REVIEW

PFMT relevant strategies to prevent perineal trauma: a systematic review and network meta-analysis

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Abstract

Background Most women suffer from perineal trauma during childbirth, whether it is natural tears or episiotomy.

Objectives To perform a systematic review and network meta-analysis investigating the effectiveness of different PFMT relevant strategies in the prevention of perineal trauma.

Search strategy PubMed, Embase, the Cochrane Library, CINAHL, CNKI, CBM, WANFANG DATABASE, and Clinical-Trials.gov were searched for citations published in any language from inception to 1 July 2021.

Selection criteria Randomized controlled trials (RCTs) of PFMT relevant prevention strategies for preventing perineal trauma during childbirth.

Data collection and analysis Data were independently extracted by two reviewers. Relative treatment effects were estimated using network meta-analysis (NMA).

Main results Of 12 632 citations searched, 21 RCTs were included. Comparing with usual care, "PFMT combine with perineal massage" and PFMT alone showed more superiority in intact perineum (RR = 5.37, 95% CI: 3.79 to 7.60, moderate certainty; RR = 2.58, 95% CI 1.34–4.97, moderate certainty, respectively), episiotomy (RR = 0.26, 95% CI 0.14–0.49, very low certainty; RR = 0.63, 95% CI 0.45–0.90, very low certainty, respectively), and OASIS (RR = 0.35, 95% CI 0.16–0.78, moderate certainty; RR = 0.49, 95% CI 0.28–0.85, high certainty, respectively). "PFMT combine with perineal massage" showed superiority in reducing perineal tear (RR = 0.41, 95% CI 0.20–0.85, moderate certainty).

Conclusions In view of the results, antenatal "PFMT combine with perineal massage" and PFMT were effective strategies for the prevention of perineal trauma.

Keywords PFMT · Perineal trauma · Vaginal delivery · Network meta-analysis

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What does this study add to the clinical work

Issue : How effective is PFMT in preventing perineal trauma?

What is already known : PFMT can be effective in preventing and treating pelvic floor muscle dysfunction, but its preventive effect on perineal injury has yet to be verified.

What this paper adds : With moderate certainty of evidence, "PFMT combine with perineal massage" and PFMT showed more superiority for preventing perineal trauma.

Introduction

Most women suffer from perineal trauma during childbirth, whether it is natural tears or episiotomy, affecting 53–79% of women [1]. In Queensland, 59.16% women required surgical repair because of perineal trauma in 2020 [2]. Injury to the perineum without involvement of the anal sphincter does not generally cause long term problems for women. In contrast, injury to the anal sphincter can result in long term sequelae, such as fecal incontinence, and can significantly affect women's quality of life [1]. Episiotomy and obstetric anal sphincter injuries (OASIS) rates are commonly used as quality indicators of health systems and health care. [3]

The prevention of perineal trauma through exercise during pregnancy was feasible and effective, which has been verified and recommended by a number of guidelines and clinical studies [4–10]. However, the results concerning the relationship between different antenatal PFMT relevant prevention strategies and perineal trauma seemed to be inconclusive. Therefore, we intended to use network meta-analysis method to combine results of RCTs to assess the relative effectiveness of different PFMT relevant strategies in the prevention of perineal trauma during childbirth.

Methods

Our systematic review and NMA manuscript were written in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension statement for reporting systematic reviews incorporating NMA [11].

Search strategy

We searched PubMed, Embase, the Cochrane Library, CINAHL, CNKI, CBM, WANFANG DATA and

ClinicalTrials.gov for citations published in any language from inception to 1 July 2020. We also reviewed reference lists of included studies and related systematic reviews. The search strategy was provided in Appendix Table 2

Study selection and criteria

We included RCTs of different strategies (except antenatal perineal massage) used to prevent perineal trauma in pregnant women. We followed the PICO (population, strategies, comparison, outcome) framework to determine the research question and to facilitate literature search: (1) Population: single pregnant women, there were no other restrictions; (2) Strategies: PFMT relevant strategies; (3) Comparison: usual care or other strategies. Usual care means that pregnant women only receive routine guidance and nurse during pregnancy; (4) Outcome: perineal trauma; (5) Study design: RCTs. We excluded: (1) in vitro and animal studies, (2) studies whose data were unable for extraction and analysis. Appendix Table 3 shows the definitions of different prevention strategies.

Data extraction

Pairs of reviewers (XC, QY) independently screened all citations and extracted data from the included studies. Discrepancies in study inclusion were resolved by deliberation within the reviewer pairs or with input from a third reviewer (MYS). The following items were extracted from each identified study: (1) basic information: title, authors, publication year, etc.; (2) risk of bias domains; and (3) study outcomes: the rate of intact perineal, the rate of episiotomy, the rate of perineal tear, etc.

Risk of bias assessment

Two reviewers independently assessed risk of bias with adjudication by a third reviewer, using a Cochrane Collaboration tool [12]. This tool included seven domains: random sequence generation, allocation concealment, blinding of participants and personal, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias.

Statistical analysis

We conducted network meta-analysis with R version 4.1.2 and Stata 17.0 [13, 14]. For the dichotomous outcomes, we calculated risk ratios (RRs) and 95% confidence intervals, and mean differences (MDs) and 95% confidence intervals for the continuous outcomes. We assessed the heterogeneity in strategies effects among studies using visual inspection of forest plots and the I^2 We assessed the transitivity (similarity) assumption by comparing the distribution of the

population, the strategies, and the methodological characteristics of the studies across strategies comparisons [15]. To assess incoherence, we assessed the global incoherence for the entire network for each outcome under the assumption of a full design-by-strategies interaction random effects model, and then local incoherence for each comparison using the node-splitting model [16, 17]. We ranked strategies according to their P score, which is between 0 and 1 [18]. We used the egger's test and the funnel chart test to publish bias.

Certainty of evidence assessment

We used the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) approach to assess the certainty of evidence [19]. Regarding the certainty of evidence in estimates: high certainty means that further research is very unlikely to change our confidence in the estimate of effect; moderate certainty means that further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; low certainty means that further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; and very low certainty means that any estimate of effect is very uncertain. [20]

Results

The search strategies generated 12,632 citations, 21 RCTs were eligible [21–41]. Figure 1 presents the study flow diagram.

Characteristics of included studies

Twenty-one RCTs with sample sizes from 20 to 596, enrolled a total of 4931 patients. All RCTs included pregnant women, and 12 of these included primiparous women, one of these included primiparous women with bladder neck mobility (BNM), one of these included pregnant women ≥ 35 years, one of these included pregnant women with pelvic floor dysfunction.

Figure 2 presents the network plot including all studies and demonstrated that the most common comparisons were between PFMT relevant strategies and usual care. Ten RCTs compared PFMT with usual care; five RCTs compared Epi-NO with usual care; three RCTs compared "PFMT combine perineal massage" with usual care; one RCT compared "PFMT combine perineal massage" with perineal massage; two RCTs compared yoga with usual care (one Pilates, one yoga). Table 1 presents detailed characteristics of individual RCTs.

Risk of bias assessment

Most of the included studies showed a low or ambiguous risk of bias in seven areas, with one study (4.76%) showed a high risk of bias in random sequences generation and two studies (9.52%) showed a high risk of bias in the blindness. Because pelvic floor muscle exercise required patient participation, it was difficult to implement blinding method. All outcome indicators were measurable objective, we considered the impact of blinding method was small. Overall, only four studies were assessed as to be low risk of bias, and the remaining 17 studies were all high risk of bias. Appendix Fig. 5 presents the risk of bias.

Primary outcome

In this network meta-analysis, none of the outcomes formed a closed loop. Therefore, we did not need to test the inconsistency. Appendix Figs. 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 presents forest plots for each outcome. No publication bias was observed, see Appendix Figs. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33.
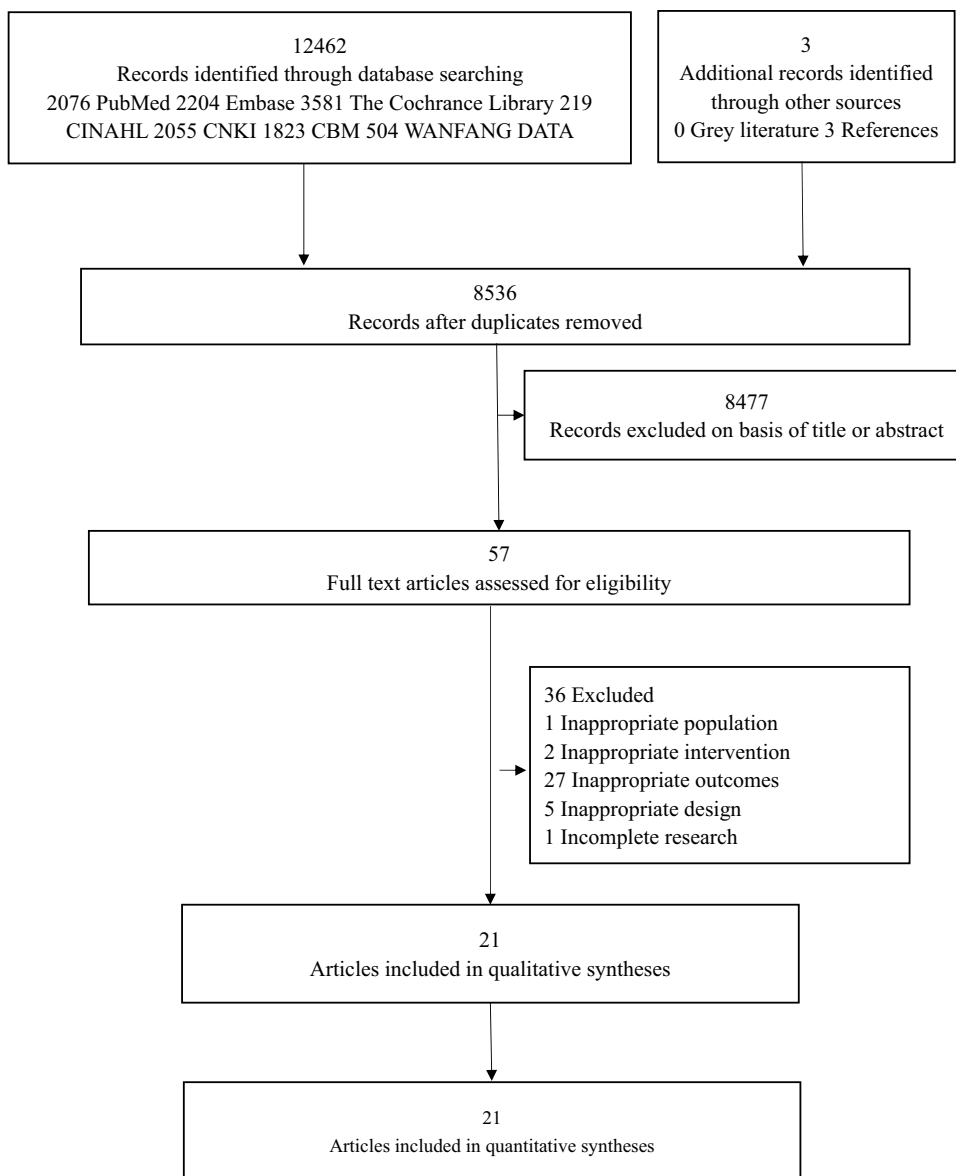
The rate of intact perineum

Eight RCTs [25, 27, 30, 31, 35, 36, 38, 39] reported the rate of intact perineum, included usual care, PFMT, Epi-NO, "PFMT combine with perineal massage", perineal massage, and Yoga. Compared with usual care, moderate certainty of evidence suggested that "PFMT combine with perineal massage" (RR = 5.37, 95% CI 3.79–7.60), Yoga (RR = 3.81, 95% CI 2.55–5.69), PFMT (RR = 2.58, 95% CI 1.34–4.97), Epi-NO (RR = 1.77, 95% CI 1.30–2.40) could significantly improve the rate of intact perineum. There were no differences between strategies except the comparison between "PFMT combine with perineal massage" and Epi-NO. Figure 3 shows the GRADE summary of findings.

The rate of episiotomy

Twenty RCTs [21–37, 39–41] reported the rate of episiotomy, included usual care, PFMT, Epi-NO, "PFMT combine with perineal massage", perineal massage, and Yoga. Compared with usual care, low certainty of evidence suggested that "PFMT combine with perineal massage" (RR = 0.26, 95% CI 0.14–0.49) and PFMT (RR = 0.63, 95% CI 0.45–0.90) could significantly reduce the rate of episiotomy, and combined strategy was better than PFMT alone (RR = 0.41, 95% CI 0.20–0.85; low certainty). There were no significant differences between other strategies (Fig. 3).

Fig. 1 Study selection flow diagram

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│  Records identified through database searching│    │ Additional records identified│
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│  Library 219 CINAHL 2055 CNKI 1823 CBM 504    │    │ 0 Grey literature 3 References│
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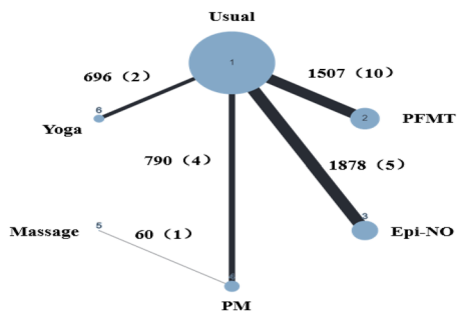

Fig. 2 Network plot of comparisons among Usual (usual care), PFMT, Epi-NO, PM (PFMT combine with perineal massage), Massage (perineal massage) or Yoga

The rate of perineal tear

Ten RCTs [21–23, 25, 30, 36–40] reported the rate of perineal tear, included usual care, PFMT, Epi-NO and "PFMT combine with perineal massage" strategies. Compared with usual care, low certainty of evidence suggested that "PFMT combine with perineal massage" could significantly reduce the rate of perineal tear (RR = 0.52, 95% CI 0.31–0.88). There were no significant differences between strategies (Fig. 4).

The rate of OASIS

Nine RCTs [21, 23, 26, 27, 29, 30, 34, 38, 41] reported the rate of OASIS, included usual care, PFMT, Epi-NO and "PFMT combine with perineal massage" strategies. Compared with usual care, high certainty of evidence suggested

Table 1 Characteristics of included RCTs

Study	Country	Population	Intervention group					Control group				
			n	Mean age (years)	Type of strategy	Start time	Frequency	n	Mean age (years)	Type of strategy	Start time	Frequency
Agur 2008 [21]	UK	Primiparous women with BNM	109	27	2	20w	Monthly Twice daily	105	27	1	NR	NR
Dias 2011 [22]	Brazil	Pregnant women	21	23.1±5.1	2	NR	Twice daily	21	23.7±4.8	1	NR	NR
Dieb 2020 [23]	Egypt	Pregnant women ≥35 years	200	38.3±1.9	2	NR	NR	200	38.0±3.5	1	NR	NR
Dietz 2014 [24]	Australia	Primiparous women	335	NR	3	37w	At least Twice daily	325	NR	1	NR	NR
El-Shamy 2017 [25]	Egypt	Pregnant women	10	23.2±1.5	2	16w	Twice daily	10	22.6±0.9	1	NR	NR
Atan 2016 [26]	Australia	Primiparous women	235	NR	3	37w	Twice daily	269	NR	1	NR	NR
Larios 2017 [27]	Spain	Primiparous women	254	32.2±4.0	2	32w	Twice daily	212	29.6±5.2	1	NR	NR
Díaz 2017 [28]	Spain	Pregnant women	50	NR	6	26–28w	NR	50	NR	1	NR	NR
Ruckhäberl 2009 [29]	Germany	Primiparous women	135	31.3±4.2	3	35–37w	Twice daily	137	31.3±4.4	1	NR	NR
Shek 2011 [30]	Australia	Pregnant women	82	29.2±6.0	3	37 W	At Most Twice daily	64	29.8±5.3	1	NR	NR
Deng 2019 [31]	China	Primiparous women	56	28.5±2.6	2	32w	Twice–Triple daily	56	27.9±2.4	1	NR	NR
Huang 2020 [32]	China	Primiparous women	30	26.8±2.4	4	36w	NR	30	26.3±2.1	5	34w	Three to four times a week
Shi 2018 [33]	China	Primiparous women	298	NR	6	16w	Three times a Week	298	NR	1	NR	NR
Salvesen 2004 [34]	Norway	Pregnant women	111	NR	2	20w	Twice daily	113	NR	1	NR	NR
Wang 2015 [35]	China	Pregnant women	130	NR	2	28w	NR	130	NR	1	NR	NR
Wang 2015 [36]	China	Pregnant women with pelvic floor dysfunction	30	NR	2	NR	Triple daily	30	NR	1	NR	NR
Cai 2019 [37]	China	Primiparous women	50	23.5±1.7	4	34w	Three to four times a week	50	23.7±1.7	1	NR	NR
Liang 2020 [38]	China	Primiparous women	45	27.7±5.3	4	NR	Four to five times a Week	45	26.5±5.2	1	NR	NR
Hu 2014 [39]	China	Primiparous women	50	NR	2	10w	Twice–Triple daily	59	NR	1	NR	NR
KOVACS 2004 [40]	China	Primiparous women	48	NR	3	37w	NR	248	NR	1	NR	NR
Wang 2017 [41]	China	Primiparous women	100	28.7±2.1	4	34w	At least Four times a Week	100	29.0±3.1	1	NR	NR

Note: 1 for usual care, 2 for PFMT, 3 for Epi-NO, 4 for "PFMT combine with perineal massage", 5 for perineal massage, 6 for yoga

that PFMT (RR = 0.49, 95% CI 0.28–0.85) and moderate certainty of evidence suggested that "PFMT combine with perineal massage" (RR = 0.35, 95% CI 0.16–0.78) could significantly reduce the rate of OASIS. Results suggested no significant differences between any of strategies (Fig. 4).

Secondary outcomes

Compared with usual care, "PFMT combine with perineal massage" (RR = 0.70, 95% CI 0.56–0.88, moderate certainty) and perineal massage (RR = 0.60, 95% CI 0.39–0.93, low certainty) could significantly reduce the rate of slight perineal tear; Epi-NO improved the rate of assisted vaginal delivery (RR = 1.59, 95% CI 1.04–0.42, moderate certainty); PFMT combine with perineal massage (RR = 1.38, 95% CI 1.04–1.82, low certainty) and yoga (RR = 1.75, 95% CI 1.47–2.08, moderate certainty) could significantly improve the rate of natural childbirth; PFMT combine with

perineal massage (RR = 0.31, 95% CI 0.12–0.83, low certainty) and yoga (RR = 0.47, 95% CI 0.32–0.71, low certainty) could significantly reduce the rate of caesarean section; PFMT combine with perineal massage (RR = 0.35, 95% CI 0.16–0.78, low certainty) and PFMT (RR = 0.49, 95% CI 0.28–0.85, low certainty) could significantly reduce the rate of fetal distress; PFMT (MD = − 20.27, 95% CI − 38.63–1.90, low certainty) could significantly reduce the duration of the second stage of labor. Figure 5 presents the GRADE summary of findings for secondary outcomes.

Discussion

Main findings

Our meta-analysis showed that both "PFMT combine with perineal massage" and PFMT showed advantages in terms
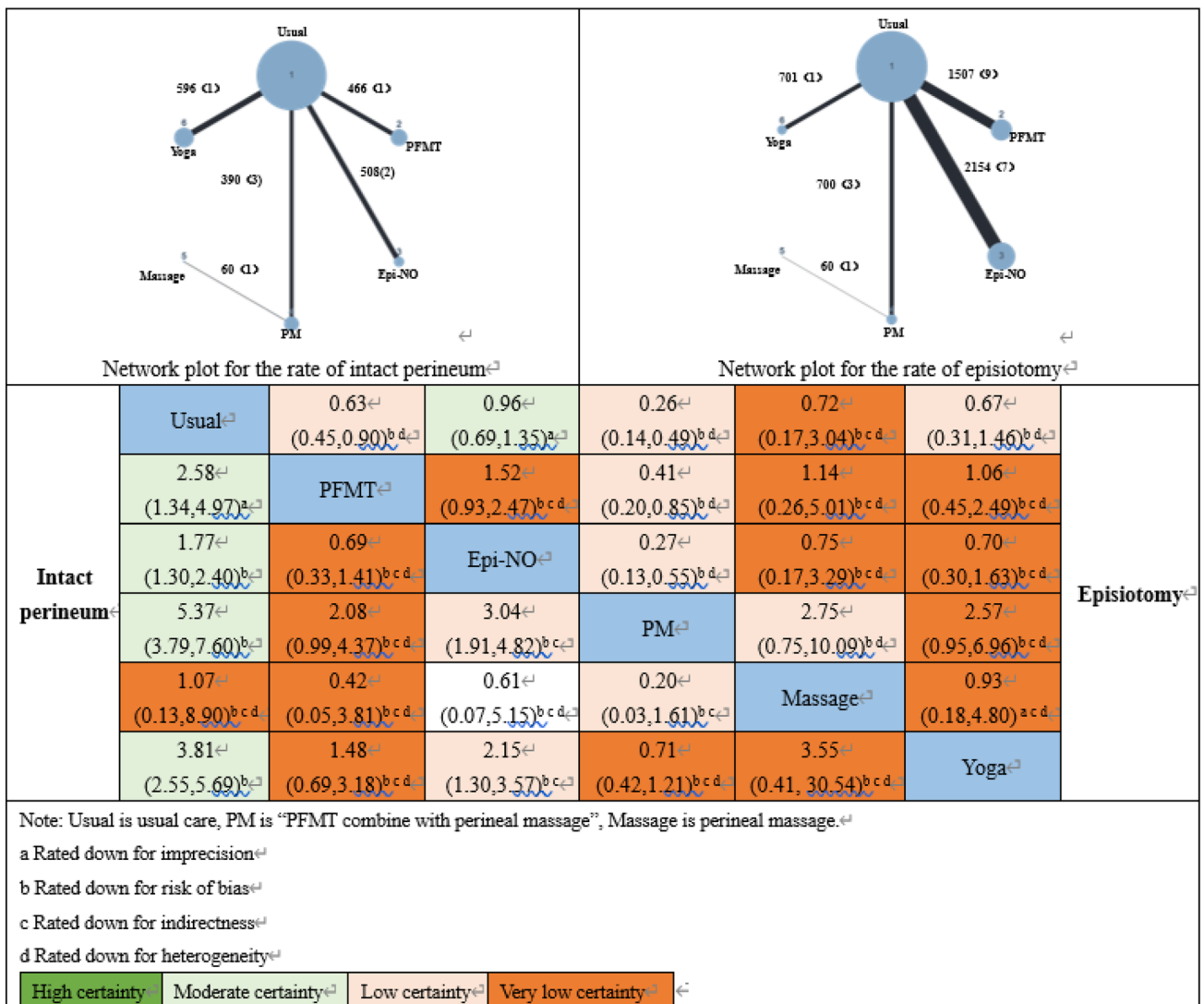
Fig. 3 GRADE summary of findings for the rate of intact perineum and episiotomy
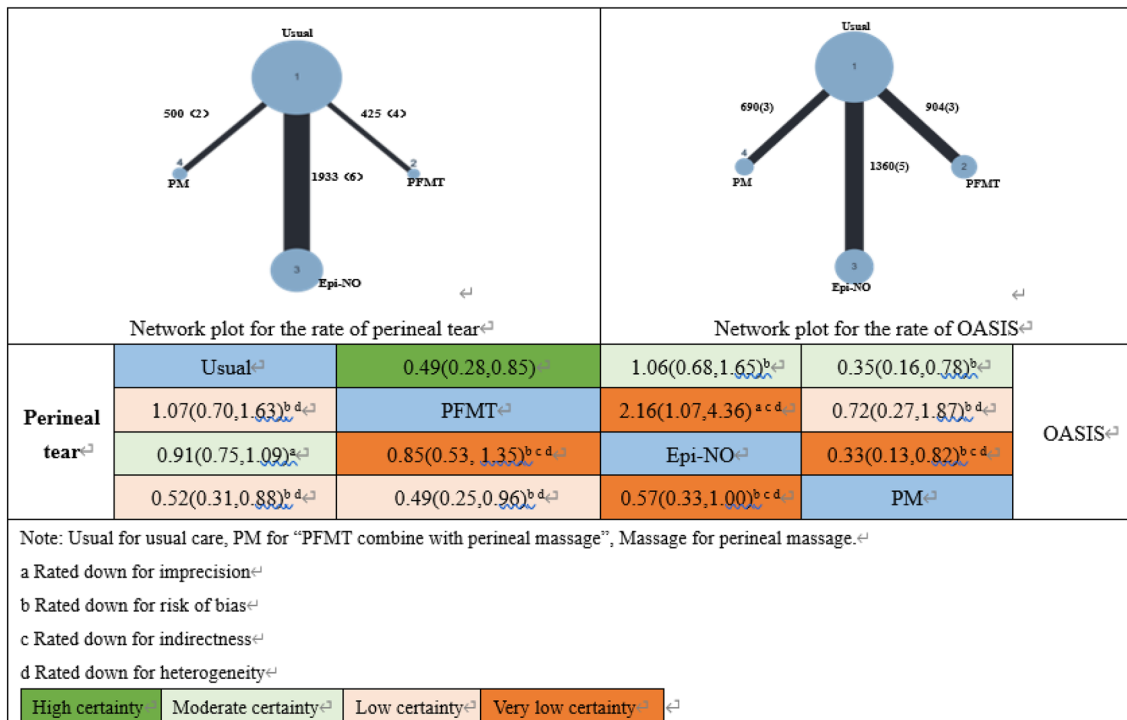
Fig. 4 GRADE summary of findings for the rate of perineal tear and OASIS

of the primary outcomes compared with usual care. This suggested that "PFMT combine with perineal massage" and PFMT might be the most effective first line strategy for the prevention of perineal trauma.

Some systematic review found that exercise could not prevent perineal trauma, but one found that perineal massage could prevent perineal trauma [12–15]. In the present network meta-analysis, we focused on the relationship between different antenatal PFMT relevant strategies and perineal trauma. Therefore, we did not deeply compare PFMT relevant strategies with perineal massage. This network meta-analysis provided moderate certainty evidence for the use of "PFMT combine with perineal massage" and PFMT to prevent perineal trauma.

Strengths and limitations

The strength of our study was that we considered most current PFMT relevant strategies for the prevention of perineal trauma. Application of the network meta-analysis framework allowed to compare multiple relative strategies and rank the best agents for preventing perineal trauma given the evidence to date from RCTs. However, there were several limitations in our study. First, we did not consider all antenatal strategies; therefore, our conclusion was limited to these strategies we focused on. Second, we did not consider cost effectiveness, scalability, and sustainability of these strategies. Third, we have not found any research about patient's preference; therefore, the most effective strategy might not be accepted by pregnant women.

Interpretation

The strategies of PFMT and perineal massage were popular in many countries. However, now, PFMT is more used in the PFM recovery, and perineal massage is more used in intrapartum. Several effective antenatal strategies, including perineal massage and exercise were already accessible in some clinical and community settings. However, the decision to use any of these strategies, and the order in which they might be used, was based on choices made by physician and patient, and to some extent was influenced by many factors.

In view of the results, with moderate certainty of evidence, antenatal "PFMT combine with perineal massage" and PFMT were effective in the prevention of perineal trauma. Clinicians and healthcare professionals could consider to recommend these strategies based on the condition and preference of pregnant women.

Appendix

Table 2 Search strategy

#	Searches	Results
Pubmed		
1	"Yoga"[Mesh] OR "Pelvic Floor"[Mesh] OR "Rehabilitation"[Mesh] OR "Exercise"[Mesh]	508,208
2	"pelvic floor"[Title/Abstract] OR "perineal exercise"[Title/Abstract] OR PFM[Title/Abstract] OR PFMT[Title/Abstract] OR Kegel*[Title/Abstract] OR Knack[Title/Abstract] OR "stabilising exercise*" OR "Postpartum Exercise"[Title/Abstract] OR apparatus*[Title/Abstract] OR "treatment instrument"[Title/Abstract] OR "therapeutic device"[Title/Abstract] OR yoga[Title/Abstract] OR "urine stream interruption"[Title/Abstract] OR "vaginal cone*"[Title/Abstract] OR "Vaginal weight cone*"[Title/Abstract] OR "EPI-NO"[Title/Abstract] OR "deep core stability exercise"[Title/Abstract] OR Rehabilitation[Title/Abstract]	291,881
3	#1 OR #2	729,995
4	Obesity, maternal [MeSH] OR Pregnancy Outcome[MeSH] OR Delivery, Obstetric[MeSH]	150,477
5	pregnant[Title/Abstract] OR pregnancy[Title/Abstract] OR perinatal[Title/Abstract] OR birth[Title/Abstract] OR childbirth[Title/Abstract] OR delivery[Title/Abstract] OR obsity[Title/Abstract] OR Maternal–Fetal[Title/Abstract]	1,188,671
6	#4 OR #5	1,232,966
7	#3 AND #6 Filters: randomized Controlled Trial	2076
Embase		
1	'Yoga'/exp OR 'pelvis floor'/exp OR 'rehabilitation'/exp OR 'exercise'/exp	795,374
2	('pelvic floor' OR 'perineal exercise' OR 'PFM' OR 'PFMT' OR 'Kegel*' OR 'Knack' OR'stabilising exercise*' OR 'Postpartum Exercise' OR 'apparatus*' OR 'treatment instrument' OR 'therapeutic device' OR 'yoga' OR 'urine stream interruption' OR 'vaginal cone*' OR 'Vaginal weight cone*' OR 'EPI-NO' OR 'deep core stability exercise' OR 'Rehabilitation' OR 'transversus abdominus contraction' OR 'physics rehabilitation' OR 'Puerperal exercise*' OR 'cure instrument' OR 'manipulation instrument'):ti,ab,kw	396,973
3	#1 OR #2	1,037,588
4	'Pregnancy'/exp OR 'delivery'/exp OR 'obstetric'/exp	946,819
5	pregnant:ti,ab,kw OR pregnancy:ti,ab,kw OR perinatal:ti,ab,kw OR birth:ti,ab,kw OR childbirth:ti,ab,kw OR delivery:ti,ab,kw OR obesity:ti,ab,kw OR 'maternal fetal':ti,ab,kw	1,928,861
6	#4 OR #5	2,294,439
7	rct:ti,ab,kw OR 'randomized controlled trial':ti,ab,kw	152,417
8	#3 AND #6 AND #7	2204
The Cochrane library		
1	MeSH descriptor: [Yoga] explode all tress	699
2	MeSH descriptor: [Pelvic Floor] explode all tress	541
3	MeSH descriptor: [Rehabilitation] explode all tress	37,180
4	MeSH descriptor: [Exercise] explode all tress	25,628
5	("pelvic floor" OR "perineal exercise" OR PFM OR PFMT OR Kegel* OR Knack OR "stabilising exercise*" OR "Postpartum Exercise" OR apparatus* OR "treatment instrument" OR "therapeutic device" OR yoga OR "urine stream interruption" OR "vaginal cone*" OR "Vaginal weight cone*" OR "EPI-NO" OR "deep core stability exercise" OR Rehabilitation OR "transversus abdominus contraction" OR "physics rehabilitation" OR "Puerperal exercise*" OR "cure instrument" OR "manipulation instrument"):ti,ab,kw	61,050
6	#1 OR #2 OR #3 OR #4 OR #5	101,239
7	MeSH descriptor: [pregnancy] explode all tress	22,652
8	MeSH descriptor: [Delivery, Obstetric] explode all tress	5,333
9	("pregnant" OR "pregnancy" OR "perinatal" OR "birth" OR "childbirth" OR "delivery" OR "obesity" OR maternal fetal): ti,ab,kw	151,434
10	#7 OR #8 OR #9	151,716
11	("RCT" OR "randomized controlled trial"): ti,ab,kw	542,751
12	#6 AND #10 AND #11	3581trials
CINAHL		
1	MH Yoga OR MH Pelvic Floor Muscles OR MH Rehabilitation + OR Exercise +	78,555

Table 2 (continued)

#	Searches	Results
2	SU "pelvic floor" OR SU "perineal exercise" OR SU "pfm" OR SU "PFMT" OR SU "kegel*" OR SU "Knack" OR SU "apparatus*" OR SU "stabilising exercise*" OR SU "Postpartum Exercise" OR SU "apparatus*" OR SU "treatment instrument" OR SU "therapeutic device" OR SU yoga OR SU "urine stream interruption" OR SU "vaginal cone*" OR SU "Vaginal weight cone*" OR SU "EPI-NO" OR SU "deep core stability exercise" OR SU Rehabilitation OR SU "transversus abdominus contraction" OR SU "physics rehabilitation" OR SU "Puerperal exercise*" OR SU "cure instrument"	41,424
3	S1 OR S2	92,137
4	MH pregnancy OR MH delivery OR MH obesity	55,463
5	SU " pregnant" OR SU "pregnancy" OR SU "perinatal" OR SU "birth" OR SU "childbirth" OR SU "delivery" OR SU "obesity" OR SU "maternal–fetal*"	89,855
6	S4 OR S5	89,855
7	SU RCT or SU randomized controlled trials	22,959
8	S3 AND S6 AND S7	219
CNKI		
1	TKA = PenDiJi OR TKA = KaiGeEr OR TKA = KangFu OR TKA = YuJia OR TKA = ShouZhiZhiShi OR TKA = YinDaoYuanZhui	422,788
2	TKA = FenMian OR TKA = WeiChan OR TKA = YunQi OR TKA = RenShen OR TKA = ChuSheng OR TKA = ChanQian OR TKA = ChanHou	644,894
3	FT = SuiJi	8,559,029
4	#1 AND #2 AND #3	12,436
5	Limit the document type to "Research Paper"	2055
CBM		
1	"PenDiJi"[Common field:intellect] OR "KaiGeEr"[Common field:intellect] OR "KangFu"[Common field:intellect] OR "YuJia"[Common field:intellect] OR "ShouZhiZhiShi"[Common field:intellect] OR "YinDaoYuanZhui"[Common field:intellect]	464,701
2	"FenMian"[Common field:intellect] OR "WeiChan"[Common field:intellect] OR "YunQi"[Common field:intellect] OR "RenShen"[Common field:intellect] OR "ChuSheng"[Common field:intellect] OR "ChanQian"[Common field:intellect] OR "ChanHou"[Common field:intellect]	485,212
3	"SuiJiDuiZhaoShiYan"[Common field:intellect] OR "SuiJiDuiZhaoShiYan"[Common field:intellect]	501,827
4	#1 AND #2 AND #3	1823
WANFANG DATA		
1	Theme:(PenDiJi) or Theme:(KaiGeEr) or Theme:(KangFu) or Theme:(YuJia) or Theme:(ShouZhiZhiShi) or Theme:(YinDaoYuanZhui)	555,422
2	Theme:(FenMian) or Theme:(WeiChan) or Theme:(YunQi) or Theme:(RenShen) or Theme:(ChuSheng) or Theme:(ChanQian) or Theme:(ChanHou)	1,905,546
3	(Theme:(SuiJiDuiZhaoShiYan) or Theme:(SuiJiDuiZhaoShiYan))	2,761,418
4	#1 AND #2 AND #3	504

Table 3 Definitions of different prevention strategies

Strategie	Definition
Pelvic floor muscle training (PFMT)	Any program of repeated voluntary PFM contractions taught by a health-care professional
Perineal massage	Massaging the perineum
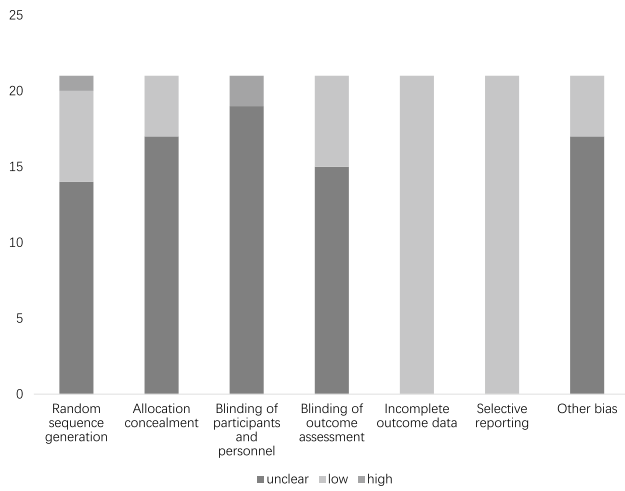
Fig. 5 The risk of bias assessments for studies
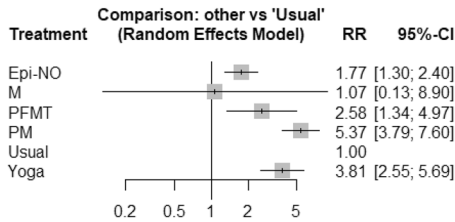
Fig. 6 The forest plot of the rate of intact perineum
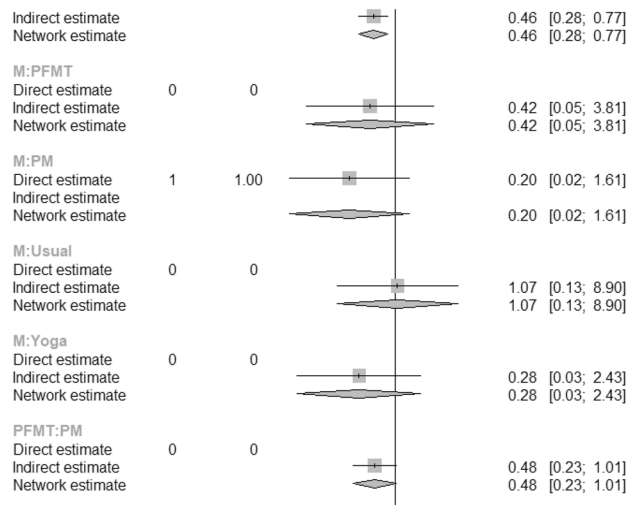
Fig. 7 The pairwise forest plot of the rate of intact perineum
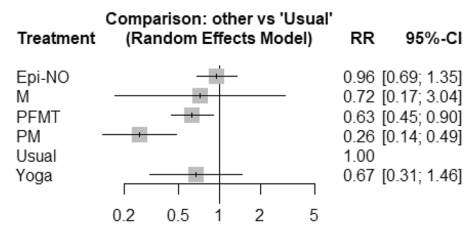
Fig. 8 The forest plot of the rate of episiotomy
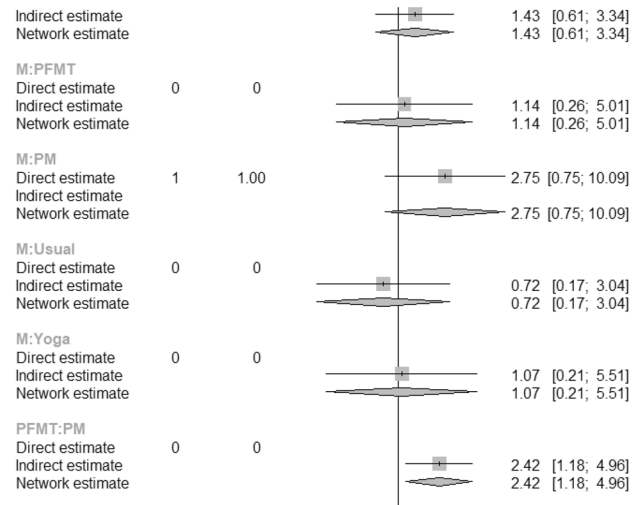
Fig. 9 The pairwise forest plot of the rate of episiotomy
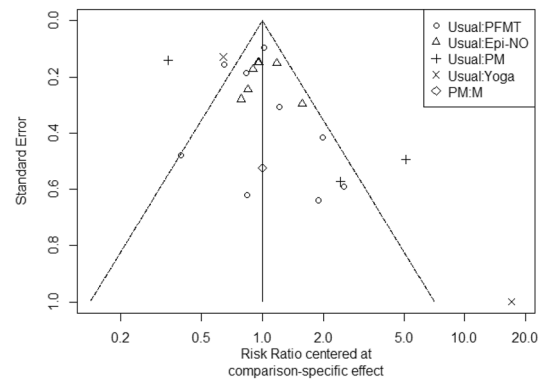
Fig. 10 The funnel plot of the rate of episiotomy
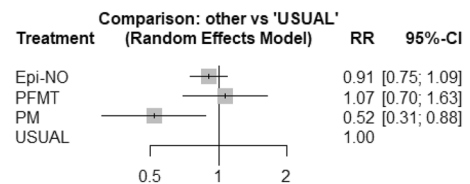
Fig. 11 The forest plot of the rate of perineal tear
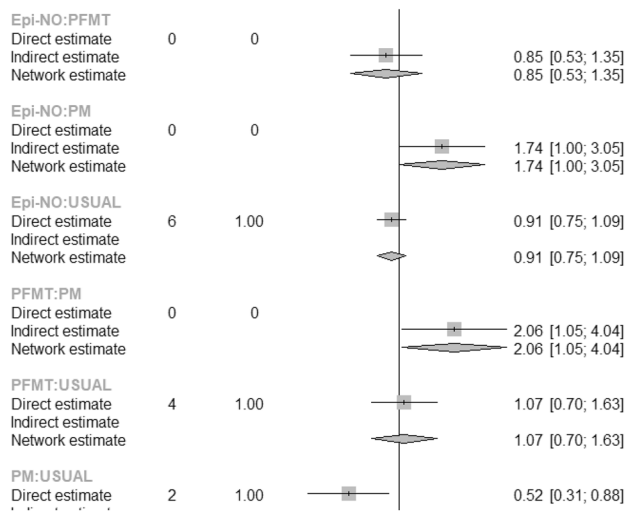
Fig. 12 The pairwise forest plot of the rate of perineal tear
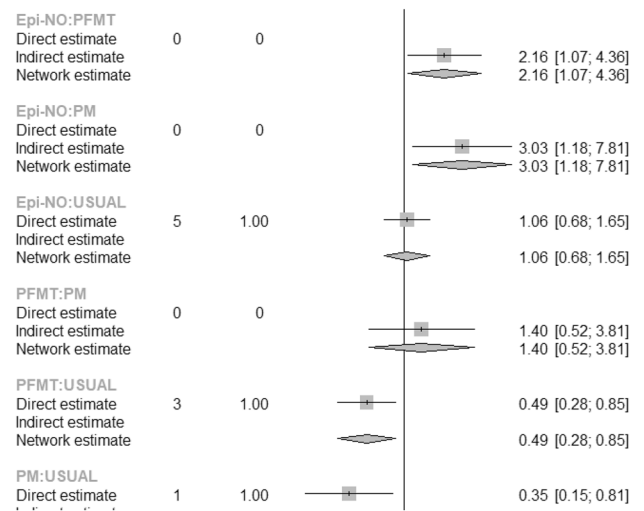
Fig. 15 The pairwise forest plot of the rate of OASIS
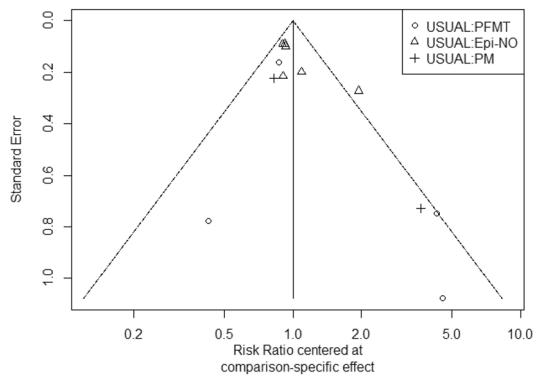
Fig. 13 The funnel plot of the rate of perineal tear
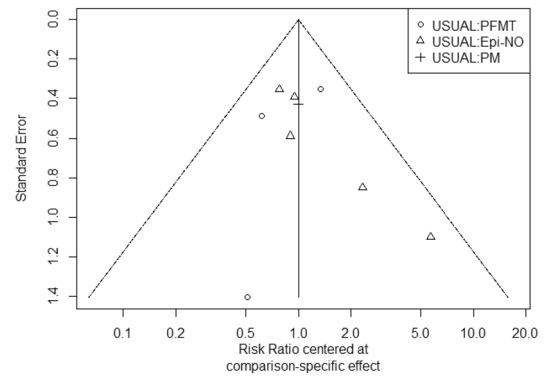
Fig. 16 The funnel plot of the rate of OASIS
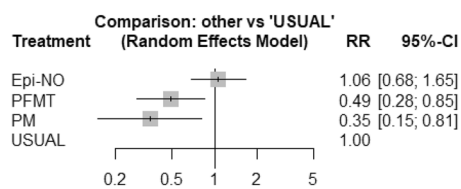
Fig. 14 The forest plot of the rate of OASIS
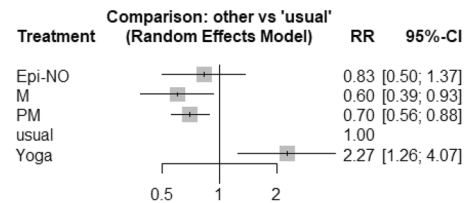
Fig. 17 The forest plot of the rate of slight perineal tear
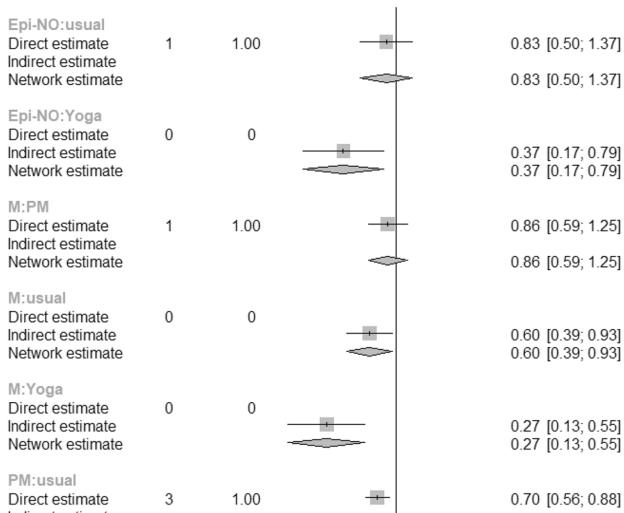
Fig. 18 The pairwise forest plot of the rate of slight perineal tear
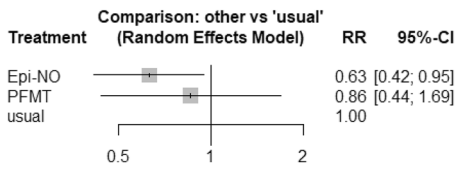
Fig. 19 The forest plot of the rate of assisted vaginal delivery
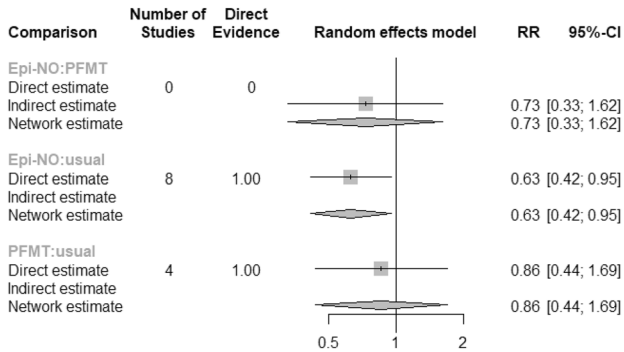
Fig. 20 The pairwise forest plot of the rate of assisted vaginal delivery
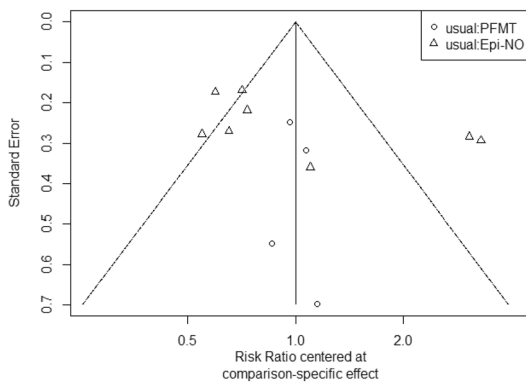
Fig. 21 The funnel plot of the rate of assisted vaginal delivery
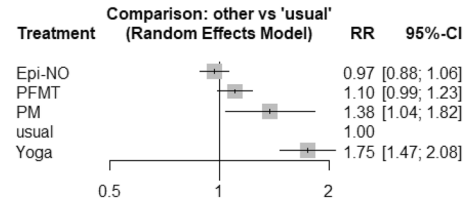
Fig. 22 The forest plot of the rate of natural childbirth
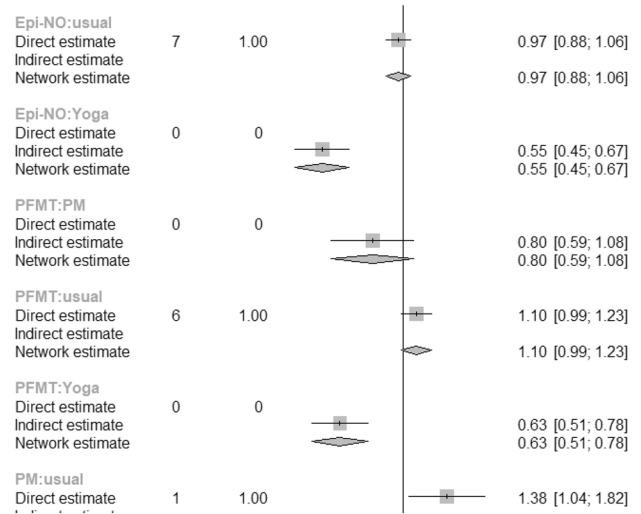
Fig. 23 The pairwise forest plot of the rate of natural childbirth
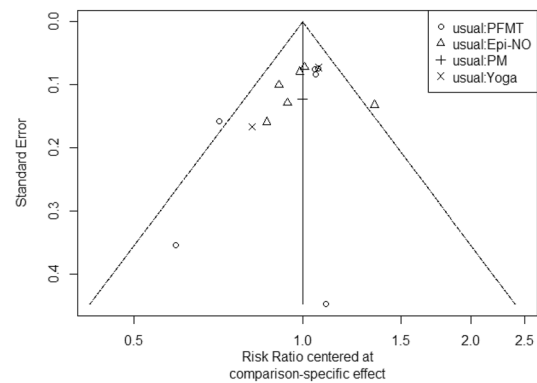
Fig. 24 The funnel plot of the rate of natural childbirth
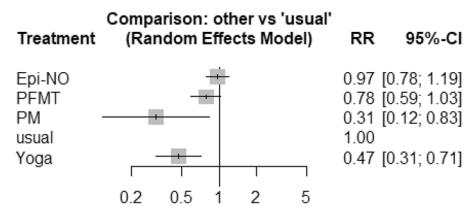
Fig. 25 The forest plot of the rate of caesarean section
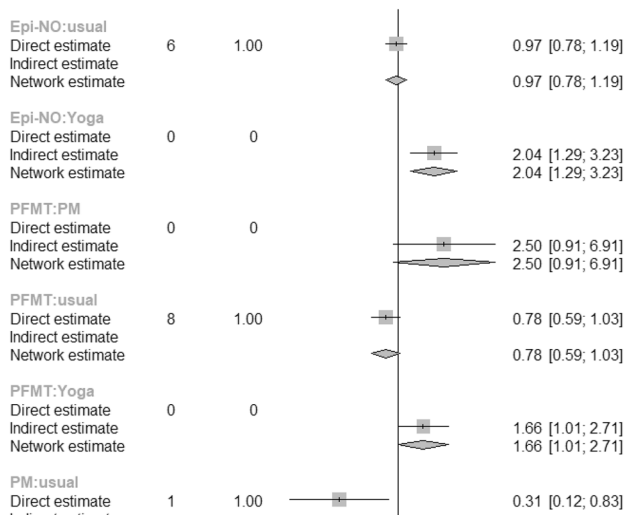
Fig. 26 The pairwise forest plot of the rate of caesarean section
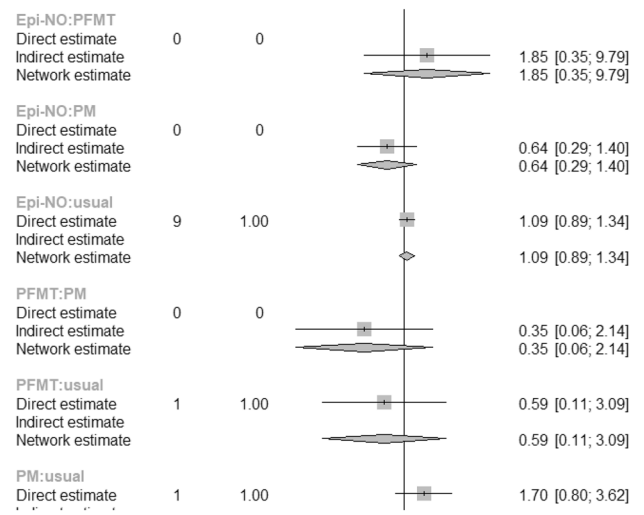
Fig. 29 The pairwise forest plot of the rate of fetal distress
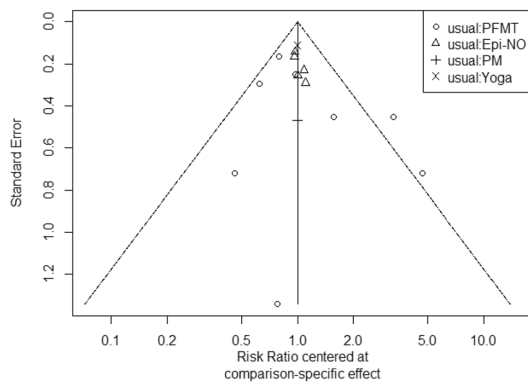
Fig. 27 The funnel plot of the rate of caesarean section
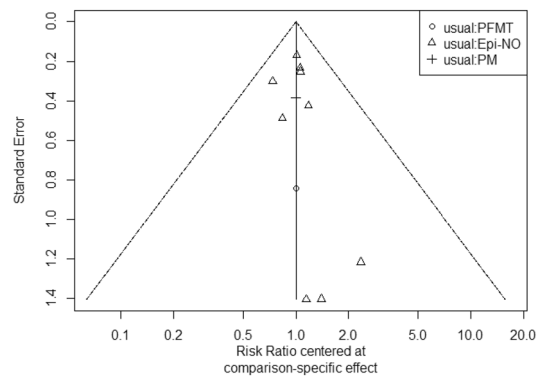
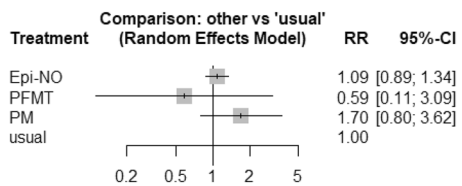**Fig. 30** The funnel plot of the rate of fetal distress
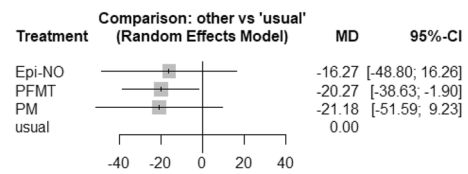

Fig. 28 The forest plot of the rate of fetal distress

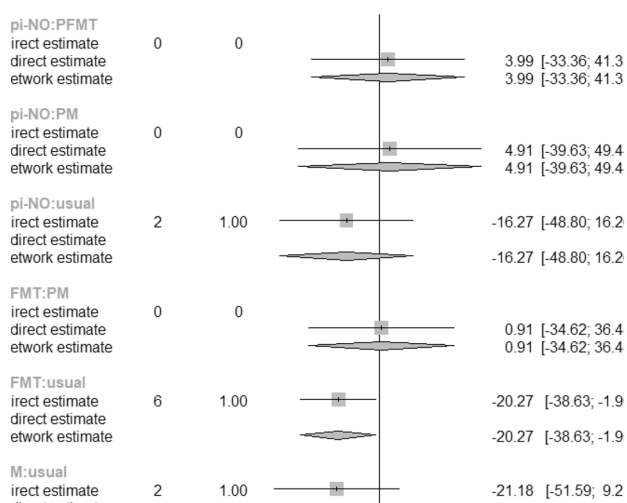**Fig. 31** The forest plot of the duration of the second stage of labor

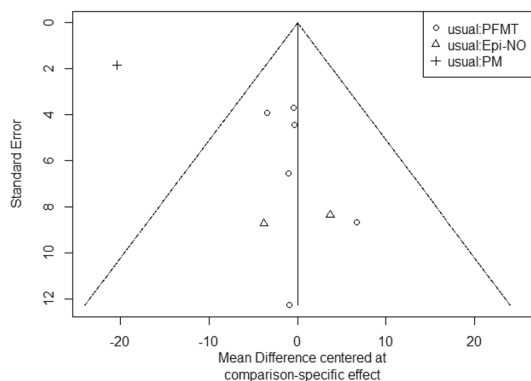**Fig. 32** The pairwise forest plot of the duration of the second stage of labor

Fig. 33 The funnel plot of the duration of the second stage of labor

Author contribution XC: the conception of the work, the acquisition, analysis, and interpretation of data for the work, draft and revise the work. QYY: the conception of the work, the acquisition, analysis, and interpretation of data for the work. QW: the conception of the work, the acquisition, analysis, and interpretation of data for the work, revise the work. SH: the design of the work, the acquisition, analysis, and interpretation of data for the work. LH: the conception of the work, the acquisition, analysis, and interpretation of data for the work, revise the work. MS: the conception of the work, the acquisition, analysis, and interpretation of data for the work. HL: the conception of the work, the acquisition, analysis, and interpretation of data for the work, revise the work. CW: the conception of the work, the acquisition, analysis, and interpretation of data for the work. YW: the conception of the work, the acquisition, analysis, and interpretation of data for the work. LX: the design of the work, the acquisition, and interpretation of data for the work, revise the work. XL: the design of the work, revise the manuscript, final approval of the version to be published. JT: the design of the work, revise the manuscript, final approval of the version to be published. LG: the conception and design of the work, revise the

manuscript, final approval of the version to be published, coordinate the overall work. CL: t the conception and design of the work, revise the manuscript, final approval of the version to be published, coordinate the overall work.

Declarations

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