternal infections (RR, 0.42; 95% CI, 0.21−0.84; I^2 = NA; 1 study, 9348 women). Moreover, IOL was characterized by an insignificant lower risk of chorioamnionitis (RR, 0.63; 95% CI, 0.31−1.30; I^2=99%; 2 studies, 1,292,720 women), postpartum hemorrhage (RR, 0.86; 95% CI, 0.52−1.42; I^2=79%; 2 studies, 44,599 women, very low certainty evidence), and pulmonary embolism (RR, 0.30; 95% CI, 0.02−5.40; I^2 = NA; 1 study, 9,375 women) than expectant management. Conversely, IOL was associated with a significantly higher risk of instrumental vaginal delivery (RR, 1.12; 95% CI, 1.02−1.22; I^2=74%; 3 studies, 1,302,095 women, low certainty evidence) and hysterectomy (RR, 1.94; 95% CI, 1.34−2.80; I^2=0%; 2 studies, 1,193,433 women) than expectant management. There was a similar risk between groups for shoulder dystocia (RR, 0.97; 95% CI, 0.73−1.30; I^2=67%; 2 studies, 118,037 women), uterine rupture (RR, 1.01; 95% CI, 0.62−1.63; I^2 = NA; 1 study, 1,184,058 women), and maternal ICU admission (RR, 0.99; 95% CI, 0.81−1.20; I^2 = 0%; 2 studies, 1,191,915 women). Moreover, 1 study reported indications for cesarean delivery.[14] Compared with women managed expectantly, women at 39 weeks of gestation with IOL were less likely to have a planned cesarean delivery (RR, 0.33; 95% CI, 0.17−0.63; I^2 = NA), a cesarean delivery for nonreassuring fetal heart rate (RR, 0.52; 95% CI, 0.41−0.67, I^2 = NA), failure to progress (RR, 0.64; 95% CI, 0.55−0.74; I^2 = NA), and chorioamnionitis (RR, 0.33; 95% CI, 0.04−2.56; I^2 = NA). Only 1 study reported on maternal death, but no event occurred in any of the intervention groups.[14]

The results for neonatal secondary outcomes are presented in Figure 6. IOL was associated with a significantly lower risk of perinatal death (RR, 0.41; 95% CI, 0.18−0.90; I^2=0%; 2 studies, 118,037 women, low certainty evidence), 5-minute Apgar score of <7 (RR, 0.48; 95% CI, 0.26−0.91; I^2 = NA; 1 study, 9,375 women), meconium aspiration syndrome (RR, 0.40; 95% CI, 0.28−0.56; I^2 = NA; 1 study, 108,662 women), and macrosomia (RR, 0.57; 95% CI, 0.43−0.75; I^2 = 88%; 2 studies, 118,037 women) than expectant management. The risks of brachial plexus injury (RR, 0.82; 95% CI, 0.53−1.26; I^2 = NA; 1 study, 108,662 women) and NICU admission (RR, 0.96; 95% CI, 0.52−1.75; I^2 = 97%; 2 studies, 118,037 women, low certainty evidence) were similar between the 2 groups.

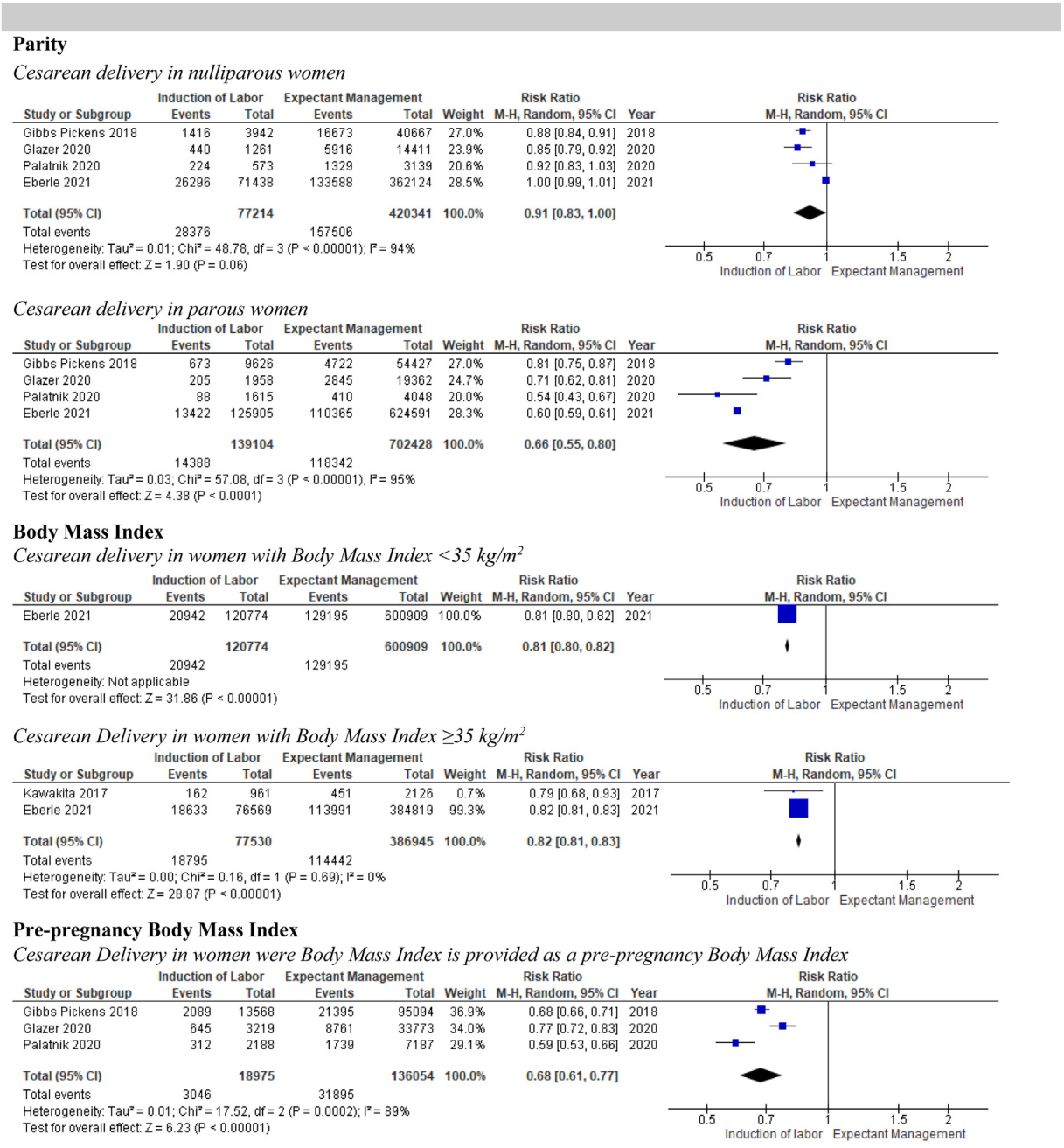
Heterogeneity of the maternal and neonatal secondary outcomes differed from none to considerable. No study reported data on the remaining outcomes.

Discussion

Principal findings

Full-term IOL in women with obesity was associated with a lower risk of cesarean delivery and was more pronounced in parous women. Moreover, IOL was associated with a reduction in perinatal mortality, third- and fourth-degree perineal lacerations, maternal infection, low Apgar score, meconium aspiration, and macrosomia. In contrast, IOL seemed to be associated with a higher risk of instrumental vaginal delivery and hysterectomy. The level of

FIGURE 4
Forrest plots of the subgroup analyses



CI, confidence interval.

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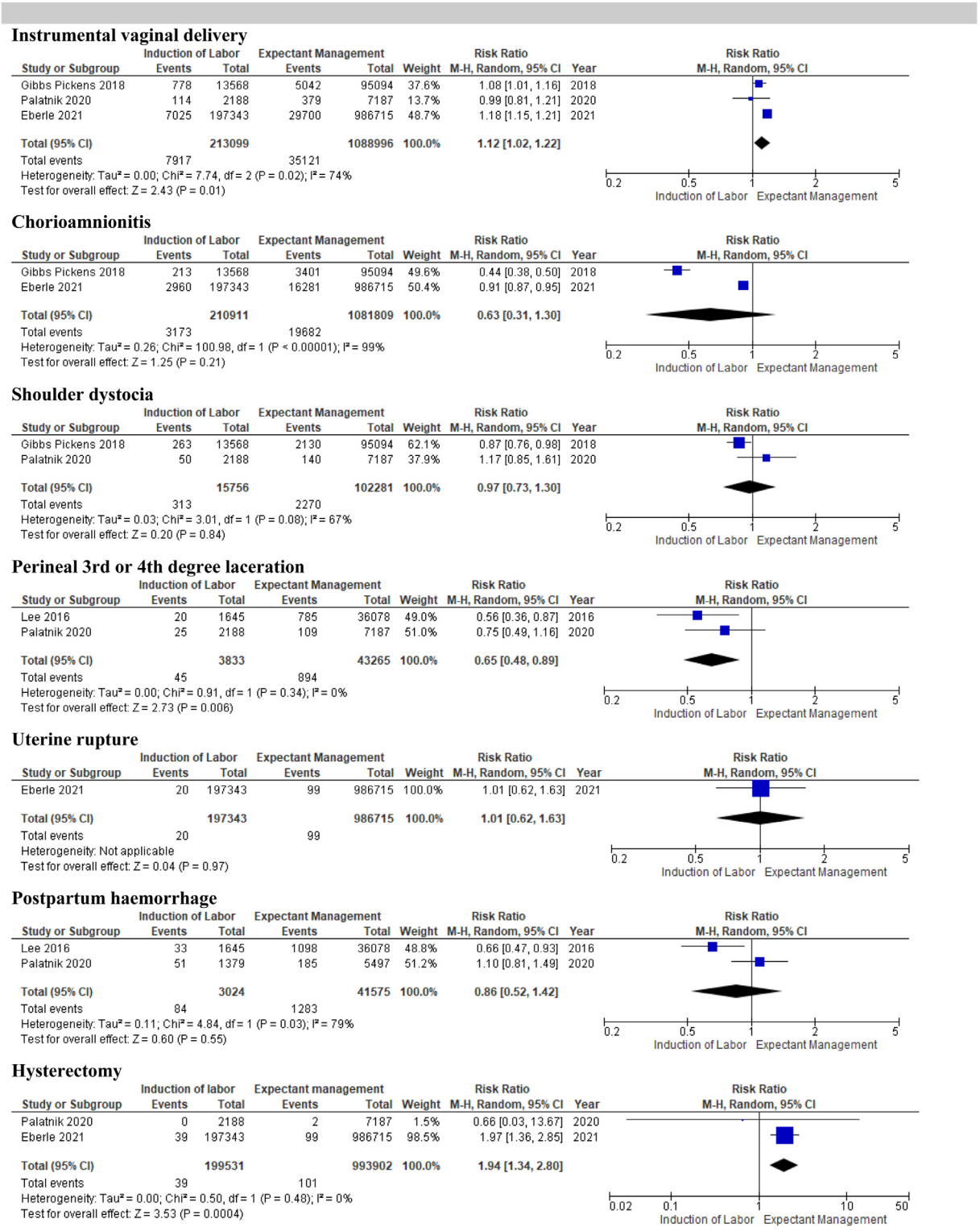
evidence of the findings varied from low to very low quality.

Comparison with existing literature

This study was a systematic review that addressed the effect of full-term IOL on women with obesity.

Our main finding of an increased risk of cesarean delivery has a magnitude very similar to a recent systematic review by Grobman et al[40] that included observational studies evaluating the same interventions in a general population of low-risk nulliparous women (no BMI restriction). In that review, there was a slightly smaller risk reduction of 17% in cesarean delivery than what we found (RR, 0.83; 95% CI, 0.74–0.93). The A Randomized Trial of Induction Versus Expectant Management (ARRIVE) trial, which was an RCT on

FIGURE 5
Forrest plots of the secondary maternal outcomes



CI, confidence interval.

Krogh. Full-term induction of labor vs expectant management and cesarean delivery in women with obesity. Am J Obstet Gynecol MFM 2023.

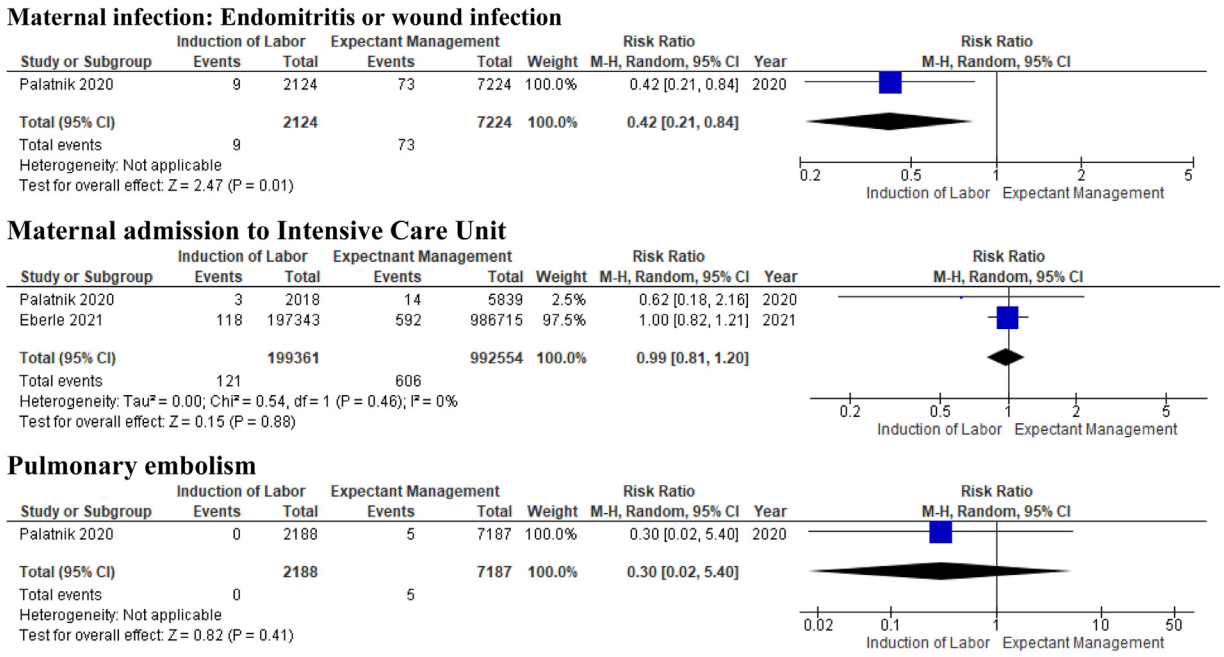


FIGURE 5 CONTINUED.

low-risk nulliparous women on the same comparison, demonstrated a lower risk of cesarean delivery (RR, 0.84; 95% CI, 0.76−0.93) with IOL at 39 weeks of gestation.[10] In the ARRIVE trial, more than half of the participants in both groups had a BMI of ≥30 kg/m^2 at delivery admission. The 35/39 trial, another RCT on IOL at 39 weeks of gestation compared with expectant management in nulliparous women aged >35 years, found no difference in the frequency of cesarean delivery (RR, 0.99; 95% CI, 0.87−1.14).[12] Less than 30% of the participants were women with obesity (unknown time of BMI assessment). Our findings indicated that obesity might attenuate the association between expectant management and cesarean section compared to groups with a lower overall risk.

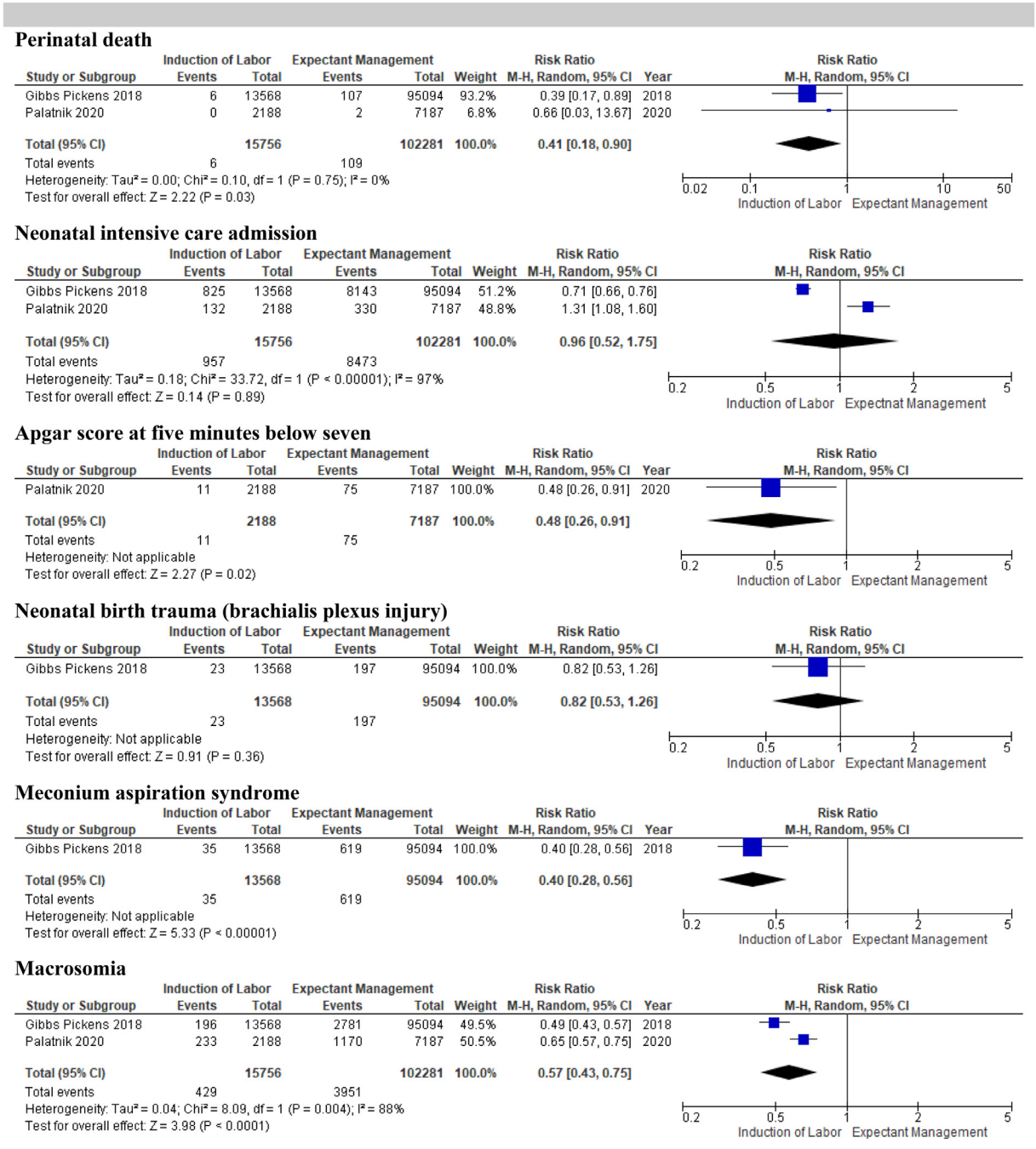
In several of our secondary outcomes, there was a possible risk reduction with IOL. These findings support the results from the Grobman review and the ARRIVE trial and the magnitude of the risk reduction in the individual adverse outcomes.[10,40] In contrast, few of our secondary outcomes suggested a possible risk increase with IOL. In the 35/39 trial, the direction and magnitude of the increased risk of instrumental vaginal delivery were similar to our findings,[12] whereas, in the ARRIVE trial, there was no increased risk of instrumental delivery with IOL.[10] The Grobman review did not report on instrumental vaginal delivery.[40] The apparent increase in hysterectomy with IOL in our data should be interpreted with great caution because of the aforementioned uncertainties in the data and the limited number of cases. Hysterectomy is not reported in any of the prospective studies to qualify our results.[10,12]

Strengths and limitations

The strength of our review was that it followed the Preferred Items for Reporting Systematic Reviews and Meta-analyses criteria and the Cochrane Handbook and GRADE guidelines, and the protocol was registered before the literature search was initiated. Multiple databases were searched without language, geographic, or data restriction. We included both unpublished and ongoing studies, and the authors were contacted to seek further information or clarification.

Limitations of this systematic review and meta-analysis should be recognized. As all included studies were observational, the data used might be biased by unknown factors. First, multivariable adjustments were performed in the individual studies. In studies that did not stratify results by parity, we found similar results when comparing the adjusted point estimates from the individual studies with the corresponding unadjusted, nonpooled point estimates presented in the forest plots. However, the risk of confounding by IOL might be high in this observational scenario because the decision to induce labor at full term might include several unknown factors that cannot easily be adjusted for, even though women with medical indications for IOL were excluded from the included studies. Such bias might distort the association of cesarean delivery in either direction. Second, there was considerable heterogeneity for most outcomes. This is likely due to differences in populations (eg, different BMI thresholds among studies; however, it might also relate to different policies for operative interventions and IOL regimes in different settings. Third,

FIGURE 6
Forrest plots of the secondary neonatal outcomes



CI, confidence interval.

Krogh. Full-term induction of labor vs expectant management and cesarean delivery in women with obesity. Am J Obstet Gynecol MFM 2023.

the meta-analyses included studies with low to very low quality of evidence on our core outcomes. Fourth, for some outcomes, there was only 1 or 2 studies that contributed data to the estimates. Of note, 1 important example is the evaluation of hysterectomy. It was based on 1 small and 1 larger study,[14,39] where no absolute number was available for the meta-analysis from the larger study. In addition, some outcomes were predominated by 1 or 2 large studies.[15,39]

Conclusions and implications

In women with obesity, full-term IOL may be associated with reduced cesarean delivery compared with expectant management. Moreover, the risk of perinatal death and severe perineal

lacerations may be reduced with IOL, whereas the risk of instrumental vaginal delivery may be increased with IOL. All findings should be interpreted with caution because of the low certainty of the evidence. High-quality RCTs are needed to evaluate these findings and should report the core outcome set for trials on IOL. ■

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.ajogmf.2023.100909.

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