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Effects of parental involvement in infant care in neonatal intensive care units: a meta-analysis

Original article

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Abstract: **Objective:** This meta-analysis aimed to examine the effects of parental involvement in infant care in neonatal intensive care units (NICUs).

Methods: PubMed, Embase, Cochrane Library, Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang database, and VIP database were searched till November 2017. Randomized controlled trials (RCTs) and controlled clinical trials (CCTs) examining the effect of parental involvement in the NICU were considered for inclusion.

Results: We included 10 studies (three RCTs, seven CCTs) with a total of 1,851 participants. The meta-analysis demonstrated that there were no statistically significant differences on nosocomial infection between two groups (risk ratio [RR] = 0.90, 95% CI 0.63–1.30, $P = 0.58$). Compared with no parental involvement groups, parental involvement groups showed more weight gain (mean difference [MD] = 1.47, 95% CI 0.65–2.29, $P < 0.05$), higher breast-feeding rate (RR = 1.38, 95% CI 1.25–1.53, $P < 0.05$), lower readmission rate (RR = 0.35, 95% CI 0.15–0.80, $P < 0.05$), and higher satisfaction rate (RR = 1.09, 95% CI 1.02–1.16, $P < 0.05$).

Conclusions: Parental involvement in the NICU interventions could not increase the rate of nosocomial infection of neonates, but could improve their weight gain, breast-feeding and parental satisfaction and decrease their readmission. However, since the conclusion of this meta-analysis was drawn based on the limited number of high-quality RCTs, more high-quality studies should be conducted in the future to confirm its positive intervention effects.

Keywords: *family integrated care • intensive care units • neonatal • infant • newborn • meta-analysis*

1. Introduction

With the advances in neonatal intensive care unit (NICU) medicine, more and more premature or sick infants are being successfully rescued. However, although equipment and technology in the NICU have improved dramatically in recent years, the patterns of care for NICU infants remain unchanged in China.[1] As a policy, parents are not allowed to enter the NICU wards during infant's stay, with all care of infants provided by medical specialists. This is different from the regular nursery that parents care neonates all the time from birth. In addition, in the current NICU conditions, newborns are usually physically, psychologically, and emotionally separated from their parents, which may inhibit parent–infant interaction and may affect parents' and infants' health outcomes.[2]

Canada has recently proposed a novel model of NICU called "family integrated care" (FICare), which involves parents in the care of their NICU infants. In addition, the study showed that, compared with matched controls, parental involvement group resulted in an increase in weight gain and the rate of breast-feeding and a decrease in parental stress, nosocomial infection, and critical incident reports,[3] while the results of the relevant studies conducted in India and China had some differences with it.[4,5]

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Given the different available evidence in the literature, this meta-analysis aimed to evaluate whether parents participating in their NICU management are good for neonates and their parents.

2. Methods

2.1. Search Strategy

Seven databases, i.e., PubMed, Embase, Cochrane Library, Web of Science, CNKI, Wanfang database, and VIP were searched till November 2017, including articles published in both English and Chinese. A combination of text words and controlled vocabulary terms was used: family nursing, family integrated care (FIC), family centered care (FCC), family support*, family involve*, family integrated nursing*, family centered nursing*, parent* integrated, parent* centered; NICU, neonatal intensive care unit*, newborn intensive care unit*, neonatal icu*, newborn icu*. Duplicate studies were removed from the search results prior to the screening process using Endnote software. First screening and full-text screening were conducted independently by two investigators. A third investigator was consulted to resolve inconsistent opinions in either phase. In addition, relevant articles were hand searched in an effort to obtain additional studies for inclusion.

2.2. Inclusion and exclusion criteria

2.2.1. Study types

Studies were eligible for inclusion if they were randomized controlled trials (RCTs) or controlled clinical trials (CCTs), which addressed the effects of parental involvement in the NICU.

2.2.2. Study participants

Newborns or premature neonates who were treated in the NICUs were included. However, infants or premature neonates who were in the no-accompany neonatal wards would be excluded. We also excluded those who were suffering from genetic metabolic diseases, congenital malformations, ischemic and hypoxic encephalopathy, and severe heart disease or critically sick.

2.2.3. Types of interventions

Studies were included if they reported the intervention of parental involvement in the NICU under the guidance of nurses, such as feeding, bathing, dressing, holding, providing skin-to-skin care, kangaroo care, eyes care, oral care, umbilical care, massage, interaction, or other basic nursing. Articles with parental involvement were included regardless of patterns, duration and frequency. Considering continuous care after discharge may be an interference factor of our interventions, which may influence the interventions' effect on readmission and satisfaction, we excluded studies with continuous nursing. Interventions that were only conducted several days near discharge to make discharge education or combined with other therapies were also excluded.

2.2.4. Types of controls

The control group was treated with traditional nursing in NICUs that parents were not allowed to enter the NICU ward or there were only short-time visits within the time prescribed, and the care of infants was provided exclusively by medical specialists.

2.2.5. Types of outcome measures

We defined our primary outcomes as nosocomial infection. Our secondary outcomes were weight gain, breastfeeding, readmission within 1 month after discharge, and satisfaction.

2.3. Data extraction

Data were collected independently by two investigators and compared for accuracy. A third investigator was consulted to resolve differences in opinions. Extracted data included general study design (author, year, design, sample size), sample characteristics (gender, age), intervention characteristics (content, time, frequency), and outcome measures. Continuous data, including mean with standard error of the mean, were gathered. If the outcomes were dichotomous data, events and total number were extracted.

2.4. Risk of bias

Risk of bias for each study was assessed independently by two investigators based on the Cochrane Risk of Bias Assessment Tool.[6] A third investigator was consulted to resolve differences in opinions. The Cochrane Risk of Bias Assessment Tool contains seven assessment domains related to random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Each domain was assessed as low, high, or unclear risk of bias.

2.5. Data analysis

Statistical heterogeneity between studies was calculated using the I^2 metric[6] and $I^2 > 50\%$ suggesting obvious heterogeneity. Potential sources of heterogeneity, if significant, were further investigated by subgroup analysis. A random-effects model was used to combine the studies with $I^2 > 50\%$, and a fixed-effects model was applied to combine the studies with $I^2 \leq 50\%$. For the relevant outcomes, either unidentified heterogeneity or incomparable data points that prevented quantitative analysis, we just provided a narrative summary of significant results. The publication bias was evaluated by funnel plots. Funnel plots were visually assessed for asymmetry.[6] All statistical analyses were performed using the Cochrane statistical software, RevMan 5.3.[7]

3. Results

3.1. Study selection

Our literature search generated 1,851 results based on the utilized search terms, and one result was included by manual searching. A total of 1,506 studies remained after duplicates were removed. After preliminary screening by title and abstract, 282 studies were isolated for full-text review. From this, 10 publications met the predefined eligibility criteria (Figure 1).

3.2. Description of the included studies

The review studies included 1,208 subjects, with gestational age ranging from 24 to 42 years. The main characteristics of the 10 clinical trials are summarized in Table 1.

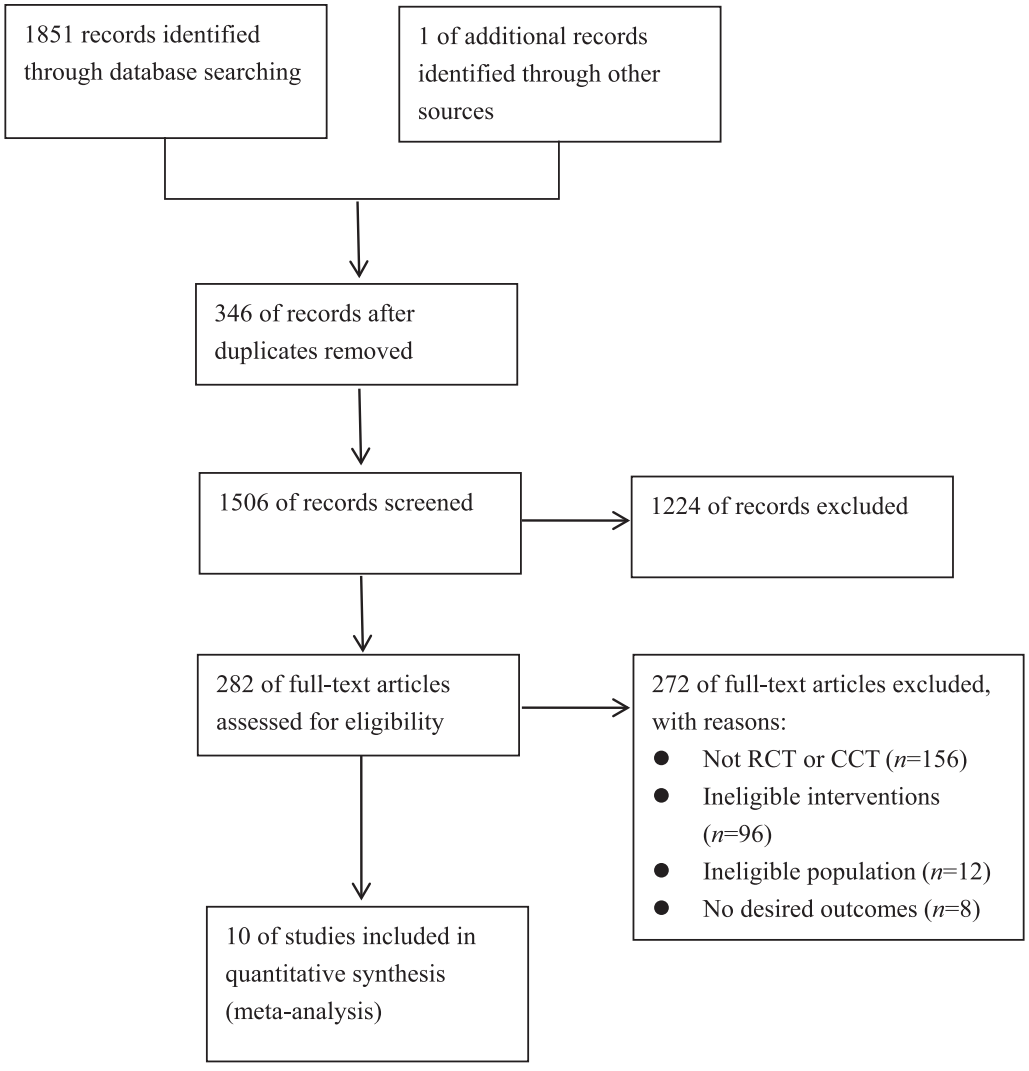

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart of selection process of the meta-analysis.

Author	Study design	Sample size	Participants (gender, gestational age)	Interventions	Time/ frequency	Controls	Outcomes
Verma et al[4]	RCT	E: 148 C: 147	203 males, 92 females; 28–42 weeks	1. Preparation 2. Receive training 3. Participate in nursing	Not reported	Traditional care	Nosocomial infection; hospitalization time; breast-feeding
O'Brien et al[3]	CCT	E: 31 C: 62	Gender was not reported; ≤35 weeks	1. Receive training 2. Participate in nursing	≥8 hours/day	Traditional care	Nosocomial infection; weight gain; breast-feeding
Shen et al[11]	CCT	E: 36 C: 38	43 males, 31 females; <34 weeks	1. Preparation 2. Receive training 3. Participate in nursing 4. Discharge education	Not reported	Traditional care	Nosocomial infection; hospitalization time; breast-feeding; weight gain; readmission
Lv et al[12]	CCT	E: 54 C: 52	64 males, 42 females; 26–34 weeks	1. Preparation 2. Receive training 3. Participate in nursing	3 hours/day	Traditional care	Nosocomial infection; hospitalization time; breast-feeding; weight gain; readmission; satisfaction
Li et al[13]	CCT	E: 23 C: 23	27 males, 19 females; 28–36 weeks	1. Preparation 2. Receive training 3. Participate in nursing 4. Discharge education	≥3 hours/day	Traditional care	Care knowledge; satisfaction
Yu et al[14]	CCT	E: 58 C: 56	58 males, 56 females; 28–37 weeks	1. Receive training 2. Participate in nursing	Every day, but intervention time per day was not reported	Traditional care	Satisfaction
Ma[10]	CCT	E: 48 C: 48	43 males, 53 females; 28–33 weeks	1. Preparation 2. Receive training 3. Participate in nursing 4. Discharge education	Every day, but intervention time per day was not reported	Traditional care	Readmission
Liang et al[8]	RCT	E: 34 C: 34	37 males, 31 females; 24–36 weeks	1. Receive education 2. Participate in nursing	Not reported	Traditional care	Breast-feeding
Ding et al[9]	RCT	E: 56 C: 62	Gender was not reported; 32–37 weeks	1. Receive training 2. Participate in nursing	≥8 hours/day	Traditional care	Hospitalization time; breast-feeding
He et al[5]	CCT	E: 100 C: 98	Gender was not reported; E: 35.22 ± 1.70 weeks C: 34.63±1.91 weeks	1. Preparation 2. Receive training 3. Participate in nursing	≥4 hours/day	Traditional care	Nosocomial infection

Table 1. Characteristics of the included studies.

Notes: Preparation: learning sterile environment and operation, washing hand, wearing gown, learning NICU system, familiarizing with NICU environment. Receive training: any education or training about infant nursing. Participate in nursing: including feeding, bathing, dressing, holding, providing skin-to-skin care, kangaroo care, eyes care, oral care, umbilical care, massage, interaction, or other basic nursing. Discharge education: heath education about how to care infants after discharge. Traditional care: parents were not allowed to enter the NICU ward or there were only short-time visits within the time prescribed, and the care of infants was provided exclusively by medical specialists.C, control group; CCT, controlled clinical trial; E, experiment group; NICU, neonatal intensive care unit; RCT, randomized controlled trial.

3.3. Risk of bias assessment

For quality assessment, three studies described a random component,[4,8,9] but only one study mentioned the random sequence generation.[4] Verma et al.[4] only correctly employed allocation sequence concealment. Blinding of participants and assessors was not performed in all the included studies because the interventions could not be concealed. However, the outcome measures (nosocomial infection, hospitalization time, breast-feeding, weight gain, readmission) of Ding et al. and He et al. were objective and were not likely to be influenced by the lack of blinding,[3-5,8-11] so the blinding risk of these studies was evaluated as low. Nine studies did not have the missing data; one had different dropouts between groups and did not have intent-to-treat analysis.[10] All the studies had low selective reporting bias risk. The risk of other bias was considered not present. Allocation concealment and random sequence generation were the most frequent factors for the risk of bias. The risk of bias assessment is shown in Figures 2 and 3.

3.4. Meta-analysis

3.4.1. Nosocomial infection

Five studies compared the nosocomial infection rate across parental involvement groups and no parental involvement groups.[3-5,11,12] There was no significant difference between two groups, as shown in Figure 4 (Fixed effect model [FEM], $Z = 0.56$, $P = 0.58$, $I^2 = 0\%$). One of the studies included in the meta-analysis for this measure had an "A" level of risk of bias,[4] and the other four studies were deemed level "B".[3,5,11,12]

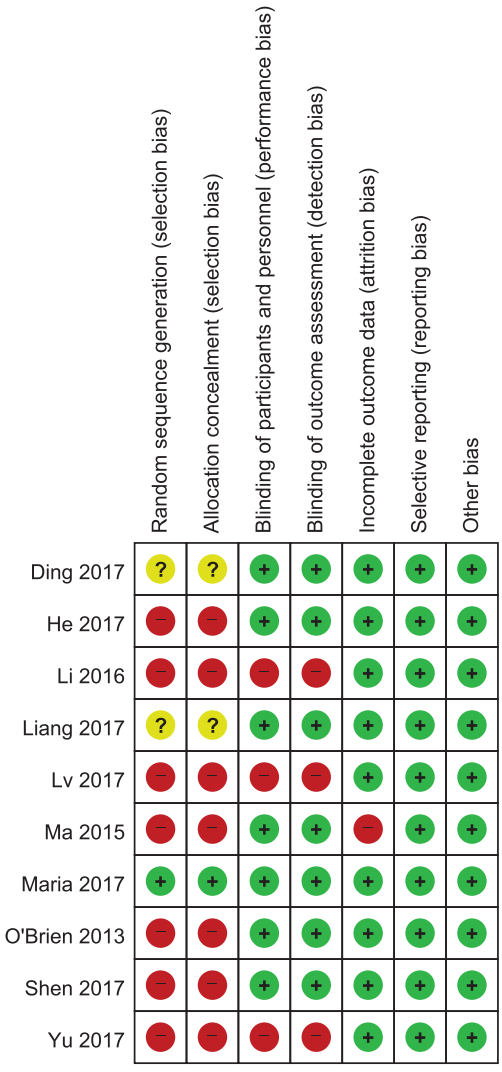

Figure 2. Table of the risk of bias of the included studies.

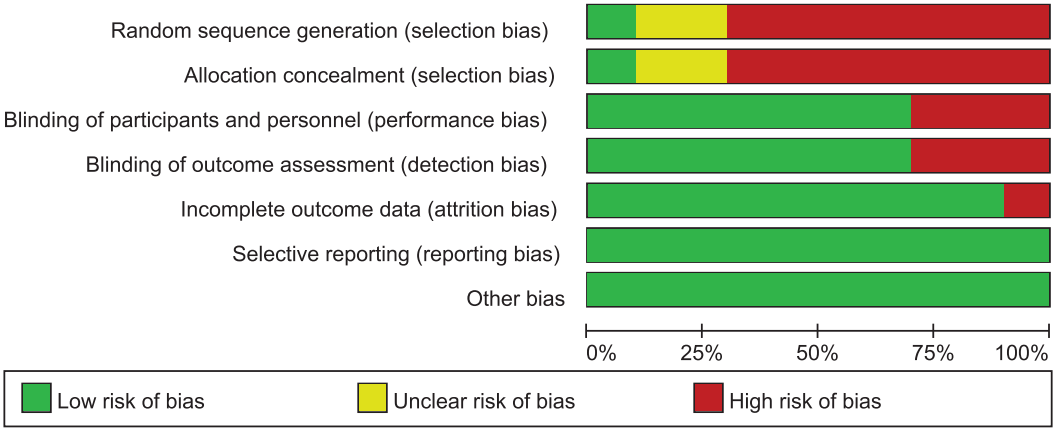

Figure 3. Quality assessment of clinical trials included.

3.4.2. Weight gain

Three studies compared the weight gain per day across parental involvement groups and no parental involvement groups.[3,11,12] Parental involvement groups demonstrated significantly higher weight gain than no parental involvement groups, as shown in Figure 5 (FEM, mean difference [MD] = 1.47, 95% CI 0.65–2.29, $P < 0.05$, $I^2 = 0\%$). All three studies included in the meta-analysis for this measure had a "B" level of risk of bias.[3,11,12]

3.4.3. Breast-feeding

Six studies compared the breast-feeding rate across parental involvement groups and no parental involvement groups.[3,4,8,9,11,12] Parental involvement groups demonstrated significantly higher breast-feeding rate than no parental involvement groups, as shown in Figure 6 (FEM, risk ratio [RR] = 1.38, 95% CI 1.25–1.53, $P < 0.05$, $I^2 = 43\%$). One of the studies included in the meta-analysis for this measure had a "A" level of risk of bias,[4] and the other five studies were deemed level "B".[3,8,9,11,12]

3.4.4. Readmission

Three studies compared the readmission rate within 1 month after discharge across parental involvement groups and no parental involvement groups.[10-12] Parental involvement groups demonstrated significantly

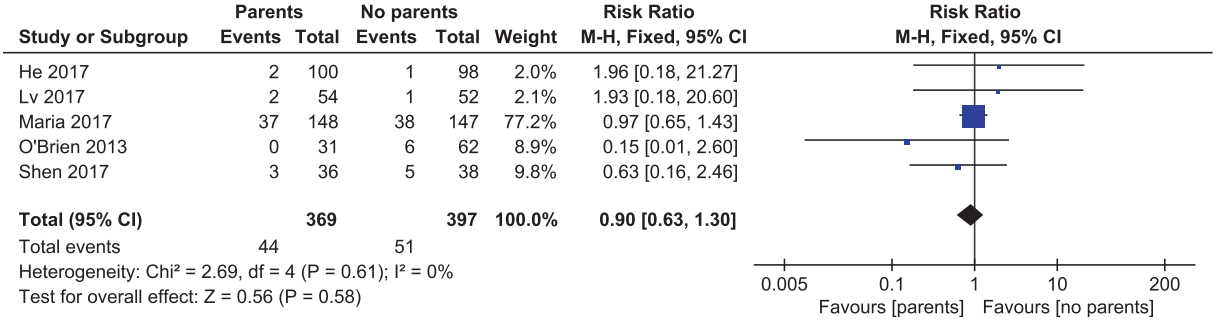

Figure 4. Effects of parental involvement care on nosocomial infection in NICU.
NICU, neonatal intensive care unit.

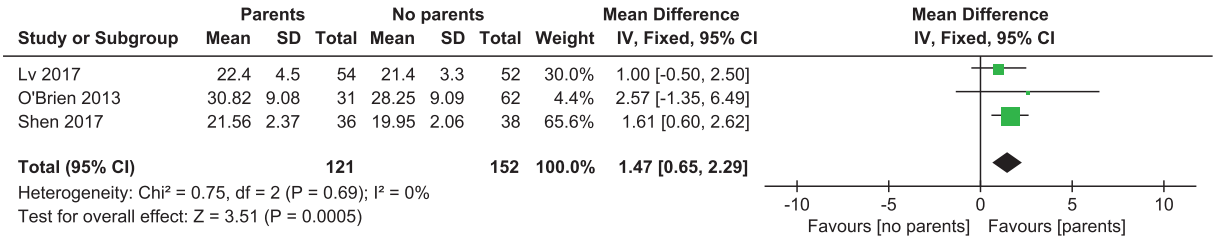

Figure 5. Effects of parental involvement care on weight gain in NICU.
NICU, neonatal intensive care unit.

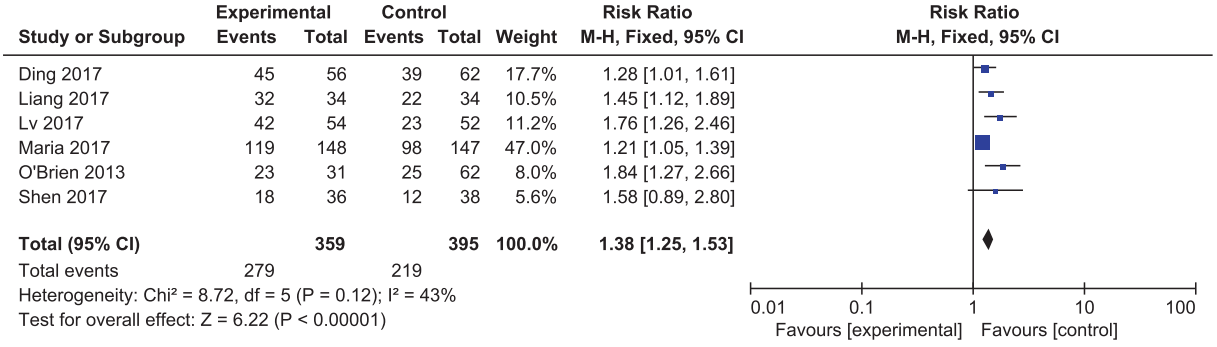

Figure 6. Effects of parental involvement care on breast-feeding in NICU.
NICU, neonatal intensive care unit.

lower readmission rate than no parental involvement groups, as shown in Figure 7 (FEM, RR = 0.35, 95% CI 0.15–0.80, $P < 0.05$, $I^2 = 1\%$). All the three studies included in the meta-analysis for this measure had a "B" level of risk of bias.[10-12]

3.4.5. Satisfaction

Three studies compared the satisfaction rate of parents across parental involvement groups and no parental involvement groups.[12-14] Parental involvement groups demonstrated significantly higher satisfaction rate than no parental involvement groups, as shown in Figure 8 (FEM, RR = 1.09, 95% CI 1.02–1.16, $P < 0.05$, $I^2 = 32\%$). All the three studies included in the meta-analysis for this measure had a "B" level of risk of bias.[12-14]

4. Discussion

This meta-analysis found that there were no significant differences in nosocomial infection between parental involvement groups and no parental involvement groups. The reason why parents' participation did not increase the infection rate might be related to the well preparation of parents before entering NICU, such as sterile environment and operation learning, hand washing, and gown wearing.[4,5,11,12] It could been seen apparently from the forest figure that the nosocomial infection rate in the study by Verma et al.[4] was higher than the other included studies,[4] which may be related to higher rate of invasive procedures. However, the result remained unchanged (FEM, $Z = 0.81$, $P = 0.42$, $I^2 = 0\%$) after removing it.

It is interesting to note that infants in the family involvement groups had a higher body weight than those in the no parental involvement groups in the NICU. In the intervention groups,[3,11,12] parents were encouraged to provide kangaroo style care, touch, and massage, so that neonates could feel more comfortable, quiet, which may reduce their crying and energy consumption. Meanwhile, infants were more likely to fall asleep with parents' touch and massage in the intervention groups, and quiet sleep could help in the secretion of growth hormones.[15] In addition, breast-feeding rate in intervention groups was higher.[4,8,9] Therefore, the weight of neonates grew faster in the parental involvement groups.

Breast milk is the ideal food for newborns; our meta-analysis indicated that parental involvement in infant care can help improve the breast-feeding rate. The main reasons for this were that participating in the care of infants could reduce mother's anxiety and stress,[3,16] which is conducive to the secretion of milk.[17] In addition, close maternal–infant bonding during the procedure of neonate nursing plays the important role in the stimulation of the breast-feeding.[18] Moreover, the guidance by nurses is helpful for building up mothers' confidence on breast-feeding.[19]

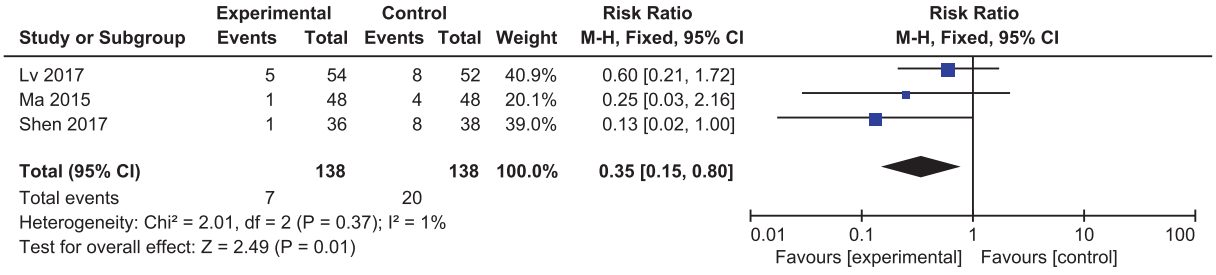

Figure 7. Effects of parental involvement care on readmission in NICU.
NICU, neonatal intensive care unit.

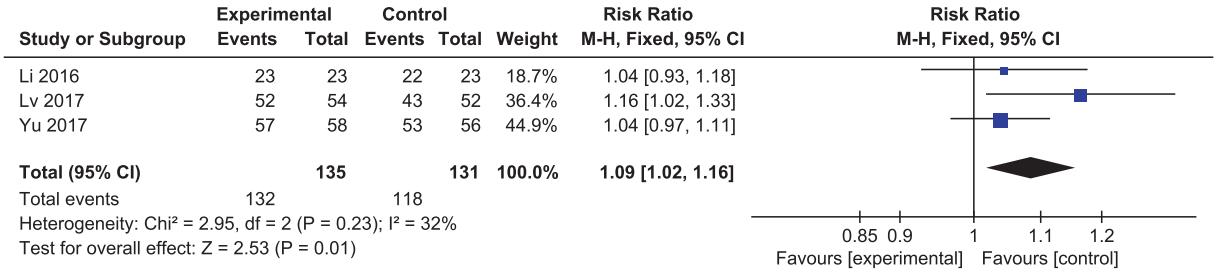

Figure 8. Effects of parental involvement care on parental satisfaction in NICU.
NICU, neonatal intensive care unit.

Our meta-analysis also demonstrated a significant difference between two groups on readmission within 1 month after neonates were discharged. This may be related to the improvement in parents' care knowledge and care skills in the process of nursing participation.[19,20]

For satisfaction rate, intervention groups had a more positive effect than controls. One reason was that parents' anxiety about separation from and suffering of their babies could be released.[16] Another reason was that parents could receive information about their infants appropriately and timely, and they were able to communicate with the health care team effectively and felt that they had been considered and respected, which is supported by the previous study.[19]

The limitation of this meta-analysis was that only three studies had RCT design,[4,8,9] and two of which did not describe the specific random sequence generation.[8,9] In addition, only one study was ranked level "A" level according to the Cochrane Risk of Bias Assessment Tool.[4] In addition, we included studies published only in English and Chinese. Due to insufficient information about intervention time, subgroup analysis based on the intervention time was not conducted. A further limitation of this review was that most studies we included were from China. First, we intended to evaluate publication bias by funnel plots. But for each outcome measure, less than six studies were included, so the funnel plots were not conducted finally.

5. Conclusions

Involving parents in the NICU care did not increase nosocomial infection rate, but could significantly improve weight gain, breast-feeding, and parental satisfaction, and decrease readmission. However, since the conclusion of this meta-analysis was drawn based on the limited number of high-quality RCTs, additional studies should be conducted in future to confirm its positive intervention effects. Considering intervention time may influence the effect of interventions, studies based on different intervention time should be conducted in the future.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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