Placenta and Reproductive Medicine

META-ANALYSIS

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

Xiaoqing He[1,2,#], Xiaojun Jia[3,#], Xiaojing Zeng[2], Jianxia Fan[1], Jun Zhang[1,2]

[1]The International Peace Maternity and Child Health Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai 200030, China;

[2]Ministry of Education-Shanghai Key Laboratory of Children's Environmental Health, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai 200030, China;

[3]Department of Obstetrics and Gynecology, Shanghai Putuo Maternity and Infant Hospital, Shanghai 200030, China

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 I^2 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], I^2 = 47%; cohort studies: RR = 0.62 [0.55, 0.70], I^2 = 58%), intrapartum cesarean section (RCTs: RR = 0.52 [0.47, 0.59], I^2 = 0; cohort studies: RR = 0.61 [0.55, 0.67], I^2 = 75%) and operative vaginal delivery (RCTs: RR = 0.60 [0.42, 0.87], I^2 = 0; cohort studies: RR = 0.69 [0.55, 0.86], I^2 = 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]

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

Peer review under responsibility of the Editorial Board.

#These authors contributed equally to this work.

Corresponding Author:

Dr. Jun Zhang, E-mail: junjimzhang@sjtu.edu.cn; https://orcid.org/0000-0003-1706-1611

Citation:

He X, Jia X, Zeng X, Fan J, Zhang J. New labor management and obstetric outcomes: A systematic review and meta-analysis. *Placenta Reprod Med*. 2023;2:10.

DOI: 10.54844/prm.2023.0319

Received: 09 January 2023
Accepted: 23 May 2023
Published: 27 July 2023

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 ≥ 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 ± 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.

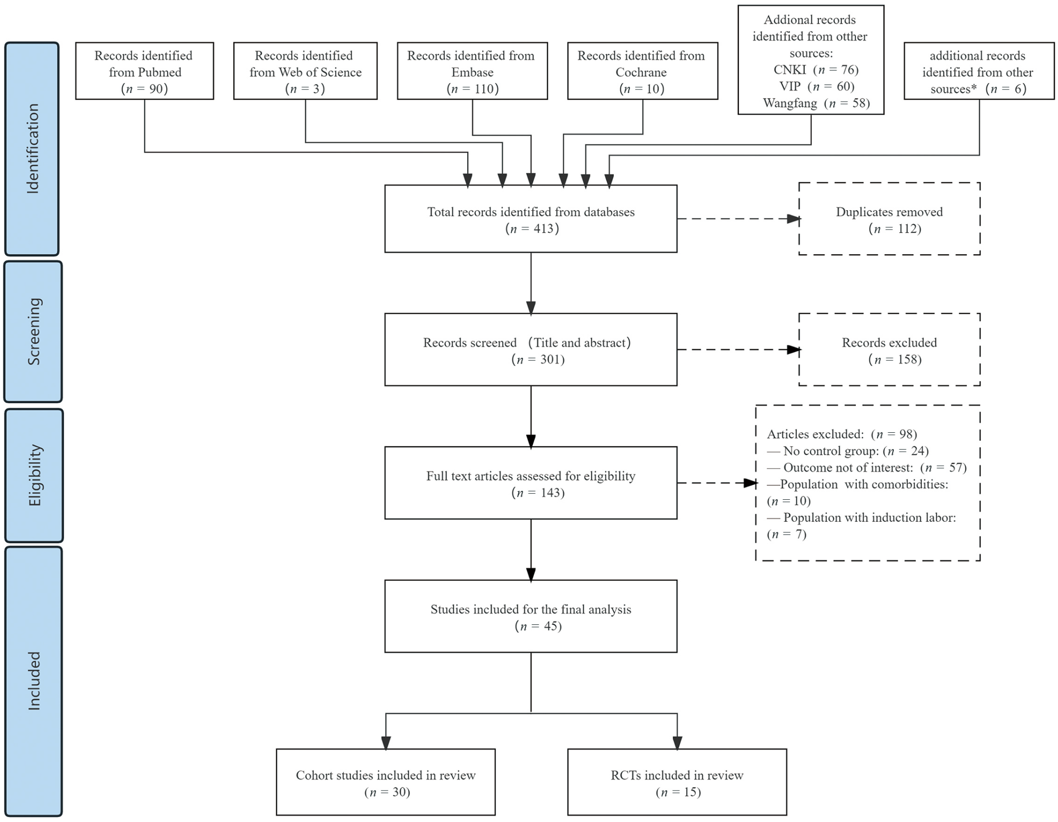

Figure 1. Flow chart of study selection. *Additional records identified from checking through the reference lists of relevant studies and personal communicating with authors.

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

Table 1: Characteristics of included studies and patients

Author, year	Study types	Intervention/ Comparison	Sample size		Nulliparas		Age		Pre-pregnancy BMI		Gestational age		Outcomes*
			New	WHO	New	WHO	New	WHO	New	WHO	New	WHO	
Liu 2016[15]	RCT	New labor / WHO labor	60	60	60	60	-	-	-	-	-	-	③⑤⑥⑧⑨⑩
Huang *et al.* 2017[16]	RCT	New labor / WHO labor	242	238	-	-	-	-	-	-	-	-	②④⑤⑥⑨
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	②③⑤⑥⑨
Li and Ren *et 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 *et al.* 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	-	-	-	-	①②③⑧⑨⑩
Zhou 2019[24]	RCT	New labor / WHO labor	200	200	-	-	26.2 ± 0.1	25.1 ± 0.4	-	-	-	-	②
Bernitz *et al.* 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	①②③④⑤⑨
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	②⑤⑥⑦⑧⑨
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	①②⑤⑦⑨
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	②③⑤⑥⑨⑩
Han *et al.* 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	②③④⑤⑥⑧⑨
Lin *et al.* 2016[30]	Retrospective cohort study	New labor / WHO labor	755	1050	-	-	-	-	-	-	-	-	①②⑤⑥⑧⑨
Lv *et al.* 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	①②③⑤⑥⑦⑨
Zhang *et al.* 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	①②③⑤⑦⑧⑨
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	①②③⑤⑥⑦⑧⑨⑩
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	②③⑤⑧⑨
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	②③④⑤⑥⑨
Jin 2017[34]	Prospective cohort study	New labor / WHO labor	42	42	-	-	26.0 ± 2.2	26.5 ± 1.5	-	-	-	-	①②③⑤⑥⑧⑨
Li *et al.* 2017[35]	Prospective cohort study	New labor / WHO labor	88	101	-	-	-	-	-	-	-	-	②⑤⑦⑨
Wang *et al.* 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	①②③⑨⑩
Wang *et al.* 2017[37]	Retrospective cohort study	New labor / WHO labor	6836	5385	6836	5385	31.2 ± 3.7	30.9 ± 3.5	-	-	-	-	②③④⑤⑥⑨⑩
Wei *et al.* 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 *et al.* 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	①②③⑤⑧⑨⑩

(continued...)

Author, year	Study types	Intervention/ Comparison	Sample size		Nulliparas		Age		Pre-pregnancy BMI		Gestational age		Outcomes*
			New	WHO	New	WHO	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 *et al.* 2018[43]	Retrospective cohort study	New labor / WHO labor	739	751	-	-	-	-	-	-	-	-	②
Thuillier *et al.* 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	②③④⑤⑨⑩
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 *et al.* 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	①②⑤⑥⑦⑧⑨
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 *et al.* 2019[47]	Retrospective cohort study	New labor / WHO labor	625	640	-	-	32.4 ± 5.2	31.8 ± 5.4	-	-	-	-	②③⑤⑥⑦
Zhang *et al.* 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	①②③⑤⑧⑨
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	-	-	-	-	-	-	②③④⑤⑥⑦
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	①②⑤⑧⑨
Shi *et al.* 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	①②⑤⑥⑨
Sun *et al.* 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 *et al.* 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	②④⑤⑦⑧⑨
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	①②③⑤⑧⑨
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	②④⑤⑥⑧

Age, Pre-BMI and Gestational age are presented as mean ± standard deviation. *①labor augmentation with oxytocin; ②intrapartum cesarean section; ③operative vaginal delivery; ④3rd- and 4th-degree perineal laceration; ⑤postpartum hemorrhage; ⑥infectious morbidity (chorioamnionitis, endometritis and puerperal infection); ⑦postpartum urine retention; ⑧fetal distress; ⑨neonatal asphyxia; ⑩neonatal intensive care unit admission. †This study was from Norway. ‡This study was from America. §This 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* value
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				WHO				RR
	I^2	P	Pooled proportion	95 CI%	I^2	P	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. Hypo-contractile activity is the most common reason for labor

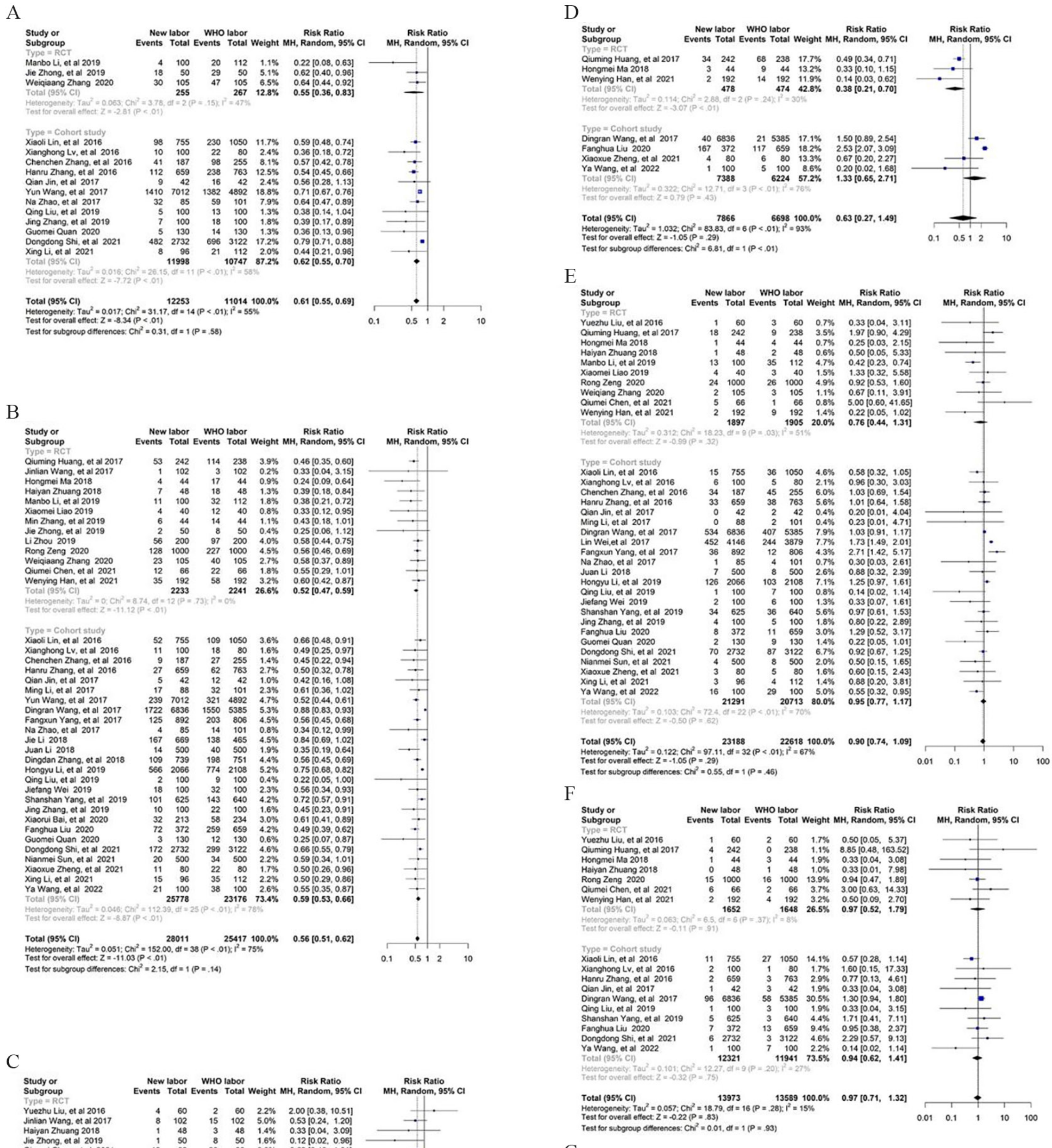

Figure 2. Risk ratio for maternal morbidity. (A): labor augmentation with oxytocin. (B): intrapartum cesarean section. (C): operative vaginal delivery. (D): 3rd- and 4th-degree perineal laceration. (E): postpartum hemorrhage. (F): infectious morbidity (chorioamnionitis, endometritis and puerperal infection). (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

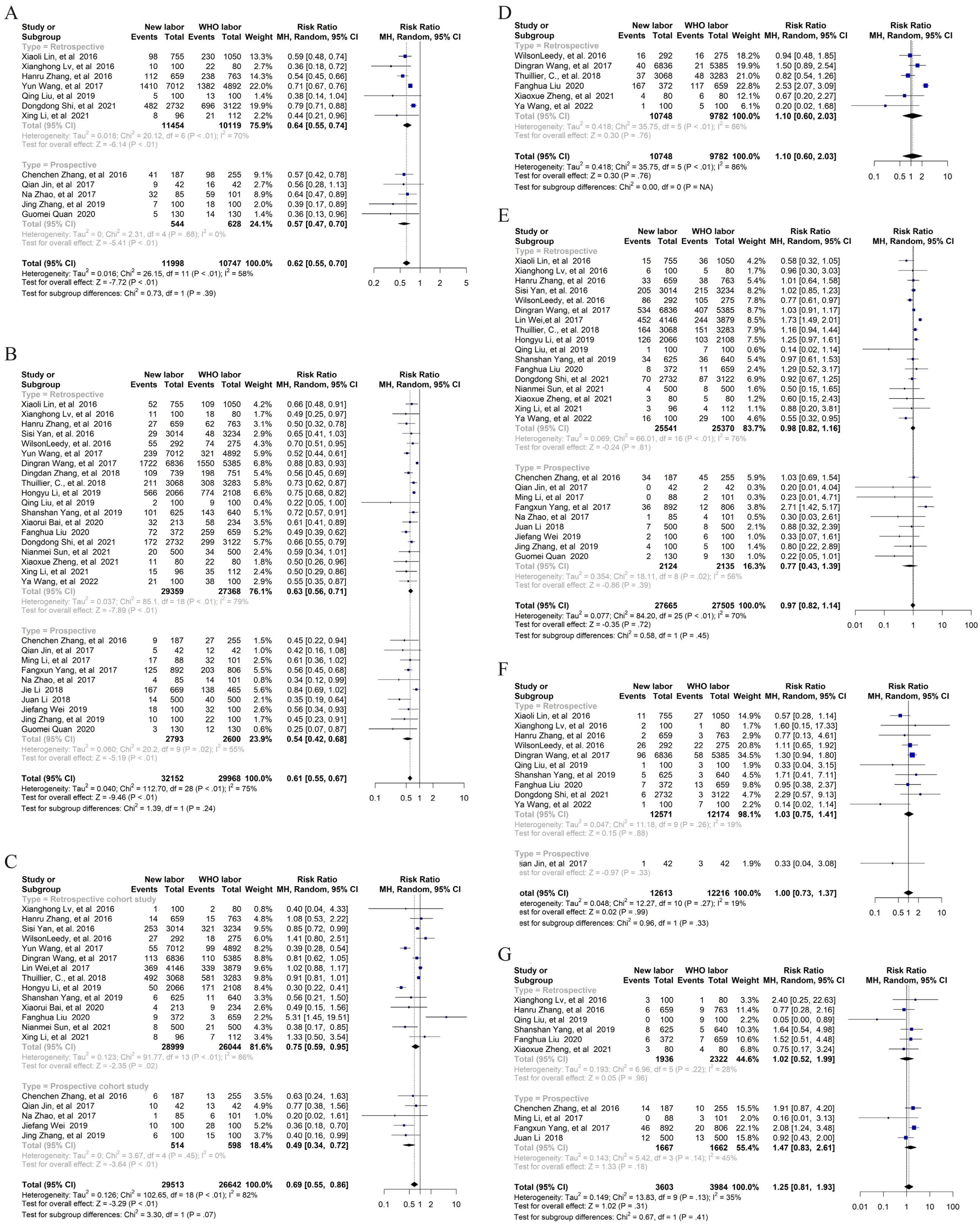

Figure 3. Subgroup analysis for maternal morbidity. (A): labor augmentation with oxytocin. (B): intrapartum cesarean section. (C): operative vaginal delivery. (D): 3rd- and 4th-degree perineal laceration. (E): postpartum hemorrhage. (F): infectious morbidity (chorioamnionitis, endometritis and puerperal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

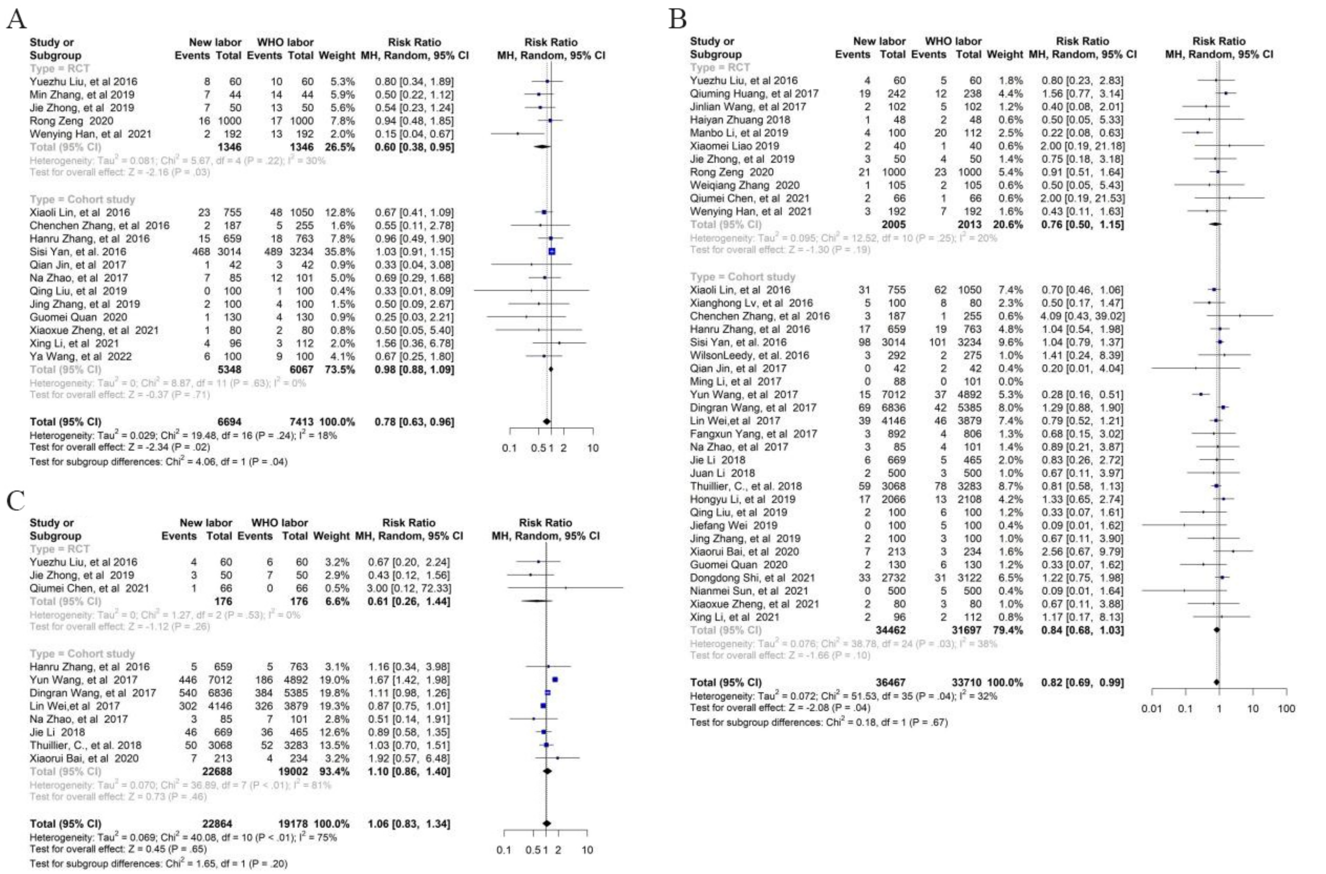

Figure 4. Risk ratio for neonatal morbidity. (A): fetal distress. (B): neonatal asphyxia. (C): neonatal intensive care unit admission.

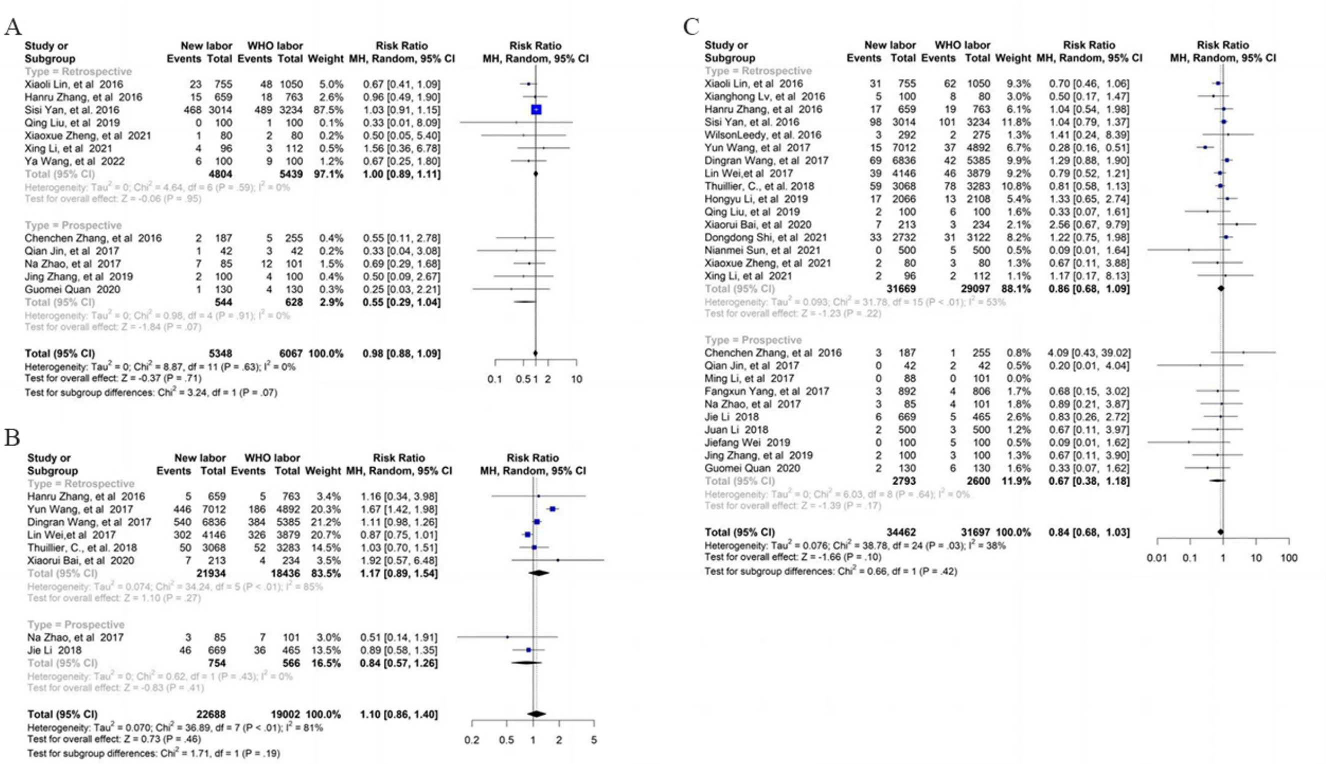

Figure 5. Subgroup analysis for neonatal morbidity. (A): fetal distress. (B): neonatal asphyxia. (C): neonatal intensive care unit admission.

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 high-quality 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.

Source of funding

This work was supported by a grant from the National Key Research and Development Program of China (No. 2018YFC1004602).

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.

REFERENCE

1. Williams JW. *Obstetrics: A Text-book for the Use of Students and Practitioners: Appleton*. D. Appleton and Company; 1903.
2. Friedman EA. Primigravid labor; a graphicostatistical analysis. *Obstet Gynecol*. 1955;6(6):567–589.
3. Philpott RH, Castle WM. Cervicographs in the management of labour in Primigravidae. I. The alert line for detecting abnormal labour. *J Obstet Gynaecol Br Commonw*. 1972;79(7):592–598.
4. Philpott RH, Castle WM. Cervicographs in the management of labour in Primigravidae. II. The action line and treatment of abnormal labour. *J Obstet Gynaecol Br Commonw*. 1972;79(7):599–602.
5. World health organization partograph in management of labour. World Health Organization maternal health and safe motherhood programme. *Lancet*. 1994;343(8910):1399–1404.
6. World Health Organization. Maternal Health and Safe Motherhood Programme. Preventing prolonged labour: a practical guide: the partograph. Accessed June 28, 2023. https://apps.who.int/iris/handle/10665/58903
7. World Health Organization. The Partograph: the application of the WHO partograph in the management of labour, report of a WHO multicentre study, 1990-1991. No. WHO/FHE/MSM/94.4. Accessed June 28, 2023. https://apps.who.int/iris/handle/10665/58589
8. Zhang J, Troendle JF, Yancey MK. Reassessing the labor curve in nulliparous women. *Am J Obstet Gynecol*. 2002;187(4):824–828.
9. Neal JL, Lowe NK, Patrick TE, Cabbage LA, Corwin EJ. What is the slowest-yet-normal cervical dilation rate among nulliparous women with spontaneous labor onset? *J Obstet Gynecol Neonatal Nurs*. 2010;39(4):361–369.
10. Zhang J, Landy HJ, Ware Branch D, *et al*. Contemporary patterns of spontaneous labor with normal neonatal outcomes. *Obstet Gynecol*. 2010;116(6):1281–1287.
11. Laughon SK, Branch DW, Beaver J, Zhang J. Changes in labor patterns over 50 years. *Am J Obstet Gynecol*. 2012;206(5):419.e1–419.e4199.
12. Obstetric care consensus no. 1: safe prevention of the primary cesarean delivery. *Obstet Gynecol*. 2014;123(3):693–711.
13. Expert Consensus on new Labor Standards and Management (2014). *Chin J Obstet Gynecol*. 2014;49(7):486–486.
14. Wan X, Wang W, Liu J, Tong T. Estimating the sample mean and standard deviation from the sample size, Median, range and/or interquartile range. *BMC Med Res Methodol*. 2014;14:135.
15. Liu YZ. [Comparative analysis of the clinical application value of the new and old labor standards]. *Med Innov China*. 2016;13(24):120–123.
16. Huang QM, Chen H, Liang MJ, *et al*. [The effect of application of new labor standard on pregnancy outcome]. *Hainan Med J*. 2017;28(06):989–990.
17. Wang JL, Liu L. [The effect of new labor standards and patterns of midwifery on the incidence of adverse pregnancy outcomes (forceps delivery, caesarean section, and neonatal asphyxia)]. *Psychologist*. 2017;23(5):61–62.
18. Ma HM. [Application of the new labor standard and its influence on pregnancy outcome]. *China Pract Med*. 2018;13(27).
19. Zhuang HY. [The influence of clinical labor on labor outcome based on new labor process standards]. *Heilongjiang Med J*. 2018;42(7).
20. Li MB, Ren ZF. [Comparison of clinical application of old and new labor curves in spontaneous delivery among primipara]. *Ningxia Med J*. 2019;41(01):76–77.
21. Liao XM. [The application of new labor time observation method in parturition]. *China Med Pharm*. 2019;9(24):114–116.
22. Zhang M, Zhang Q, Zhang B. [Effect of new labor standard on indications of cesarean section and pregnancy outcomes during labor]. *Spec Health*. 2019(19):141–142.
23. Zhong J, Su QP. [Analysis of the influence of new labor standard on clinical indications and prognosis of mother and newborn during labor]. Bao Jian Wen Hui 2019(9):19–20.
24. Zhou L. [Analysis of the effect of labor management on pregnancy outcome]. *Psychol Mon*. 2019;14(16):145.
25. Bernitz S, Dalbye R, Zhang J, *et al*. The frequency of intrapartum Caesarean section use with the WHO partograph versus Zhang's guideline in the Labour Progression Study (LaPS):a multicentre, cluster-randomised controlled trial. *Lancet*. 2019;393(10169):340–348.
26. Zeng R. [Effect of new labor standard on spontaneous delivery and pregnancy outcomes]. *Health Everyone*. 2020(12):83.
27. Zhang WQ. [The effect of labor management according to new labor standard in painless labor on maternal and infant outcomes]. *China Mod Med*. 2020;27(2).
28. Chen QM, Su ML. [Effect of implementation of new labor standard on maternal and infant outcomes]. *Clin Med Eng*. 2021;28(4):487–488.
29. Han WY, Li LX, Li MQ, Chen N, Li XY, Zhu XM. [Effect of labor management based on new labor standard on maternal labor outcome]. *J Xinxiang Med Univ*. 2021;38(5):418–421,426.
30. Lin XL, Mei SZ, Zhang MJ. [Clinical analysis of pregnancy outcomes of 755 parturients based on the new labor standard]. *Heilong Med J*. 2016;40(10):905–907.
31. Lv XH, Chen N, Wang CX. [Effect of new labor standard on pregnancy outcomes of spontaneous delivery pregnant women]. *J Med Forum*. 2016;37(7):70–71.
32. Zhang CC, Li J, Xia YX. Effect of old and new labor management on pregnancy outcomes. *Chin J Disaster Med*. 2016;4(12).
33. Zhang HR. [Comparative study on the clinical application of old and new labor curves]. *Gansu Prov: Lanzhou Univ*. 2016.
34. Jin Q. [Effect of new labor standard on spontaneous delivery and pregnancy outcomes of pregnant women]. *World Mother Infant*. 2017;(22):37.
35. Li M, Li Y, Yu JM, Niu BL. [Effect of new labor standard on indications of intrapartum caesarean section]. *World Mother Infant*. 2017;(19):68.
36. Wang Y, Yue YF, He XY. [Effect of implementing modified new labor standard on reducing intrapartum cesarean section rate and maternal and infant outcomes]. *J Int Obstet Gynecol*. 2017;44(06):633–635,641.
37. Wang DR, Ye SL, Tao LY, Wang YQ. [Effects of new and old labor standards on maternal and infant outcomes]. *Chin J Clin Obstet Gynecol*. 2017;18(06):507–510.
38. Wei L, Yan TT, Fan L. [Comparison of labor and pregnancy outcomes in 8025 patients with vaginal delivery under old and new labor management]. *Chin J Fam Plan*. 2017;25(07):459–462.
39. Yang FX. [Effect of new labor standard on indications of intrapartum cesarean section and pregnancy outcome during labor]. *Chin J Fam Plan*. 2017;25(2):101–103,111.
40. Zhao N, Li N, Jiang XM, Qu XJ, Qi YL, Pang NN. [Effects of new labor standards on clinical indications and maternal and infant outcomes during labor]. *Prog in Mod Biomed*. 2017;17(27):5362–5364,5372.
41. Li J. [Effect of new labor management on cesarean section rate and pregnancy outcome]. *Mod Instrum Med Treat*. 2018;24(5):134–135,138.
42. Li J. [Clinical effect of new labor management on reducing cesarean section rate and maternal and infant outcomes]. *Syst Med*. 2018;3(21):111–113.
43. Zhang DD, Wang NN, Pan DH. [The influence of new labor standard on indications of cesarean section and pregnancy outcome]. *Mod Diagn Treat*. 2018;29(11):1765–1766.
44. Li HY, Chang Q, Zheng CM, Wang D. [Effect of new labor standard

implementation on low-risk pregnant women's pregnancy outcomes]. *Chin J Obstet Gynecol Pediatr (Electronic Edition)*. 2019;15(2):180–185.
45. Liu Q, Liu GR, Guo P. [Clinical application effect of new labor standard in parturient women]. *China Mod Med*. 2019;26(22):101–103.
46. Wei JF. [The application of new labor standards in promoting spontaneous labor]. *Chin J Mod Drug Appl*. 2019;13(4):51–52.
47. Yang SS, Xue J, Zheng W. [Retrospective analysis of the application of new labor standard in labor management in primary hospital]. *China Med Pharm*. 2019;9(14):68–70.
48. Zhang J, Cui JH, Zhou WJ, Xin ZQ. [Analysis of indications and outcomes of the intrapartum cesarean section under new and old labor standards]. *Chin J Clin Ration Drug Use*. 2019;12(19):151–152.
49. Bai XR, Xue YY. [Effect of new labor stage standard on delivery mode of primipara and adverse neonatal outcomes]. *Clin Res Pract*. 2020;5(7):144–145,148.
50. Liu FH. [A comparative study of pregnancy outcomes by new and old labor standards]. *Guide China Med*. 2020;18(13):122–123.
51. Quan GM. [A comparative study on the application of old and new labor curves in spontaneous delivery of primipara]. *Med Diet Health*. 2020;(16):206,208.
52. Shi DD, Cheng Y, Zhang QY. [Effect of the application of new labor standard on maternal and infant outcomes]. *Chin J Birth Health Hered*. 2021;29(9):1276–1280.
53. Sun NM, An L, Xiong YM, Zhou M. [Study on the correlation between the new labor standard and intrapartum cesarean section after latent phase]. *Electron J Clin Med Lit*. 2021;8(13):39–42.
54. Zheng XX, Liu Z, Chen AP. [Effect of painless labor combined with new labor management on pregnancy outcomes and maternal and infant prognosis of low-risk women]. *Doctor*. 2021;6(14):43–46.
55. Li X, Wu C, Zhou X, *et al*. Influence of painless delivery on the maternal and neonatal outcomes under the guidance of new concept of labor. *Am J Transl Res*. 2021;13(11):12973–12979.
56. Wang Y, Cheng XY. [Effect of new labor standard on the rate of intrapartum cesarean section and maternal and infant complications]. *Contemp Med*. 2022;28(18):9–11.
57. Thuillier C, Roy S, Peyronnet V, Quibel T, Nlandu A, Rozenberg P. Impact of recommended changes in labor management for prevention of the primary cesarean delivery. *Am J Obstet Gynecol*. 2018;218(3):341.e1-341341.e9.
58. Wilson-Leedy JG, DiSilvestro AJ, Repke JT, Pauli JM. Reduction in the cesarean delivery rate after obstetric care consensus guideline implementation. *Obstet Gynecol*. 2016;128(1):145–152.
59. Yan SS, Xiao L. [Effect of new labor standard and midwifery patterns on the incidence of forceps assisted delivery, intrapartum cesarean section and neonatal asphyxia]. *Chin J Perinat Med*. 2016;19(4):315–317.
60. WHO Guidelines Approved by the Guidelines Review Committee. WHO recommendations: Intrapartum care for a positive childbirth experience. Accessed June 28, 2023. https://www.who.int/publications/i/item/9789241550215
61. Bugg GJ, Siddiqui F, Thornton JG. Oxytocin versus no treatment or delayed treatment for slow progress in the first stage of spontaneous labour. *Cochrane Database Syst Rev*. 2013;(6):CD007123.
62. Berglund S, Grunewald C, Pettersson H, Cnattingius S. Severe asphyxia due to delivery-related malpractice in Sweden 1990-2005. *BJOG Int J Obstet Gynaecol*. 2008;115(3):316–323.
63. Berglund S, Pettersson H, Cnattingius S, Grunewald C. How often is a low Apgar score the result of substandard care during labour? *BJOG Int J Obstet Gynaecol*. 2010;117(8):968–978.
64. Espada-Trespalacios X, Ojeda F, Perez-Botella M, *et al*. Oxytocin administration in low-risk women, a retrospective analysis of birth and neonatal outcomes. *Int J Environ Res Public Health*. 2021;18(8):4375.
65. WHO. WHO labour care guide: user's manual. Accessed June 28, 2023. https://www.who.int/publications/i/item/9789240017566
66. Mathai M, Sanghvi H, Guidotti RJ. Managing complications in pregnancy and childbirth: a guide for midwives and doctors. Accessed June 28, 2023. https://apps.who.int/iris/bitstream/handle/10665/255760/9789241565493-eng.pdf;sequence=1
67. Jalloul RJ, Bury-Fiol A, Ibarra CJ, Chen HY, Sibai BM, Ward C. Maternal and neonatal morbidity after cesarean delivery for active phase arrest following adoption of the obstetric care consensus guidelines. *Am J Perinatol*. 2023;40(1):51–56.
68. Nunes JP, Pinto PV, Neves AM, *et al*. Concerns about the contemporary labor curves and guidelines: Is it time to revisit the old ones? *Eur J Obstet Gynecol Reprod Biol*. 2022;270:169–175.