META-ANALYSIS

New labor management and obstetric outcomes: A systematic review and meta-analysis

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Abstract

Objective: This systematic review and meta-analysis is to compare the new labor management guideline with the traditional WHO guideline with regard to obstetric outcomes. **Methods:** The literature search was performed in the following databases: PubMed, Embase, Web of Science, the Cochrane Library and Chinese databases (including CNKI, WanFang Database and VIP). Randomized controlled trials (RCTs) or cohort studies comparing the new labor management and the old WHO guideline in terms of maternal and neonatal morbidity in low-risk pregnant women were included. Study quality was assessed using the Cochrane Risk Bias Evaluation Tool and Newcastle-Ottawa Scale (NOS). The l² statistic was used to evaluate heterogeneity. We used the random-effects model to pool the relative risk (RR) with corresponding 95% confidence intervals (CI). Prespecified subgroup and sensitivity analyses were conducted to explore the potential influencing factors. Publication bias analysis was also assessed based on funnel plots. Results: A total of 45 studies with a total sample size of 82,016 women were eventually included, with 15 RCTs and 30 cohort studies. 44 studies were included for data synthesis. Women with new labor management had less labor augmentation with oxytocin (RCTs: RR = 0.55 [0.36, 0.83], I² = 47%; cohort studies: RR = 0.62 [0.55, 0.70], $l^2 = 58\%$), intrapartum cesarean section (RCTs: RR = 0.52 [0.47, 0.59], $l^2 = 0$; cohort studies: RR = 0.61 [0.55, 0.67], $l^2 = 75\%$) and operative vaginal delivery (RCTs: RR = 0.60 [0.42, 0.87], I² = 0; cohort studies: RR = 0.69 [0.55, 0.86], I² = 82%) without increasing the incidence of 3rd- and 4th-degree perineal laceration, postpartum hemorrhage, infectious morbidity and postpartum urine retention, fetal distress, neonatal asphyxia or neonatal intensive care unit (NICU) admission. These results were robust to sensitivity analyses. Conclusion: Our study indicates that the new labor management guideline may be more beneficial than the traditional WHO guideline, with fewer intrapartum interventions and no increase in adverse obstetric outcomes.

Key words: Friedman labor curve, Zhang's labor curve, labor management, obstetric outcome

BACKGROUND

Labor management is a key component of obstetrics and gynecology practice. Prior to the mid-1950s, the evaluation of labor progress was based primarily on its duration. Vague admonitions based on prevailing observations about average labor duration and outcomes were commonly intoned.^[1]

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In 1955, Dr. Emmanuel Friedman published a milestone article, illustrating a normal labor pattern that was based on cervical dilation against time and subdivided into 1st stage (including latent phase, acceleration phase, maximum slope of cervical dilation, deceleration phase), 2nd stage (from full dilation to delivery of the infant) and 3rd stage (from delivery of the infant to delivery of the placenta).^[2] In the early 1970s, Philpott and colleagues developed guidelines to assess

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labor progression on the basis of Friedman's findings.^[3,4] With this approach, all partograms were designed using 1 cm/hour or faster as an acceptable rate of dilatation in active phase, which was designated as the alert line on the partograph. The action line was drawn parallel to but 4 hours to the right of the alert line. This partogram was promoted worldwide by the WHO in 1994 following its landmark trial suggesting benefits.^[5-7] WHO's research and subsequent promotion played a key role in translating Phillpott's partogram into worldwide use. At the onset of active labor, typically defined as 3–4 cm cervical dilatation, a timeline is placed on the woman's partograph. The linear curve of expected labor progression is constant throughout labor and serves as a reference point for labor dystocia.

Due to changes in clinical practices and obstetric populations during the past decades, the use of the WHO partograph in contemporary obstetric populations has been questioned.^[8-11] In 2010, Zhang et al. presented a labor curve based on a large cohort of women with normal outcomes in contemporary obstetrical practice, which was markedly different from the Friedman curve.^[10] In this study, it was noted that more than half of the patients did not dilate at the rate proposed by Friedman et al. until 6 cm of cervical dilation, proposing a new threshold for diagnosing dystocia. And they also found that cervical dilatation accelerates as labor advances. This finding implies that following Zhang's guideline allows more time in early labor before labor dystocia is diagnosed. As a result, a new guideline promulgated jointly by the American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine (SMFM) was released which was mainly based on Zhang et al.'s studies. The Consensus Statement recommends that perinatal care providers should not perform cesarean births for lack of progress in active labor until a person's cervical examination has remained unchanged at a minimum of 6 cm dilatation for at least 4 hours with adequate contractions, or for at least 6 hours with oxytocin augmentation.^[12]

However, there is an ongoing debate concerning which guideline is more beneficial for managing labor. Many authors raised concerns of patient safety in adopting the new recommendations while there is lack of robust evidence on either direction. Some studies reported a reduction in cesarean delivery due to arrest disorders, while others found no difference. It also remains unclear whether changes in the cesarean rate as a result of the application of the new guidelines can also be translated into improved maternal and neonatal outcomes or portends an increase in morbidity. We therefore conducted a systematic review and meta-analysis to investigate whether the risk of adverse obstetric outcomes differed when adhering to the WHO guideline *vs.* the new guideline for labor management.

MATERIALS AND METHODS

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and prospective registration in the International Prospective Register of Systematic Reviews (PROSPERO-CRD: CRD42022383775), without a prepared protocol.

Review questions

The review questions were based on the PICO protocol (population, intervention, comparison, outcomes). What are the differences between the new labor management guideline (I) and the WHO guideline (C) in terms of adverse obstetric outcomes, including maternal and neonatal morbidity (O) in low-risk pregnant women (P)? Are there any differences in the indications for cesarean section between the two guidelines? Women in the control group were monitored with the WHO guideline, with an alert line (drawn on the partograph) that showed the expected cervical dilatation if labor was progressing by at least 1 cm per hour, and an action line drawn 4 hours later than the alert line. The first stage of labor was divided into the latent phase (0-3 cm) and active phase (4-10 cm), labor dystocia was diagnosed when the latent phase lasted longer than 16 hours or if the action line was crossed in the active phase. Labor dystocia in the second stage of labor (from 10 cm of cervical dilatation until the baby is born) was diagnosed if it lasted longer than 2 hours (or 3 hours for women with epidural analgesia [EDA]).

Women in the intervention group adopted the new labor management. With the reference point of the onset of active phase starting from 6 cm, prolonged latent phase was no longer an indication for cesarean section. Dilation stopping > 4 hours during the active period was considered as protracted active phase. When the uterine contraction was not good, dilation stopping > 6 hours was defined as protracted active phase. Labor dystocia in the second stage of labor was diagnosed if it lasted longer than 3 hours (or 4 hours for women with EDA) in nulliparas, and longer than 2 hours (or 3 hours for women with EDA) in multiparas.^[13]

Inclusion and exclusion criteria

Randomized controlled trials (RCTs), original prospective or retrospective cohort studies were included in this analysis. We included the publications that met the following criteria: (1) the study population were nulliparous or multiparous women or sub-groups with a singleton fetus at \geq 37 weeks gestation, cephalic presentations and spontaneous labor onset, or no evidence to the contrary; (2) "low-risk" at study entry based on their description in the abstract (*e.g.*, without medical condition, pregnancy complication, or diagnosed labor abnormality) or had no evidence to the contrary; (3) the study presented identifiable method of labor management and pregnancy outcomes. We excluded studies focusing on induction of labor, or women with comorbidities or complications (*e.g.*, gestational diabetes, hypertensive disorders, previous caesarean delivery), or with sample size lower than 40. Studies that applied the new labor management guideline only in the second stage were also excluded. Publications that were not scientific research, including reports, books, news articles, editorials, and letters were excluded due to limited detailed information.

Database search and study selection

A search of the relevant literature was conducted using the electronic databases of PubMed, Embase, Web of Sciences, the Cochrane Library, CNKI, VIP, Wanfang Database with publications up to December 07, 2022, using Medical Subject Headings (MeSH) or Emtree terms "labor, obstetric" and the term "management", "Zhang's", "new" or "contemporary". Literature searches of bibliographies of related systematic reviews and eligible studies complemented the search strategies. There were no date or language restrictions. Details of the search strategy are presented in Figure S1.

The Endnote software and manual checking have been used to remove duplicates. Two authors independently evaluated the retrieved titles and abstracts to determine their compliance with the full-text review criteria. For all documents that were not excluded at this stage, we read the full-text articles and determined if they met the inclusion criteria. Any different opinions between the evaluators were resolved by consensus or a third reviewer.

Data extraction

The following data were extracted: the study characteristics, such as sample size, study types, the year of publication; the basic characteristics of the included population, such as age, pre-pregnancy body mass index (BMI), gestational age; and adverse obstetric outcomes, including both maternal and neonatal morbidity. Adverse maternal outcomes included intrapartum cesarean section, operative vaginal delivery, 3rd- and 4th-degree perineal laceration, postpartum hemorrhage, postpartum urine retention and infectious morbidity (chorioamnionitis, endometritis and puerperal infection). Adverse neonatal outcomes included fetal distress, neonatal asphyxia and neonatal intensive care unit (NICU) admission. The indications for cesarean sections were also extracted, if available, which include failure in labor induction, prolonged latent phase, protracted active phase, prolonged second phase, relative cephalon-pelvic disproportion, fetal distress and the others.

Study quality assessment

The quality of RCTs was assessed using the Cochrane Risk Bias Evaluation Tool, which included random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. The quality of the cohort studies was assessed using the Newcastle-Ottawa Scale (NOS), which included the selection of the cohort, comparability between groups, and results.

Data synthesis and statistical analysis

Data synthesis and statistical analysis were performed using Review Manager (RevMan, Version 5.4.1, The Cochrane Collaboration, Copenhagen, Denmark) and R (Windows Version 4.2.1, R Foundation for Statistical Computing, Vienna, Austria). Continuous outcomes were presented as mean difference (MD) between experimental and control groups with 95% confidence intervals (CI); for dichotomous data, they were presented as risk ratio (RR) with 95% CI. For studies which only reported median and interquartile range (IQR), the estimation of sample mean \pm standard deviation (SD) proposed by Wan *et al.*^[14] was used to convert the data. The results are represented by forest plots. For the indications for cesarean section, a pooled proportion of indications was obtained based on binomial distribution with Freeman-Tukey double-arcsine transformation and expressed as proportions and 95% CI. Zero event was managed using continuity correction adding 0.5 in each cell. The random-effects model was used for all analyses to account for variation between studies. We performed the average age, pre-pregnancy BMI and gestational age at delivery among all studies, which may indicate the source of heterogeneity. The heterogeneity of the pooled data was estimated by calculating the Q and I^2 statistics, and the difference was considered significant when P < 0.05 or $I^2 > 40\%$. For the results with high heterogeneity, a subgroup and sensitivity analysis were used to assess the probable source of heterogeneity and the result's strength. Subgroup analyses that pre-specified was according the type of cohort study (retrospective or prospective cohort study). A sensitivity analysis assesses the effect of overall results by eliminating specific low-quality studies. Finally, funnel charts were used to observe whether there was publication bias. Corrections for asymmetry were performed according to the trim and fill method.

RESULTS

A total of 413 citations were screened and 112 references were removed as duplicates. All 301 abstracts were screened to identify labor progression publications. 143 publications were selected for full review, and in 98 studies either the study population or the outcomes did not meet the inclusion criteria. Finally, 45 studies were included in this systematic review. The selection procedure and screened studies are presented in a PRISMA flowchart (Figure 1).

Characteristics of included studies and patients

Forty-five studies were eventually included. There were 15 RCTs^[15–29] and 30 cohort studies.^[30–59] The analysis included 44 single-center studies and 1 multi-center study.^[25] The tabulated studies included a total of 82,016 women.



Figure 1. Flow chart of study selection. *Additional records identified from checking through the reference lists of relevant studies and personal communicating with authors.

The intervention group consisted of 42,563 individuals (6265 women from RCTs, 36,298 women from cohort studies). The comparison group consisted of 39,453 individuals (5606 women from RCTs, 33,847 women from cohort studies). Region of origin for included studies were China (n = 41), Norway (n = 1),^[25] America (n = 1)^[58] and France (n = 1).^[57] Of note, the Norwegian study was the only multicenter RCT. A full description of included studies is presented in Table 1. Risk of bias and quality assessment are presented in the supplementary materials. The quality of RCTs was assessed using the Cochrane Risk Bias Evaluation Tool (Figure S2). The quality of the cohort studies was assessed using the NOS (Table S1). Since the study by Bernitz et al. employed different criteria of labor dystocia,^[25] it was not included in the data synthesis. We first compared the women's characteristics that may affect the outcomes and found no difference between the two groups in age, pre-pregnancy BMI, gestational age at delivery and the proportion of nulliparas (Table 2).

Maternal morbidity

Labor augmentation with oxytocin: 15 studies with 3 RCTs^[20,23,27] and 12 cohort studies^[30–34,36,40,45,48,51,52,55] examined this outcome. The results showed that the intervention group used less oxytocin for labor augmentation than the comparison group in both the RCTs and cohort studies (RCTs: RR = 0.55 [0.36, 0.83], $I^2 = 47\%$; cohort studies: RR = 0.62 [0.55, 0.70], $I^2 = 58\%$) (Figure 2A).

Intrapartum cesarean section: 13 RCTs^[16-24,26-29] and 29 cohort studies^[30-37,39-59] examined this outcome. The results showed that the intrapartum cesarean section rate in the intervention group was lower than the comparison group in both the RCTs and cohort studies (RCTs: RR = 0.52 $[0.47, 0.59], I^2 = 0$; cohort studies: RR = 0.61 [0.55, 0.67], $I^2 = 75\%$) (Figure 2B). There were 1 RCT^[22] and 12 cohort studies^[32,33,37,39,41-44,49,52,57,58] examined the indications for intrapartum cesarean section. As shown in Table 3, there was no significant difference in failure in induction of labor, protracted active phase, prolonged second phase and fetal distress between two groups. The major indications for cesarean section were protracted active phase and fetal distress in the intervention group and protracted active phase and relative cephalo-pelvic disproportion in the comparison group respectively. Prolonged latent phase was no longer the indication for cesarean section in the intervention group, and the pooled proportion of prolonged latent phase in indications was 0.14 (0.11, 0.18) in the comparison group. The other indications including maternal request, maternal complications and placental abnormality etc. were more often in the intervention group compared with the comparison group $(0.09 \ [0.05, 0.13] \ vs.$ 0.06 [0.03, 0.09], RR = 1.57 [1.04, 2.36]).

Operative vaginal delivery: 6 RCTs^[15,17,19,23,28,29] and 19 cohort studies^[31–34,36–38,40,44,46–50,53,55,57–59] examined this outcome. The results showed that operative vaginal delivery was less common in the intervention group than that in the

| Author, year | Study types | Intervention/ Comparison | Sample size | | Nulli | oaras | Age | | Pre-preg BMI | nancy | Gestatio | nal age | Outcomes* | |
|--|-------------------------------|-----------------------------|----------------|------|-------|-------|----------------|----------------|-----------------|--------------|----------------|----------------|--------------------|--|
| - | | - | New | wно | New | wно | New | WHO | New | WHO | New | WHO | - | |
| Liu 2016 ^[15] | RCT | New labor / WHO labor | 60 | 60 | 60 | 60 | - | - | - | - | - | - | 356 8910 | |
| Huang <i>et al.</i> 2017 ^[16] | RCT | New labor / WHO labor | 242 | 238 | - | - | - | - | - | - | - | - | 245 69 | |
| Wang and Liu 2017 ^[17] | RCT | New labor / WHO labor | 102 | 102 | - | - | 28.6 ± 1.3 | 28.5 ± 1.1 | - | - | 39.1 ± 1.1 | 38.9 ± 1.3 | 239 | |
| Ma 2018 ^[18] | RCT | New labor / WHO labor | 44 | 44 | 44 | 44 | 29.7 ± 3.9 | 28.0 ± 3.1 | - | - | - | - | 2456 | |
| Zhuang 2018 ^[19] | RCT | New labor / WHO labor | 48 | 48 | 48 | 48 | 27.5 ± 3.5 | 27.8 ± 3.4 | - | - | 39.8 ± 1.1 | 39.5 ± 1.3 | 235 69 | |
| Li and Ren <i>et</i> al. 2019 ^[20] | RCT | New labor / WHO labor | 100 | 112 | 100 | 112 | 29.1 ± 8.6 | 30.3 ± 8.2 | - | - | 38.6 ± 1.3 | 39.5 ± 0.3 | 1259 | |
| Xiaomei Liao 2019 ^[21] | RCT | New labor / WHO labor | 40 | 40 | 23 | 21 | 26.8 ± 2.3 | 26.1 ± 2.4 | - | - | - | - | 2579 | |
| Zhang <i>et al.</i> 2019 ^[22] | RCT | New labor / WHO labor | 44 | 44 | 25 | 28 | 28.7 ± 3.6 | 30.5 ± 3.4 | - | - | - | - | 28 | |
| Zhong and Su 2019 ^[23] | RCT | New labor / WHO labor | 50 | 50 | - | - | 31.7 ± 1.3 | 31.3 ± 1.1 | - | - | - | - | 123 8910 | |
| Zhou 2019 ^[24] | RCT | New labor / WHO labor | 200 | 200 | - | - | 26.2 ± 0.1 | 25.1 ± 0.4 | - | - | - | - | 2 | |
| Bernitz <i>et al.</i> 2019 ^[25] † | RCT | New labor / WHO labor | 3972 | 3305 | 3972 | 3305 | - | - | 23.6 ± 4.3 | 23.8 ± 4.3 | 40.1 ± 1.1 | 40.1 ± 1.0 | 123 459 | |
| Zeng 2020 ^[26] | RCT | New labor / WHO labor | 1000 | 1000 | - | - | 28.3 ± 3.3 | 28.5 ± 3.4 | - | - | 39.6 ± 0.4 | 39.5 ± 0.4 | 256 789 | |
| Zhang 2020 ^[27] | RCT | New labor / WHO labor | 105 | 105 | - | - | 26.7 ± 2.3 | 29.1 ± 2.5 | - | - | 39.2 ± 0.6 | 37.5 ± 0.4 | 125 79 | |
| Chen and Su 2021 ^[28] | RCT | New labor / WHO labor | 66 | 66 | - | - | 28.1 ± 1.6 | 28.3 ± 1.5 | - | - | 40.1 ± 0.5 | 40.1 ± 0.5 | 235 6910 | |
| Han <i>et al.</i> 2021 ^[29] | RCT | New labor / WHO labor | 192 | 192 | 192 | 192 | 28.4 ± 3.3 | 28.5 ± 3.3 | - | - | 40.4 ± 0.3 | 40.4 ± 0.3 | 234 5689 | |
| Lin <i>et al.</i> 2016 ^[30] | Retrospective cohort study | New labor / WHO labor | 755 | 1050 | - | - | - | - | - | - | - | - | 125 689 | |
| Lv <i>et al.</i> 2016 ^[31] | Retrospective cohort study | New labor / WHO labor | 100 | 80 | 57 | 48 | 31.2 ± 3.6 | 30.6 ± 3.3 | - | - | 39.4 ± 0.3 | 39.3 ± 0.1 | 123 5679 | |
| Zhang <i>et al.</i> 2016 ^[32] | Prospective cohort study | New labor / WHO labor | 187 | 255 | - | - | 29.6 ± 3.7 | 30.0 ± 3.9 | 21.2 ± 3.1 | 21.7 ± 3.6 | 39.4 ± 0.9 | 39.4 ± 1.1 | 123 5789 | |
| Zhang 2016 ^[33] | Retrospective cohort study | New labor / WHO labor | 659 | 763 | 659 | 763 | 27.6 ± 3.1 | 27.3 ± 3.6 | 20.4 ± 4.0 | 20.3 ± 3.2 | 39.6 ± 1.2 | 39.7 ± 1.2 | 123 567 8910 | |
| Yan and Xiao 2016 ^[59] | Retrospective cohort study | New labor / WHO labor | 3014 | 3234 | - | - | 29.1 ± 3.3 | 28.9 ± 4.0 | - | - | 38.9 ± 1.9 | 39.1 ± 1.8 | 235 89 | |
| Wilson-Leedy et al. 2016 ^[58] ‡ | Retrospective cohort study | New labor / WHO labor | 292 | 275 | 292 | 275 | 26.5 ± 5.4 | 26.6 ± 5.5 | 24.7 ± 4.9 | 25.2 ± 5.2 | 39.5 ± 1.7 | 39.6 ± 1.3 | 234 569 | |
| Jin 2017 ^[34] | Prospective cohort study | New labor / WHO labor | 42 | 42 | - | - | 26.0 ± 2.2 | 26.5 ± 1.5 | - | - | - | - | 123 5689 | |
| Li et al. 2017 ^[35] | Prospective cohort study | New labor / WHO labor | 88 | 101 | - | - | - | - | - | - | - | - | 2579 | |
| Wang <i>et al.</i> 2017 ^[36] | Retrospective cohort study | New labor / WHO labor | 7012 | 4892 | - | - | 27.0 ± 3.8 | 26.8 ± 3.2 | 21.3 ± 3.0 | 21.3 ± 3.2 | 39.1 ± 5.0 | 39.1 ± 2.4 | 123 910 | |
| Wang <i>et al.</i> 2017 ^[37] | Retrospective cohort study | New labor / WHO labor | 6836 | 5385 | 6836 | 5385 | 31.2 ± 3.7 | 30.9 ± 3.5 | - | - | - | - | 234 56910 | |
| Wei <i>et al.</i> 2017 ^[38] | Retrospective cohort study | New labor / WHO labor | 4146 | 3879 | 4146 | 3879 | 29.9 ± 3.1 | 29.6 ± 3.0 | 21.5 ± 2.2 | 21.7 ± 3.9 | 39.2 ± 1.0 | 39.2 ± 1.1 | 35910 | |
| Yang 2017 ^[39] | Prospective cohort study | New labor / WHO labor | 892 | 806 | 614 | 549 | 28.1 ± 4.3 | 26.5 ± 3.6 | - | - | 38.8 ± 1.4 | 38.2 ± 1.1 | 2579 | |
| Zhao <i>et al.</i> 2017 ^[40] | Prospective cohort study | New labor / WHO labor | 85 | 101 | 85 | 101 | 28.2 ± 3.2 | 28.5 ± 3.4 | 22.2 ± 3.2 | 22.1 ± 3.2 | 39.7 ± 1.2 | 39.8 ± 1.0 | 123 58910 | |

Table 1: Characteristics of included studies and patients

(continued...)

| Author, | Study | Intervention/ | Sample | | Nulliparas | | Age | | Pre-preg | nancy | Gestatio | Outcomes* | |
|---|-----------------------------|--------------------------|--------|------|------------|------|----------------|--------------|------------|--------------|------------|----------------|--------------------------------------|
| year | types | Comparison | New | wно | New | wно | New | WHO | New | WHO | New | WHO | - |
| Li 2018 ^[41] | Prospective cohort study | New labor / WHO labor | 669 | 465 | 669 | 465 | - | - | - | - | - | - | 2910 |
| Li 2018 ^[42] | Prospective cohort study | New labor / WHO labor | 500 | 500 | - | - | 27.5 ± 2.2 | 27.4 ± 2.2 | 22.5 ± 0.4 | 22.5 ± 0.5 | 39.3 ± 0.4 | 39.3 ± 0.5 | 2579 |
| Zhang <i>et al.</i> 2018 ^[43] | Retrospective cohort study | New labor / WHO labor | 739 | 751 | - | - | - | - | - | - | - | - | 2 |
| Thuillier <i>et al.</i> 2018 ^{[57] §} | Retrospective cohort study | New labor / WHO labor | 3068 | 3283 | 1497 | 1679 | 30.4 ± 5.2 | 30.4 ± 5.2 | 25.4 ± 5.2 | 24.3 ± 5.2 | 40.2 ± 1.5 | 40.1 ± 1.4 | 234 5910 |
| Li et al. 2019 ^[44] | Retrospective cohort study | New labor / WHO labor | 2066 | 2108 | 2066 | 2108 | 27.2 ± 5.5 | 26.9 ± 4.7 | - | - | 39.4 ± 1.9 | 39.3 ± 1.4 | 2359 |
| Liu <i>et al.</i> 2019 ^[45] | Retrospective cohort study | New labor / WHO labor | 100 | 100 | 77 | 75 | 28.0 ± 2.3 | 28.0 ± 2.4 | - | - | 39.9 ± 1.1 | 40.0 ± 1.0 | 125 6789 |
| Wei 2019 ^[46] | Prospective cohort study | New labor / WHO labor | 100 | 100 | 68 | 65 | 30.2 ± 3.0 | 29.6 ± 2.8 | - | - | 39.5 ± 1.6 | 40.2 ± 1.5 | 2359 |
| Yang <i>et al.</i> 2019 ^[47] | Retrospective cohort study | New labor / WHO labor | 625 | 640 | - | - | 32.4 ± 5.2 | 31.8 ± 5.4 | - | - | - | - | 235 67 |
| Zhang <i>et al.</i> 2019 ^[48] | Prospective cohort study | New labor / WHO labor | 100 | 100 | 70 | 72 | 29.0 ± 4.5 | 28.5 ± 5.0 | - | - | 38.0 ± 0.4 | 38.0 ± 0.5 | 123 589 |
| Bai and Xue 2020 ^[49] | Retrospective cohort study | New labor / WHO labor | 213 | 234 | 213 | 234 | 24.4 ± 3.1 | 24.6 ± 3.0 | 23.7 ± 3.6 | 23.7 ± 3.7 | 39.5 ± 1.1 | 39.5 ± 1.3 | 23910 |
| Liu 2020 ^[50] | Retrospective cohort study | New labor / WHO labor | 372 | 659 | 372 | 659 | - | - | - | - | - | - | 234 567 |
| Quan 2020 ^[51] | Prospective cohort study | New labor / WHO labor | 130 | 130 | 130 | 130 | 29.2 ± 6.1 | 28.5 ± 5.7 | - | - | 38.1 ± 1.4 | 37.6 ± 1.3 | 125 89 |
| Shi <i>et al.</i> 2021 ^[52] | Retrospective cohort study | New labor / WHO labor | 2732 | 3122 | - | - | 30.0 ± 3.5 | 29.1 ± 3.4 | - | - | 38.9 ± 1.4 | 38.8 ± 1.5 | $\begin{array}{c}125\\69\end{array}$ |
| Sun <i>et al.</i> 2021 ^[53] | Retrospective cohort study | New labor / WHO labor | 500 | 500 | 500 | 500 | 29.9 ± 5.0 | 39.2 ± 1.2 | - | - | 39.2 ± 1.2 | 39.2 ± 1.0 | 2359 |
| Zheng <i>et al.</i> 2021 ^[54] | Retrospective cohort study | New labor / WHO labor | 80 | 80 | 48 | 49 | 26.5 ± 3.3 | 26.2 ± 3.3 | - | - | 39.4 ± 1.1 | 39.3 ± 1.0 | 245 789 |
| Li et al. 2021 ^[55] | Retrospective cohort study | New labor / WHO labor | 96 | 112 | 96 | 112 | 24.9 ± 2.3 | 25.2 ± 3.3 | - | - | 39.2 ± 4.9 | 38.8 ± 4.8 | 123 589 |
| Wang and Cheng 2022 ^[56] | Retrospective cohort study | New labor / WHO labor | 100 | 100 | 100 | 100 | 29.0 ± 4.96 | 29.2 ± 5.1 | - | - | 39.1 ± 0.5 | 39.2 ± 0.6 | 245 68 |

Age, Pre-BMI and Gestational age are presented as mean ± standard deviation. *(1)labor augmentation with oxytocin; (2)intrapartum cesarean section; (3) operative vaginal delivery; (4)3rd- and 4th-degree perineal laceration; (5) postpartum hemorrhage; (6) infectious morbidity (chorioamnionitis, endometritis and puerperal infection); (7) postpartum urine retention; (8) fetal distress; (9) neonatal asphysia; (10) neonatal intensive care unit admission. ⁺This study was from Norway. ⁺This study was from America. ⁵This study was from France. All other studies were from China. -: No specific numbers were mentioned in the article.

| Table 2: Comparison of patient baseline characteristics between the new labor management and the WHO guideline | | | | | | | | | |
|--|--------------------------|------|--|--|--|--|--|--|--|
| Characteristics | Effect P va | | | | | | | | |
| Age | MD = -0.16 [-0.55, 0.23] | 0.42 | | | | | | | |
| Nulliparas | RR = 1.00 [0.99, 1.00] | 0.88 | | | | | | | |
| Pre-pregnancy BMI | MD = 0.08 [-0.15, 0.31] | 0.52 | | | | | | | |
| Gestational age at delivery | MD = 0.07 [-0.03, 0.17] | 0.18 | | | | | | | |
| Epidural anesthesia | RR = 1.05 [0.84, 1.31] | 0.66 | | | | | | | |

MD: mean deviation; RR: risk ratio; BMI: body mass index.

comparison group in both the RCTs and cohort studies (RCTs: RR = 0.60 [0.42, 0.87], $I^2 = 0$; cohort studies: RR = 0.69 [0.55, 0.86], $I^2 = 82\%$) (Figure 2C).

The 3rd- or 4th perineal laceration: 3 RCTs^[16,18,29] and 6

cohort studies^[37,50,54,56–58] examined this outcome, and all the 6 cohort studies were retrospective cohort studies. In the RCTs, the 3rd- or 4th perineal laceration was less likely to occur in the intervention group compared with the comparison group, while no significant difference was

| Table 3: Indications for cesarean section | | | | | | | | | | | | | |
|---|-----|---------|-------------------|--------------|-----|---------|-------------------|--------------|-------------------|--|--|--|--|
| Indications | New | | | _ | WHC |) | | | RR | | | | |
| | ľ | Р | Pooled proportion | 95 CI% | ľ | Р | Pooled proportion | 95 CI% | | | | | |
| Failure in induction of labor | 72% | 0.003 | 0.15 | [0.11, 0.20] | 75% | 0.001 | 0.14 | [0.11, 0.18] | 1.18 [0.91, 1.52] | | | | |
| Prolonged latent phase | - | - | - | - | 75% | 0.001 | 0.14 | [0.11, 0.18] | - | | | | |
| Protracted active phase | 98% | < 0.001 | 0.28 | [0.15, 0.44] | 98% | < 0.001 | 0.31 | [0.20, 0.43] | 0.83 [0.65, 1.07] | | | | |
| Prolonged second phase | 95% | < 0.001 | 0.10 | [0.04, 0.18] | 94% | < 0.001 | 0.14 | [0.08, 0.20] | 0.73 [0.48, 1.11] | | | | |
| Relative cephalo-pelvic disproportion | 97% | < 0.001 | 0.17 | [0.08, 0.29] | 98% | < 0.001 | 0.31 | [0.20, 0.43] | 0.93 [0.79, 1.10] | | | | |
| Fetal distress | 98% | < 0.001 | 0.35 | [0.22, 0.49] | 98% | < 0.001 | 0.28 | [0.16, 0.41] | 1.31 [0.98, 1.75] | | | | |
| Other indications | 84% | < 0.001 | 0.09 | [0.05, 0.13] | 85% | < 0.001 | 0.06 | [0.03, 0.09] | 1.57 [1.04, 2.36] | | | | |

RR: risk ratio; Others including: maternal request, maternal complications and placental abnormality etc.

observed in cohort studies (RCTs: RR = 0.38 [0.21, 0.70], $I^2 = 30\%$; cohort studies: RR = 1.10 [0.60, 2.03], $I^2 = 86\%$) (Figure 2D).

Postpartum hemorrhage: 10 RCTs^[15,16,18–21,26–29] and 26 cohort studies^[30–35,37–40,42,44–48,50–59] examined this outcome. Women in the intervention group showed comparable postpartum hemorrhage to that of women in the comparison group in both the RCTs and the cohort studies (RCTs: RR = 0.76 [0.44, 1.31], $I^2 = 51\%$; cohort studies: RR = 0.97 [0.82, 1.14], $I^2 = 70\%$) (Figure 2E).

Maternal infectious morbidity: 7 RCTs^[15,16,18,19,26,28,29] and 11 cohort studies^[30,31,33,34,37,45,47,50,52,56,58] examined this outcome. The infectious morbidity showed no significant difference between the intervention group and the comparison group among all studies (RCTs: RR = 0.97 [0.52, 1.79], $I^2 = 8\%$; cohort studies: RR = 1.00 [0.73, 1.37], $I^2 = 19\%$) (Figure 2F).

Postpartum urine retention: 3 RCTs^[21,26,27] and 10 cohort studies^[31–33,35,39,42,45,47,50,54] examined this outcome, and no great difference was observed between two groups in both the RCTs and cohort studies (RCTs: RR = 0.82 [0.45, 1.50], $I^2 = 0$; cohort studies: RR = 1.25 [0.81, 1.93], $I^2 = 35\%$) (Figure 2G).

For the results of maternal morbidity with high heterogeneity, a subgroup analysis was performed, and the results are shown in Figure 3. Sensitivity analysis for maternal morbidity did not change the summary OR (Figure S3). Funnel plots modified by trim-and-fill method were used to evaluate the presence of publication bias for maternal morbidity (Figure S4).

Neonatal morbidity

Fetal distress: 5 RCTs^[15,22,23,26,29] and 12 cohort studies^[30,32–34,40,45,48,51,54–56,59] examined this outcome. Fetal distress seemed less common in the intervention group than that in the comparison group in the RCTs, while

no significant difference was observed in cohort studies (RCTs: RR = 0.60 [0.38, 0.95], $I^2 = 30\%$; cohort studies: RR = 0.98 [0.88, 1.09], $I^2 = 0$) (Figure 4A).

Neonatal asphyxia: 11 RCTs^[15–17,19–21,23,26–29] and 26 cohort studies^[30–42,44–46,48,49,51–55,57–59] examined this outcome, no significant difference was observed between two groups in both the RCTs and cohort studies (RCTs: RR = 0.76 [0.50, 1.15], $I^2 = 20\%$; cohort studies: RR = 0.84 [0.68, 1.03], $I^2 = 38\%$) (Figure 4B).

NICU admission: 3 RCTs^[15,23,28] and 8 cohort studies^[33,36–38,40,41,49,57] examined this outcome, which showed no significant difference between the intervention group and the comparison group in both the RCTs and cohort studies. (RCTs: RR = 0.61 [0.26, 1.44], I^2 = 0; cohort studies: RR = 1.10 [0.86, 1.40], I^2 = 81%) (Figure 4C).

For the results of neonatal morbidity with high heterogeneity, a subgroup analysis was performed, and the results are shown in Figure 5. A sensitivity analysis for neonatal morbidity did not change the summary OR. (Figure S5) Funnel plots modified by trim-and-fill method were used to evaluate the presence of publication bias for neonatal morbidity (Figure S6).

DISCUSSION

This systematic review and meta-analysis demonstrates a lower maternal morbidity and no increase in neonatal morbidity for women under the new labor management compared to women under the WHO guideline. The results were supported by the overall estimate from RCTs and cohort studies. The subgroup and sensitivity analyses showed that the combined results were quite stable.

We found that women managed by the new guideline had less labor augmentation with oxytocin, fewer intrapartum caesarean section and operative vaginal delivery. Hypocontractile activity is the most common reason for labor

Risk Ratio Random, 95% CI

0.01 0.1 1 10 100

MH

0.01 0.1 1

n. 95% CI

10

100

0.01 0.1 10 100

1

Risk Ratio Random, 95% CI

Risk Ratio MH, Random, 95% CI

•

0.1 0.5 1 2 10

Risk Ra

10 95% CI

| А | | | | D | | |
|--|--|---|--|---|--|--|
| Study or Subgroup | New labor WHO labor Events Total Events Total Weight MH, I | Risk Ratio Random, 95% Cl | Risk Ratio MH, Random, 95% CI | Study or Subgroup | New labor WHO labor Ri Events Total Events Total Weight MH, Ra | sk Ratio ndom, 95% CI |
| Type = RCT Manbo Li, et al 2019 Jie Zhong, et al 2019 | 4 100 20 112 1.1% 0. 18 50 29 50 5.1% 0 | .22 [0.08, 0.63] - | | Qiuming Huang, et al Hongmei Ma 2018 | 2017 34 242 68 238 17.7% 0.49 3 44 9 44 13.2% 0.33 | [0.34, 0.71] [0.10, 1.15] |
| Weiqiaang Zhang 2020 Total (95% CI) | 30 105 47 105 6.5% 0. 255 267 12.8% 0. | .64 [0.44, 0.92] .55 [0.36, 0.83] | + | Wenying Han, et al 2 Total (95% Cl) | 1021 2 192 14 192 11.9% 0.14 478 474 42.8% 0.38 | [0.03, 0.62] [0.21, 0.70] |
| Heterogeneity: Tau" = 0.063; Test for overall effect: Z = -2.0 | Chi" = 3.78, df = 2 (P = .15); l" = 47% 81 (P < .01) | | | Test for overall effect 2 | = -3.07 (P < .01) | |
| Type = Cohort study Xiaoli Lin, et al 2016 Xiaochoog Ly, et al 2016 | 98 755 230 1050 11.7% 0. 10 100 22 80 2.4% 0 | .59 [0.48, 0.74] 36 [0.18, 0.72] | | Dingran Wang, et al Fanghua Liu 2020 | 2017 40 6836 21 5385 17.1% 1.50 167 372 117 659 18.2% 2.53 | [0.89, 2.54] [2.07, 3.09] |
| Chenchen Zhang, et al 20 Hanru Zhang, et al 2016 | 16 41 187 98 255 8.1% 0. 112 659 238 763 12.5% 0. | .57 [0.42, 0.78] .54 [0.45, 0.66] | + | Xiaoxue Zheng, et al Ya Wang, et al 2022 Total (95%, Cl) | 2021 4 80 6 80 13.3% 0.67 1 100 5 100 8.6% 0.20 7388 6224 57.2% 1.33 | [0.20, 2.27] [0.02, 1.68] - |
| Qian Jin, et al 2017 Yun Wang, et al 2017 Na Zhao, et al 2017 | 9 42 16 42 2.4% 0. 1410 7012 1382 4892 18.8% 0. 32 85 59 101 7.9% 0. | 0.56 [0.28, 1.13] 0.71 [0.67, 0.76] 0.64 [0.47, 0.89] | | Heterogeneity: Tau ² = 0 Test for overall effect: 2 | 0.322; Chi ² = 12.71, df = 3 (P < .01); l ² = 76% (= 0.79 (P = .43) | [0.00, 2.71] |
| Qing Liu, et al 2019 Jing Zhang, et al 2019 Guorai Quan, 2020 | 5 100 13 100 1.3% 0. 7 100 18 100 1.8% 0. 5 130 14 130 1.8% 0. | .38 [0.14, 1.04] .39 [0.17, 0.89] | | Total (95% CI) Heterogeneity: Tau ² = 1 | 7866 6698 100.0% 0.63 1.032; Chi ² = 83.83, df = 6 (P < .01); l ² = 93% | [0.27, 1.49] |
| Dongdong Shi, et al 2021 Xing Li, et al 2021 | 482 2732 696 3122 17.2% 0. 8 96 21 112 2.0% 0. | 0.79 [0.71, 0.88] 0.44 [0.21, 0.96] | • | Test for overall effect: 2 Test for subgroup differ | t = -1.05 (P = .29) ences: $Chi^2 = 6.81$, df = 1 (P < .01) | |
| Total (95% CI) Heterogeneity: Tau ² = 0.016; Test for overall effect: Z = -7.1 | 11998 10747 87.2% 0. Chi ² = 28.15, df = 11 (P < .01); l ² = 58% 72 (P < .01) | .62 [0.55, 0.70] | • | Е | | |
| Total (95% CI) | 12253 11014 100.0% 0. | .61 [0.55, 0.69] | · · · · · · · · · · · · · · · · · · · | Study or Subgroup | New labor WHO labor Events Total Events Total Weight MH, | Risk Ratio Random, 95% 0 |
| Test for overall effect: Z = -8.3 Test for subgroup differences | 34 (P < .01) s: $Chi^2 = 0.31$, $df = 1 (P = .58)$ | 0 | .1 0.5 1 2 10 | Yuezhu Liu, et al 2016 Qiuming Huang, et al | 5 1 60 3 60 0.7% 0 2017 18 242 9 238 3.5% 1 | .33 [0.04, 3.11] .97 [0.90, 4.29] |
| | | | | Hongmei Ma 2018 Haiyan Zhuang 2018 Manbo Li, et al 2019 | 1 44 4 44 0.7% 0 1 48 2 48 0.6% 0 13 100 35 112 4.7% 0 | .25 [0.03, 2.15] .50 [0.05, 5.33] .42 [0.23, 0.74] |
| | | | | Xiaomei Liao 2019 Rong Zeng 2020 | 4 40 3 40 1.5% 1 24 1000 26 1000 4.9% 0 | .33 [0.32, 5.58] .92 [0.53, 1.60] |
| В | | | | Qiumei Chen, et al 20 Wenying Han, et al 2 | 021 5 66 1 66 0.8% 5. 021 2 192 9 192 1.4% 0 | 00 [0.60, 41.65] .22 [0.05, 1.02] |
| Study or Subgroup | New labor WHO labor Events Total Events Total Weight MH, I | Risk Ratio Random, 95% CI | Risk Ratio MH, Random, 95% CI | Total (95% CI) Heterogeneity: Tau ² = 0 Test for overall effect: 2 | 1897 1905 20.0% 0 0.312; Chi ² = 18.23, df = 9 (P = .03); l ² = 51% = -0.99 (P = .32) | .76 [0.44, 1.31] |
| Type = RCT Qiuming Huang, et al 2017 Jinlian Wang, et al 2017 | 53 242 114 238 3.9% 0. 1 102 3 102 0.2% 0. | 46 [0.35, 0.60] | | Type = Cohort study | 15 755 26 1050 4 6% 0 | 58 10 22 1 051 |
| Hongmei Ma 2018 Haiyan Zhuang 2018 | 4 44 17 44 0.9% 0. 7 48 18 48 1.3% 0. | .24 [0.09, 0.64] .39 [0.18, 0.84] | | Xianghong Lv, et al 2 Chenchen Zhang, et a | 016 6 100 5 80 2.1% 0 al 2016 34 187 45 255 6.0% 1 | .96 [0.32, 1.63] .96 [0.30, 3.03] .03 [0.69, 1.54] |
| Manbo Li, et al 2019 Xiaomei Liao 2019 Min Zhang, et al 2019 | 11 100 32 112 1.8% 0. 4 40 12 40 0.8% 0. 6 44 14 44 1.1% 0. | .38 [0.21, 0.72] .33 [0.12, 0.95] .43 [0.18, 1.01] | | Hanru Zhang, et al 20 Qian Jin, et al 2017 Ming Li, et al 2017 | 016 33 659 38 763 5.6% 1 0 42 2 42 0.4% 0 0 88 2 101 0.4% 0 | .01 [0.64, 1.58] .20 [0.01, 4.04] .23 [0.01, 4.71] |
| Jie Zhong, et al 2019 Li Zhou 2019 Rong Zeng 2020 | 2 50 8 50 0.4% 0. 56 200 97 200 4.0% 0. 128 1000 227 1000 4.5% 0. | 25 [0.06, 1.12] 58 [0.44, 0.75] 56 [0.46, 0.69] | | Dingran Wang, et al 2 Lin Wei, et al 2017 | 2017 534 6836 407 5385 7.9% 1 452 4146 244 3879 7.7% 1 | .03 [0.91, 1.17] .73 [1.49, 2.01] |
| Weigiaang Zhang 2020 Qiumei Chen, et al 2021 | 23 105 40 105 2.7% 0. 12 66 22 66 1.8% 0. | .58 [0.37, 0.89] .55 [0.29, 1.01] | - | Na Zhao, et al 2017 Juan Li 2018 | 1 85 4 101 0.7% 0 7 500 8 500 2.6% 0 | .30 [0.03, 2.61] .88 [0.32, 2.39] |
| Wenying Han, et al 2021 Total (95% CI) Heterogeneity: Tau ² = 0; Ch ² | 35 192 58 192 3.2% 0.1 2233 2241 26.6% 0.1 = 8.74, df = 12 (P = .73); l ² = 0% | .52 [0.47, 0.59] | - | Hongyu Li, et al 2019 Qing Liu, et al 2019 Jiefang Wei 2019 | 126 2066 103 2108 7.1% 1 1 100 7 100 0.8% 0 2 100 6 100 1.3% 0 | .25 [0.97, 1.61] .14 [0.02, 1.14] .33 [0.07, 1.61] |
| Test for overall effect: Z = -11 | .12 (P < .01) | | | Shanshan Yang, et al Jing Zhang, et al 201 | 2019 34 625 36 640 5.6% 0 9 4 100 5 100 1.8% 0 9 272 11 660 2.0% 1 | .97 [0.61, 1.53] .80 [0.22, 2.89] |
| Xiaoli Lin, et al 2016 Xianghong Lv, et al 2016 | 52 755 109 1050 3.6% 0.1 11 100 18 80 1.6% 0.1 | .66 [0.48, 0.91] .49 [0.25, 0.97] | _ | Guomei Quan 2020 Dongdong Shi, et al 2 | 2 130 9 130 1.4% 0 2021 70 2732 87 3122 6.7% 0 | .22 [0.05, 1.01] .92 [0.67, 1.25] |
| Chenchen Zhang, et al 201 Hanru Zhang, et al 2016 Qian Jin, et al 2017 | 16 9 187 27 255 1.4% 0. 27 659 62 763 2.7% 0. 5 42 12 42 1.0% 0. | .45 [0.22, 0.94] .50 [0.32, 0.78] .42 [0.16, 1.08] | | Nianmei Sun, et al 20 Xiaoxue Zheng, et al Xing Li, et al 2021 | 021 4 500 8 500 2.0% 0 2021 3 80 5 80 1.6% 0 3 96 4 112 1.4% 0 | .50 [0.15, 1.65] .60 [0.15, 2.43] .88 [0.20, 3.81] |
| Ming Li, et al 2017 Yun Wang, et al 2017 Discret Wang, et al 2017 | 17 88 32 101 2.3% 0.0 239 7012 321 4892 4.7% 0.0 1722 6836 1550 5385 5.3% 0.0 | .61 [0.36, 1.02] .52 [0.44, 0.61] | ÷. | Ya Wang, et al 2022 Total (95% CI) | 16 100 29 100 5.0% 0 21291 20713 80.0% 0 | .55 [0.32, 0.95] .95 [0.77, 1.17] |
| Fangxun Yang, et al 2017 | 125 892 203 806 4.5% 0.5 | 56 [0.45, 0.68] | +1 | Test for overall effect: 2 | 1,103; GnF = 72.4, oF = 22 (P < ,01); F = 70% C = -0.50 (P = .62) | |
| Na Zhao, et al 2017 | 4 85 14 101 0.8% 0. | .34 [0.12, 0.99] | | | | |
| Na Zhao, et al 2017 Jie Li 2018 Juan Li 2018 Dingdan Zhang, et al 2018 | 4 85 14 101 0.8% 0. 167 669 138 465 4.5% 0. 14 500 40 500 1.9% 0. 109 739 198 751 4.4% 0. | .34 [0.12, 0.99] .84 [0.69, 1.02] .35 [0.19, 0.64] .56 [0.45, 0.69] | | Total (95% CI) Heterogeneity: Tau ² = 0 Test for overall effect: Z | 23188 22618 100.0% 0 0.122; $Chi^2 = 97.11$, $df = 32 (P < .01)$; $I^2 = 67\%$ = -1.05 (P = .29) | .90 [0.74, 1.09] |
| Na Zhao, et al 2017 Jie Li 2018 Juan Li 2018 Dingdan Zhang, et al 2018 Hongyu Li, et al 2019 Qing Liu, et al 2019 Jiefano Wei 2019 | 4 85 14 101 0.8% 0.0 167 669 138 465 4.5% 0. 14 500 40 500 1.9% 0. 109 739 138 751 4.4% 0. 566 2066 774 2108 5.2% 0. 2 100 9 100 0.4% 0. 18 100 32 100 2.3% 0. | .34 [0.12, 0.99] .84 [0.69, 1.02] .35 [0.19, 0.64] .56 [0.45, 0.69] .75 [0.68, 0.82] .22 [0.05, 1.00] .56 [0.34, 0.93] | | Total (95% CI) Heterogeneity: Tau ² = 0 Test for overall effect 2 Test for subgroup differ | $\begin{array}{llllllllllllllllllllllllllllllllllll$ | .90 [0.74, 1.09] |
| Na Zhao, et al 2017 Jie Li 2018 Juan Li 2018 Dingdan Zhang, et al 2018 Hongyu Li, et al 2019 Ging Liu, et al 2019 Jiefang Wei 2019 Shanshan Yang, et al 2010 | 4 85 14 101 0.8% 0.0 167 669 138 655 4.5% 0.0 14 500 40 500 1.9% 0.2 100 739 198 751 4.4% 0.0 566 2068 774 2108 5.2% 0. 2 100 9 100 0.4% 0. 18 100 32 100 2.3% 0. 9 101 625 140 5.2% 0. 18 100 32 100 2.3% 0. 9 101 625 104 1.6% 0. 10 102 22 100 1.6% 0. | 34 [0.12, 0.99] 84 [0.69, 1.02] 35 [0.19, 0.64] 56 [0.45, 0.69] 75 [0.68, 0.82] 22 [0.05, 1.00] 56 [0.34, 0.93] 77 [0.57, 0.91] 45 [0.23, 0.91] | | Total (95% Cl) Heterogeneity: Tau ² = 0 Test for overall effect. Z Test for subgroup differ F Study or | 23188 22518 100.0% 0 1.122: Chi ² = 97.11, df = 32 (P < .01); l ² = 67% = -1.05 (P = .29) ences: Chi ² = 0.55, df = 1 (P = .46) New labor WHO labor | .90 [0.74, 1.09] Risk Ratio |
| Na Zhao, et al 2017 Jie Li 2018 Juan Li 2018 Hongyu Li, et al 2018 Qing Liu, et al 2019 Jiefang Wei 2019 Shanshan Yang, et al 2019 Xiaorui Bai, et al 2019 Xiaorui Bai, et al 2020 Fanghua Liu 2020 | 4 85 14 101 0.8% 0.7 167 689 138 465 4.6% 0.1 14 500 40 500 1.9% 0.1 109 739 188 751 4.4% 0. 2 100 32 100 2.3% 0. 18 100 32 100 2.3% 0. 10 100 32 143 640 4.2% 0. 10 103 2.8% 3.0% 0.7 32 313 3.0% 0. 10 100 2.2 100 1.6% 0. 3 1.30% 0.6% 0.5% </td <td>34 (0,12, 0,99] 84 (0,69, 1,02] 35 (0,19, 0,64] 56 (0,45, 0,69] 75 (0,68, 0,82] 22 (0,05, 1,00] 56 (0,34, 0,33] 72 (0,57, 0,91] 45 (0,23, 0,91] 61 (0,41, 0,89] 49 (0,39, 0,62] 25 (0,07, 0,87]</td> <td></td> <td>Total (95% CI) Heterogeneity: Tau² = Test for overall effect 2 Test for subgroup differ F Study or Subgroup Type = RCT Yupe = RCT</td> <td>23188 22618 100.0% 0 1.122: Chi² = 67.11, df = 32 (P < 01); l² = 67% = = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 5 1 (P = 46) NHO labor Events Total Events Total Events Total Weight MH, I 5 1 60 2 60 1.7% 0.5</td> <td>.90 [0.74, 1.09] Risk Ratio Random, 95% CI 0 [0.05, 5.37]</td> | 34 (0,12, 0,99] 84 (0,69, 1,02] 35 (0,19, 0,64] 56 (0,45, 0,69] 75 (0,68, 0,82] 22 (0,05, 1,00] 56 (0,34, 0,33] 72 (0,57, 0,91] 45 (0,23, 0,91] 61 (0,41, 0,89] 49 (0,39, 0,62] 25 (0,07, 0,87] | | Total (95% CI) Heterogeneity: Tau ² = Test for overall effect 2 Test for subgroup differ F Study or Subgroup Type = RCT Yupe = RCT | 23188 22618 100.0% 0 1.122: Chi ² = 67.11, df = 32 (P < 01); l ² = 67% = = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 5 1 (P = 46) NHO labor Events Total Events Total Events Total Weight MH, I 5 1 60 2 60 1.7% 0.5 | .90 [0.74, 1.09] Risk Ratio Random, 95% CI 0 [0.05, 5.37] |
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| Na Zhao, et al 2017 Je Li 2018 Juan Li 2018 Dirgidan Zhang, et al 2018 Hongyu Li, et al 2019 Gategy by 2019 Nanahan Yang, et al 2019 Xiaonu Bai, et al 2020 Guomei Quan 2020 Dorgdong Shi, et al 2021 Nannnei Sun, et al 2021 Nannnei Sun, et al 2021 Nannei Sun, et al 2021 To Hotergenety: Tair 9 0.061 Test for overall effect 2 = 4.0 Hotergonehy: Tair 9 0.061 Test for overall effect 2 = 1.0 Hotergonehy: Tair 9 0.061 Test for subgroup differences | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 34 [0.12, 0.99] 48 (0.69, 1.02] 35 [0.19, 0.64] 56 [0.45, 0.69] 77 [0.68, 0.62] 22 [0.05, 1.00] 56 [0.34, 0.63] 47 [0.68, 0.62] 22 [0.07, 0.67] 48 [0.34, 0.63] 49 [0.39, 0.62] 23 [0.07, 0.67] 59 [0.26, 0.64] 50 [0.26, 0.64] 50 [0.28, 0.64] 56 [0.51, 0.62] 56 [0.51, 0.62] 57 [0.53, 0.66] 58 [0.51, 0.62] 59 [0.51, 0.62] 50 [0.28, 0.61] 50 [0.51, 0.62] 50 [0.51, 0.62] 51 [0.51, 0.62] 53 [0.54, 1.20] 53 [0.54, 1.20] 54 [0.55] 55 [0.55] | 0.1 0.5 1 2 10 | Total (85%, Ci) Heterogenetic, Tau ² = d Test for subgroup differ F Study or Study | $\begin{array}{c} 23188 & 22618 & 100.0\% & 0\\ 1.122 \cdot Ch^2 = 67.11, df = 22 (P < .01); P = 67% \\ = -1.05 (P = 20)\\ ences. Ch^2 = 0.55, df = 1 (P = .46)\\ \hline \\ \hline$ | 90 (0.74, 1.09) Risk Ratio tandom, 95% CI (0.05, 5.37] (0.04, 163.25) (0.04, 163.25) (0.04, 163.25) (0.04, 163.25) (0.05, 2.47) (0.05, 2.47) (0.05, 2.47) (0.05, 2.47) (0.05, 2.47) (0.04, 1.49) (0.05, 2.47) (0.05, 2.47) (0.05, 2.47) (0.05, 2.47) (0.04, 1.43) (0.04, 1.41) (0.04, 1.41) (0.04 |
| Na Zhao, et al 2017 Je Li 2018 Juan Li 2018 Juan Li 2018 Hongyu Li, et al 2019 Chongyu Li, et al 2019 Sharahan Yang, et al 2019 Xiaonu Bai, et al 2020 Guomei Quan 2020 Guomei Quan 2020 Chong et al 2021 Nammei Sun, et al 2021 Total (95% CI) Heterogeneh; Tari # 0.046; Tretof or consta effect 2 = 4.4 Total (95% CI) Heterogeneh; Tari # 0.046; Tretof or consta effect 2 = 4.4 Total (95% CI) Heterogeneh; Tari # 0.046; Tretof or consta effect 2 = 4.4 C Study or Study or Study or Study or Study or Direct CI Tretof or consta effect 2 = 4.4 C Li 2016 Li 2016 C Li 2016 C Li 2016 Li 2016 | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | Risk Ratio | Risk Ratio MH, Randem, 55% Cl | Total (85%, CI) Heterogenehit, Fau ² = C Test for subgroup differ F Study or Study | 23188 22618 100.0% 0 1.122. Ch ² = 67.11, df = 22 ($P < .01$; $P = 6776$ = 1.05 ($P = 20$) ences: Ch ² = 0.35, df = 1 ($P = .46$) New labor WHO labor Events Total Events Total Weight MH, J 5 1 60 2 60 1.7% 0.5 2017 4 242 0 238 1.1% 8.48 1 44 3 44 1.0% 0.3 0 48 1 48 1.0% 0.3 0 48 1 48 1.0% 0.3 0 48 1 48 1.0% 0.3 0 21 5 1006 15 1000 12.5% 0.9 2018 2 169 2 4 0.232.5% 0.9 2019 2 162 2 1050 14.1% 0.5 2019 2 162 2 1050 14.1% 0.5 0.016 2 100 1.7% 16 0.016 2.00 1.7% 16 0.016 2.00 1.7% 16 0.01 1.725 2.77 1050 14.1% 0.5 1.00 1.7% 16 0.01 1.7% 17 0.01 1.7% 16 0.01 1.7% 17 0.01 1.0% 17 0. | 90 (0.74, 1.09) Risk Ratio tandom, 95% Cl (0.05, 5.37) (0.04, 163.26) (0.04, 163.26) (0.04, 163.26) (0.04, 163.26) (0.04, 163.26) (0.04, 1.00) (0.05, 17.39) 7 (0.28, 1.14] (0.04, 3.06) 7 (0.28, 1.14] 1 (0.04, 1.00) (0.04, 1.00) (0.04, 1.00) (0.04, 1.00) (0.04, 1.00) (0.04, 1.01) (0.04, 1.01) (0.04, 1.01) (0.04, 1.02) (0.04, 1.0 |
| A 2200 ct al 2017 Je Li 2018 Juan Li 2018 Dirgidan Zinang, et al 2018 Dirgidan Zinang, et al 2019 Dirgidan Zinang, et al 2019 Sharahan Yang, et al 2019 Xiaorui Bai, et al 2020 Guomei Qaan 2020 Diorgidono Shi, et al 2020 Yakorui Bai, et al 2020 Yakorui Bai, et al 2020 Total (95% CI) Heterogonehy Tsaf = 0.046 Test for overal effect 2 = 41 Test for subgroup differences C Study or Subgroup Type RCI Yuezhu Lu, et al 2016 Julian Wang, et al 2021 Yakoru 2 Zinang, et al 2016 Julian Wang, et al 2016 Julian Wang, et al 2016 Julian Wang, et al 2016 Julian Wang, et al 2021 Yakoru 2018 Jakoru 2 Zinang, et al 2019 Qimenel Chen, et al 2020 Yakoru 2018 Size 2 Zinang, et al 2019 Qimenel Chen, et al 2020 Yakoru 2018 Size 2 Zinang, et al 2019 Diversite 2 Zinang, et al 2019 | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | Risk Ratio Ratom, 95% C1 20 (0.5), 0.62] 33 (0.14, 0.69) 73 (0.68, 0.62) 23 (0.14, 0.69) 73 (0.68, 0.62) 23 (0.04, 1.03) 32 (0.04, 1.03) 32 (0.04, 1.03) 32 (0.04, 1.03) 34 (0.14, 0.69) 45 (0.23, 0.62) 25 (0.7, 0.61) 46 (0.41, 0.69) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.35, 0.67) 45 (0.51, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.34, 0.62) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.64) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0.44, 0.44) 35 (0. | Risk Ratio MH, Random, 95% Cl | Total (195%, CI) Heterogenebic, Total * G Test for subgroup differ F Study or Subgroup Types RCT Yuszhu Liu, et al 2016 Hongmei Ma 2018 Hongmei Ma 2018 Hongme | $\begin{array}{c} 23188 & 22618 \ 100.0\% \ 0\\ 1.122. \mbox{Ch}^2 = 67.11, \mbox{df} = 22 \ (P < 01); \mbox{f}^2 = 67.56 \\ = -10.65 \ (P = 30) \\ ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 1 \ (P = .46) \\ \hline \ences: \mbox{Ch}^2 = 0.25, \mbox{df} = 0 \ (P = .27); \mbox{df} = 0 \ (P = .26); \mbox{df} = 0 \ (P = .$ | 90 (0.74, 1.09) Risk Ratio tandom, 95% CI (0.05, 5.37) (0.04, 163.26) 10.04, 163.26) 10.04, 163.26) 10.04, 10.36 10.04, 10.98 10.04, 1.08 10.04, 1.08 10.04, 1.08 10.04, 1.08 10.04, 3.08 10.04, 3.04 |
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| Na Zhao, et al 2017 Je Li 2018 Juan Li 2018 Dirgidan Zhang, et al 2018 Hongyu Li, et al 2019 Gardia (Wei 2019 Shanshan Yang, et al 2019 Jiago Zhang, et al 2019 Jiago Zhang, et al 2020 Guomei Quan 2020 Dorgidon Shi, et al 2021 Nianmei Sun, et al 2021 Total (S% C) Heterogenehy: Tai" = 0.051 Test for overall effect 2 = -14 Total (S% C) Heterogenehy: Tai" = 0.051 Test for overall effect 2 = 14 C Study of Study o | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | Al (0.12, 0.99) Al (0.12, 0.99) Al (0.69, 1.02) Al (0.69, 1.02) Al (0.69, 1.02) Al (0.69, 1.02) Al (0.69, 1.02) Al (0.69, 0.62) Al (0.69, 0.62) Al (0.69, 0.62) Al (0.70, 0.67) Al (0.30, 0.62) Al (0.55, 0.35, 0.62) Al (0.55, 0.62) Al (0.62, 0.62) | 0.1 0.5 1 2 10 | Total (85%, Ci) Heterogenetic, Tax" = G Test for subgroup differ F Subgroup Version of the Circle Subgroup Version of the Circle Subgroup Version Circle Subgroup Version Circle Circle Circle Subgroup Version Circle Circle Subgroup Version Circle Circle Subgroup Version Circle Circl | 23188 22618 100.0% 0 1.122 $Ch^2 = 67.11$, df = 22 (P < .01); P = 67% = 1.05 (P = 20) ences: Ch ² = 0.55, df = 1 (P = .46) New labor WHO labor Events Total Events Total Weight MH, J 5 1 60 2 60 1.7% 0.5 2017 4 242 0 2.3 1.1% 8.43 0 48 1 48 10.5% 0.3 0 21 6 66 2 66 3.7% 3.0.9 15 1000 16 1000 13.9% 0.9 021 2 166 2 66 3.7% 3.0.9 164 1 48 28.5% 0.9 164 2 100 1 0 1.7% 1.6 0 16 2 100 1 0 01.7% 1.6 0 16 2 100 1 00 1.7% 1.6 0 16 2 6 10 1 00 1.7% 1.6 0 16 2 6 3 7.7% 3.0.9 104 1 42 3 42 1.9% 0.3 105 1 1 05 3 100 1.5% 0.9 105 2 1 6 2732 3 3122 4.6% 2.2 1 100 7 100 2.2% 0.5 1201 7 9 6.63 55 53.50.5% 1.3 2019 7 105 3 100 1.5% 0.9 105 1 105 7 1359 9100.0% 0.9 105 1 105 7 1359 9100.0% 0.9 1067 Ch ² = 127. 16.6 (P = .37); f = 15% = 0.22 (P = .5); 1 3373 1359 100.0% 0.9 1067 Ch ² = 127. 16.6 (P = .30); f = 15% = 0.01, df = 1 (P = .50); f = 15% = 0.01, df = 1 (P = .50); f = 15% = 0.01, df = 1 (P = .50); f = 15% = 0.01, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% = 0.00, df = 1 (P = .50); f = 15% | 90 (0.74, 1.09) Risk Ratio Random, 95% CI (0.05, 5.37] (0.05, 5.37] (0.05, 5.37] (0.05, 1.30) (0.05, 1.43) (0.05, 1.43) |
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Figure 2. Risk ratio for maternal morbidity. (A): labor augmentation with oxytocin. (B): intrapartum cesarean section. (C): operative vaginal delivery. (D): 3rd- and 4th-degree perineal laceration. (E): postpartum hemorrhage. (F): infectious morbidity (chorioamnionitis, endometritis and puerperal infection). (G): postpartum urine retention.

dystocia and synthetic oxytocin is the most frequently used medicine for augmentation. According to various hospital protocols, augmentation may be used to address slow labor progress and/or inefficient uterine contractions. In 2018, WHO advised that the expectation of 1 cm cervical dilation per hour and the use of alert or action lines to guide intrapartum intervention decisions were no longer recommended.^[60] A systematic review involving a total of

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| | Type = Ketrospective 98 755 230 1050 13.3% 0.59 10.48,0.74 Xianghong Lv, et al. 2016 10 100 22 80 2.7% 0.39 10.18,0.74 Xianghong Lv, et al. 2016 10 100 22 80 2.7% 0.36 10.48,0.74 Yun Veng, et al. 2017 112 258 258 14.3% 0.54 10.45,0.68 Yun Veng, et al. 2017 110 7102 1328 4928 22.0% 0.54 10.45,0.68 Oring Lu, et al. 2017 5 100 1.6% 0.38 10.41,1.04 Domgdong Shi, et al. 2021 452 2708 68 21 12.4% 0.38 10.11,0.45 Domgdong Shi, et al. 2021 452 2708 68 21 12.4% 0.610 11.04 Domgdong Shi, et al. 2021 452 2708 68 21 12.4% 0.610 10.5% 0.610 15.6 66 15.6 67.6 76.0 66.0 66.0 | | Npie – Ratrospaciny State State <td>* * • •</td> | * * • • |
| | $\label{eq:constraint} \begin{array}{c} \text{train}_{12} (200, 0.17) \\ \text{Hereogeneity}_{12} (201, 0.16) \\ \text{Hereogeneity}_{12} (201, 0.$ | | $\label{eq:constraint} \begin{array}{c} \mbox{Treat}(r) = 0.01 \ (r) \ (r) = 0.01 \ (r) \ (r) = 0.01 \ (r) \ (r) = 0.001 \ (r) \ (r) \ (r) = 0.001 \ (r) \ $ | 0.5 1 2 10 |
| | Na Zhao, et al 2017 32 85 59 101 8.9% 0.64 (0.47, 0.89) Jing Zhang, et al 2019 7 100 18 100 2.0% 0.39 [0.17, 0.89] Guomei Quan 2020 5 130 14 130 1.4% 0.38 [0.13, 0.96] Total (95%, C1) Heterogeneity: Tar ² = 0.0% ² = 2.31, df = 4 (P = .08); I ² = 0% Tast for overall effect: Z = -3.41 (P < .01) | | E Study or New Jabor WHO Jabor Risk Ratio Subgroup Events Total Events Total Weight MH, Random, 95% CI M | Risk Ratio H, Random, 95% Cl |
| | $ \begin{array}{llllllllllllllllllllllllllllllllllll$ | 0.2 0.5 1 2 5 | Type Transbugget/reg TSS 36 1050 4.2% 0.58 [0.32, 1.05] Xiang/ung Lv, et al. 2016 6 100 55 36 1.5% 4.2% 0.58 [0.32, 1.05] Xiang/ung Lv, et al. 2016 30 59 36 7.5% 1.01 [0.64, 1.58] Heir U/Energy 2.16 2.15 2.24 5.4% 1.01 [0.64, 1.58] Wilson, et al. 2016 2.65 301 4.25 2.25 7.26 7.0% 1.07 [0.64, 1.59] Ung and Wang, et al. 2016 2.65 2.15 2.24 7.26 7.6% 0.70 [0.61, 0.97] Dingram Wang, et al. 2017 5.34 6.36 4.46 7.338 6.5% 1.73 [1.40, 2.01] Lin Wei, et al. 2017 4.52 4.446 2.448 2.43 8.5% 1.73 [1.40, 2.01] | + |
| В | Study or New labor WHO labor Risk Ratio Subgroup Events Total Formula < | Risk Ratio H, Random, 95% Cl | Hongyu Li, et al 2019 126 2068 103 2108 7.5% 1.25 0.97 1.611 Qing Liu, et al 2019 1 100 7 100 0.6% 0.14 1002 1.14 — Shanshan Yang, et al 2019 34 625 36 640 5.4% 0.37 1611 — Shanshan Yang, et al 2020 8 372 11 659 2.4% 1.29 0.52, 3.17] Dongdong Shi, et al 2021 70 732 6.79 0.22 6.06 0.57 0.671, 1.25] Nianoue Zheng, et al 2021 4 50 8 600 1.6% 0.50 0.15, 1.65] Xiaoue Zheng, et al 2021 3 80 8 0.03 0.68 0.50 0.55, 1.63 Xiaoue Zheng, et al 2021 3 86 4 112 1.1% 0.88 0.20, 3.81 Ya Wang, et al 2022 16 100 4.6% 0.55 0.02, 0.55 | |
| | Hannu Zhang, et al 2016 27 659 62 763 3.1% 0.50 0.65 0.14 1.03 Wilson-Leedy, et al. 2016 25 29 014 48 3234 2.9% 0.65 0.41 1.03 Wilson-Leedy, et al. 2016 25 292 74 275 4.3% 0.76 0.65 0.41 1.03 Vin Wang, et al. 2017 239 7012 321 4925 5.9% 0.52 0.44 0.61 0.44 0.61 0.61 0.45 0.64 0.66 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.65 0.64 0.64 0.65 0.64 0.64 0.64 0.64 0.64 0.64 0.65 | | Total (95% CI) 25541 25370 83.7% 0.98 [0.82, 1.16] Heterogenety Tau ² = 0.080; Ch ² = 66.01, dl = 16 (P < 0.1); P ² = 76% Test for overall effect: Z = -0.24 (P = .81) Type = Prospective Cherchen Zhang, et al 2016 34 187 45 255 5.9% 1.03 [0.69, 1.54] Cherchen Zhang, et al 2017 0 42 2 42 0.3% 0.23 [0.01, 4.04] | + + |
| | Sharabati rang, et al. 2019 101 0.23 143 84.0 5.1% 0.21 0.51 0.61 0.41 0.68 0.61 0.41 0.68 0.61 0.41 0.68 0.61 0.41 0.68 0.61 0.41 0.64 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.65 0.78 0.61 0.41 0.68 0.65 0.78 0.68 0.65 0.78 0.68 0.65 0.78 0.68 0.65 0.78 0.68 0.65 0.67 0.68 0.55 0.78 0.68 0.65 0.62 0.68 0.55 0.68 0.65 0.68 0.65 0.61 | | $ \begin{split} &\text{Na Zhao, et al} \ 2017 & 1 & 85 & 4 & 101 & 0.5\% & 0.30 \ [0.03, 2.61] &\\ &\text{Juan Li} \ 2018 & 7 & 500 & 8 & 500 & 21\% & 0.88 \ [0.22, 2.89] \\ &\text{Jiefang Wei 2019} & 2 & 100 & 6 & 100 & 1.0\% & 0.33 \ [0.07, 1.61] \\ &\text{Jing Zhang, et al} \ 2019 & 4 & 100 & 5 & 100 & 1.4\% & 0.80 \ [0.22, 2.89] \\ &\text{Guomel Quan 2020} & 2 & 130 & 9 & 130 & 1.0\% & 0.22 \ [0.05, 1.01] &\\ &\text{Total} \ \ [0.5\% & C] & 2132 & 16.3\% & 0.77 \ [0.43, 1.39] \\ &\text{Heterogenety, Tau2} = 0.354; \ Chi2 = 1.8 \ (P = .02); i2 = 56\% \\ &\text{Test for overall effect } 2 = -0.88 \ (P = .39) \end{split} $ | |
| | metodynetiky fait = 0.537 (bit = 0.637 (bit = 16 (< 5.07)) = 7.5% Type = Prospective Chenchen Zhang, et al 2016 9 187 27 255 1.5% 0.45 [0.22, 0.94] Olan Jin, et al 2017 5 42 12 42 1.0% 0.42 [0.16, 1.08] Ming Li, et al 2017 17 88 32 101 2.5% 0.65 [0.45, 0.68] | | Total (95% CI) D2 D27665 27505 100.0% 0.97 [0.82, 1.14] Heterogenety Heterogenety 0.077; Ch ² = 84 20, df = 25 (P < .01); l ² = 70% 0.01 0.01 Test for overall effect; Z = -0.35 (P = 72) 0.01 0.01 0.01 0.01 Test for subgroup differences: Chi ² = 0.58, df = 1 (P = .45) 0.58, df = 1 (P = .45) 0.01 0.01 | D.1 1 10 100 |
| | Na Zhao, et al. 2017 4 85 14 101 0.8% 0.34 [b 12, 0.99] juan Li 2018 167 669 134 8465 56% 0.84 [b 68, 102] juan Li 2018 14 500 40 500 2.1% 0.35 [b 19, 0.64] juan Guan 2019 18 100 32 100 2.6% 0.58 [b 34, 0.93] juang Zhang, et al. 2019 10 100 22 100 1.7% 0.45 [b 23, 0.91] Guomei Quan 2020 3 130 12 130 0.6% 0.25 [b 0.7, 0.87] Total (8%, C) Heterogenety: Tau ² = 0.060; Chi ² = 20.2, cf = 0 [P = 02]; F = 55% Test to overall effect. 2 = 5.51 [P = 01] | | Study or New labor WHO labor Risk Ratio Subgroup Events Total Events Total Weight MH, Random, 95% Cl MH Type = Retrospective Kandom (Lin, et al 2016) 11 755 27 1050 14.9% 0.57 10.28 1.14 Xiandpong Lv, et al 2016 12 700 180 1.7% 160 16.17 1.33 Hannu Zhang, et al 2016 2 659 3 763 2.9% 0.77 10.13 4.61 WilsonLedey, et al 2016 26 282 22 275 20.8% 1.110 65 1.92 Dingram Wang, et al 2017 26 886 58 585 3.100 9.4 1.80 - Dingram Wang, et al 2017 10 58 588 3.45% 1.300 3.100 - - | Risk Ratio ,, Random, 95% Cl |
| | $ \begin{array}{llllllllllllllllllllllllllllllllllll$ | 0.1 0.5 1 2 10 | $ \begin{array}{llllllllllllllllllllllllllllllllllll$ | |
| С | Shuthan New John Wild Jahan Dist Davis | Disk Datis | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| | Subjection Events Total Verification Total Weight MH, Random, 95%. G Type = Respective cohort study Stanghong Lv, et al. 2016 100 2 80 0.8% 0.40 [0.04, 4.33] Hamuz Jhang, et al. 2016 14 659 15 763 4.8% 10.80 [0.32, 22] Sila Yan, et al. 2016 25 3014 321 3234 9.5% 0.85 [0.72, 0.99] WilsonLeedy, et al. 2016 27 282 16 275 6.0% 1.41 [0.80, 2.51] Vin Vang, et al. 2016 27 282 18 275 6.0% 1.41 [0.80, 2.51] Vin Vang, et al. 2017 25 7012 9.4952 2.5% 0.38 [0.28, 0.54] | MH, Random, 95% Cl | otal (95% CI) 12613 12216 100.0% 1.00 [0.73, 1.37] eterogenetity: Tau ² = 0.048; Ch ² = 12.27, d ² = 10 (P = 27); l ² = 19% est for overall effect Z = 0.02 (P = 99) 0.1 est for subgroup differences: Ch ² = 0.96, df = 1 (P = .33) | 0.51 2 10 |
| | Dingran wang, et al 2017 113 6836 110 5365 8.8% 0.81 [0.62, 1.05] Lin Wei, et al 2017 369 4146 339 3879 9.6% 1.02 [0.88, 1.17] Thuillier, C., et al. 2018 492 3068 581 3283 9.8% 0.91 [0.81, 1.01] Homoul Li et al 2019 50 2068 171 318 8.4% 0.91 [0.22, 0.41] | | Study or New labor WHO labor Risk Ratio Subgroup Events Total Events Total Weight MH, Random, 95% CI MH | Risk Ratio , Random, 95% Cl |
| | Shanshan Yang, et al 2019 6 625 11 640 3.3% 0.56 [0.2.1, 1.50] Xiaorui Bai, et al 2020 4 213 9 234 2.6% 0.49 [0.15, 1.56] Fandhua Liu 2020 9 372 3 659 2.2% 5.31 [1.45, 19.51] | | Type = Retrospective 3 100 1 80 3.3% 2.40 [0.25, 22.63] 100 1 80 3.3% 2.40 [0.25, 22.63] 100 1 80 3.3% 2.40 [0.25, 22.63] 100 1 80 3.3% 2.40 [0.25, 22.63] 100 1 80 3.3% 2.40 [0.25, 22.63] 100 1 100 2.3% 0.05 100.0 9.1% 100 100 100 2.3% 0.05 100.0 9.1% 100 100 2.3% 0.05 100.0 9.1% 100 100 2.3% 0.05 100.0 9.1% 100 100 2.3% 100 9.1% 100.05 | |
| | Niannei Sun, et al 2021 8 500 21 500 4.3% 0.38 [0.17, 0.85] Xing Li, et al 2021 8 8 8 7 112 3.4% 1.33 [0.50, 3.54] Total (85%, Cl. 2022, Ch ² = 0.123; Ch ² = 0.17, of = 13 (P < 01); P = 86% Heterogeneity: Tau ² = 0.123; Ch ² = 0.17, of = 13 (P < 01); P = 86% Type = Prospective cohort study | • | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | | Type = Prospective Operation | |
| | | 0.1 0.5 1 2 10 | Total (95% CI) 3603 3984 100.0% 1.25 [0.81, 1.93] Heterogeneity: Tau ² = 0.149; Chi ² = 13.83, df = 9 (P = .13); l ² = 35% |).1 1 10 100 |

Figure 3. Subgroup analysis for maternal morbidity. (A): labor augmentation with oxytocin. (B): intrapartum cesarean section. (C): operative vaginal delivery. (D): 3^{rd} - and 4^{th} -degree perineal laceration. (E): postpartum hemorrhage. (F): infectious morbidity (chorioamnionitis, endometritis and puerperal infection). (G): postpartum urine retention.

| А | | | | | | В | | | | | | | |
|---|---|------------------|--------------------|--------------------|---------------------------------------|--|-------------------------|-------------|----------|------------|--------|---------------------|--------------------|
| Study or | New labor | WHO la | bor | Risk Ratio | Risk Ratio | Study or | New | labor | WHO | labor | | Risk Ratio | Risk Ratio |
| Subgroup | Events Total | Events T | otal Weight | MH, Random, 95% CI | MH, Random, 95% CI | Subgroup | Events | Total E | vents | Total | Weight | MH, Random, 95% Cl | MH, Random, 95% CI |
| Type = RCT | 0 00 | 40 | | 0.00.00.04.4.001 | | Type = RCT Vicential bit at al 2016 | | 60 | | 80 | 1 00/ | 0 00 10 00 0 001 | |
| Min Zhang, et al 2019 | 7 44 | 14 | 44 5.9% | 0.50 [0.34, 1.09] | | Oiuming Huang, et al 2017 | 19 | 242 | 12 | 238 | 4 4% | 1 56 [0 77 3 14] | |
| lie Zhong, et al. 2019 | 7 44 | 14 | 44 0.9% 50 5.6% | 0.50 [0.22, 1.12] | | linlian Wang et al 2017 | 2 | 102 | 5 | 102 | 1 2% | 0.40 [0.08 2.01] | |
| Rong Zeng, 2020 | 16 1000 | 17 1 | 000 7.8% | 0.94 [0.48, 1.85] | | Haivan Zhuang 2018 | 1 | 48 | 2 | 48 | 0.6% | 0.50 [0.05, 5.33] | |
| Wenving Han et al 2021 | 2 192 | 13 | 192 2.0% | 0 15 [0 04 0 67] | | Manbo Li, et al 2019 | 4 | 100 | 20 | 112 | 2.5% | 0.22 [0.08, 0.63] | ¹ |
| Total (95% CI) | 1346 | 1 | 346 26.5% | 0.60 [0.38, 0.95] | - | Xiaomei Liao 2019 | 2 | 40 | 1 | 40 | 0.6% | 2.00 [0.19, 21, 18] | |
| Heterogeneity: Tau ² = 0.081; C | $h^2 = 5.67$, df = 4 | $(P = .22); I^2$ | = 30% | | | Jie Zhong, et al 2019 | 3 | 50 | 4 | 50 | 1.4% | 0.75 [0.18, 3.18] | |
| Test for overall effect: Z = -2.16 | 6 (P = .03) | | | | | Rong Zeng 2020 | 21 | 1000 | 23 | 1000 | 5.4% | 0.91 [0.51, 1.64] | |
| | | | | | | Weigiang Zhang 2020 | 1 | 105 | 2 | 105 | 0.6% | 0.50 [0.05, 5.43] | |
| Type = Cohort study | | | | | | Qiumei Chen, et al 2021 | 2 | 66 | 1 | 66 | 0.6% | 2.00 [0.19, 21.53] | |
| Xiaoli Lin, et al 2016 | 23 755 | 48 1 | 050 12.8% | 0.67 [0.41, 1.09] | | Wenying Han, et al 2021 | 3 | 192 | 7 | 192 | 1.6% | 0.43 [0.11, 1.63] | |
| Chenchen Zhang, et al 2016 | 3 2 187 | 5 | 255 1.6% | 0.55 [0.11, 2.78] | | Total (95% CI) | | 2005 | | 2013 | 20.6% | 0.76 [0.50, 1.15] | 1 |
| Hanru Zhang, et al 2016 | 15 659 | 18 | 763 7.8% | 0.96 [0.49, 1.90] | | Heterogeneity: Tau" = 0.095; Ch | hi" = 12,52 | , df = 10 | (P = 25 |); = 20 | 196 | | |
| Sisi Yan, et al. 2016 | 468 3014 | 489 3 | 234 35.8% | 1.03 [0.91, 1.15] | P | l'est for overall effect, 2. = -1,30 | (19 = ,19) | | | | | | |
| Qian Jin, et al 2017 | 1 42 | 3 | 42 0.9% | 0.33 [0.04, 3.08] | | Turse a Celeast study | | | | | | | |
| Na Zhao, et al. 2017 | / 80 | 12 | 101 5.0% | 0.09 [0.29, 1.68] | | Yippi - Conort study | 21 | 755 | 62 | 1050 | 7 404 | 0 70 10 46 1 061 | |
| Ung Liu, et al. 2019 | 0 100 | | 100 0.4% | 0.53 [0.01, 8.09] | | Xiaonohong Ly, et al. 2016 | 5 | 100 | 62 | 1000 | 2 3% | 0.50 [0.46, 1.06] | |
| Guomoi Quon 2020 | 2 100 | 4 | 120 0.9% | 0.35 [0.03, 2.67] | | Chenchen Zhang et al 2016 | 3 | 187 | 1 | 255 | 0.6% | 4 09 [0.43, 39 02] | |
| Xiaoxue Zhang et al 2021 | 1 80 | 2 | 80 0.8% | 0.50 [0.05, 5.40] | | Hanni Zhang, et al. 2016 | 17 | 659 | 19 | 763 | 4.8% | 1 04 [0 54 1 98] | - |
| Xing Li et al 2021 | 4 96 | 3 | 112 2.0% | 1 56 [0 36 6 78] | | Sisi Yan, et al. 2016 | 98 | 3014 | 101 | 3234 | 9.6% | 1.04 [0.79, 1.37] | 1 |
| Ya Wang et al 2022 | 6 100 | 9 | 100 4 1% | 0 67 [0 25 1 80] | | WilsonLeedy, et al. 2016 | 3 | 292 | 2 | 275 | 1.0% | 1.41 [0.24, 8.39] | |
| Total (95% CI) | 5348 | 6 | 067 73.5% | 0.98 [0.88, 1.09] | • | Qian Jin, et al 2017 | 0 | 42 | 2 | 42 | 0.4% | 0.20 [0.01, 4.04] | |
| Heterogeneity: Tau ² = 0; Chi ² = | 8.87, df = 11 (P | = .63); 12 = 0 | 196 | | | Ming Li, et al 2017 | 0 | 88 | 0 | 101 | 0.0% | | |
| Test for overall effect: Z = -0.37 | (P = .71) | | | | 1 | Yun Wang, et al 2017 | 15 | 7012 | 37 | 4892 | 5.3% | 0.28 [0.16, 0.51] | |
| | | | | | | Dingran Wang, et al 2017 | 69 | 6836 | 42 | 5385 | 8.0% | 1.29 [0.88, 1.90] | |
| Total (95% CI) | 6694 | 7 | 413 100.0% | 0.78 [0.63, 0.96] | • | Lin Wei,et al 2017 | 39 | 4146 | 46 | 3879 | 7.4% | 0.79 [0.52, 1.21] | - |
| Heterogeneity: Tau ² = 0.029; C | :hi ² = 19.48, df = | 16 (P = .24); | $l^2 = 18\%$ | | | Fangxun Yang, et al 2017 | 3 | 892 | 4 | 806 | 1.3% | 0.68 [0.15, 3.02] | |
| Test for overall effect: Z = -2.34 | (P = .02) | | | | 0.1 0.51 2 10 | Na Zhao, et al 2017 | 3 | 85 | 4 | 101 | 1.4% | 0.89 [0.21, 3.87] | |
| Test for subgroup differences: | Chi ² = 4.06, df = | 1 (P = .04) | | | | Jie Li 2018 | 6 | 669 | 5 | 465 | 2.0% | 0.83 [0.26, 2.72] | |
| | | | | | | Juan Li 2018 | 2 | 500 | 3 | 500 | 1.0% | 0.67 [0.11, 3.97] | |
| C | | | | | | Hannullier, C., et al. 2018 | 59 | 3068 | 18 | 3283 | 8.7% | 0.81 [0.58, 1.13] | |
| C | | | | | | Oing Live et al. 2019 | 2 | 2000 | 13 | 2100 | 4.276 | 1.33 [0.65, 2.74] | |
| Study or | New labor | WHO lab | or | Risk Ratio | Risk Ratio | liefeng Mei 2019 | 0 | 100 | 5 | 100 | 0.4% | 0.09 [0.01 1.62] | |
| Subgroup E | vents Total I | Events To | tal Weight | MH, Random, 95% CI | MH, Random, 95% CI | Jing Zhang, et al. 2019 | 2 | 100 | 3 | 100 | 1.0% | 0.67 [0.11, 3.90] | |
| Type = RCT | | | | | | Xiaonui Bai, et al. 2020 | 7 | 213 | 3 | 234 | 1.6% | 2 56 [0 67 9 79] | |
| Yuezhu Liu, et al 2016 | 4 60 | 6 | 60 3.2% | 0.67 [0.20, 2.24] | | Guomei Quan 2020 | 2 | 130 | 6 | 130 | 1.2% | 0.33 [0.07, 1.62] | |
| Jie Zhong, et al 2019 | 3 50 | 7 | 50 2.9% | 0.43 [0.12, 1.56] | | Dongdong Shi, et al 2021 | 33 | 2732 | 31 | 3122 | 6.5% | 1.22 [0.75, 1.98] | |
| Qiumei Chen, et al 2021 | 1 66 | 0 | 66 0.5% | 3.00 [0.12, 72.33] | · · · · · · · · · · · · · · · · · · · | Nianmei Sun, et al 2021 | 0 | 500 | 5 | 500 | 0.4% | 0.09 [0.01, 1.64] | |
| Total (95% CI) | 176 | 1 | 76 6.6% | 0.61 [0.26, 1.44] | | Xiaoxue Zheng, et al 2021 | 2 | 80 | 3 | 80 | 1.0% | 0.67 [0.11, 3.88] | |
| Heterogeneity: Tau" = 0; Chi" = | = 1.27, df = 2 (P = | = .53); 1° = 09 | 63 | | | Xing Li, et al 2021 | 2 | 96 | 2 | 112 | 0.8% | 1.17 [0.17, 8.13] | |
| Test for overall effect; Z = -1,12 | (P = .26) | | | | | Total (95% CI) | | 34462 | | 31697 | 79.4% | 0.84 [0.68, 1.03] | • |
| Tune = Cohort study | | | | | | Heterogeneity: Tau" = 0.076; Cl | ni" = 38,78 | , df = 24 | (P = .03 |); 1" = 38 | 196 | | |
| Hanny Zhang et al 2016 | 5 650 | 5 7 | 62 2 104 | 1 16 (0 34 3 09) | | rest for overall effect: Z = -1.66 | (12 = 10) | | | | | | |
| Yun Wang et al 2017 | 446 7012 | 186 48 | 92 19 0% | 1.67 [1.42 1.98] | | Total (05%/ CI) | | 20407 | | 22740 | 100.0% | 0 00 00 00 0001 | |
| Dingran Wang, et al. 2017 | 540 6836 | 384 53 | 85 19.8% | 1 11 [0 98 1 26] | - | Hotar (95% CI) | 2 - 54 -0 | 3040/ | - C+ | 33/10 | 100.0% | 0.02 [0.69, 0.99] | |
| Lin Wei et al 2017 | 302 4146 | 326 38 | 79 19.3% | 0.87 [0.75, 1.01] | | Test for overall effect: 7 = -2.08 | P = 0.4 | , dt = 35 | (P = .04 |);1 = 32 | 70 | | 0.01 0.1 1 10 100 |
| Na Zhao, et al 2017 | 3 85 | 7 1 | 01 2.8% | 0.51 [0.14, 1.91] | | Test for subgroup differences C | thi ² = 0 49 | df = 1 /5 | 2 = 671 | | | | 0.01 0.1 1 10 100 |
| Jie Li 2018 | 46 669 | 36 4 | 65 12.6% | 0.89 [0.58, 1.35] | | reación subgroup diferences. c | /11 = 0.10 | , ui = 1 (r | = .07) | | | | |
| Thuillier, C., et al. 2018 | 50 3068 | 52 32 | 83 13.5% | 1.03 [0.70, 1.51] | + | | | | | | | | |
| Xiaorui Bai, et al 2020 | 7 213 | 4 2 | 34 3.2% | 1.92 [0.57, 6.48] | + | | | | | | | | |
| Total (95% CI) | 22688 | 190 | 02 93.4% | 1.10 [0.86, 1.40] | + | | | | | | | | |
| Heterogeneity: Tau ² = 0.070; C Test for overall effect: Z = 0.73 | (hi ² = 36.89, df = (P = .46) | 7 (P < .01); 1 | 2 = 81% | | | | | | | | | | |
| Total (95% CI) | 22864 | 191 | 78 100.0% | 1.06 [0.83, 1.34] | 4 | | | | | | | | |
| Heterogeneity: Tau ² = 0.069; C | thi ² = 40.08, df = | 10 (P < .01) | $ ^2 = 75\%$ | | r fr i | | | | | | | | |
| Test for overall effect: Z = 0.45 | (P = .65) | | 0.000000000 | | 0.1 0.51 2 10 | | | | | | | | |
| Test for subgroup differences: | Chi ² = 1.65, df = | 1 (P = .20) | | | | | | | | | | | |

Figure 4. Risk ratio for neonatal morbidity. (A): fetal distress. (B): neonatal asphyxia. (C): neonatal intensive care unit admission.

| А | | | | | | | | С | | | | | | | | | | | |
|---|----------------------------------|-----------|--------------------------------------|----------|-----------|--------------------|-----------------------|---|-------------------------|------------|----------------|------------------------|---------|-------------|----------|--------|--------|----------|-----|
| Study or | New I | abor | WHO la | bor | | Risk Ratio | Risk Ratio | Study or | Nev | v labor | WHO | labor | | Risk Ra | itio | | Risk R | atio | |
| Subgroup | Events 1 | Total E | Events To | otal W | eight MF | I, Random, 95% CI | MH, Random, 95% CI | Subgroup | Events | Total | Events | Total W | eight M | H, Random | , 95% CI | MH, | Randon | n, 95% C | 1 |
| Yipoli Lip et al 2016 | 22 | 755 | 48 1 | 050 | 5.0% | 0 67 (0 41 1 09) | | Xiaoli Lin, et al. 2016 | 31 | 755 | 62 | 1050 | 9.3% | 0 70 10 46 | 1.061 | | | | |
| Hanry Zhang, et al. 2016 | 15 | 659 | 18 | 763 | 2.6% | 0.96 [0.49, 1.90] | | Xianghong Ly, et al. 2016 | 5 | 100 | 8 | 80 | 3.0% | 0.50 [0.17 | 1.471 | | -+- | | |
| Sisi Yan, et al. 2016 | 468 | 3014 | 489 3 | 234 8 | 87.5% | 1.03 [0.91, 1.15] | | Hanru Zhang, et al 2016 | 17 | 659 | 19 | 763 | 6.1% | 1.04 [0.54. | 1.98] | | - | | |
| Qing Liu, et al 2019 | 0 | 100 | 1 | 100 | 0.1% | 0.33 [0.01, 8.09] | | Sisi Yan, et al. 2016 | 98 | 3014 | 101 | 3234 1 | 1.8% | 1.04 [0.79] | 1.37] | | + | | |
| Xiaoxue Zheng, et al 2021 | 1 | 80 | 2 | 80 | 0.2% | 0.50 [0.05, 5.40] | | WilsonLeedy, et al. 2016 | 3 | 292 | 2 | 275 | 1.3% | 1.41 [0.24, | 8.39] | | -+- | | |
| Xing Li, et al 2021 | 4 | 96 | 3 | 112 | 0.5% | 1.56 [0.36, 6.78] | | Yun Wang, et al 2017 | 15 | 7012 | 37 | 4892 | 6.7% | 0.28 [0.16, | 0.51] | | - | | |
| Ya Wang, et al 2022 | 6 | 100 | 9 | 100 | 1.2% | 0.67 [0.25, 1.80] | -+- | Dingran Wang, et al 2017 | 69 | 6836 | 42 | 5385 | 9.9% | 1.29 [0.88, | 1.90] | | • | | |
| Total (95% CI) | | 4804 | 5 | 439 9 | 97.1% | 1.00 [0.89, 1.11] | + | Lin Wei,et al 2017 | 39 | 4146 | 46 | 3879 | 9.2% | 0.79 [0.52, | 1.21] | | - | | |
| Heterogeneity: Tau ² = 0; Chi ² = | 4.64, df = 6 | 6 (P = .5 | 59); l ² = 09 | % | | | | Thuillier, C., et al. 2018 | 59 | 3068 | 78 | 3283 1 | 0.8% | 0.81 [0.58, | 1.13] | | 1 | | |
| Test for overall effect: Z = -0.06 | (P = .95) | | | | | | | Hongyu Li, et al 2019 | 17 | 2066 | 13 | 2108 | 5.4% | 1.33 [0.65, | 2.74] | | - | _ | |
| T | | | | | | | | Qing Liu, et al 2019 | 2 | 100 | 6 | 100 | 1.6% | 0.33 [0.07, | 1.61 | | | | |
| Type = Prospective | 2 | 107 | | 255 | 0.49/ | 0 55 10 11 0 791 | | Dependence Shi, et al. 2021 | 22 | 213 | 21 | 2122 | 2.1% | 1 22 10 75 | 1 081 | | T | | |
| Oian lin et al 2017 | 1 | 42 | 3 | 42 | 0.476 | 0.33 [0.04 3.08] | | Nianmei Sun, et al. 2021 | 0 | 500 | 5 | 500 | 0.5% | 0.09 [0.01 | 1.64] | | | | |
| Na Zhao et al 2017 | 7 | 85 | 12 | 101 | 1.5% | 0.69 [0.29 1.68] | | Xiaoxue Zheno, et al. 2021 | 2 | 80 | 3 | 80 | 1.3% | 0.67 [0.11 | 3.881 | | | _ | |
| Jing Zhang, et al. 2019 | 2 | 100 | 4 | 100 | 0.4% | 0.50 [0.09. 2.67] | | Xing Li, et al 2021 | 2 | 96 | 2 | 112 | 1.1% | 1.17 (0.17. | 8,131 | | - | _ | |
| Guomei Quan 2020 | 1 | 130 | 4 | 130 | 0.3% | 0.25 [0.03, 2.21] | | Total (95% CI) | | 31669 | | 29097 8 | 8.1% | 0.86 [0.68, | 1.09] | | | | |
| Total (95% CI) | | 544 | | 628 | 2.9% | 0.55 [0.29, 1.04] | | Heterogeneity: Tau ² = 0.093; | chi ² = 31.7 | 8, df = 18 | 5 (P < .01) | 1 ² = 53% | | | | | | | |
| Heterogeneity: Tau ² = 0; Chi ² = Test for overall effect: Z = -1.84 | 0.98, df = 4 (P = .07) | 4 (P = .9 | 91); l ² = 09 | % | | | | Test for overall effect: Z = -1.2 | 3 (P = .22) | | | | | | | | | | |
| | | | | | | | | Type = Prospective | | | | | | | | | | | |
| Total (95% CI) | | 5348 | 6 | 067 10 | 00.0% | 0.98 [0.88, 1.09] | | Chenchen Zhang, et al 201 | 6 3 | 187 | 1 | 255 | 0.8% | 4.09 [0.43, | 39.02] | | + | • | - |
| Heterogeneity: Tau ² = 0; Chi ² = | 8.87, df = 1 | 11 (P = | .63); I ² = 0 | 0% | | | 1 111 1 | Qian Jin, et al 2017 | 0 | 42 | 2 | 42 | 0.5% | 0.20 [0.01, | 4.04] | | · + | _ | |
| Test for overall effect: Z = -0.37 | (P = .71) | | | | | | 0.1 0.51 2 10 | Ming Li, et al 2017 | 0 | 88 | 0 | 101 | 0.0% | | | | | | |
| Test for subgroup differences: C | chi ⁴ = 3.24, | df = 1 (| (P = .07) | | | | | Fangxun Yang, et al. 2017 | 3 | 892 | 4 | 806 | 1.7% | 0.68 [0.15, | 3.02] | | | _ | |
| | | | | | | | | Na Zhao, et al 2017 | 3 | 85 | 4 | 101 | 1.8% | 0.89 [0.21, | 3.87] | | | _ | |
| | | | | | | | | Jie Li 2018 | 0 | 669 | 5 | 465 | 2.0% | 0.83 [0.26, | 2.72 | | | | |
| B | | | | | | | | liefang Wei 2019 | 2 | 100 | 5 | 100 | 0.5% | 0.09 [0.11, | 1.621 | | | | |
| Study or | Mauria | her | | har | | Diele Datia | Diek Datie | Jino Zhano, et al. 2019 | 2 | 100 | 3 | 100 | 1.3% | 0.67 [0.01] | 3 901 | | | _ | |
| Subgroup E | wonte To | otal Ex | who lat | otal W. | oight MH | Risk Ratio | MH Pandom 95% Cl | Guomei Quan 2020 | 2 | 130 | 6 | 130 | 1.6% | 0.33 10.07 | 1.621 | _ | | | |
| Type = Retrospective | venus no | | rents ru | Juan III | eight min | , Randolli, 33% Cl | min, Randolli, 55% Ci | Total (95% CI) | - | 2793 | - | 2600 1 | 1.9% | 0.67 [0.38. | 1.18] | | - | | |
| Hanru Zhang, et al. 2016 | 5 (| 659 | 5 7 | 763 | 3.4% | 1.16 [0.34, 3.98] | | Heterogeneity: Tau ² = 0; Chi ² | 6.03, df = | 8 (P = . | 64); $l^2 = 0$ | % | | • | | | | | |
| Yun Wang, et al 2017 | 446 70 | 012 | 186 48 | 892 2 | 0.3% | 1.67 [1.42, 1.98] | - | Test for overall effect: Z = -1.3 | 9 (P = .17) | | | | | | | | | | |
| Dingran Wang, et al 2017 | 540 68 | 836 | 384 53 | 385 2 | 1.2% | 1.11 [0.98, 1.26] | | | | | | | | | | | | | |
| Lin Wei, et al 2017 | 302 4 | 146 | 326 38 | 879 2 | 0.7% | 0.87 [0.75, 1.01] | - | Total (95% CI) | | 34462 | | 31697 10 | 0.0% | 0.84 [0.68, | 1.03] | | • | | _ |
| Thuillier, C., et al. 2018 | 50 30 | 068 | 52 32 | 283 1 | 4.5% | 1.03 [0.70, 1.51] | | Heterogeneity: Tau ² = 0.076; | chi ² = 38.7 | 8, df = 24 | 4 (P = .03) | ; I ² = 38% | | | | | | | |
| Xiaorui Bai, et al 2020 | 7 3 | 213 | 4 2 | 234 | 3.5% | 1.92 [0.57, 6.48] | | lest for overall effect: 2 = -1.6 | 5 (P = .10) | | - | | | | | 0.01 0 | .1 1 | 10 | 100 |
| Total (95% CI) | 219 | 934 | 184 | 436 8 | 3.5% | 1.17 [0.89, 1.54] | - | Test for subgroup differences: | Chi" = 0.6 | 6, df = 1 | (P = .42) | | | | | | | | |
| Heterogeneity: Tau" = 0.074; C | $hi^{\circ} = 34.24$ (P = 27) | , df = 5 | (P < .01); | 1" = 85 | % | | | | | | | | | | | | | | |
| Test for overall effect. 2 = 1.10 | (P= .27) | | | | | | | | | | | | | | | | | | |
| Type = Prospective | | | | | | | | | | | | | | | | | | | |
| Na Zhao, et al 2017 | 3 | 85 | 7 1 | 101 | 3.0% | 0.51 [0.14, 1.91] | | | | | | | | | | | | | |
| Jie Li 2018 | 46 (| 669 | 36 4 | 465 1 | 3.5% | 0.89 [0.58, 1.35] | | | | | | | | | | | | | |
| Total (95% CI) | | 754 | 5 | 566 1 | 6.5% (| 0.84 [0.57, 1.26] | - | | | | | | | | | | | | |
| Heterogeneity: Tau ² = 0; Chi ² = | 0.62, df = | 1 (P = . | 43); I ² = 0 ⁴ | 1% | | | | | | | | | | | | | | | |
| Test for overall effect: Z = -0.83 | B(P = .41) | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| Total (95% CI) | 220 | 688 | 190 | 002 10 | 0.0% | 1.10 [0.86, 1.40] | | 1 | | | | | | | | | | | |
| Heterogeneity: Tau" = 0.070; C Test for overall effect: 7 = 0.73. | nr = 36.89 (P = 46) | , at = 7 | (P < .01); | F = 81 | 70 | | 02 05 1 2 5 | | | | | | | | | | | | |
| Tast for subgroup differences: (| (r40) $chi^2 = 1.71$ | df = 1 | (D = 10) | | | | 0.2 0.0 1 2 5 | 0 | | | | | | | | | | | |
| reactor autyroup undrences: (| - 1./1 | , an - 1 | (| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Figure 5. Subgroup analysis for neonatal morbidity. (A): fetal distress. (B): neonatal asphyxia. (C): neonatal intensive care unit admission.

1338 low-risk women in the first stage of spontaneous labor at term concluded that for low-risk women making slow progress in spontaneous labor, treatment with oxytocin as compared to no treatment or delayed oxytocin treatment did not result in any discernable difference in the number of caesarean deliveries performed, and there were no detectable adverse effects for mother or baby. The use of oxytocin was associated with a reduction of approximately two hours of the time to delivery which might be important to some women.^[61] There is also evidence, however, that oxytocin administration during labor for low-risk women may lead to worse birth outcomes with an increased risk of instrumental birth and cesarean, episiotomy and the use of epidural analgesia for pain relief, as well as fetal asphyxia.^[62–64] In 2020, the use of oxytocin for prevention of delay in labor in women receiving epidural analgesia is not recommended by WHO.[65]

Under the new labor management guideline, the probability of intrapartum caesarean section and operative vaginal delivery were significantly reduced, without increasing the incidence of 3rd- and 4th-degree perineal laceration, postpartum hemorrhage, infectious morbidity and postpartum urine retention, fetal distress, neonatal asphyxia or NICU admission. We further explored the indications for intrapartum caesarean section and found that the major decrease in intrapartum cesarean section may be attributable to the fact that the prolonged latent phase along was no longer an indication for cesarean section under the new labor guideline. However, the pooled result of 44 studies differed from the only multi-center study conducted by Bernitz et al.[25] This cluster-randomized controlled trial of the new guideline was done in 14 hospitals in Norway, with low baseline cesarean rates and labor care provided primarily by midwives. The study resulted in no significant difference in the rate of intrapartum cesarean delivery for primigravid people in spontaneous active labor. Intrapartum cesareans were performed for 5.9% of participants in the comparison group (the WHO guideline based on Friedman's partograph)[66] and 6.8% of the intervention group (partograph based on Zhang et al.). As Bernitz et al. acknowledged,^[25] the intrapartum cesarean rate decreased from 9.3% before the trial to 6.8% during the trial in the hospitals randomized to the comparison group, suggesting that the trial may have had a Hawthorne effect on the comparison group.

Another single center retrospective cohort study based on 525 women who underwent primary cesarean delivery for arrest disorder^[67] indicated that the primary cesarean delivery rate was not reduced after the publication of the 2014 guidelines (WHO guideline *vs.* the new guideline: 13.4% *vs.* 13.3%, P = 0.81); the rate of composite maternal morbidities significantly increased from 50% to 75% (P =0.02) in patients who had cesarean delivery for arrest of descent, with no significant change in the composite neonatal morbidities. Nunes *et al.* conducted a single center retrospective cohort study based on 3665 women who had achieved 4 cm of cervical dilation.^[68] Women were classified into 3 groups: normal progress group, a group met Zhang's criteria for labor arrest (n = 400) and a group that did not meet criteria for Zhang's but met for Friedman's (n = 426). No statistical differences were found when comparing Zhang's and Friedman's groups for maternal and neonatal morbidities, which including: postpartum hemorrhage, infectious morbidity, perineal trauma and thrombotic events and a composite neonatal morbidity. This may also strength our results regarding the safety of the new labor management.

It should be pointed out that labor management is very complex, highly individualized, and often physician/ midwife-influenced process. Labor management styles vary wildly from physician to physician, hospital to hospital even within the same country. The definition of dystocia is just one important aspect of labor management. Thus, it is plausible that different trials and observational studies may produce diverse results.

In our study, we aimed to present results based on clinical practice and therefore included both RCT and cohort studies to overall estimate the evidence of the safety of the new labor management. This study also has several limitations that must be taken into account. First, the evidence was limited to some of the evaluated outcomes. For instance, only 3 RCTs and 6 cohort studies examined the 3rd- and 4th-degree perineal laceration. Second, there was high heterogeneity among the studies included for some of the evaluated outcomes. Subgroup analyses showed higher heterogeneity in retrospective cohort studies. However, no significant difference of pooled results was observed across subgroup analyses. Besides, the region of origin for included studies are only 3 studies from Norway, America and France respectively, the rest of studies were all from China, and the level of evidence was weak. More highquality studies are needed to confirm these findings.

CONCLUSION

Our results indicate that the new labor management guideline may lead to less intrapartum intervention with no increase in adverse obstetric outcomes. More high-quality studies are needed to confirm these findings.

DECLARATIONS

Supplementary materials

Supplementary materials mentioned in this article are online available at the journal's official site only.

Author contributions

He X: Data curation, Writing—Original draft preparation, Software. Jia X: Data curation, Writing—Original draft preparation. Zeng X: Visualization, Investigation, Software and Validation. Fan J: Supervision, Reviewing and Editing. Zhang J: Conceptualization, Methodology, Supervision, Reviewing and Editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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