

# The Effectiveness of Laid-back Position on Lactation Related Nipple problems and comfort: A meta-analysis

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## Research article

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## Abstract

**Background** The importance of breastfeeding for maternal and child health has become an international consensus. However, it has been found that lactation-related nipple problems are common and there are some important factors affecting the breastfeeding. Multiple studies recommended the laid-back breastfeeding, but they are on various levels of quality and the results are inconclusive.

**Methods** We systematically searched the following twelve databases: Cochrane Library, EMBASE, Medline, Ovid, PubMed, Web of Science, CINAHL, Scopus, SinoMed, Chinese National Knowledge Infrastructure (CNKI), WanFang, and VIP from inception to January 28,2020. All studies regarding the laid-back breastfeeding or biological nurturing were considered, regardless of whether they are randomized controlled trials or not. Two trained investigators independently evaluated the quality of the selected articles and screened the data. All the data were analyzed separately using Review Manager Version 5.3 and STATA/SE Version 15.1.

**Results** A total of 12 studies involving 1,936 groups of postpartum women and their newborns were included. The results of meta-analysis showed that nipple pain (RR = 0.24; 95% CI 0.14,0.40;  $p < 0.00001$ ), nipple trauma (RR = 0.47; 95% CI 0.29,0.75;  $p = 0.002$ ), the correct position of latching (RR = 1.22; 95% CI 1.11,1.33;  $p < 0.00001$ ) and position comfort (ES = 0.09; 95% CI -0.63,0.81;  $p = 0.000$ ) of experimental groups were all better than that of the control groups, and the differences were statistically significant ( $p < 0.05$ ), which indicate that the laid-back position has a positive effect on maternal breastfeeding.

**Conclusion** Laid-back position has been proved to related with decreasing the incidence of nipple trauma and nipple pain compared with traditional breastfeeding positions, and it appears that laid-back position is conducive to the correct position of latching. However, current evidence does not show different breastfeeding outcomes in the two groups of position comfort. Laid-back position is helpful to solve lactation-related nipple problems and it can be used as a recommended position for breastfeeding.

## Background

Breastmilk provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life [1]. Two papers published in the journal of Lancet [2, 3] showed that over 820 000 children's lives could be saved every year among children under 5 years, if all children 0-23 months were optimally breastfed. In 2012, the World Health Assembly (WHA) Resolution 65.6 endorsed a comprehensive implementation plan on maternal, infant and young child nutrition, which specified the target that by 2025, it aimed to increase the rate of exclusive breastfeeding in the first 6 months up to at least 50% [4]. According to the implementation plan for maternal, infant and young child nutrition, in 2011–2016, an estimated 40% of infants under 6 months were exclusively breastfed. Actually, among the 101 countries of which statistics are available, 33 countries have exclusive breastfeeding rates of above 50% while 68 have rates of below 50% [5].

There are many factors that affect breastfeeding, and the breastfeeding position is among the most important ones. Inappropriate breastfeeding position may have negatively effect on the mother's wellbeing and exacerbate related diseases through a negative impact on the infant's positioning, latch and duration of breastfeeding events[6]. According to a study[7], around 70.3% of mothers suffered breastfeeding difficulties, including cracked nipples, perception of insufficient amount of milk, pain, and fatigue. It was painful for many mothers to hold their infant to breastfeed, pick up their infant, and sit comfortably to breastfeed. Nipple pain is the second most common reason for early weaning, exceeded only by the insufficient milk supply[8, 9]. Nipple fissures are accessible for bacteria and can lead to mastitis. The major causes of nipple pain and trauma are inappropriate breastfeeding techniques and improper positioning of infants[8]. A systematic review[10] showed that the most common themes were perceived inadequate supply and breast or nipple pain in economically developed countries. Nipple pain caused by the incorrect position of latching is a common problem among breastfeeding mothers, which can lead to nipple trauma and pose an important obstacle to successful breastfeeding[11-13]. Poor latching is associated with pain when breastfeeding. In the meantime, correct positioning and latch are essential for increasing milk supply and intake[14-16].

Traditional breastfeeding positions include patterns like the cradle, cross cradle, side-lying and football position. Breastfeeding initiation is associated with releasing inborn baby reflexes and instinctive mothering behaviors[17]. Colson developed the concept of Biological Nurturing (BN) in the early 1990s[18], then she put forward the strategy of biological nurturing in 2000[19], which was also known as Laid-back Breastfeeding (LBBF). It was a breastfeeding instinct of returning to biology, which included lactation concepts of environment, reflex, intervention, and neurodevelopment. It was defined as a neurobehavioral approach to the initiation of breastfeeding so as to reduce latch problems and accidental early cessation of breastfeeding[17]. Biological nurturing can be used throughout the breastfeeding period (from the time of birth to the end of breastfeeding). It is a collective term for mother-baby positions and states that interrelate and interact to release primitive neonatal reflexes and spontaneous maternal breastfeeding behaviors[20].

However, at present, the varied quality of relevant researches bring out the controversial results. The laid-back position has not been popularized in breastfeeding health education around the world and there are also insufficient high-quality researches setting as backbone for this approach in relation to the effects of breastfeeding. This paper was targeted at evaluating the effect of laid-back breastfeeding (Biological Nurturing) on breastfeeding through evidence-based methods, so as to provide references for the formulation and specification of breastfeeding position/positions.

## Methods

The study has been prepared according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline[21] (Supplementary file 1). All articles were imported into to a citation manager (EndNote X9), and the duplicates were removed. Two trained investigators (the first and second

authors of this paper) searched the databases and screened the titles and abstracts independently.

### **Criteria of inclusion and exclusion**

The criteria for studies to be included in this review were the following: (1) Participating mothers aged over 18 (of which will not be considered as Child marriage [22]) who are healthy and willing to breastfeed; (2) mothers adopted laid-back breastfeeding (Biological Nurturing) position in the experienced group while any of traditional breastfeeding positions, including the cradle, cross cradle, side-lying and football position were used in control group; (3) the effects of the intervention were assessed by nipple trauma, nipple pain, the correct position of latching and position comfort; (4) the use of clinical studies, including randomized controlled trials (RCTs) and quasi-randomized controlled trials.

In this review, the laid-back breastfeeding (Biological Nurturing) refers to mothers are in comfortable semi-reclined positions where every part of their body is supported especially their shoulders, neck and arms, babies lie prone or on their tummies but their bodies are not flat but tilted up in the process of breastfeeding[20]. Nipple pain is pain that occurs in the breast tissue around the area of the nipple, which can be associated with other symptoms that may include breast pain, nipple discharge, breast lump or mass, itching, or skin changes[23]. Nipple trauma was defined as a macroscopic traceable cutaneous lesion in the area of the nipple and areola, which may occur in the form of fissures, eroded skin and ulcerations, or clinical evidence of erythema, edema, blisters, white, yellow, or dark stains, and ecchymosis[24]. The correct position of latching refers to that the infant's gum line is placed well over the mother's lactiferous sinuses, the tongue is positioned under the areola, and both lips are flanged outward[25]. Position comfort in this study is regarded theoretically as a state of being strengthened by having needs met of human experience and mothers are happy with their health care in the process of breastfeeding[26].

The studies were excluded if they: (1) were different from the research contents; (2) had no full-text available; (3) included the unextractable raw data and fail to contact with the author; (4) lacked of outcome indicators; (5) were published other than in English or Chinese; (6) were those of reviews, editorials, books, thesis, news etc.

### **Search Strategy**

We systematically searched the following twelve databases: Cochrane Library, EMBASE, Medline, Ovid, PubMed, Web of Science, CINAHL, Scopus, SinoMed, Chinese National Knowledge Infrastructure (CNKI), WanFang, and VIP, from inception to January 28,2020. The search was carried out using the following keywords or medical subject headings

(Mesh) terms: ["breast-feed" OR "Feeding, Breast" OR "Breastfeeding" OR "Breast Feeding, Exclusive" OR "Exclusive Breast Feeding" OR "Breastfeeding, Exclusive" OR "Exclusive Breastfeeding" OR "Breast-feeding"] AND ["Laid-back" OR "Half lay" OR "Semi recumbent position" OR "Semi-reclining position" OR "semirecumbent" OR "Half lying type" OR "semi supine position" OR "semiprone position"] AND ["Biological Nurturing" OR "recommending biological breeding" OR "Laid-back Breastfeeding" OR "Laid-back breast feeding" OR "Half lay breast-feeding"]. In order to have a full understanding of this topic, we also manually tracked the references in the included articles and contacted investigators in the field to locate unpublished studies, but no one is available. The search strategies are listed in Supplementary file 2.

### **Data Extraction and Synthesis**

Two reviewers independently assessed the studies for eligibility and extracted the data using a standardized data extraction form and then checked by the third reviewer. Disagreements were resolved via discussion with a third author. Studies selected for inclusion were transferred to a Microsoft Excel spreadsheet for extraction of data items of: Basic information of the included literature (first author, year of publication, study design), baseline characteristics (sample size, inclusion and exclusion criteria, deliver mode, maternal category, gestational weeks, age mothers) and analysis index (interventions, intervention time, outcomes). When information regarding study methods and results was unclear, we contacted the authors for further details. Disagreements were resolved by discussion with all members of the research team until a consensus was reached.

### **Quality Assessment**

The risk of bias of each RCT was evaluated independently by two investigators using the RoB 2.0 tool excerpted from the Cochrane Handbook for Systematic Reviews of Interventions (Version 6,2019)[27], which included the following domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. For each domain, the tool comprises a series of "signalling questions" and once they were answered, the next step is to reach a risk-of-bias judgement and assign one of three levels to each domain[27, 28]: "low risk of bias", "some concerns", or "high risk of bias". Finally, risk-of-bias judgements within domains were mapped to an overall judgement for the outcome. The risk of bias of each quasi-randomized controlled trial was evaluated independently by two investigators using the JBI Critical Appraisal Checklist for Quasi-Experimental Studies (JBI, 2016)[29], "Yes", "No", "Unclear" or "Not applicable" were evaluated for 9 items respectively. Any disagreements regarding the inclusion of studies were resolved through discussion; if a consensus failed to be reached, a senior reviewer served as the final arbiter.

### **Statistical Analysis**

Statistical analyses were performed by Review Manager Version 5.3 and STATA/SE Version 15.1 (StataCorp, College Station, TX, USA). In order to eliminate the errors by man-made and combine the functions of different software, all the data were analyzed separately by two investigators using different softwares (ZW: STATA/SE and QL: RevMan). Dichotomous outcome data were pooled using the risk ratio (RR) and presented as 95%CI, and continuous

outcome data were presented as Mean  $\pm$  SD and were pooled using mean difference (MD) and 95% CI. For the situation where data for the same outcome are presented in some studies as dichotomous data and in other studies as continuous data (position comfort), we re-expressed odds ratios as SMDs according to the simple formula  $SMD = \log OR \times (\sqrt{3}/\pi = 0.5513)$ , then computed SMDs (or log odds ratios) and their standard errors for all studies in the meta-analysis, allowing dichotomous and continuous data to be combined by using the generic inverse-variance method [30, 31].

Heterogeneity was assessed statistically by using the Chi<sup>2</sup> ( $\chi^2$ , or chi-squared) test and I<sup>2</sup> statistic. When  $p > 0.10$  or  $I^2 \leq 50\%$ , a fixed-effects model was utilized. It is considered that several similar studies included have homogeneity or the heterogeneity are acceptable. When  $p \leq 0.10$  or  $I^2 > 50\%$ , it is believed that there is heterogeneity in the results of multiple included studies, and subgroup analysis or sensitivity analysis was performed to identify sources of heterogeneity. Then removed the selected literatures one by one, recalculated overall correlation results and I<sup>2</sup>. A random-effects model was selected if the heterogeneity still couldn't be eliminated. To assess the effects of covariates on the pooled estimates, subgroup analysis [32] and meta-regression analysis were conducted respectively. If there is considerable variation in results and that cannot be removed, the meta-analysis should be abandoned, and the evidences would be presented in a narrative form only.

Publication bias was detected using Egger linear regression tests [33] since no more than 10 original articles were enrolled in all analyses.  $p$ -values (two-tailed)  $< 0.05$  was considered statistically significant. For the studies with publication bias, we conducted sensitivity analyses (trim and fill method) to explore publication bias and the robustness of the meta-analysis conclusions to different assumptions about the causes of funnel plot asymmetry [34-36].

## Results

### Search Results

Literature selection process was shown in the PRISMA flow diagram [21] (Figure 1), including reasons for exclusion. Initially, a total of 296 publications were retrieved from the following 12 electronic databases: Cochrane Library ( $n = 7$ ), EMBASE ( $n = 13$ ), Medline ( $n = 14$ ), Ovid ( $n = 122$ ) PubMed ( $n = 12$ ), Web of Science ( $n = 31$ ), CINAHL ( $n = 22$ ), Scopus ( $n = 11$ ), SinoMed ( $n = 13$ ), CNKI ( $n = 18$ ), WanFang ( $n = 17$ ) and VIP ( $n = 16$ ). The search of the reference lists of included studies did not yield any additional studies. After eliminating duplicates, 214 references were included. Then, the remaining 214 studies were screened by titles and abstracts yielding an additional 179 being excluded. The rest 35 articles were screened for full text, of which 22 were excluded as they were not appropriate study designs ( $n = 18$ ) or interventions ( $n = 4$ ). Moreover, one article was excluded because the data was difficult to extract and we failed to contact with the author. Finally, 12 articles were fulfilled the eligibility criteria and included in the meta-analysis.

### Characteristics of the included studies

A total of 12 unique studies ( $n=1,936$  groups of postpartum women and their newborns, there were 970 groups in the experimental groups and 966 groups in the control groups.) from 2 countries (China and Thailand) were included. There were 11 RCTs and 1 quasi-randomized controlled trial. The included studies were reported in English (one trial) and Chinese (eleven trials). No significant difference was observed between the two groups in terms of the studied variables. All the included studies were published from 2017 up to 2019. The intervention time of the studies ranged from 0~3 days to 0~8 weeks. The outcomes included nipple trauma ( $n = 7$ ), nipple pain ( $n = 8$ ), the correct position of latching ( $n = 3$ ) and position comfort ( $n = 4$ ). We set three subgroups according to intervention, deliver mode and maternal category. Studies were divided into two groups according to whether or not they took the skin-to-skin care (SSC) [37], in another words, the mother and baby had direct skin contact. The group of laid-back breastfeeding was represented by LBBF and LBBF+SSC was used to represent the group of taking skin-to-skin care on the basis of laid-back breastfeeding. In the maternal delivery mode subgroup, according to the category of the included subjects, studies were divided into "vaginal delivery" group and "vaginal delivery & caesarean" group. In the subgroup of the maternal category, studies were divided into "primipara" group and "primipara & multipara" group according to whether the delivery times is restricted. Further details about the included studies were shown in Table 1, Table 4 and Table 5.

Unfortunately, all included studies did not report the age of the infants. We only found that all the researches began with after the babies born. Thus, the baby's age is estimated to be 0 day to 8 weeks based on the periods of the intervention.

**Table 1: Characteristics of the studies included in the meta-analysis.**

Author (year)	Sample size (n) (E/C)	Study design	Vaginal delivery/ Caesarean (n)		Primipara /Multipara (n)		Gestational weeks (Mean±SD) (E/C)	Age of mothers (years) (Mean±SD) (E/C)	Interventions (E/C)	Intervention periods	Outcomes
			E	C	E	C					
Zhuang (2019)[38]	75/75	RCT	38/37	35/40	—	—	—	26.2±4.7/ 25.3±4.5	Laid-back Breastfeeding (BN) /Traditional breastfeeding position	108w	Nipple pain
Shi et al. (2017)[39]	84/84	RCT	50/34	52/32	56/28	55/29	36039/ 36040	27.98±4.25/ 28.51±4.69	Laid-back Breastfeeding (BN) /Traditional breastfeeding position	103d	Nipple pain, Nipple trauma
Li et al. (2017)[40]	100/100	RCT	64/36	68/32	60/40	64/36	38040/ 37040	27.86±4.25/ 27.43±4.17	Laid-back Breastfeeding (BN) /Traditional breastfeeding position	103d	Nipple pain, Nipple trauma, Position Comfort, The correct posture of latching
Yu et al. (2019)[41]	100/100	RCT	0/100	0/100	100/0	100/0	39.06±1.08/ 39.33±1.06	27.43±4.14/ 27.40±3.81	Laid-back Breastfeeding (BN) /Cradle breastfeeding (Traditonal position)	103d	Nipple trauma, Position Comfort
Zeng et al. (2019)[42]	60/60	RCT	42/18	44/16	—	—	39.35±1.23/ 39.42±1.13	26.75±4.23/ 27.28±4.42	Laid-back Breastfeeding (BN) /Cradle breastfeeding (Traditonal position)	1d04w	Nipple pain
Puapornpong et al. (2017) [43]	76/76	RCT	0/76	0/76	—	—	38.5±0.9/ 38.6±1.0	27.5±5.9/ 27.1±6.1	Laid-back Breastfeeding (BN) /Side-Lying Breastfeeding (Traditonal position)	1d06w	Position Comfort
Liu et al. (2019)[44]	49/49	RCT	—	—	—	—	—	—	Laid-back Breastfeeding (BN) /Traditional breastfeeding position	104w	Nipple pain, Nipple trauma
Zhang (2019)[45]	74/70	RCT	58/16	56/14	74/0	70/0	38.89±0.96/ 39.09±0.97	25.82±3.43/ 26.16±3.62	Laid-back Breastfeeding (BN+SSC) /Cradle breastfeeding (Traditonal position)	1042d	Nipple pain, The correct posture of latching
Zhao (2019)[46]	48/48	RCT	48/0	48/0	—	—	39.57±1.06/ 39.40±1.11	26.31±2.82/ 27.27±3.83	Laid-back Breastfeeding (BN+SSC) /Traditional breastfeeding position	103d	Nipple pain
Liang et al. (2017)[47]	200/200	RCT	200/0	200/0	—	—	—	—	Laid-back Breastfeeding (BN+SSC) /Traditional breastfeeding position	103d 04h/d0	Nipple trauma
Wang (2019)[48]	50/50	RCT	27/23	30/20	34/16	32/18	—	27.9±2.3/ 27.7±2.1	Laid-back Breastfeeding (BN+SSC) /Standard care (Traditonal position)	1m	Nipple pain, Nipple trauma
Lu et al. (2019)[49]	54/54	Q-RCT	—	—	26/28	25/29	38.95±0.45/ 39.50±0.50	26.88±3.32/ 26.76±3.25	Laid-back Breastfeeding (BN+SSC) /Standard care (Traditonal position)	1w	Nipple trauma, Position Comfort, The correct posture

E: experimental group  
C: control group  
h: hour; d: day; w: week; m: month  
SD: standard deviation  
Q-RCT: quasi-randomized clinical trial

### Risk of Bias Assessment

The quality of all included RCT studies was shown in Table 2 and Fig. 2, further details (all the domains) about the risk assessments were shown in Supplementary file 3. For the judgement of "bias arising from the randomization process", five[39-41, 44, 48] of the 11 included RCT didn't show the detailed information on random components in the sequence generation process, eight studies[38-42, 44, 46, 48] were judged to raise some concerns, while three studies[43, 45, 47] were judged to be at low risk of bias. They concealed the allocation sequence by envelopes which were sequentially numbered, sealed with a tamper-proof seal and opaque. With regard to the judgement of "Bias due to deviations from intended interventions", only two studies[43, 45] reported the compliance to the intervention, and they were judged to be at low risk of bias. All included studies were judged to be at low risk of bias in the judgement of "bias due to missing outcome data". For the judgement of "Bias in measurement of the outcome", three studies[39, 47, 48] judged to raise some concerns and others[38, 40-46] were judged to be at low risk of bias. For the judgement of "bias in selection of the reported result", there was one study[47] judged to raise some concerns because the trial didn't analyze in accordance with a pre-specified plan, ten studies[38-46, 48] were judged to be at low risk of bias. Overall, three RCTs (27 %) are at high RoB, six (55 %) showed some concerns, and two (18 %) are at low RoB for their outcomes. The quality of the only one quasi-randomized controlled trial included was presented in Table 3.

**Table 2: Results of critical appraisal for Randomized Controlled Trials (Cochrane, 2019)**

Study (year)	Bias arising from the randomization process	Bias due to deviations from intended interventions	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall risk-of-bias
Zhuang (2019) [38]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Shi et al. (2017)[39]	Some concerns	Some concerns	Low risk	Some concerns	Low risk	High risk
Li et al. (2017) [40]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Yu et al. (2019)[41]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Zeng et al. (2019)[42]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Puapornpong et al. (2017) [43]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Liu et al. (2019)[44]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Zhang (2019) [45]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Zhao (2019) [46]	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Liang et al. (2017)[47]	Low risk	Some concerns	Low risk	Some concerns	Some concerns	High risk
Wang (2019) [48]	Some concerns	Some concerns	Low risk	Some concerns	Low risk	High risk

**Table 3: Results of critical appraisal for quasi-experimental studies (JBI, 2016)**

Questions (potential bias)	Lu et al. (2019)[49]
1. Is it clear in the study what is the 'cause' and what is the 'effect'? (causation/reverse causation)	Yes
2. Were the participants included in any comparisons similar? (selection bias)	Yes
3. Were the participants included in any comparisons receiving similar treatment/care, other than the intervention of interest? (history threat/ systematic difference/contamination bias)	Yes
4. Was there a control group? (measurement bias)	Yes
5. Was there multiple measurements of the outcome both pre and post the intervention? (maturation threat, regression to the mean)	Yes
6. Was follow-up complete, and if not, was follow-up adequately reported and strategies to deal with loss to follow-up employed? (attrition bias)	Yes
7. Were the outcomes of participants included in any comparisons measured in the same way? (instrumentation / testing effects threats)	Yes
8. Were outcomes measured in a reliable way? (detection / instrument / measurement bias)	Yes
9. Was appropriate statistical analysis used? (performance / detection bias)	Yes

## Synthesis of results

### Nipple pain

Eight studies[38-40, 42, 44-46, 48], with a total of 1,076 groups of postpartum women and their newborns, compared traditional breastfeeding positions vs. laid-back breastfeeding in nipple pain. There was substantial heterogeneity among these studies ( $\chi^2 = 125.27, p < 0.00001, I^2 = 94\%$ ) by using the heterogeneity test (Fig. 4). It seems that one outlier[38] has a great influence on the results of the overall meta-analysis by using the sensitivity analyses, which is a major source of heterogeneity. After removing it, the result of the heterogeneity test with the remaining 7 studies decreased the  $I^2$  to 73% ( $\chi^2 = 22.46, p = 0.001, I^2 = 73\%$ ). Therefore, a random-effects model was utilized for meta-analysis, the result showed that the experimental group had a lower incidence of nipple pain than the control group (RR = 0.24; 95% CI 0.14,0.40;  $p < 0.00001$ ). It is worth mentioning that the result of the heterogeneity test decreased the  $I^2$  to 0% ( $\chi^2 = 2.02, p = 0.85, I^2 = 0\%$ ) after removing the two studies[38, 45], probably because of the different measurement tools of included studies.

### Nipple trauma

Seven studies[39-41, 44, 47-49], which included 1,274 groups of postpartum women and their newborns, reported nipple trauma. The result what these trials of the heterogeneity test showed that there was substantial heterogeneity among these studies ( $\chi^2 = 40.95, p < 0.00001; I^2 = 85\%$ ) (Fig. 3), probably because of the different interventions. However, the sensitivity analyses did not show any study to be substantially influencing the heterogeneity. Thus, a random-effects model was utilized for meta-analysis, the result showed that the experimental group had a lower incidence of nipple trauma than the control group (RR = 0.47; 95% CI 0.29,0.75;  $p = 0.002$ ).

### The correct position of latching

There are three studies[40, 45, 49], which included 452 couples of postpartum women and their newborns, that reported the correct position of latching. The incidence of the correct position of latching did not significantly differ between the two groups ( $\chi^2 = 0.09, p = 0.95, I^2 = 0\%$ ), so we used a fixed-effect model

to pool the summary outcome, the results showed that the experimental group had a higher incidence of correct position of latching than the control group (RR = 1.22; 95% CI 1.11,1.33;  $p < 0.00001$ ) (Fig. 5).

### Position comfort

Four studies[40, 41, 43, 49] reported the data of position comfort, and these studies including 660 couples of postpartum women and their newborns. There were two dichotomous data[40, 49] and two continuous data[41, 43] among them. The results of the heterogeneity test showed that there was substantial heterogeneity among these studies ( $\chi^2 = 25.58$ ,  $p < 0.0001$ ,  $I^2 = 88\%$ ) using the heterogeneity test, probably because of the different deliver modes.

Nevertheless, the sensitivity analyses did not show any study to be substantially influencing the heterogeneity. Therefore, a random-effects model was utilized for meta-analysis, the result showed that there was no statistical significance in the two groups (ES = 0.09; 95% CI -0.63,0.81;  $p = 0.000$ ) (Fig. 6).

### Subgroup Analysis

Three subgroups analysis were undertaken according to the intervention, deliver mode and maternal category. We evaluated the reliability of outcomes and the results are presented in Table 4 and Table 5. For the outcome of nipple trauma, the results of subgroup analysis are, on the whole, the same as the overall results, and the direction had no change. There was no evidence of a different effect related to the intervention ( $p$  for interaction = 0.24), deliver mode ( $p$  for interaction = 0.37), and Maternal category ( $p$  for interaction = 0.37). The subgroup analysis of different interventions showed that the experimental group had a lower incidence (RR = 0.68; 95% CI 0.47,0.99) of nipple trauma than the control group according to the group of Laid-back Breastfeeding (LBBF), but there was no statistical significance (RR = 0.24; 95% CI 0.04,1.31) in the group of taking skin-to-skin care on the basis of Laid-back Breastfeeding (LBBF+SSC). The subgroup analysis of different deliver modes and Maternal categories showed that the group of vaginal delivery & caesarean (RR = 0.50, 95% CI 0.30,0.82) and primipara & multipara (RR = 0.50, 95% CI 0.30,0.82) both had a slightly higher incidence of nipple trauma than the group of caesarean (RR 0.32; 95% CI 0.13,0.76) and primipara (RR = 0.32; 95% CI 0.13,0.76). Similarly, the results of subgroup analyses of nipple pain indicate that there was no evidence of a different effect related to the intervention ( $p$  for interaction = 0.51), deliver mode ( $p$  for interaction = 0.97), and Maternal category ( $p$  for interaction = 0.14). Overall, the results of subgroup analysis showed that all the experimental group had a lower incidence of nipple trauma than the control group, and there was no change about the results of study.

**Table 4: Subgroup Analysis of the Effect of Intervention Elements on Nipple trauma.**

Subgroups	Number of studies	Participants(n#)	The test for heterogeneity		Effects model	Meta-analysis RR#95%CI#	Interaction <i>p</i> -value
			(Experiments /Controls)	<i>p</i> -value			
Intervention							0.24
LBBF	4[39-41, 44]	333/333		0.023	68.5%	Random	0.68 (0.47,0.99)
LBBF +SSC	3[47-49]	304/304		0.000	90.2%	Random	0.24 (0.04,1.31)
Deliver mode							0.37
Caesarean	1[41]	100/100		—	—	Random	0.32 (0.13,0.76)
Vaginal delivery & Caesarean	6[39, 40, 44, 47-49]	537/537		0.000	85.8%	Random	0.50 (0.30,0.82)
Maternal category							0.37
Primipara	1[41]	100/100		—	—	Random	0.32 (0.13,0.76)
Primipara & Multipara	6[39, 40, 44, 47-49]	537/537		0.000	85.8%	Random	0.50 (0.30,0.82)

**Table 5: Subgroup Analysis of the Effect of Intervention Elements on Nipple pain.**

Subgroups	Number of studies	Participants(n#)	The test for heterogeneity		Effects model	Meta-analysis RR#95%CI#	Interaction <i>p</i> -value
			(Experiments /Controls)	<i>p</i> -value			
Intervention							0.51
LBBF	5[38-40, 42, 44]	368/368		0.000	96.9%	Random	0.23 (0.06,0.94)
LBBF +SSC	3[45, 46, 48]	172/168		0.096	57.3%	Random	0.39 (0.21,0.71)
Deliver mode							0.97
Vaginal delivery	1[46]	48/48		—	—	Random	0.27 (0.15,0.51)
Vaginal delivery & Caesarean	7[38-40, 42, 44, 45, 48]	492/488		0.000	94.9%	Random	0.28 (0.12,0.66)
Maternal category							0.14
Primipara	1[45]	74/70		—	—	Random	0.57 (0.39,0.84)
primipara & multipara	7[38-40, 42, 44, 46, 48]	466/466		0.000	95.6%	Random	0.24 (0.08,0.70)

### Publication bias

We used Egger linear regression tests to detect the publication bias arising from various influencing factors quantitatively for there is a concern remains that visual interpretation of funnel plots is inherently subjective. The  $p$ -values of the correct position of latching ( $p = 0.152$ ) and position comfort ( $p = 0.138$ ) were greater than 0.05, which indicates that there is no significant publication bias. Although the  $p$ -values of nipple pain ( $p = 0.008$ ) and nipple trauma ( $p = 0.013$ ) were less than 0.05, there is no missing 'counterparts' to filled after analyzed by trim and fill method. It indicates that the results of the two outcomes are stable and the effect of publication biases is negligible. To sum up, the results showed no significant risk of publication bias among the studies that were included.

## Discussion

This meta-analysis was conducted to estimate the effect of laid-back position on lactation-related nipple problems. The results of this study showed that the experimental group had a lower incidence of nipple trauma (22.4% vs. 38.5%) and nipple pain (13.8% vs. 55.1%) than that of the control group. It is suggested that the laid-back position has a positive effect on maternal breastfeeding on nipple pain, nipple trauma and the correct position of latching. Further study about the position comfort remains to be done.

Nipple pain is reported as one of the main causes for giving up breastfeeding prematurely[50, 51]. Most women experience some degree of pain during breastfeeding, ranging from mild to severe pain, which may be accompanied by nipple trauma. A Systematic Review indicated that averagely 80% to 90% of breastfeeding women experienced the nipple pain[52]. Our meta-analysis showed that the experimental group had a lower incidence than the control group (13.8% vs. 55.1%, RR = 0.24; 95% CI 0.14,0.40;  $p < 0.00001$ ). This result is similar to study carried out in Italy[53], which has reported that biological nurturing significantly reduced the risk of sore nipples from 46.9% to 27.8% (RR 0.59, 95% CI 0.40, 0.88). These results may be explained by a higher proportion of successful latching and self-attachment with the laid-back position[53]. Nipple pain was measured on rating scales which was developed based on general population. No unified and specialized comprehensive assessment scale for nipple pain has been formed.

Nipple trauma is the main cause of nipple pain, and it is a well-recognized risk for breastfeeding cessation[51]. A study in Australia reported that 58% of women experienced nipple trauma in the first 8 weeks postpartum[54]. Our results suggested that BN reduced the incidence of nipple trauma with 16.1% (RR = 0.47; 95% CI 0.29,0.75;  $p = 0.002$ ). Nipple trauma includes nipple redness and swelling, nipple crack, nipple blister, nipple ulcer, nipple keratinization and nipple defect[45]. Nipple cracks is the most common type of nipple trauma in this study and there were 4 studies[41, 44, 47, 48] showed that laid-back position can help to reduce the incidence of nipple cracks compared to traditional position (4.2% vs. 19.8%). Nipple trauma causes pain and discomfort, which render it difficult for the mother to continue breastfeeding[55]. Nipple pain and nipple trauma exert an influence on each other, Improper feeding position can interfere with the tissue repair process and can lead to further damage[11]. we should pay more attention to the evaluation of these two aspects.

Correction of positioning and attachment is the most common experience-based recommendation for treatment of nipple pain[56]. A qualitative analysis to identify breastfeeding barriers in early postpartum found that the most common barrier was the mother's perceived inadequate supply and difficulty with latch[57]. This study indicated that BN increased the success rate of "the correct position of latching" with RR of 1.22(95% CI 1.11,1.33;  $p < 0.00001$ ). Laid-back position is conducive to the correct position of latching (89.5% in the intervention group and 73.7% in the control group), which may be contribute to successful breastfeeding. However, this conclusion should be treated with caution because only three trials[40, 45, 49] included.

It is not sure from this study that if the laid-back position were superior to the traditional position regarding to comfort in the period of breastfeeding. Current evidence did not show differences of position comfort that are subjective feelings of the mothers between the two groups. This could be due to the small sample size of included studies or the different data types, which weakens the assessment of the results of meta-analysis. Thus, further research about the effect of laid-back position on position comfort remains to be done in the future.

Breastfeeding is biology-based nurturing rooted in instinct[20]. Laid-back breastfeeding can be adopted even if there is early separation after the birth or the mother was suffering problems with breastfeeding. National Childbirth Trust (NCT) breastfeeding counsellor Ros Vinall [58] considers that Biological Nurturing or "Laid-back Breastfeeding" taps into mothers' and babies' own instincts for getting breastfeeding successfully underway. She also highlighted that the Biological Nurturing approach can take breastfeeding out of the medical model with its need for instruction and prescriptive rules. Colson's research emphasized the biological underpinnings of breastfeeding, empowering parents to be active participants in feeding, rather than merely relying on the instincts of the infant[20]. Colson is also committed to train Biological Nurturing Certified Lactation Consultant (BNCLC) to assist mothers with Laid-back Breastfeeding[59]. Meanwhile, laid-back breastfeeding was a revelation for human beings, as it accords with our humanist, non-interventionist and back-to-biological spirit.

The quality of included studies was moderate and the results should be interpreted with caution. Many of the original studies set it as a single blind. The nurses who followed up with the breastfeeding outcomes did not know the breastfeeding position groups and all the included studies did not report if the researchers who analyzed data know which is experimental group or not. Most of the original studies did not report compliance to the intervention. The reason might be that breast-feeding is a private activity, researchers can only give guidance, so it was hard to monitor the whole process. Thus, we should pay attention to this issue in future studies and take some measures to ensure compliance, such as videotaping with informed consent.

All the data were analyzed separately by two investigators using different software, the results show that this method can effectively avoid human errors such as data entry errors and improper operation, and it also combined the functions of different software. We found that, in practice, the  $I^2$  and Z values of the continuous variables obtained by the two software are slightly different but it didn't affect the outcomes, which is probably related to software algorithms, and all other results were identical.

## Limitation

The present meta-analysis has some potential limitations: (1) We considered all RCTs and quasi-randomized controlled trials published in English and Chinese, the studies that published in other language were not included, the selection bias might be existed; (2) The heterogeneity in some comparisons is significant and it may influence the pooled results, although we used random-effects model; (3) Three subgroups analysis were undertaken according to the intervention, deliver mode and maternal category, but other factors that could influence the outcome might exist; (4) In this study, only quantitative indicators were analyzed and the vast majority of the included studies were published in Chinese for the reason that most of the studies were qualitative reports researched in other countries.

## Conclusions

The results of this meta-analysis suggest that the laid-back position is helpful to solve lactation-related nipple problems and it can be used as a recommended position for breastfeeding. Nurses and researchers may instruct mother to take the laid-back position for decreasing the incidence of nipple trauma and nipple pain during breastfeeding. However, current evidence does not show significant disparities of breastfeeding outcomes between the two groups. Also, the quality of included studies is not high. Therefore, further researches with high-quality and large scale are needed to be done to explore the effects of laid-back breastfeeding on lactation-related nipple problems.

## Abbreviations

WHO: World Health Organization

WHA: World Health Assembly

BN: Biological Nurturing

LBBF: Laid-back Breastfeeding

LLL: La Leche League International

RCT: Randomized Controlled Trials

SSC: skin-to-skin care

BFC: breastfeeding counsellor

NCT: National Childbirth Trust

BNLCL: Biological Nurturing Certified Lactation Consultant

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Availability of data and materials

The data sets analyzed during the current study will be available upon reasonable request of the corresponding author.

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

ZW formulated the research question and led the design of the study. ZW and QL conceived the study, contributed to the conception and design of the meta-analysis, generated search strategy, determined selection criteria, evaluated literature quality, extracted and synthesized data, did statistical analysis, described the results, conducted bias risk assessment and drafted the manuscript. LM and XM contributed to the conception and design of the study, reviewed the manuscript, provided advice on data analysis and proposed amendments and addenda to the first draft. All authors have read and approved the final manuscript.

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## Figures

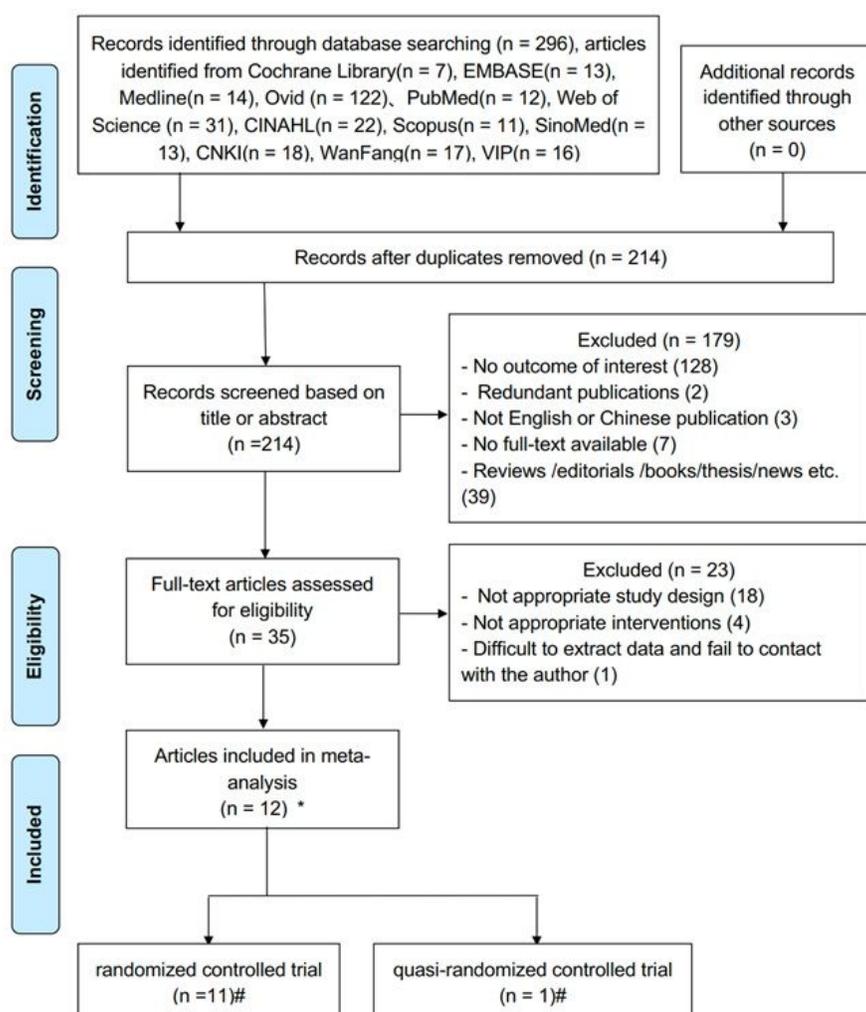


Figure 1

PRISMA: Flow diagram of literature search and study selection. \*Twelve papers were included in meta-analysis. #Eleven studies were included in RCT and one study was included in quasi-randomized controlled trial.

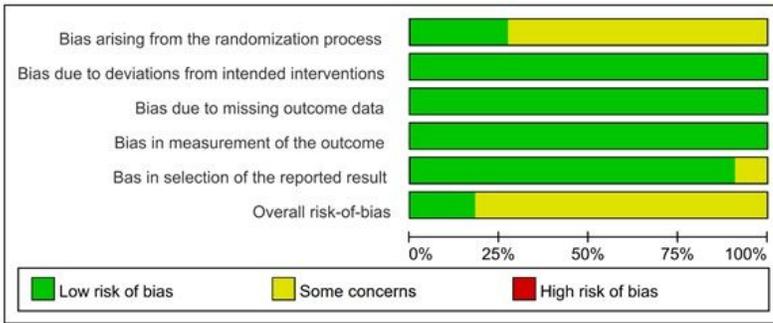


Figure 2

Risk of bias graph (RCT)

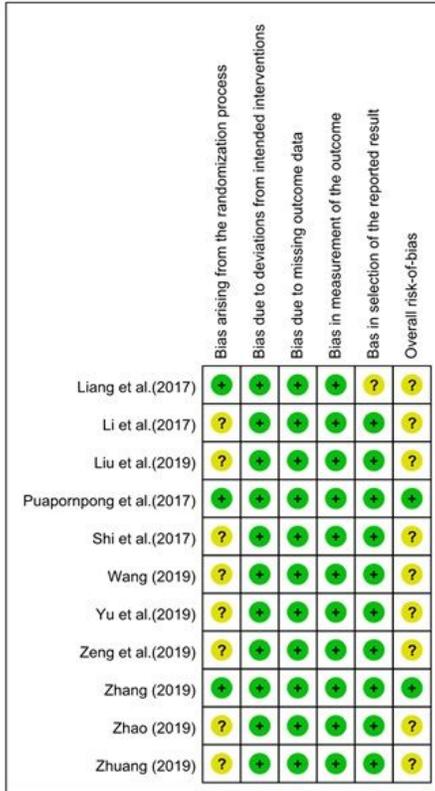


Figure 3

Risk of bias summary graph (RCT)

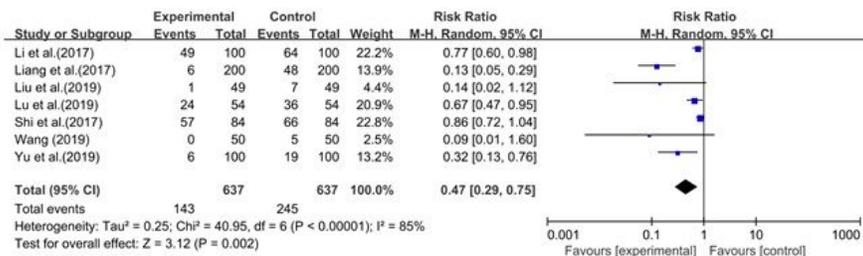


Figure 4

Forest plots for the incidence of nipple trauma between laid-back position and traditional position on breastfeeding.

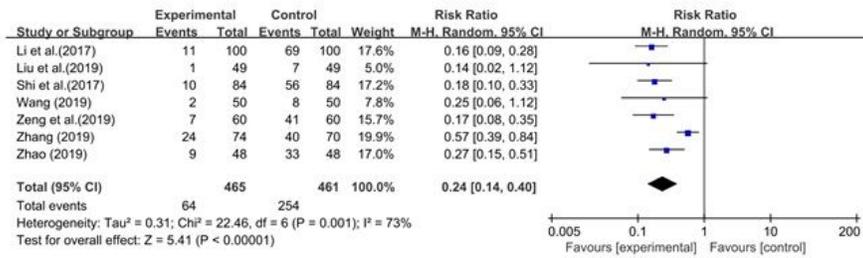


Figure 5

Forest plots for the incidence of nipple pain between laid-back position and traditional position on breastfeeding.

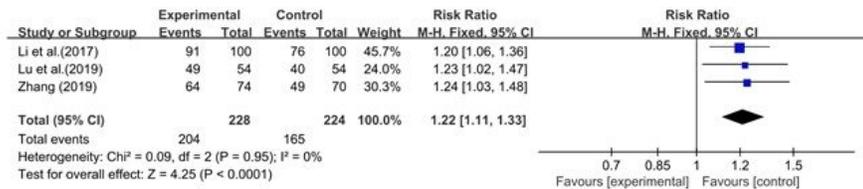


Figure 6

Forest plots for the correct position of latching between laid-back position and traditional position on breastfeeding.

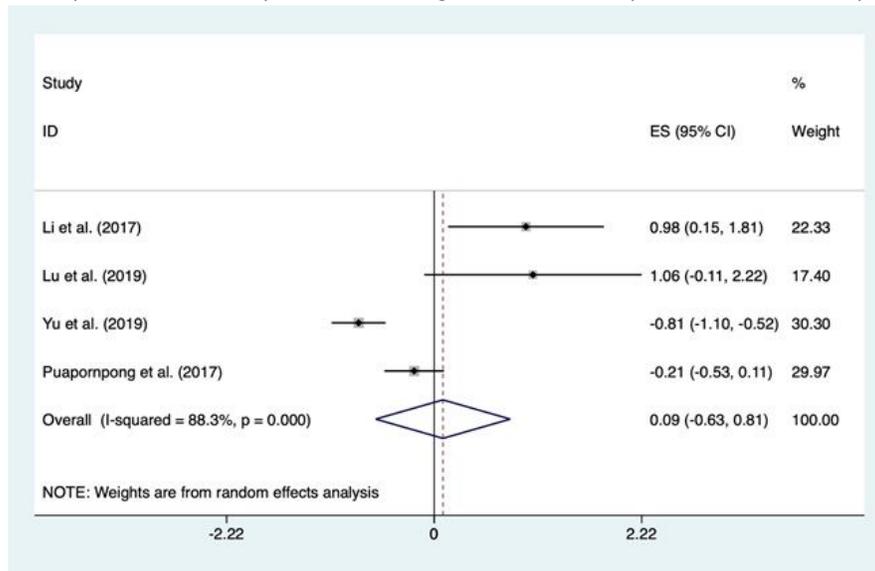


Figure 7

Forest plots for the position comfort between laid-back position and traditional position on breastfeeding.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementaryfile1PRISMA2009checklist.pdf](#)
- [Supplementaryfile2Searchstrategies.pdf](#)
- [Supplementaryfiles.rar](#)