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# Effects of family-centered care interventions on preterm infants and parents in neonatal intensive care units: a systematic review and meta-analysis of randomized controlled trials

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**ABSTRACT**

**Objective:** To review English and Chinese randomized controlled trials (RCTs) to determine the effects of family-centered care interventions on preterm infants' and parental outcomes in Neonatal Intensive Care Units and to conduct a meta-analysis.

**Review method used:** Systematic review and meta-analysis.

**Data sources:** MEDLINE, CINAHL, EMBASE, PsycInfo, BNI, AMED and the Chinese databases CNKI and Wanfang were searched in April 2017 and updated in August 2018.

**Review methods:** Only RCTs were included. Participants were preterm infants ≤ 37 weeks gestational age and parents. Interventions were related to family-centered care and outcome measures were infant and parent clinical outcomes. Included studies were assessed for risk of bias using Cochrane Manual 5.1.0. Meta-analyses used Mean Differences (MD), Standardized Mean Differences (SMD) or Odds Ratio (OR) followed by 95% Confidence Interval (CI). Heterogeneity was tested with Cochran's Q chi-square, tau-squared and inconsistency index ($I^2$).

**Results:** Included were 19 studies (10 from English and 9 from Chinese databases); meta-analysis included 15 studies (7 English and 8 Chinese RCTs). Meta-analysis showed significant improvements in weight gain (7 studies: MD 4.57; 95%CI: 2.80;6.34; P<0.001; $I^2$ 94%); readmission (3 studies: OR=0.23; 95%CI: 0.10;0.52; P<0.001; $I^2$=0%); parent satisfaction (5 studies: OR=11.20; 95%CI: 4.76;26.34; p<0.001; $I^2$=0%); Skills of parents (4 studies: SMD=2.57; 95%CI: 2.19;2.96; P<0.001; $I^2$=53%); Knowledge of parents (4 studies: SMD=2.74; 95%CI: 2.47;3.00; P<0.001; $I^2$=0%); Parental anxiety at follow-up: (3 studies: SMD=-0.19; 95%CI: -0.28;-0.09; P<0.001; $I^2$=0%); Parent depression at follow-up: (2 studies: SMD=0.37; 95%CI: -0.63;-0.12; P=0.004; $I^2$=44%); Parental stress: (3 studies: MD=-0.20; 95%CI: -0.26;-0.13; P<0.001; $I^2$=0%). No statistical differences were observed in neuro-behavioral-development (3 studies) and hospital-length-of-stay (7 studies).

**Conclusions:** Family-centered care interventions can improve weight gain and readmission in preterm infants as well as parent satisfaction, knowledge and skills, and possibly long-term anxiety, depression and stress. Developing standardized outcome sets for testing

family-centered care interventions is recommended.

**Keywords:** Family Centered Care; Infant; Meta-analysis; Neonatology; Nursing; Parents; Randomized controlled trail; Review.

## 1. INTRODUCTION

The concept of family-centered-care (FCC) has been implemented over the last 60 years in various healthcare settings.[1,2] Family-centered-care has not been described clearly as a care model but rather an approach and has been defined as the involvement of family members in patient care and emphasizes the patient's emotional, social and developmental needs.[3] It is an innovative approach to develop a trustworthy, respectful partnership between healthcare professionals and family members. The overall principals of FCC have been described as dignity and respect, sharing of information, participation in care and decision making.[4,5] Although FCC has been widely accepted in pediatric settings, the reality remains that in many countries parents have limited access to Neonatal Intensive Care Units (NICUs) and limited involvement in the care of their infant.[6,7,8] Therefore, it can be assumed that FCC practices are still developing.

With the continuous improvements in medical technology, birth and survival rates of preterm infants have been greatly improved. The World Health Organization (WHO) statistics in 2012 showed that 15 million preterm infants are born each year globally, accounting for up to 11.1% of all newborns, and China ranks second for the number of preterm infants with more than 250,000 preterm births in 2010.[9] A survey in 2005 among 80 Chinese hospitals recorded 43,289 neonates in 80 hospitals and among them 26.2% were preterm infants.[10] Compared to their previous survey in 2002, the number of premature infants increased by 6.5% and is expected to rise every year. A more recent survey, 2011, from mainland China described a retrospective analysis of 101,163 newborns from 39 hospitals.[11] The low birth weight infants (< 2500 grams) were recorded at an incidence rate of 6.1%.

The birth and hospitalization of a preterm infant may impose pressure on parents and other family members and could potentially lead to a family crisis. Research shows that FCC can decrease anxiety and support them to adapt into their new roles.[12] Additionally, FCC practices also support parents to understand the importance of interaction with their infant which can improve infants' growth and development.[13] The FCC model has already drawn attention from international institutions and medical communities. While the developed

countries have studied the impact of FCC on preterm infants and parents, China is still in the beginning of implementing and testing this innovative practice. The outcome of infants and parents in NICU with FCC practices remains unclear and robust evidence supporting FCC compared to standard care is sparse. Standard care varies but usually includes limitations on parents visiting the NICU or providing basic care to their baby. Therefore, it is timely to conduct a systematic review and meta-analysis to support the body of knowledge and clinical practice. The aims of our study are to: 1) systematically review English and Chinese reported randomized controlled trials (RCTs) related to the effects of family-centered care interventions on preterm infants' and parental outcomes in NICUs, and 2) conduct a meta-analysis of the identified RCTs.

## 2. METHODS

### 2.1 Design

This systematic review and meta-analysis is structured and reported according to the PRISMA guidelines.[14]

### 2.2 Eligibility criteria

Only RCTs were eligible if the study aim was related to test an FCC intervention. We defined that an FCC intervention should be related to one or more components of FCC including educational support (skills and knowledge of care); partnership in care (empowerment and involvement in care); personalized care (needs and wishes); parent support (psychological and visiting access); information and communication; NICU environment (noise-light levels and design/lay-out of NICU).[3,5,12] Standard care in this review was defined as care with no or limited support to parents, limitations in visiting or involvement of care. The study population was defined as preterm infants with a gestational age of ≤37 weeks and their parents.

The PICO (Population, Intervention, Comparison and Outcome) question was defined as: Does family-centered care (I) compared to standard care (C) improve clinical outcomes (O) in preterm infants and parents in the NICU (P)?

### 2.3 Information sources

The following international databases were used: Medline, CINAHL, EMBASE, PsycINFO, BNI, AMED. The Cochrane Database of Systematic Reviews was used to identify RCTs in previous published reviews. The Chinese databases CNKI and Wanfang Data were used to identify Chinese articles. Additionally, reference mapping was performed manually by searching the reference lists of identified articles. The searches in both English and Chinese databases were performed in April 2017. An update search in August 2018 resulted in three additional English articles.

**2.4 Search strategy**

The search strategy used both English and Chinese MeSH terms and keywords. The English articles were searched using the keywords parent(s), preterm infant(s), family centered care, family nursing, randomized controlled trial. A full search strategy is available online (Electronic Supplement Material 1). The Chinese articles were searched using the Chinese characters: 家庭式护理 (family-centered-care), 家庭护理干预 (family nursing), 家庭式参与护理 (family involvement), 家长参与式护理 (family integrated care), 新生儿 (neonate), 早产儿 (preterm infant), 随机对照实验 (randomized controlled trial), 随机对照临床实验 (randomized controlled clinical trial). The search terms in Chinese are slightly different compared to the English search terms because the meaning of Chinese characters cannot always directly translated into English. For the Chinese readers, the full Chinese search strategy is available online (Electronic Supplement Material 1).

Studies reported in English and Chinese were considered and no date limit was set because FCC has been described in the literature since the 1960s. The searches of the English databases were conducted by [blinded: insert author initials] and [blinded: insert author initials] and the Chinese databases by [blinded: insert author initials] and [blinded: insert author initials].

**2.5 Study selection**

Only articles with a RCT design testing a FCC intervention were included. The intervention should have been defined as a FCC intervention by the authors and related to the main

principles of FCC. Articles published in English and Chinese from the time of the establishment of the database to April 2017 were included. Three researchers (blinded: insert author initials) screened all titles and abstracts that were identified in the search strategy based on the FCC definition, eligibility criteria and the PICO question. Discrepancies were discussed until consensus was reached. All discussions throughout the full review process were in English as all authors had overseas training background with experience in NICUs with FCC practices and proficient level of English.

**2.6 Data collection process**

The data was extracted from each article by three researchers (blinded: insert author initials) in a data extraction form including: authors, year of publication, country, study design, setting, participants, FCC intervention, outcome measures, main outcomes.

**2.7 Risk of bias in individual studies**

The Cochrane Handbook for Systematic Reviews or Interventions (version 5.1.0) was used to assess the risk of bias and quality of the included RCTs.[15] Although the Cochrane handbook explicitly discourage the assessment of quality or risk of bias, we have evaluated the studies by two researchers (blinded: insert author initials) using a score of low, unclear or high risk for seven bias categories: selection bias (random sequence), selection bias (allocation concealment), performance bias, detection bias, attrition bias, reporting bias, and other bias. A quality score was given based on the total score of the seven categories: score 1 (low risk) score 0 (unclear or high risk).

**2.8 Synthesis of results**

All analyses were performed using R version 3.4.1 (R Foundation for Statistical Computing) and the meta package (version 4.8-4). Mean differences (MD) or Standardized mean difference (SMD) and corresponding 95% confidence interval (CI) were calculated using fixed-effects model (FEM), or in the presence of heterogeneity, using random-effects model (REM). In the same way, the pooled odds ratio (OR) and its 95% CI were calculated. Cochran's Q chi-square ($\chi^2$) was used to assess heterogeneity with a P-value >0.1 interpreted as the effect size being homogeneous across studies and thus allowing a FEM to

be used. The inconsistency index ($I^2$), the proportion of heterogeneity not due to chance, and tau-squared ($\tau^2$), the estimate of the variance in effect size when a REM is used were also calculated. If studies were heterogeneous, an REM was applied to calculate the consolidated effect value. $I^2$ value of $\leqslant$ 25% represents a low heterogeneity; 26-50% moderate heterogeneity; 51-75% high heterogeneity; 76-100% a very high heterogeneity. Meta-analysis was performed with the outcome measures if two or more studies presented the data that could be pooled. The meta-analysis of the outcome measures including only two or three studies are presented in detail in Electronic Supplement Material 5 of this article.

## 3. RESULTS

### 3.1 Study Selection

In the identification phase, the searches in English and Chinese database revealed 121 articles (Fig. 1). After removing duplicates (n=49), 72 titles and abstracts were reviewed in the screening phase and 38 articles were removed leaving 34 articles for full text assessment in the eligibility phase. We excluded 18 articles based on the study design, no FCC intervention defined such as a pain intervention or endotracheal suctioning, no comparable outcomes such as salivary cortisol (Fig. 1). In the inclusion phase we included seven English articles[16-22] and nine Chinese articles.[23-31] Because the full search strategy was conducted in April 2017, an update search was performed in August 2018 and three additional articles were included.[32,33,34] The systematic review included eventually 19 articles. Of these, 15 articles were included in the meta-analysis. Four RCTs were excluded from the meta-analysis due to limited requisite information. One study provided only mean values of the parent anxiety scores and this data could not be pooled with data from other studies.[22] Similarly, two studies provided only the interquartile range (IQR) of the outcome measures.[17,32] One Chinese study used a neuro-development tool that was not comparable with other studies.[24]

### 3.2 Study Characteristics

All included studies used a RCT design.[16-34] Most studies (n=13) were conducted at a single

center NICU (Table 1). The total numbers of study participants were 4,478 preterm infants and 3158 parents in studies using parental outcome measures. One study included infants with a gestational age up to 39 weeks rather than 37 weeks.[22] It was decided to include this study in the systematic review but not in the meta-analysis.

Most studies were unclear in defining parents; mothers and/or fathers. In particular, studies reporting parent outcome measures (n=13) were often unclear if the surveys were completed by both mother and father individually or together (Table 1). Only Weis et al (2013) reported the completion of a parent stress scale by mothers and fathers individually and documented that mothers had higher stress levels than fathers (2.91 vs 2.58; $p<0.001$).[20] Two studies provided outcome measures of mothers only[17,21] and in four studies mothers and fathers were included but the data were not reported separately.[16,19,23,27,31] The remaining six studies did not specify the parent's role of study participant.[22,28-30,33,34]

Studies differed in the components of FCC interventions (Electronic Supplement Material 2). Most FCC interventions were related to the component *Educational support* (n=16) with seven studies from the English literature and all Chinese studies.[14,15,17,19,21-29,30-32] Most of the studies including an educational program in their FCC intervention also included the component of *Partnership in care*.[15,17,19,20,22,27-29,31,32] The next most common component of FCC described in the studies was *Information and communication*.[14,18,19,20,32] The other FCC components described in the FCC interventions were *Personalized care*[18], *Parent support*[32], and *NICU environment*.[16]

The studies included various outcome measures (Table 1). Six studies used only infants' clinical outcome measures[18,19,24-26,32], four studies used only parent reported outcome measures[20-22,27], and nine studies used both infants and parent outcome measures.[16,17,23,28-31,33,34] Five Chinese RCTs used parent satisfaction as an outcome measure.[27-31] Of these, three self-designed parent satisfaction questionnaires were identified. We were able to obtain two questionnaires (Electronic Supplement Material 4). Four Chinese RCTs measured parental knowledge and skills.[27,28,30,31] An example of the self-reported knowledge questionnaire used by two RCTs is presented in Electronic Supplement Material 4.

Two Chinese RCTs specifically described the assessment of parental skills[27,31] which were assessed by a research nurse using a care check-list.

### 3.3 Risk of bias within studies

The risk of bias and methodological quality was low in five of the nine Chinese articles. [23,24,26,28,29] and two of the English articles.[21,22] (Table 1 and Electronic Supplement Material 3). The most common reasons for a low score among Chinese articles were the poor reporting of selection, performance and detection bias. The two English articles reported incomplete data.

### 3.4 Meta-analysis infant outcomes

Seven studies (four Chinese; three English) reported the infants' daily weight gain (grams per day) as an outcome measure between the FCC group and the standard care (SC) group.[19,23,25,26,28,33,34] According to the heterogeneity test, high heterogeneity existed ($I^2$=94%, $\tau^2$=4.63, $\chi^2$=93.27, P<0.001). Therefore, REM was applied to consolidate the effect value. Figure 2.1 shows that the weight gain in the FCC group was significantly higher than the SC group (MD 4.57; 95%CI: 2.80;6.34; P<0.001).

The hospital length-of-stay was reported in seven studies; five English and two Chinese.[16,18,19,25,31,33,34] The studies were heterogeneous confirmed by the heterogeneity test ($I^2$=100%, $\tau^2$=49.38, $\chi^2$=2002.91, P=0.0). The REM was used to consolidate effect value. The pooled MD=-3.73 (95%CI: -9.25;1.79) (Fig.2.2) showing that the hospital length-of-stay in the FCC group was shorter than the SC group, but not significant (P=0.185).

There were four studies reporting readmission rates and the heterogeneity test resulted in homogeneity ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.10, P=0.992) and FEM was used.[21,29-31] The pooled OR=0.23 (95%CI: 0.10;0.52) (Fig. 2.3). The readmission rate in the FCC group was significantly lower than in the SC group (P<0.001).

There are three Chinese studies (total n=213) measuring behavioral outcomes using the same instrument; the Neonatal Behavioral Neurological Assessment (NBNA). In brief, the NBNA scores in the FCC group were higher than the SC group, but not statistically significant (Data presented in detail in Electronic Supplement Material 5).

### 3.5 Meta-analysis parent outcomes

Parent satisfaction was used as an outcome measure in only Chinese RCTs (n=5).[27-31] The studies were homogeneous ($I^2$=0%, $\tau^2$=0, $\chi^2$=3.39, P=0.494). Thus, FEM was applied to combine with the effect values. The pooled OR=11.20 (95%CI: 4.76;26.34) representing that the odds of parent satisfaction (number satisfied/number not satisfied) in the FCC group was 11.2 times higher than that in the SC group (Fig. 3.1). The difference was statistically significant (P<0.001).

Four Chinese studies with an educational FCC intervention measured the nursing skills of parents.[27,28,30,31] The skills were observed by a researcher and it was unclear if they used the same instrument. Therefore, the SMD was used. These studies were not homogeneous ($I^2$=53%, $\tau^2$=0.08, $\chi^2$=6.36, P=0.095). The REM and effect value were used. Figure 3.2 shows the pooled SMD= 2.57 (95%CI: 2.19;2.96) representing that the nursing skills of parents in the FCC group was higher than the SC group (P<0.001). The same studies also measured the knowledge of parents. Two of these studies used a similar survey to test the parental knowledge.[27,31] We were unable to obtain the questionnaires of the other two studies.[28,30] Therefore SMD was applied in the meta-analysis. Heterogeneity test resulted that there was no heterogeneity between the studies ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.36, P=0.947), thus we used FEM. Figure 3.3 shows the pooled SMD=2.74 (95%CI: 2.47;3.00). The FCC group had more parental knowledge than the SC group (P<0.001).

The meta-analyses of parental anxiety, depression and stress are presented in detail in Electronic Supplement Material 5. Parental anxiety was measured in three studies (two English; one Chinese).[16,23,34] Two studies used the State Anxiety Inventory index[16,34] and one study the Self-Rating Anxiety Scale.[23] In brief, at follow-up (time point 3), the parents in the FCC group showed significantly less anxiety than the SC group (Electronic Supplement Material 5). Parental depression was measured by two studies using the Self-rating Depression Scale and the Beck Depression Inventory.[16,23] In brief, at follow-up (time point 3) the FCC group had significantly less depression than those in the SC group (Electronic

Supplement Material 5). Parental stress was measured in three studies using the Parental Stressor Scale:NICU.[16,20,34] Stress in the FCC group was significantly lower than in the SC group (Electronic Supplement Material 5).

## 4. DISCUSSION

This systematic review and meta-analysis identified 19 RCTs testing FCC interventions. Various FCC interventions were described, mostly related to education and training of parents followed by active involvement and participation in care. Surprisingly, the studies did not clearly define standard care received by the control group. All studies provided data supporting a positive association between the intervention and at least one outcome measure. Our meta-analysis confirmed that FCC interventions are associated with improved clinical outcomes of infants and parent reported outcomes. In terms of publication date, eight out of nine Chinese RCTs were from the past six years possibly indicating that there is an increased interest in implementing FCC practices in Chinese NICUs. However, the publication date of the English RCTs (seven out of 10 published in the last six years) did not differ much with the Chinese RCTs considering that FCC has been a model of care in NICUs for some decades in many parts of the developed world. Overall, in the past six years there seems to be an increased interest to implement and test the effect of FCC interventions in Chinese and non-Chinese NICUs.

Although FCC is an accepted care model in many NICUs, our systematic review revealed that there is no uniform approach with FCC interventions. Recently, an international group of experts tried to define eight principles for patient-centered and family-centered care in NICUs.[12] The principles, such as 24-hour access, psychological support, supportive environment, and other basic caring procedures, provide NICU clinicians guidance to deliver care according to the infants and family needs. In our review, most RCTs have designed and tested an FCC intervention related to education/information for parents and their active involvement in care and decision-making. The heterogeneity of the interventions might implicate the difficulty in confirming that FCC as a practice model in NICUs is beneficial to

preterm infants and their parents. FCC as a concept is responsible for the improvements seen or, given the heterogeneity observed, some aspects of FCC are efficacious and others not. That some outcomes displayed heterogeneity and other not may suggest both possibilities are correct depending on outcome. Additionally, the reality remains that FCC is not yet fully accepted in many NICUs across the world. For example, many NICUs in China do not welcome parents to visit their infant. However, in the past five years several Chinese NICUs are becoming more flexible in visiting hours and allowing parents to become involved in the care.[35] Evidence suggest that European NICUs also have limited visiting hours such as in Spain, Italy and France, and most NICUs having restrictions to parental presence during rounds or procedures.[36] Implementing FCC can be challenging for clinicians. A study in 11 NICUs in Europe identified that the lowest rated principles of FCC were emotional support, parental involvement in decision-making and fathers' involvement in care.[37] Guidelines are available and might help NICU clinicians in further developing and implementing FCC practices.[38]

Only one RCT performed subgroup analysis according to gestational age[18]. In this study, hospital length-of-stay was not significantly different between FCC and standard care groups for the total study population. However, within infants with gestational age <30 weeks (n=20; total n=183) the FCC group appeared to have a significantly shorter length-of-stay compared to the SC group using the Mean (95% CI) and Median ($25^{th}$–$75^{th}$) in their parametric and non-parametric analysis. This study suggests that FCC interventions may result in a shorter length-of-stay for premature infants with a gestational age <30 weeks. Future studies may benefit from considering subgroup analysis based on gestational age.

The results of our meta-analysis provide evidence that FCC interventions might improve infants' clinical outcomes. The analysis included only RCTs but other studies with other study designs have reported similar clinical outcomes.[39-41] A currently ongoing large international trial is the Family Integrated Care study initiated by colleagues in Canada.[42] Part of this trial is recently published and included in this review[34] and the trial is currently expanding in China.[43] In their pilot cohort study, the authors reported a significant increase in weight gain in the

intervention group (n=31) compared to the matched control group (n=62).[44] Other significantly improved clinical outcomes were retinopathy of prematurity stage 3 and breast feeding.

A few limitations need to be addressed. Although articles are available using other study methods, we only included RCTs studies. This might have limited the results of the meta-analysis. However, 15 of the 19 included articles were used in the meta-analysis. The total number of studies included in the meta-analysis of the individual outcome measures was limited between two and seven studies. Furthermore, several articles were limited by the reporting quality, failing to describe several bias effects. We did not exclude poor quality RCTs from the meta-analysis. This might influence the overall outcomes presented in this review. Finally, the meta-analysis of the hospital length-of-stay must be interpreted with caution. The data of the included RCTs were likely to be skewed which can question the validity of the presented statistical tests. Ideally this meta-analysis should be performed with the geometric mean.[15] However, we did not obtain the raw data from the authors of the articles but instead used the reported mean and SD of the hospital length-of-stay.

The implication for clinical practice of our results can be translated to some recommendations. NICUs with limited FCC practices should start implementing FCC with interventions related to education of parents and encourage them to become actively involved in the care of their infant. NICUs with advanced FCC practices should consider using standardized parent reported outcome measures such as a validated parent satisfaction questionnaire.[45] Studies evaluating FCC interventions in NICUs reported many different outcomes measures. Our review demonstrated the variation and possible limitations of studies when comparing or combining the findings. Using a core outcome set for FCC intervention studies is recommended and it is hoped that such outcome sets become available in the near future.[46] Our review strengthen the evidence of the principles of patient and family centered care in NICU.[12] Five of the described principles are related to patient-centered care, namely pain management, postural support, skin-to-skin care, breastfeeding, and sleep protection.[12] The other three principles are related to

family-centered care, 24-hour unlimited access, psychological support, and NICU environment. In 16 identified FCC interventions the patient-centered care principles were included in the parent education programs. This strengthen the recommendation that NICU clinicians should consider to include issues of pain management, positioning, skin-to-skin care, breastfeeding, promotion of sleep, and supportive environment in their parent education programs. The family-centered care principle of 24-hour access[12] is essential to all FCC interventions and should be promoted by all NICUs. Psychological support[12] should be provided to parents throughout the NICU admission. However, it is recommended to identify standardized outcome measures to assess stress, anxiety and depression including a general agreement about uniform time-points of the measurements because our review identified a variety of measurement instruments and time-points.

To our knowledge this is the first systematic review and meta-analysis of FCC interventions in NICU settings. The novelty of our review is based on the inclusion of RCTs published in Chinese journals representing a large part of the world. However, we acknowledge that we have not included RCTs published in Spanish or Portuguese journals which represents another large part of the world. Only one meta-analysis of FCC interventions in adult intensive care settings has been identified in a recent review.[49] Their review used the FCC definition of the Institute of Medicine including respect of patients, information, education, access to care, emotional support, family involvement, continuity of care, physical support and coordination of care. The authors of this adult intensive care article identified 32 different FCC interventions in the 46 included studies.[47] Similar to our review, their review reported also heterogeneous outcome measures.

In conclusion, several FCC interventions have been identified and tested by a variety of outcome measures. The FCC interventions of RCTs performed in China were mostly related to parental education followed by their involvement and participation in the basic care. The RCTs published in the English literature tested FCC interventions related to education, information and communication tools or a new NICU environment with separate family rooms in the NICU. The outcome measures in the RCTs were heterogeneous using a wide variety of

preterm infants' clinical outcomes and parent reported outcomes. Meta-analysis revealed that the tested FCC interventions improved the infant's weight gain and readmission rates. The FCC interventions also improved the parent reported outcomes parent satisfaction, skills and knowledge. Follow-up data revealed that anxiety, depression and stress of parents can be improved after an FCC intervention. The meta-analysis of the neuro-behavioral-development tested with three studies indicated no statistically significant differences. No benefits for infants were observed in the meta-analysis regarding hospital length-of-stay, however as stated in the limitations, this needs to be concluded with caution. Nearly half of the included RCTs were of low quality leading to some caution of interpreting the meta-analysis results. More high-quality studies are needed to further evaluate the impact of FCC practices in NICUs. Developing standardized FCC interventions and core outcome measures will benefit studies and enable future comparison of the clinical effectiveness of FCC interventions. This will enhance the evidence base for FCC practices in preterm infants and their parents.

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**Table 1**. Characteristics of studies included in systematic analysis

**Fig. 1.** Flow Diagram study selection April 2017 and updated August 2018

**Fig. 2.** Forest plots of infant clinical outcomes; (1) weight gain; (2) hospital length-of-stay; (3) readmission

**Fig. 3.** Forest plots of parent reported outcomes; (1) parent satisfaction; (2) skills of parents; (3) knowledge of parents

**Table 1**. Characteristics of studies included in systematic review

| Source and Country | Design | Settings | Study participants | FCC intervention[1] | Outcome measures | Main outcomes | Quality |
|---|---|---|---|---|---|---|---|
| Melnyk et al (2006) [16] USA | RCT | 2 NICUs:<br>52-bed NICU<br>60-bed NICU | 138 intervention<br>109 control<br>Infants:<br>GA 26-34 weeks<br>Parents:<br>mothers and fathers. If fathers not involved in care, mothers could select a significant other to participate | COPE | Parents:<br>- Trait Anxiety Inventory (A-Trait)<br>- State Anxiety Inventory (A-State)<br>- Beck Depression Inventory (BDI-II)<br>- Parental Stressor Scale (PSS-NICU)<br>- Index of Parent Behavior-NICU (IPB)<br>- Interaction with Infant-NICU (VAS-I)<br>- Involvement in Infant Care-NICU (VAS-C)<br>- Sensitivity to Needs of Infant-NICU (VAS-S)<br>- Parental Beliefs Scale (PBS)<br>Infants:<br>- LOS NICU<br>- LOS Hospital | Parents:<br>- A-Trait at T1: NSD<br>- A-State at T2: NSD<br>- BDI at T2: NSD<br>- PSS-NICU at T2: 1.78 vs 1.98 (p=0.03)<br>- IPB at T3: NSD<br>- VAS-I at T3: NSD<br>- VAS-C at T3: NSD<br>- VAS-S at T3: NSD<br>- PBS at T2: 66.57 vs 61.48 (p<0.001)<br>Infants:<br>- LOS NICU:<br>All infants: 31.86 vs 35.63 (p≤0.05)<br>VLBW infants: 51.81 vs 60.12 (p≤0.05)<br>- LOS Hospital:<br>All infants: 35.29 vs 39.19 (p≤0.05)<br>VLBW infants: 57.16 vs 65.03 (p≤0.05) | 7/7 |
| Glazebrook et al (2007) [17] UK | Cluster RCT | 6 NICUs | 112 intervention<br>121 control<br>Infants:<br>GA <32 weeks<br>Parents:<br>mothers only | PBIP | Mothers:<br>- Parenting Stress Index short form (PSI-SF)<br>- Nursing Child Assessment Teaching Scale (NCATS)<br>Infants:<br>- Neurobehavioural Assessment of the Preterm Infant (NAPI)<br>- Home Observation for Measurement of the Environment (HOME) (subscale responsiveness only) | Parents:<br>- PSI-SF: NSD<br>- NCATS: NSD<br>Infants:<br>- NAPI z scores: NSD<br>- HOME (responsiveness): NSD | 6/7 |
| Ortenstrand et al (2010) [18] Sweden | RCT | 2 NICUs | 177 intervention<br>168 control<br>Infants:<br>GA <37 weeks<br>Parents:<br>at least 1 parent stay 24 hours a day during entire | FC ward | Infants:<br>- LOS NICU<br>- LOS Hospital<br>- Morbidity: Sepsis, NEC, PDA, IVH, ROP, BPD, severe morbidity | Infants:<br>- LOS NICU: 13.3 vs 18.0 (p=0.02)<br>- LOS Hospital: 27.4 vs 32.8 (p=0.25); but subgroup GA < 30 weeks 56.6 vs 66.7 (p=0.02)<br>- Moderate-to-severe BPD: 3% vs 11% (adjusted OR 0.18; 95% CI 0.04–0.8)<br>- Other morbidities NSD | 5/7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | hospital stay | | | | |
| Chen et al (2013) [19] Taiwan | RCT | 3 NICUs | 120 intervention<br>CBIP group n=57<br>HBIP group n=63<br>58 control<br>62 term group<br>Infants:<br>GA <37 weeks<br>Birth weight <1500 g<br>Parents:<br>mothers and fathers | CBIP<br>HBIP | Infants:<br>- Morbidity: LOS Hospital, Ventilation days, CPAP days, duration of oxygen use, PDA, Grade II IVH, mild-to-severe BPD, stage II -III ROP, sepsis.<br>- Growth: Enteral feeding, feeding desaturation, weight gain.<br>- Neuro-development: Neonatal Neurobehavioral Examination — Chinese version (NNE-C) | Infants:<br>- stage II–III ROP: 12% vs 15% (p≤0.05)<br>- Other morbidities: NSD<br>- Feeding desaturation: 3% vs 7% (p≤0.05)<br>- Weight gain (g/d): 25.6 vs 23.7 (p≤0.05)<br>- Enteral feeding: NSD<br>- NNE-C: NSD | 5/7 |
| Weis et al (2013) [20] Denmark | RCT | 1 NICU: 38-bed NICU | 74 intervention<br>60 control<br>Infants:<br>GA ≤34 weeks<br>Parents:<br>mothers and fathers | GFCC | Parents:<br>- Parental Stressor Scale (PSS-NICU)<br>- Nurse Parent Support Tool (NPST) | Parents:<br>- PSS-NICU overall: NSD<br>- PSS-NICU mothers vs fathers: 2.91 vs 2.58 (p<0.001)<br>- NPST: NSD | 7/7 |
| Bastani et al (2015) [21] Iran | RCT | 1 NICU | 47 intervention<br>44 control<br>Infants:<br>GA 30-36 weeks<br>Parents:<br>mothers only | FCC | Parents:<br>- Maternal satisfaction (self designed)<br>Infants:<br>- Hospital readmission rate | Parents:<br>- Satisfaction: 22.36 vs 59.28 (p<0.001)<br>Infants:<br>- Readmission (1x): 2 vs 6 (p=0.04) | 0/7 |
| Clarke - Pounder et al (2015) [22] USA | RCT | 1 NICU | 9 intervention<br>10 control<br>Infants:<br>GA 23-39 weeks<br>Parents:<br>not specified | N-DMT | Parents:<br>- State-Trait Anxiety Inventory (STAI)<br>- Family Inventory of Needs – Pediatrics (FIN-PED)<br>- Neonatal intensive care unit - Decision-Making Tool (N-DMT) | Parents:<br>All outcome measure: NSD | 0/7 |
| Verma et al (2017) [32] India | RCT | 1 NICU | 148 intervention<br>147 control<br>Infants:<br>GA not specified (<42 weeks) | FCC | Infants:<br>- nosocomial infection rate (culture positive and negative)<br>- LOS Hospital<br>- Mortality<br>- Breastfeeding at discharge | Infants:<br>- nosocomial infection rate: NSD<br>- LOS Hospital: NSD<br>- Mortality: NSD<br>- Breastfeeding rate: 98% vs 119% (p=0.007) | 4/7 |
| Yu et al (2017) [33] | RCT | 3 NICUs | 122 intervention<br>129 control | FCIP | Infants:<br>- Neonatal Neurobehavioral | Infants:<br>- NNEC total score: 71.5 vs 70.2 (p<0.05) | 5/7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Taiwan | | | Infants:<br>GA <37 weeks and birth weight <1,500 grams<br>Parents:<br>not specified | | Examination–Chinese version (NNE-C)<br>- Morbidity: duration oxygen use, sepsis, BPD, ROP, LOS hospital, postmenstrual age (PA) at discharge<br>- Feeding: time to full enteral feeding, feeding desaturation<br>- Growth: daily weight gain from 36 to 40 weeks GA and weight/normalized weight (z) at term<br>Parents:<br>- Parental adherence to Intervention related to NNE-C and weight gain | - Morbidity: NSD; PA at discharge (wks), 37.7 vs 38.3 (p<0.05)<br>- Feeding: PA to full enteral feeding (wks), 35.5 vs 36.6 (p<0.05); feeding desaturation NSD<br>- Growth: Weight gain (g/d), 40.0 vs 36.7 (p<0.05); (z) NSD<br>Parents:<br>- Parental motivation in hospital positive associated with NNE-C (tone and motor) r=0.21, p=0.02; total scores at term age r=0.28, p=0.002<br>- Full FCIP goal achievement correlated with greater weight gain $r_{pb}$=0.31, p=0.001 | |
| O'Brien et al (2018) [34] Canada, Australia, New Zealand | Cluster RCT | 26 NICUs | 895 intervention<br>891 control<br>Infants:<br>GA ≤33 weeks<br>Parents:<br>not specified | FICare | Infants:<br>- Weight gain, high frequency breastfeeding at hospital discharge, NICU mortality, neonatal morbidities, LOS hospital<br>Parents:<br>- Parental Stress Scale (PSS:NICU)<br>- State Trait Anxiety Index (STAI). | Infants:<br>- Weight gain Z score at 21 days: 1.58 vs 1.45 (<0·0001)<br>- Weight gain (g/d): 26.7 vs 24.8 (<0·0001)<br>- High-frequency breastmilk feeds (>6 times/d) at discharge home: 70% vs 63% (p=0·016)<br>- LOS hospital: NSD<br>- Mortality: NSD<br>- Morbidities: NSD<br>Parents:<br>PSS:NICU day 21: 2.3 vs 2.5 (p<0·001)<br>STAI day 21: 70.8 vs 74.2 (p=0·0045) | 7/7 |
| Zhao et al (2008) [23] China | RCT | 1 NICU | 13 intervention<br>10 control<br>Infants:<br>GA 28-36 weeks<br>Parents:<br>mothers or fathers | FCC | Parents:<br>- Self-rating Depression Scale (SDS)<br>- Self-Rating Anxiety Scale(SAS)<br>Infants:<br>- Weight gain, length, head circumference<br>- Neonatal Behavioral Neurological Assessment (NBNA) | Parents:<br>- SDS significant at 40 weeks corrected age: 36.62 vs 43.10 (p<0.05)<br>- SAS is NSD<br>Infants:<br>- Weight gain (g/d): 23.45 vs 17.83 (p<0.05)<br>- Length and head circumference NSD<br>- NBNA domain behaviour:10.46 vs 9.30 (p<0.05) other NBNA domains NSD | 1/7 |
| Hou et al (2012) [24] China | RCT | 1 NICU | 30 intervention<br>30 control<br>30 Term group<br>Infants: | FIC | Infants:<br>- Neuro development by Gesell Developmental Scale with domains gross motor, fine motor, language, | Infants:<br>- Gross motor: 91.97 vs 86.04 vs 93.85 (p<0.001)<br>- Fine motor: 88.97 vs 84.36 vs 93.48 | 1/7 |

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|---|---|---|---|---|---|---|---|
| | | | not specified<br>Parents:<br>not specified | | social behaviour, adaptation | (p<0.001)<br>- Language: 89.53 vs 82.30 vs 89.89 (p<0.001)<br>- Social behaviour: 92.81 vs 88.17 vs 95.50 (p<0.001)<br>- Adaptation: 95.47 vs 89.35 vs 95.89 (p<0.001) | |
| Ying et al (2012) [25] China | RCT | 1 NICU | 50 intervention<br>50 control<br>Infants:<br>GA 27-35 weeks<br>Parents:<br>not specified | Developmental caring model | Infants:<br>- LOS Hospital<br>- Weight gain<br>- Sleep Duration<br>- Intake of milk | Infants:<br>- Weight gain (g/d):18.5 vs 12.8 (p<0.01)<br>- Sleep duration (t/d):19.82 vs 16.71 (p<0.01)<br>- Intake of milk (ml): 50.2 vs 36.8 (p<0.01)<br>- LOS Hospital:18.50 vs 26.57 (p<0.01) | 5/7 |
| Chang et al (2013) [26] China | RCT | 1 NICU | 45 intervention<br>45 control<br>Infants:<br>GA 28-36 weeks<br>Parents:<br>not specified | FCC | Infants:<br>- Weight gain, length, head circumference<br>- Neonatal Behavioral Neurological Assessment (NBNA) | Infants:<br>- Weight gain (g/d): 23.65 vs 17.86 (p<0.05)<br>- Length, head circumference NSD<br>- NBNA domain behaviour: 10.47 vs 9.32 (p<0.05); other NBNA domains NSD | 1/7 |
| Wang et al (2013) [27] China | RCT | 1 NICU | 82 intervention<br>80 control<br>Infants:<br>GA 27-35 weeks<br>Parents:<br>mothers or fathers | PPN | Parents:<br>- Parent knowledge and skills questionnaire<br>- Parent satisfaction questionnaire<br>- Attending follow-up clinics | Parents:<br>- Knowledge: 82.5 vs 73.3 (p<0.05)<br>- Skills: 86.3 vs 72.5 (p<0.05)<br>- Satisfaction: 98.78% vs 72.50% (p<0.05)<br>- Number of follow-up visits: 84.14 vs 43.75 (p<0.05) | 3/7 |
| Wang et al (2015) [28] China | RCT | 1 NICU | 50 intervention<br>50 control<br>Infants:<br>GA 28-36 weeks<br>Parents:<br>not specified | FCC | Parents:<br>- Parent knowledge and skills questionnaire<br>- Parent satisfaction questionnaire<br>Infant:<br>- Weight gains, length, head circumference<br>- Neonatal Behavioral Neurological Assessment (NBNA) | Parents:<br>- Knowledge: 91.61 vs 68.78 (p<0.05)<br>- Skills: 92.37 vs 66.45 (p<0.01)<br>- Satisfaction: 98.12% vs 76.37% (p<0.05)<br>Infants:<br>- Weight gain (g/d): 26.34 vs 18.73 (p<0.05)<br>- Length and head circumference NSD<br>- NBNA domain behaviour: 12.38 vs 9.69 (p<0.01) other domains NSD | 1/7 |
| Kang et al (2016) [29] China | RCT | 1 NICU | 48 intervention<br>48 control<br>Infants:<br>GA 28-32 weeks<br>Parents:<br>not specified | FIC | Parents:<br>- Parent satisfaction questionnaire<br>Infants:<br>- Sleep Quality<br>- Weight gain<br>- Visiting follow-up clinics | Parents:<br>- Satisfaction: 95.83% vs 79.17% (p<0.05)<br>Infants:<br>- Sleep quality (h/d): 19 vs 15 (p<0.05)<br>- Weight gain (g/w): 138.1 vs 96 (p<0.05) | 1/7 |

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|---|---|---|---|---|---|---|---|
| | | | | | - Rate of pure breast-feeding<br>- Readmission | - Visiting follow-up clinics: 95.83% vs 68.75% (p<0.05)<br>- Rate of pure breast-feeding: 72.92 vs 52.08 (p<0.05)<br>- Readmission rates: 4.17 vs 16.67 (p<0.05) | |
| Li et al. (2016) [30] China | RCT | 1 NICU | 23 intervention<br>23 control<br>Infants:<br>GA 28-34 weeks<br>Parents:<br>not specified | FIC | Parents:<br>- Parent knowledge and skills questionnaire<br>- Parent satisfaction questionnaire<br>Infants:<br>- Readmission | Parents:<br>- Knowledge: 89.72 vs 76.63 (p<0.05)<br>- Skill: 85.54 vs 73.52 (p<0.05)<br>- Satisfaction: 98.83% vs 93.67% (p<0.05)<br>Infants:<br>- Readmission: 0 vs 8.7 (p<0.05) | 4/7 |
| Xiao et al (2016) [31] China | RCT | 1 NICU | 65 intervention<br>65 control<br>Infants:<br>not specified<br>Parents:<br>mothers or fathers | FIC | Parents:<br>- Parent knowledge and skills questionnaire<br>- Parent satisfaction questionnaire<br>Infants:<br>- Weight gains, length, head circumference<br>- LOS Hospital<br>- Readmission | Parents:<br>- Knowledge: 83.32 vs 74.03 (p<0.05)<br>- Skill: 87.16 vs 73.23 (p<0.05)<br>- Satisfaction: 98.46% vs 86.15% (p<0.05)<br>Infants:<br>- Weight gain (g/day): 26.34 vs 18.73 (p<0.05)<br>- Length (cm): 54.76 vs 53.45 (p<0.05)<br>- Head circumference (cm): 37.16 vs 35.96 (p<0.05)<br>- LOS Hospital: 24.78 vs 25.46 (p=0.742)<br>Readmission: 3 vs 10 (p<0.05) | 4/7 |

[1] For intervention details see Electronic Supplement Material 3: Characteristics of Family-Centered Care Interventions; BPD=Bronco-Pulmonary Dysplasia; CBIP=Clinic-Based Intervention Program; COPE=Creating Opportunities for Parent Empowerment; FC=Family Care; FCC=Family-Centered Care; FIC=Family Integrated Care; GA=Gestational Age; GFCC=Guided Family-Centred Care intervention; HBIP=Home-Based Intervention Program; IVH=Intra-Ventricular Hemorrhage; LOS=Length-Of-Stay; NBNA=Neonatal Behavioral Neurological Assessment; N-DMT=Decision-Making Tool for the Neonatal Intensive Care Unit; NEC=Necrotizing EnteroColitis; NICU=Neonatal Intensive Care Unit; NSD=No Significant Difference; PBIP=Parent Baby Interaction Programme; PDA=Patent Ductus Arteriosus; PPN=Parent Participation in Nursing; RCT=Randomized Controlled Trial; ROP=Retinopathy Of Prematurity.

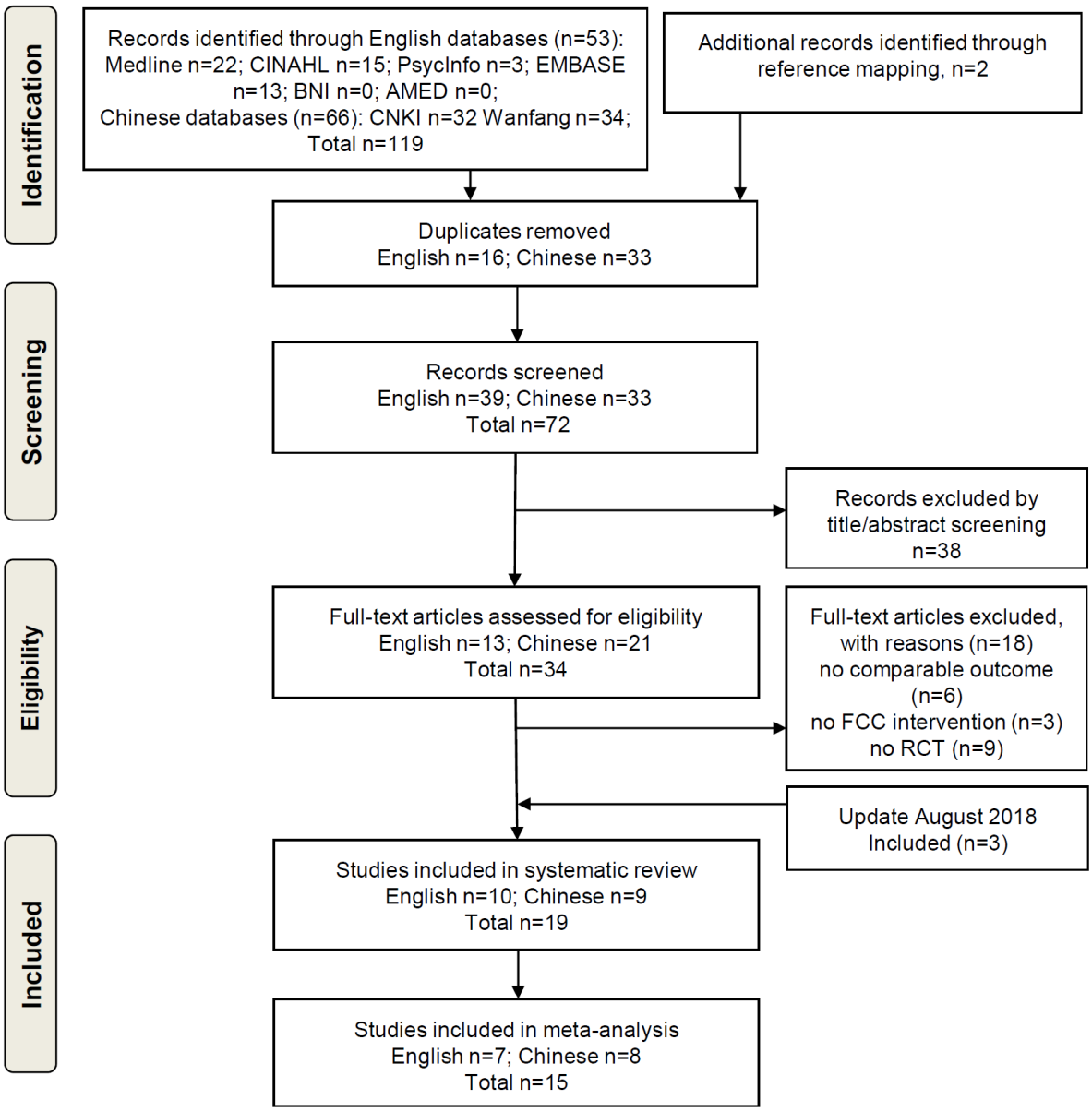
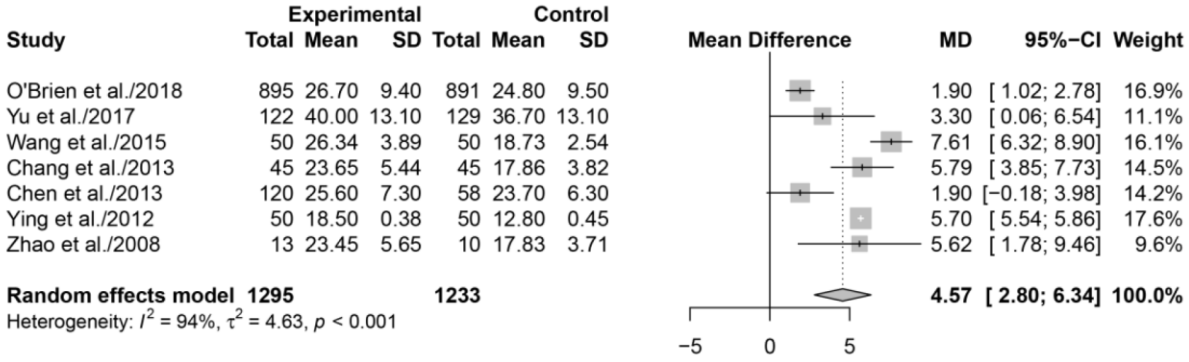
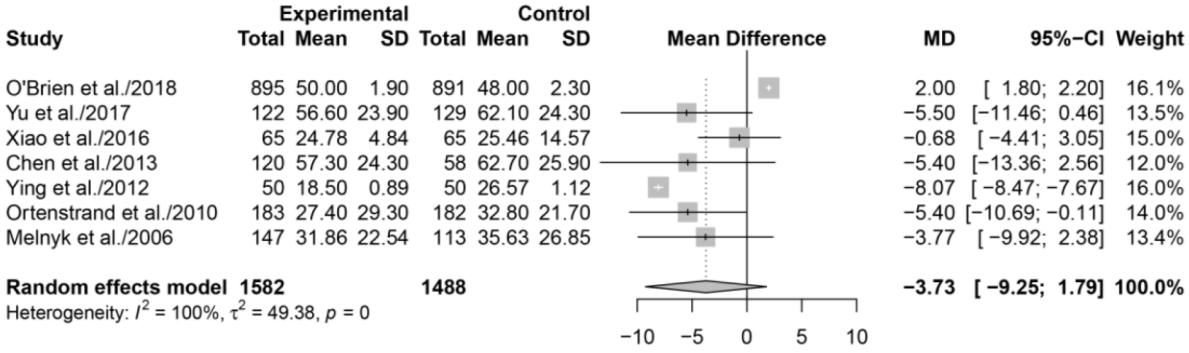



**Fig. 1.** Flow Diagram study selection April 2017 and updated August 2018

## 2.1 Weight gain




## 2.2 Hospital Length of Stay




## 2.3 Readmission

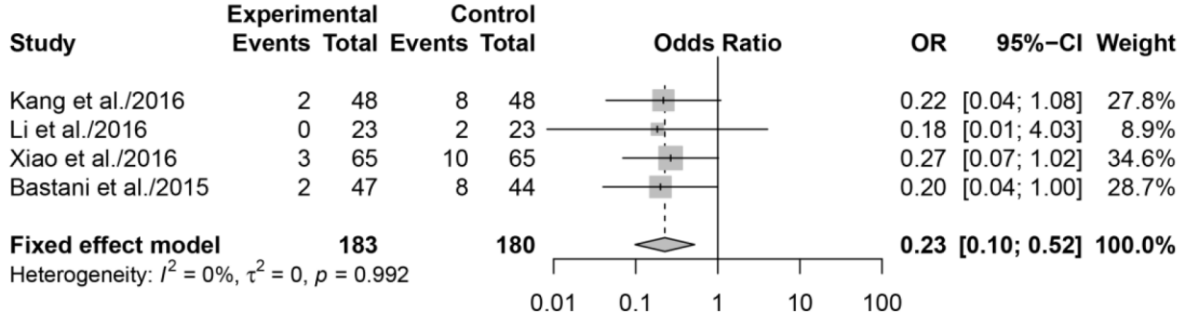
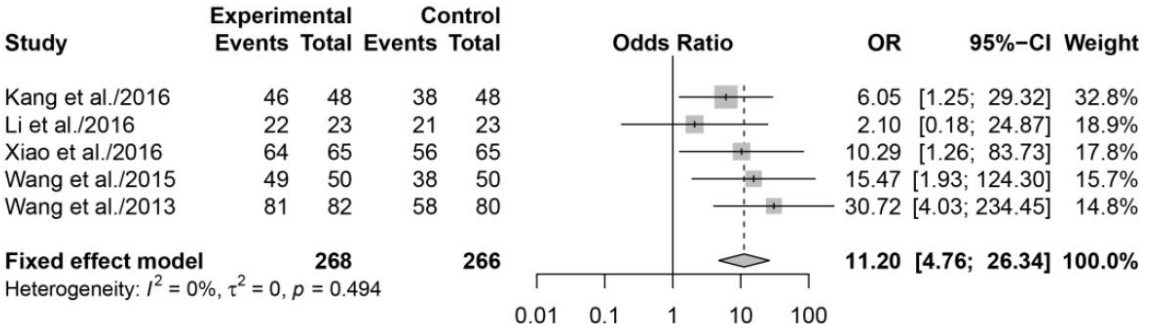
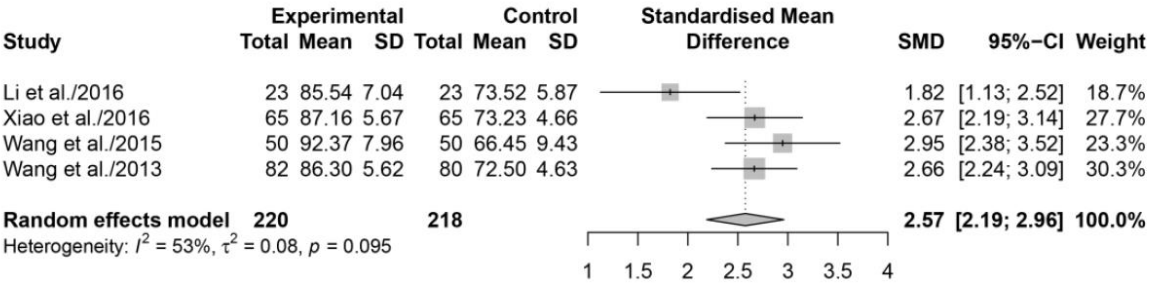



**Fig. 2.** Forest plots of infant clinical outcomes; (2.1) weight gain; (2.2) hospital length-of-stay; (2.3) readmission

### 3.1 Parent satisfaction




### 3.2 Skills of parents




### 3.3 Knowledge of parents

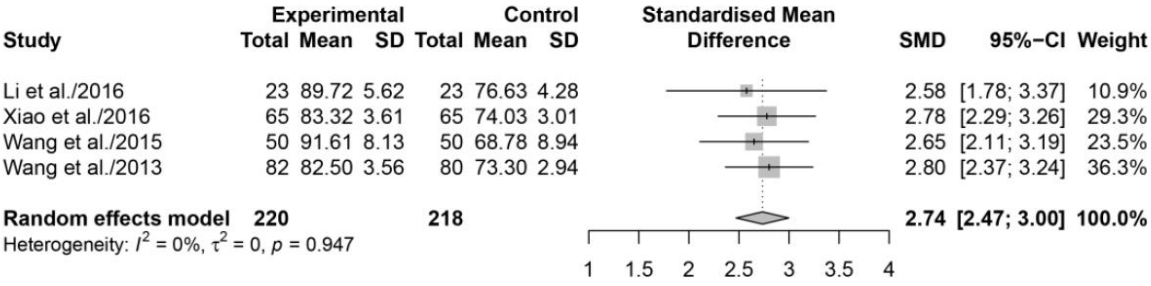



**Fig. 3.** Forest plots of parent reported outcomes; (3.1) parent satisfaction; (3.2) skills of parents; (3.3) knowledge of parents

## **Electronic Supplement Material 1:** Search strategies

**Search Strategies Medline, CINAHL, EMBASE, PsycInfo**

**Medline**

| Database | Search term | Results |
|---|---|---|
| Medline | ((((parent*).ti,ab OR (father*).ti,ab OR (mother*).ti,ab OR (family OR families).ti,ab OR exp FAMILY/ OR exp FATHERS/ OR exp MOTHERS/ OR exp PARENT-CHILD RELATIONS/ OR exp PARENTING/) AND ((premature).ti,ab OR (neonat*).ti,ab OR (infant*).ti,ab OR INFANT, PREMATURE/ OR INFANT, EXTREMELY PREMATURE/ OR exp INFANT, NEWBORN/ OR (preterm).ti,ab)) AND (("family centred care").ti,ab OR ("family centered care").ti,ab OR (fcc).ti,ab OR ("family integrated care").ti,ab OR exp FAMILY NURSING/ OR exp PROFESSIONAL-FAMILY RELATIONS/)) AND (RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC OR ("randomized controlled trial").ti,ab OR ("randomised controlled trial").ti,ab OR (rct).ti,ab OR ("randomized control trial").ti,ab OR ("randomised control trial").ti,ab) | 22 |

| # | Database | Search term | Results |
|---|---|---|---|
| 1 | Medline | (parent*).ti,ab | 338599 |
| 2 | Medline | (father*).ti,ab | 34256 |
| 3 | Medline | (mother*).ti,ab | 176915 |
| 4 | Medline | (family OR families).ti,ab | 772556 |
| 5 | Medline | exp FAMILY/ | 271548 |
| 6 | Medline | exp FATHERS/ | 7371 |
| 7 | Medline | exp MOTHERS/ | 33765 |
| 8 | Medline | exp PARENT-CHILD RELATIONS/ | 50280 |
| 9 | Medline | exp PARENTING/ | 12791 |
| 10 | Medline | (premature).ti,ab | 100118 |
| 11 | Medline | (neonat*).ti,ab | 226162 |
| 12 | Medline | (infant*).ti,ab | 347480 |
| 13 | Medline | INFANT, PREMATURE/ | 46601 |
| 14 | Medline | INFANT, EXTREMELY PREMATURE/ | 1056 |
| 15 | Medline | exp INFANT, NEWBORN/ | 545520 |
| 16 | Medline | (preterm).ti,ab | 58211 |

| | | | |
|---|---|---|---|
| 17 | Medline | ("family centred care").ti,ab | 351 |
| 18 | Medline | ("family centered care").ti,ab | 1029 |
| 19 | Medline | (fcc).ti,ab | 2699 |
| 20 | Medline | ("family integrated care").ti,ab | 8 |
| 21 | Medline | exp FAMILY NURSING/ | 1244 |
| 22 | Medline | exp PROFESSIONAL-FAMILY RELATIONS/ | 13207 |
| 23 | Medline | RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC | 116196 |
| 24 | Medline | ("randomized controlled trial").ti,ab | 50778 |
| 25 | Medline | ("randomised controlled trial").ti,ab | 15569 |
| 26 | Medline | (rct).ti,ab | 14044 |
| 27 | Medline | ("randomized control trial").ti,ab | 2478 |
| 28 | Medline | ("randomised control trial").ti,ab | 678 |
| 29 | Medline | (1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9) | 1298670 |
| 30 | Medline | (10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16) | 900950 |
| 31 | Medline | (17 OR 18 OR 19 OR 20 OR 21 OR 22) | 17780 |
| 32 | Medline | (23 OR 24 OR 25 OR 26 OR 27 OR 28) | 185221 |
| 33 | Medline | (29 AND 30 AND 31 AND 32) | 22 |

**CINAHL**

| **Database** | **Search term** | **Results** |
|---|---|---|
| CINAHL | ((((parent*).ti,ab OR (father*).ti,ab OR (mother*).ti,ab OR (family OR families).ti,ab OR exp PARENTING/ OR exp FAMILY/ OR exp FATHERS/ OR exp MOTHERS/ OR exp PARENT-CHILD RELATIONS/) AND ((preterm).ti,ab OR (premature).ti,ab OR (neonat*).ti,ab OR (infant*).ti,ab OR INFANT, PREMATURE/ OR INFANT, EXTREMELY PREMATURE/ OR exp INFANT, NEWBORN/)) AND (("family centred care").ti,ab OR ("family centered care").ti,ab OR (fcc).ti,ab OR ("family integrated care").ti,ab OR exp FAMILY NURSING/ OR exp PROFESSIONAL-FAMILY RELATIONS/ OR exp FAMILY CENTERED CARE/)) AND (("randomized controlled trial").ti,ab OR ("randomised controlled trial").ti,ab OR (rct).ti,ab OR ("randomized control trial").ti,ab OR ("randomised control trial").ti,ab OR exp RANDOMIZED CONTROLLED TRIALS/) | 15 |

| # | Database | Search term | Results |
|---|---|---|---|
| 1 | CINAHL | (parent*).ti,ab | 61889 |
| 2 | CINAHL | (father*).ti,ab | 6973 |
| 3 | CINAHL | (mother*).ti,ab | 35690 |
| 4 | CINAHL | (family OR families).ti,ab | 111612 |
| 5 | CINAHL | exp PARENTING/ | 8480 |
| 6 | CINAHL | exp FAMILY/ | 121993 |
| 7 | CINAHL | exp FATHERS/ | 3652 |
| 8 | CINAHL | exp MOTHERS/ | 19669 |
| 9 | CINAHL | exp PARENT-CHILD RELATIONS/ | 16325 |
| 10 | CINAHL | (preterm).ti,ab | 13772 |
| 11 | CINAHL | (premature).ti,ab | 10208 |
| 12 | CINAHL | (neonat*).ti,ab | 28167 |
| 13 | CINAHL | (infant*).ti,ab | 46858 |
| 14 | CINAHL | INFANT, PREMATURE/ | 12272 |
| 15 | CINAHL | INFANT, EXTREMELY PREMATURE/ | 0 |
| 16 | CINAHL | exp INFANT, NEWBORN/ | 72100 |
| 17 | CINAHL | ("family centred care").ti,ab | 315 |
| 18 | CINAHL | ("family centered care").ti,ab | 856 |
| 19 | CINAHL | (fcc).ti,ab | 188 |
| 20 | CINAHL | ("family integrated care").ti,ab | 6 |
| 21 | CINAHL | exp FAMILY NURSING/ | 1146 |
| 22 | CINAHL | exp PROFESSIONAL-FAMILY RELATIONS/ | 11747 |
| 23 | CINAHL | exp FAMILY CENTERED CARE/ | 5302 |
| 24 | CINAHL | ("randomized controlled trial").ti,ab | 15246 |
| 25 | CINAHL | ("randomised controlled trial").ti,ab | 5352 |
| 26 | CINAHL | (rct).ti,ab | 6889 |
| 27 | CINAHL | ("randomized control trial").ti,ab | 670 |
| 28 | CINAHL | ("randomised control trial").ti,ab | 182 |

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|---|---|---|---|
| 29 | CINAHL | exp RANDOMIZED CONTROLLED TRIALS/ | 30956 |
| 30 | CINAHL | (1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9) | 238171 |
| 31 | CINAHL | (10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16) | 112519 |
| 32 | CINAHL | (17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23) | 17478 |
| 33 | CINAHL | (24 OR 25 OR 26 OR 27 OR 28 OR 29) | 49171 |
| 34 | CINAHL | (30 AND 31 AND 32 AND 33) | 15 |

**PsycInfo**

| **Database** | **Search term** | **Results** |
|---|---|---|
| PsycInfo | (RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC/ OR ("randomized controlled trial").ti,ab OR ("randomised controlled trial").ti,ab OR (rct).ti,ab OR ("randomized control trial").ti,ab OR ("randomised control trial").ti,ab) AND ((((("family centred care").ti,ab OR ("family centered care").ti,ab OR (fcc).ti,ab OR ("family integrated care").ti,ab) AND ((parent*).ti,ab OR (father*).ti,ab OR (mother*).ti,ab OR (family OR families).ti,ab)) AND ((preterm).ti,ab OR (premature).ti,ab OR (neonat*).ti,ab OR (infant*).ti,ab)) | 3 |

| **#** | **Database** | **Search term** | **Results** |
|---|---|---|---|
| 1 | PsycINFO | (parent*).ti,ab | 230140 |
| 2 | PsycINFO | (father*).ti,ab | 41598 |
| 3 | PsycINFO | (mother*).ti,ab | 107811 |
| 4 | PsycINFO | (family OR families).ti,ab | 321662 |
| 5 | PsycINFO | exp PARENTING/ | 85073 |
| 6 | PsycINFO | exp FAMILY/ | 45737 |
| 7 | PsycINFO | exp FATHERS/ | 9715 |
| 8 | PsycINFO | exp MOTHERS/ | 36778 |
| 9 | PsycINFO | exp PARENT-CHILD RELATIONS/ | 0 |
| 10 | PsycINFO | (preterm).ti,ab | 5716 |
| 11 | PsycINFO | (premature).ti,ab | 11183 |
| 12 | PsycINFO | (neonat*).ti,ab | 17085 |

| | | | |
|---|---|---|---|
| 13 | PsycINFO | (infant*).ti,ab | 71619 |
| 14 | PsycINFO | INFANT, PREMATURE/ | 2673 |
| 15 | PsycINFO | INFANT, EXTREMELY PREMATURE/ | 134 |
| 16 | PsycINFO | exp INFANT, NEWBORN/ | 0 |
| 17 | PsycINFO | ("family centred care").ti,ab | 166 |
| 18 | PsycINFO | ("family centered care").ti,ab | 446 |
| 19 | PsycINFO | (fcc).ti,ab | 171 |
| 20 | PsycINFO | ("family integrated care").ti,ab | 1 |
| 21 | PsycINFO | exp FAMILY NURSING/ | 0 |
| 22 | PsycINFO | exp PROFESSIONAL-FAMILY RELATIONS/ | 0 |
| 23 | PsycINFO | RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC/ | 9568 |
| 24 | PsycINFO | ("randomized controlled trial").ti,ab | 12484 |
| 25 | PsycINFO | ("randomised controlled trial").ti,ab | 2559 |
| 26 | PsycINFO | (rct).ti,ab | 3039 |
| 27 | PsycINFO | ("randomized control trial").ti,ab | 821 |
| 28 | PsycINFO | ("randomised control trial").ti,ab | 165 |
| 29 | PsycINFO | (1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9) | 0 |
| 30 | PsycINFO | (10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16) | 0 |
| 31 | PsycINFO | (17 OR 18 OR 19 OR 20 OR 21 OR 22) | 0 |
| 32 | PsycINFO | (29 AND 30 AND 31) | 0 |
| 33 | PsycINFO | (23 OR 24 OR 25 OR 26 OR 27 OR 28) | 25115 |
| 34 | PsycINFO | (32 AND 33) | 0 |
| 35 | PsycINFO | (17 OR 18 OR 19 OR 20) | 718 |
| 36 | PsycINFO | (1 OR 2 OR 3 OR 4) | 528985 |
| 37 | PsycINFO | (10 OR 11 OR 12 OR 13) | 93170 |
| 38 | PsycINFO | (35 AND 36 AND 37) | 93 |
| 39 | PsycINFO | (33 AND 38) | 3 |

**EMBASE**

| Database | Search term | Results |
|---|---|---|
| EMABSE | ((((parent*).ti,ab OR (father*).ti,ab OR (mother*).ti,ab OR (family OR families).ti,ab OR exp PARENTING/ OR exp FAMILY/ OR exp FATHERS/ OR exp MOTHERS/ OR exp PARENT-CHILD RELATIONS/) AND ((preterm).ti,ab OR (premature).ti,ab OR (neonat*).ti,ab OR (infant*).ti,ab OR INFANT, PREMATURE/ OR INFANT, EXTREMELY PREMATURE/ OR exp INFANT, NEWBORN/)) AND (RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC/ OR ("randomized controlled trial").ti,ab OR ("randomised controlled trial").ti,ab OR (rct).ti,ab OR ("randomized control trial").ti,ab OR ("randomised control trial").ti,ab)) AND (("family centred care").ti,ab OR ("family centered care").ti,ab OR (fcc).ti,ab OR ("family integrated care").ti,ab OR exp FAMILY NURSING/) | 13 |

| # | Database | Search term | Results |
|---|---|---|---|
| 1 | EMBASE | (parent*).ti,ab | 427827 |
| 2 | EMBASE | (father*).ti,ab | 44946 |
| 3 | EMBASE | (mother*).ti,ab | 227817 |
| 4 | EMBASE | (family OR families).ti,ab | 963461 |
| 5 | EMBASE | exp PARENTING/ | 76927 |
| 6 | EMBASE | exp FAMILY/ | 540475 |
| 7 | EMBASE | exp FATHERS/ | 29013 |
| 8 | EMBASE | exp MOTHERS/ | 160340 |
| 9 | EMBASE | exp PARENT-CHILD RELATIONS/ | 76927 |
| 10 | EMBASE | (preterm).ti,ab | 78689 |
| 11 | EMBASE | (premature).ti,ab | 129310 |
| 12 | EMBASE | (neonat*).ti,ab | 291148 |
| 13 | EMBASE | (infant*).ti,ab | 408334 |
| 14 | EMBASE | INFANT, PREMATURE/ | 94099 |
| 15 | EMBASE | INFANT, EXTREMELY PREMATURE/ | 98723 |
| 16 | EMBASE | exp INFANT, NEWBORN/ | 550963 |
| 17 | EMBASE | ("family centred care").ti,ab | 433 |
| 18 | EMBASE | ("family centered care").ti,ab | 1202 |

| | | | |
|---|---|---|---|
| 19 | EMBASE | (fcc).ti,ab | 1849 |
| 20 | EMBASE | ("family integrated care").ti,ab | 17 |
| 21 | EMBASE | exp FAMILY NURSING/ | 1250 |
| 22 | EMBASE | exp PROFESSIONAL-FAMILY RELATIONS/ | 751492 |
| 23 | EMBASE | RANDOMIZED CONTROLLED TRIAL/ OR RANDOMIZED CONTROLLED TRIALS AS TOPIC/ | 549216 |
| 24 | EMBASE | ("randomized controlled trial").ti,ab | 66705 |
| 25 | EMBASE | ("randomised controlled trial").ti,ab | 21364 |
| 26 | EMBASE | (rct).ti,ab | 23904 |
| 27 | EMBASE | ("randomized control trial").ti,ab | 3852 |
| 28 | EMBASE | ("randomised control trial").ti,ab | 1160 |
| 29 | EMBASE | (1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9) | 1634338 |
| 30 | EMBASE | (10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16) | 1031098 |
| 31 | EMBASE | (17 OR 18 OR 19 OR 20 OR 21 OR 22) | 754854 |
| 32 | EMBASE | (23 OR 24 OR 25 OR 26 OR 27 OR 28) | 570487 |
| 33 | EMBASE | (29 AND 30 AND 31 AND 32) | 1164 |
| 34 | EMBASE | 33 [Publication types Conference Abstract OR Conference Paper OR Conference Proceeding OR Conference Review] | 65 |
| 35 | EMBASE | (17 OR 18 OR 19 OR 20 OR 21) | 4471 |
| 36 | EMBASE | (29 AND 30 AND 32 AND 35) | 13 |

**WANG FAN DATABASE** 数据库

家庭式护理 + 家庭护理干预 + 家庭式参与护理 + 家长参与式护理 + 袋鼠式护理 期刊论文|学位论文|会议论文|外文期刊|外文会议 2017 年 4 月 27 日 GMT-7 下午 7:10:30 14100

家庭式护理 + 家庭护理干预 + 家庭式参与护理 + 家长参与式护理 + 袋鼠式护理 and 早产儿+新生儿 期刊论文|学位论文|会议论文|外文期刊|外文会议 2017年4月27日 GMT-7下午7:12:56 742

家庭式护理 + 家庭护理干预 + 家庭式参与护理 + 家长参与式护理 + 袋鼠式护理 and 早产儿+新生儿 and 随机对照试验+随机对照实验+随机对照临床试验+随机对照临床实验室 期刊论文|学位论文|会议论文|外文期刊|外文会议2017 年 4 月 27 日 GMT-7 下午 7:17:43 34

**CNKI** 检索策略

一、本次检索输入的条件：

检索控制条件：

学科范围： 不限

数据库： 中国学术期刊网络出版总库,中国博士学位论文全文数据库,

中国优秀硕士学位论文全文数据库,

中国重要会议论文全文数据库,中国重要报纸全文数据库,

中国专利数据库,国家科技成果数据库

发表时间： 1930-01-01 ～ 2017-04-27

文献来源： 不限

支持基金： 不限

作者： 不限

作者单位： 不限

检索式

(( (全文=中英文扩展(家庭式护理) 或者 全文=中英文扩展(家庭护理干预))) 或者 (全文=中英文扩展(家庭式参与护理) 或者 全文=中英文扩展(家长参与式护理))) 或者 全文=中英文扩展(袋鼠式护理))(模糊匹配)

检索内容：13250

检索式：

(( (全文=中英文扩展(家庭式护理) 或者 全文=中英文扩展(家庭护理干预))) 或者 (全文=中英文扩展(家庭式参与护理) 或者 全文=中英文扩展(家长参与式护理))) 或者 全文=中英文扩展(袋鼠式护理))(模糊匹配) 和 (( (全文=中英文扩展(新生儿) 或者 全文=中英文扩展(早产儿))) (模糊匹配)

检索内容：642

检索式

(( (全文=中英文扩展(家庭式护理) 或者 全文=中英文扩展(家庭护理干预))) 或者 (全文=中英文扩展(家庭式参与护理) 或者 全文=中英文扩展(家长参与式护理))) 或者 全文=中英文扩展(袋鼠式护理))(模糊匹配) 和 (( (全文=中英文扩展(新生儿) 或者 全文=中英文扩展(早产儿))) (模糊匹配) 和(全文=中英文扩展(随机对照试验) 或者 全文=中英文扩展(随机对照实验))) 全文=中英文扩展(随机对照临床实验)))或者 全文=中英文扩展(随机对照临床试验))(模糊匹配)

检索内容：32

查重后 33

**Electronic Supplement Material 2**: Characteristics of Family-Centered Care Interventions

| Source and Country | Details of interventions | Family-centered care component* |
|---|---|---|
| Melnyk et al (2006) [14] USA | COPE intervention is a 4-phase programme to provide parents with information: Phase 1: 2-4 days after admission audio tape and written information about infant behaviour and parental role information and set of parenting activities; Phase 2: 2-4 days after first intervention reinforce phase 1 and provide supplemental information on premature infant behaviour and development; Phase 3: 1-4 days before discharge audio tape about infant states, interaction, parent information for smooth transition home and parent-infant relationship; Phase 4: 1 week after discharged at home audio tape and written information about preterm development and activities to support cognitive development. | Educational support<br>Information & communication |
| Glazebrook et al (2007) [15] UK | PBIP intervention included education to parents to observe their infant through a series of activities. Components of PBIP were: tactile (e.g., stroking infant), discussion (e.g., infant development), verbal (e.g., greeting infant) and observation (e.g., identifying different states). | Educational support<br>Partnership in care |
| Ortenstrand et al (2010) [16] Sweden | FC ward intervention designed a ward with separate rooms for parents, including beds for both parents, a bathroom, a bed for the infant, equipment for oxygen supply, monitoring. Each family ward had a 4-bed intensive care room, with staff continuously present. From admission, at least 1 of the parents was expected to stay 24 hours a day during the entire hospital stay. | NICU environment |
| Chen et al (2013) [17] Taiwan | CBIP and HBIP interventions are based on Synactive Theory and Family-Centred Care. In both interventions the parents received in-hospital, neonatal follow-up, and after-discharge interventions. Interventions aimed to build parent–professional partnerships to involve parents early in caregiving to promote child development. and parent–child interaction. Content of both interventions included: modulation of NICU, teaching of child developmental skills, feeding support, massage (skin-to-skin contact), and parent support and education (interpretation of the infant's behavioural cues and parenting skills). Education material in the form of a book and CD were provided. | Educational support<br>Partnership in care |
| Weis et al (2013) [18] Denmark | GFCC intervention based on FCC principles, person-centred communication and Guided Self-Determination. GFCC includes: 1) regularly scheduled dialogues between parents and their primary nurse while their infant is in the NICU; 2) preparing parents for dialogues using semi-structured reflection sheets; 3) person-centred communication techniques used by nurses. Three different reflection sheets to guide dialogues during the intensive care phase, the stabilizing phase and the discharge phase. | Personalized care<br>Information & communication |
| Bastani et al (2015) [19] Iran | FCC intervention educating parents about infection-control strategies, cause of their infants' hospitalization, breathing exercises, changing infant's positions, importance of skin-to-skin contact, feeding methods (gavage and breastfeeding), and leaving the unit at specific times (due to changing shifts, physician's visits, and cardiopulmonary resuscitation). Educational leaflets were provided with information about burping, milk storage, frequency of feeding, bathing the | Educational support<br>Parent support<br>Information & communication |

| | | |
|---|---|---|
| | infant, and frequency of washing hands with disinfectant solutions. | |
| Clarke-Pounder et al (2015) [20]<br>USA | N-DMT intervention adapted to use as an interview tool between parents and clinicians during rounds. Questions address four areas including: 1) medical indications for treatment (Give a brief description of your baby's condition?); 2) parent preferences (How do you like things explained to you?); 3) quality of life (What goals and hopes do you have for your baby's life?); 4) contextual issues (How do your cultural or spiritual beliefs impact how you make decisions?). | Partnership in care<br>Information & communication |
| Verma et al (2017) [30]<br>India | FCC intervention educating parents with a simplified comprehensive audio-visual training. Training included 4 parts: 1) preparing for NICU entry (dos and don'ts before entry, hand washing, wearing gown, change of soiled diapers); 2) familiarization with NICU environment (care under warmer and phototherapy, stability of fixation of warmer/pulse oximeter probes/orogastric tube/oxygen nasal prongs and intravenous cannula); 3) building skills of recognizing and reporting danger signs (change in colour/activity/breathing pattern/bleeding rash/gastric aspirates/vomiting, abdominal distension, altered stool colour, stool/urine passed); 4) teaching orogastric/paladay/katori-spoon feeding. | Educational support |
| Yu et al (2017) [31]<br>Taiwan | FCIP intervention delivering in-NICU 5 sessions and after-discharge 4 clinic visits and 3 home visits. In-NICU and after-discharge interventions were guided by synactive theory and biosocial developmental theory incorporating the principles of family-centered care. The FCIP courses included: 7 topics: 1) NICU environmental modulation; 2) feeding support; 3) massage; 4) dyadic interaction activities; 5) child developmental skills; 6) parental support and education; 7) transition home preparation. The FCIP required early involvement and collaborative care with parents. | Educational support<br>Partnership in care |
| O'Brien et al (2018) [32]<br>Canada, Australia, New Zealand | FICare intervention: Parents are primary caregiver at the infant's bedside minimal 6 hour per day for 5 days a week. Parents attending medical rounds and education sessions for at least 3 weeks.<br>FICare has four pillars: 1) Parent education programme with small group education sessions, parent coaching at the bedside, and parent involvement in medical rounds; 2) Staff training programme with education about importance of family involvement in infant care and tools for staff to mentor, coach, and support parents; 3) policies, procedures, and environmental resources to operationalise parent involvement in care and support prolonged parental presence in the NICU; 4) programme of psychosocial support that included peer-to-peer and professional support for families while in the NICU. | Educational support<br>Partnership in care<br>Parent support<br>Information & communication |
| Zhao et al (2008) [21]<br>China | FCC intervention delivering 2-week training to parents. Training content included: Theory about premature features, feeding, bathing and routine nursing care and techniques about massage and emergency treatment. The training was evaluated with a quiz and test. | Educational support |
| Hou et al (2012) [22]<br>China | FIC intervention delivering training to parents to deliver motor skill development stimulation. Training included audio, visual, touch, smell, fine and gross motoric stimulation. | Educational support<br>Partnership in care |
| Ying et al (2012) [23] | Developmental Caring intervention delivering training to parents about the basic care of their infant. No further information provided. | Educational support |

| | | |
|---|---|---|
| China | | |
| Chang et al (2013) [24] China | FCC intervention delivering 2-week training to parents. Training content included: Theory about premature features, feeding, bathing and routine nursing care and techniques about massage and emergency treatment. | Educational support |
| Wang et al (2013) [25] China | PPN intervention delivering training to parents about:<br>- ward rules, hand hygiene, preterm infants' features, observe medical condition, emergency treatment;<br>- for parents with infants without ventilatory support: observe monitor parameters, holding babies, bathing, change diapers, oral nursing<br>- for parents with infants with ventilatory support: explain function of ventilators, how to clean and fix ventilators and tubes, sucking, nebuliser, nasogastric tube feeding. | Educational support |
| Wang et al (2015) [26] China | FCC intervention delivering 2-week training to parents. Training content included: Theory about premature features, feeding, bathing and routine nursing care and techniques about massage and emergency treatment. | Educational support |
| Kang et al (2016) [27] China | FIC intervention delivering on-site training to parents about basic nursing care of the infant, observations of medical conditions, and early interventions (not mentioned what interventions). Parents were encouraged to participate in the care of their child such as breastfeeding, observations, baby massage. | Educational support<br>Partnership in care |
| Li et al (2016) [28] China | FIC intervention delivering training to parents about ward rules, hand hygiene, mask wearing, preterm babies' features, observe medical condition, emergency treatment, observe monitor parameters, holding babies, bathing, change diapers, oral nursing, evaluate temperature, respiratory, blood pressure, explain oxygen therapy. After the training the parents participated in the nursing care together with the nurses. | Educational support<br>Partnership in care |
| Xiao et al (2016) [29] China | FIC intervention delivering training to parents. Training content included knowledge about preterm basic care, feeding, hand hygiene, early identification of critical condition, and the techniques of holding babies, bathing, feeding, resuscitation techniques and diaper change. Parents were staying and participating in the care minimal 4 hours a day. | Educational support<br>Partnership in care |

CBIP=Clinic-Based Intervention Program; COPE=Creating Opportunities for Parent Empowerment; FCC=Family-Centered Care; FCIP=Family-Centered Intervention Program; FIC=Family Integrated Care; GFCC=Guided Family-Centred Care intervention; HBIP=Home-Based Intervention Program; NFCC =Neonatal Family Centered Care; N-DMT=Decision-Making Tool for the Neonatal Intensive Care Unit; PBIP=Parent Baby Interaction Programme; PPN=Parent Participating in Nursing.

* Components of FCC: educational support (skills and knowledge of care); partnership in care (empowerment and involvement in care); personalized care (needs and wishes); parent support (psychological and visiting access); information and communication; NICU environment (noise-light levels and design/lay-out of NICU).[3,5,12]

**Electronic Supplement Material 3**: Risk of Bias of Included RCTs

| Article - Country | Random sequence generation (selection bias) | Allocation concealment (selection bias) | Blinding of participants and personal (performance bias) | Blinding of outcome assessment (detection bias) | Incomplete outcome data (attrition bias) | Selective reporting (reporting bias) | Other bias |
|---|---|---|---|---|---|---|---|
| Melnyk et al (2006) USA [16] | Low | Low | Low | Low | Low | Low | Low |
| Glazebrook et al (2007) UK [17] | Low | Low | Low | Unclear | Low | Low | Low |
| Ortenstrand et al (2010) Sweden [18] | Low | Low | Unclear | Low | Unclear | Low | Low |
| Chen et al (2013) Taiwan [19] | Low | Low | Low | Low | Unclear | Unclear | Low |
| Weis et al (2013) Denmark [20] | Low | Low | Low | Low | Low | Low | Low |
| Bastani et al (2015) Iran [21] | High | High | Unclear | Unclear | Unclear | High | Unclear |
| Clarke-Pounder et al (2015) USA [22] | Unclear | Unclear | High | High | Unclear | High | High |
| Verma et al (2017) India [32] | Low | Low | Low | Low | Unclear | Unclear | Unclear |
| Yu et al (2017) Taiwan [33] | Low | Low | Unclear | Unclear | Low | Low | Low |
| O'Briend et al (2018) Canada [34] | Low | Low | Low | Low | Low | Low | Low |
| Zhao et al (2008) China [23] | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Ying et al (2012) China [24] | Low | Low | Low | Low | Unclear | Unclear | Low |
| Chang et al (2013) China [25] | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Wang et al (2013) China [26] | Unclear | Unclear | Unclear | Low | Low | Unclear | Low |
| Hou et al (2012) China [27] | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Wang et al (2015) China [28] | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Kang et al (2016) China [29] | Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low |
| Li et al (2016) China [30] | Low | High | Low | Low | Unclear | Unclear | Low |
| Xiao et al (2016) China [31] | Low | Low | Unclear | Low | Unclear | Unclear | Low |

## **Electronic Supplement Material 4:** parent satisfaction and parental knowledge surveys

**Questionnaire Parent Satisfaction**

**Reference:** J. Wang, Q.L. Guo, Z.Z. Zhao, Y. Yang, Effects of parental participation nursing model on premature infants, Nurs J Chin PLA. 30(3) (2013 Feb) 20-22. [in Chinese, abstract in English]

Date： Department： Admission number：

Dear Parents：
In order to improve the quality of medical and nursing care and help your children reduce the length of hospital stay, we want to explore your satisfaction of medical and nursing staffs. During your evaluation, please write " √ " on the corresponding letter of each item. Thank you for your support and cooperation in the medical and nursing work of our hospital!

1. What do you think of nurse's service on admission?
A、excellent B、fair C、disappointed

2. When you were admitted to the hospital, what do you think of nurse's introduction of the rules and regulations (such as visitation, medical insurance system) and related issues?
A、excellent B、fair C、disappointed

3. When you were admitted to the hospital, what do you think of doctor's attitude of service？
A、excellent B、fair C、disappointed

4. When you were admitted to the hospital, what do you think of doctor's inquiry level of carefulness of medical history？
A、excellent B、fair C、disappointed

5. When you were in the hospital, what do you think of the medical staff's explanation of your illness？
A、excellent B、fair C、disappointed

6. When you were in the hospital, what do you think of the feeding guidance given by medical staffs?
A、excellent B、fair C、disappointed

7. When you were in the hospital, what do you think of the medication guidance given by medical staffs?
A、excellent B、fair C、disappointed

8. When you were in the hospital, what do you think of medical staff's explanation before and after special examination or operation?
A、excellent B、fair C、disappointed

9. What do you think of the reception of the medical staffs when you make a call to the hospital?
A、excellent B、fair C、disappointed

10. When you were in the hospital, What do you think of inquiry service of "expense list" provided by the department?
A、excellent B、fair C、disappointed

11. When you were in the hospital, what’s your general impression of medical moral of doctors and nurses？
A、excellent B、fair C、disappointed

12. When you were in the hospital, what do you think of the quietness and cleanliness of the department?
A、excellent B、fair C、disappointed

13. When you were in the hospital, what do you think of the medical techniques of the staffs in the department?
A、excellent B、fair C、disappointed

14. What do you think of treatment outcome of the disease?
A、excellent B、fair C、disappointed

15. What do you think of the health education and guidance given by medical staffs (eg. feeding, activity and recovery time)?
A、excellent B、fair C、disappointed

Thank you very much for your suggestions!

……...

**Parent Satisfaction Questionnaire**

**Reference:** A.Q. Xiao, R.W. Huang, R. Zhang, P. Shen, L.H. Zhu, Application of family-centered care in the high quality nursing in neonatal ward, Nurs J Chin PLA. 33(23) (2016 Dec) 70-73. [in Chinese, abstract in English]

**1. To services provided by nurses in the ward**

1.1 Being amiable and considerate of people's emotions

□ Satisfied □ Unsatisfied

1.2 Being able to actively explain related disease nursing knowledge and cautions

□ Satisfied □ Unsatisfied

1.3 Being able to actively introduce hospitalization notes, health education knowledge, hospitalization environment and ward facilities at admission

□ Satisfied □ Unsatisfied

**2. To services provided by medical insurance staff (urban and new rural cooperative medical system)**

2.1 Being able to actively verify the patients' identity and willing to answer questions about medical insurance policies

□ Satisfied □ Unsatisfied

2.2 Being able to inform the patients' family members timely of charged items and complete signature procedures

□ Satisfied □ Unsatisfied

**3. To ward environment**

3.1 With good hygiene conditions and being cleaned timely

□ Satisfied □ Unsatisfied

3.2 Being clean and tidy

□ Satisfied □ Unsatisfied

4. To appearance of doctors and nurses in the ward

□ Satisfied □ Unsatisfied

5. To medical expense list service provided by the medical staff in the ward

□ Satisfied □ Unsatisfied

6. To visitation management regulations of NICU3 (visiting hours, visiting modes, visiting equipment and reception of medical staff)

□ Satisfied □ Unsatisfied

Other comments:

……

**Knowledge Examination for Parents**

**References:**

J. Wang, Q.L. Guo, Z.Z. Zhao, Y. Yang, Effects of parental participation nursing model on premature infants, Nurs J Chin PLA. 30(3) (2013 Feb) 20-22. [in Chinese, abstract in English]

A.Q. Xiao, R.W. Huang, R. Zhang, P. Shen, L.H. Zhu, Application of family-centered care in the high quality nursing in neonatal ward, Nurs J Chin PLA. 33(23) (2016 Dec) 70-73. [in Chinese, abstract in English]

Study number: Date:

**Completion（1 point per black，26 points）**

1.Premature infants are newborns with gestational age (less than 37) weeks.
2.A term infant is a newborn with a gestational age of (37 to 42 weeks) weeks.
3.The normal neonatal anus temperature is (36.5-37.5) degrees Celsius, and the underarm temperature is (36-37) degrees Celsius.
4.For a term infant, the room temperature should be kept between (22-24) degrees Celsius; For a premature infant, the room temperature should be kept between (24-26) degrees Celsius, air humidity should be kept between (55%-65% ), daily indoor ventilation (2-3) times per day, and last for (15-30) minutes.
5.Normal neonatal heart rate is (120-140) per minute, respiratory rate (40-45) times per minute.
6.Neonatal physiological weight loss usually does not exceed (10) % of birth weight, and the birth weight is restored after the birth of (10) days. If abnormal, parents should take babies to go to the hospital in time.
7. Physiological jaundice appears in the (2nd-3rd) days after the birth, and in the (4th-5th) days,jaundice will reach the peak, generally lasting for ( 14 ) days. However, for premature infants, jaundice can be delayed to ( 3-4 ) weeks before it completely subsides.
8.When preparing infant formula, the temperature of water should be kept between (40-50) degrees Celsius. Before feeding, use ( inside of the wrist ) to test temperature. after feeding, parents should pick up the child and pat the back to expel air, then take (right) lateral decubitus.
9.For breast-feeding babies, you should take breast milk bags out of the refrigerator, and put it under the (room temperature) . If the temperature is too low ,you can put breast milk bags in the water of (40-50) degrees Celsius, but avoid hot water immersion into breast milk bags, and heating in the (microwave) is forbidden.
10.The best time for infantile touching is (after bathing) ,lasting for 10 to 15 minutes per time.
11.Normal newborns weigh more than (2,500) grams.

**Multiple choice（You are only allowed to choose one option as the best answer, 2 points for each item）**

1.Newborn bath water temperature should be kept between（A）
A 38～40℃ B 32～36℃ C 35～37℃ D 42～45℃
2.The order to bathe a newborn baby is（C）
A Wash face, body, hair, then lift the baby out and dry
B Wash hair, face, body, then lift the baby out and dry
C Wash face, hair, body, then lift the baby out and dry
D Wash face, hair, then lift the baby out and dry
3.Which one is right for the eye care, when the newborn is bathing? （A）
A From the contralateral eye: inner canthus to the outer canthus, then the proximal eye: inner canthus to outer canthus
B From the contralateral eye: outer canthus to inner canthus, then the proximal eye: inner canthus to outer canthus
C From the proximal eye: inner canthus to outer canthus, then the contralateral eye: outer canthus to inner canthus
D From the proximal eye: outer canthus to inner canthus, then the contralateral eye: inner canthus to the outer canthus
4.Appropriate time for the newborn bath should be（ D ）
A Take a bath immediately after eating. B Newborns cry or starve.

C Half an hour after the milk. D One or two hours after the milk

5.Measurement of newborn weight（ A ）

A The cleaning cloth is placed on the baby scale and you should adjust the zero point; Remove babies' clothing and diaper. Read and record the weight when the pointer is stable

B The cleaning cloth is placed on the baby scale and you should adjust the zero point；weigh with babies' clothing and diaper.Read and record the weight when the pointer is stable

C The cleaning cloth is placed on the baby scale and you need not adjust the zero point; Remove babies' clothing and diaper. Read and record the weight when the pointer is stable

D Adjust the zero point; Remove babies' clothing and diaper. Read and record the weight when the pointer is stable.

6.Measurement of newborn body length（ B ）

A Measure vertical length from the top of the head to the bottom of the foot, with a simple bed measurement(unit:cm) and keep two decimal places.

B The vertical length from the top of the head to the bottom of the foot, with a simple bed measurement(unit:cm) and keep one decimal place.

C The vertical length from the forehead to the foot with a simple bed measurement
(unit:cm) and keep two decimal places.

D The vertical length from the forehead to the foot with a simple bed measurement
(unit:cm), and keep one decimal place

7.Measurement of neonatal head circumference（ C ）

A The zero point is placed at the midpoint of the eyebrow bow line, then follow the eyebrow and occipital tuberosity to the midpoint of brow line

B The zero point is placed at the midpoint of the eyebrow bow line, then follow the eyebrow and back of the head to midpoint of the eyebrow bow line

C The zero point is placed at the midpoint of the eyebrow bow line,then follow the eyebrow and occipital tuberosity to the midpoint of the eyebrow bow line

D The zero point is placed at the midpoint of the eyebrow bow line,then follow the eyebrow and post aurem to the midpoint of the eyebrow bow line

8.The nasal feeding temperature of newborn milk should be kept between（ A ）

A 38～40℃ B 60～70℃ C40～45℃ D45～50℃

9.The length of the neonatal tube is（ A ）

A The distance between nose and the earlobe plus the distance between earlobe to xiphoid process or the distance between forehead to the xiphoid process

B The distance between the bridge of the nose and xiphoid process

C The distance between earlobe and xiphoid process

D The distance between hairline and xiphoid process

10.Neonatal gastric tube is usually kept for （ C ）

A 2-3 days B 4-5days C 5-7days D more than 10 days

11.The normal skin temperature of the newborn is between（ B ）

A 36.5-37.2℃ B36.0-37.0℃ C36.5-37.5℃ D no more than 38.0℃

12.Order of infantile touching is（ B ）

A The operation is conducted from top to bottom and from front to back, namely, the head, chest and abdomen come first , then upper limbs and the front of the lower limbs, and finally lumbar spinal cord and the back of the lower limbs

B The operation is conducted from bottom to top and from front to back, namely, the head, chest and abdomen come first , then upper limbs and the front of the lower limbs, and finally lumbar spinal cord and the back of the lower limbs

C The operation is conducted from bottom to top and from front to back, namely, the head, upper limbs, front of the lower limbs, chest and abdomen come first , then lumbar spinal cord and the back of the lower limbs

D The operation is conducted from bottom to top and from front to back, the head comes the first ,then upper limbs, chest and abdomen and the front of the lower limbs，finally lumbar spinal cord and the back of the lower limbs

13.Which one is correct（ C ）

A The neonatal can babble

B At the age of two months, the babies can grasp the objects in front, play the hand themselves, express joy when seeing food, consciously cry and laugh.

C At the age of two months, supine position becomes lateral position, baby could touch thing with the hand.

D At the age of 1-month, supine position becomes lateral position, baby could touch thing with the hand.
14.The baby could respond when you call their name, Parents should often call the name of the child, make him respond to his name, turn head immediately or stop doing the thing, and listen to you, which stage it belongs to（ C ）
A 2-3months B 4-5months C 7-9months D neonatal period
15.How long does the frozen breast milk remain valid?（ B ）
A 3 days B 24 hours C 5 days D 7 days
16.What is the calorie of breast milk?（ C ）
A 81Kcal B 90Kcal C 67Kcal D71Kcal
17.The most appropriate indoor temperature for a newborn is（ D ）
A 20-22℃ B 18-20℃ C 24-26℃ D22-24℃
18.Which one is wrong with breast milk storage? （ C ）
A Breast milk storage must be refrigerated or frozen
B Breast milk is stored in sterile sealed bottles at a time
C After thawing, if the milk was not eaten in time, it could be frozen again immediately
D Refrigerated breast milk can be stored for 24 hours
19.When running the bath water for the babies, the correct order is( A )
A water, hot water, then the baby
B water, baby, then hot water
C baby, hot water, water
D hot water，baby，then water
20.The first sense that the baby acquire is ( D )
A visual sense B auditory sense
C olfactory sensation D cutaneous sensation
21.How often should the blood oxygen probe change the site? （ B ）
A The newborn should choose wrist band type blood oxygen probe, the position should be changed per hour, and be careful of the injury.
B The newborn should choose wrist band type blood oxygen probe, the position should be changed every two hours, and be careful of the injury.
C The newborn should choose wrist band type blood oxygen probe, the position should be changed half an hour, and be careful of the injury.
D The newborn should choose wrist band type blood oxygen probe, the position should be changed every three hours, and be careful of the injury.
22.What is the character of stools if the baby is breast-feeding（ A ）
A Yellow or gold, paste, or thinner, green, not smelly, acid reaction
B Yellow or gold, paste, or thinner, green, smelly, alkaline reaction
C Pale yellow, thicker, smelly, neutral or alkaline
D Yellow, smelly and abundant
23.Neonatal normal urine volume is ( C）
A 0.5-1ml/kg B0.5ml/kg C1-3ml/kg D 5ml/kg
24.Correct treatment of neonatal fever is （ B ）
A Oral antipyretics B Physical cooling (unpacking) C Ice pillow D ice cap
25. When dressing or undressing for newborns, you should notice（ A ）
A When undressing, take off the clothes of contralateral limb first and then the affected limb
B When dressing, wear clothes of contralateral limb first, then the affected limb
C When undressing, take off the clothes of the affected limb first, then contralateral limb
D Whichever side you wear first

**Multiple choices（You should choose two or more than two options as answers）**
1.After the bath, which is the correct order when being dressed or undressed if the children are physically restricted（B D）
A When dressing, wear clothes of contralateral limb first, then the affected limb B When undressing, take off the clothes of contralateral limb first and then the affected limb
C When undressing, take off the clothes of the affected limb first, then contralateral limb
D When dressing, wear clothes of affected limb first, then the contralateral limb
2.The benefit of infantile touching is that（ABC）
A when applying infantile touching, by mild stimulation to the baby's skin, parents can transmit their

love to the baby, the baby can feel happy and safe. Touching can also help comfort crying or anxious children, stabilize emotions, reduce anxiety, and enhance the sense of confidence of babies
B It is the best way for a baby to know his or her parents by infantile touching
C Infantile touching can help promote the development of the baby's nervous system, improve intelligence and make the baby cleverer. Touching can improve the physiological function of premature babies and promote their growth and development more effectively
D The infants can be touched in these conditions: 2 hours after feeding, sleeping, being hunger or awake
3.The advantages of breastfeeding is that（ABCD）
A Breast milk is a must and ideal food for newborns
B Breast milk is nutrient-rich, and contains various nutrients suitable for infant growth, and is easy to digest and absorb
C Breast milk contains antibodies. The baby's immune system is not yet fully developed, and breast milk can help babies to resist disease, allergy and breastfed babies born within half a year is not easy to get sick.
D Breastfeeding is convenient, of favorable temperature, clean and sterile, of less pollution, and economical.
4.Which one is the training program for babies of 0 to 1 month（ABD）
A When the newborn awakens, talk to him face to face. When the child and you are looking at each other, you can slowly move the position of your face, attract the child's eyes to follow your direction of movement.
B Gently call your baby in the ear of a newborn (about 10 cm away) or use some soft or brightly colored toys to make the child listen and see
C Roll over: From supine to side lying, induce the child to turn over with a noisy toy from the side.
D When the baby is on the supine position, you can hang colorful wreaths, balloons, preferably red 20-30cm above the baby, or some toys that can make a sound. You can put one per time and it should be replaced frequently
5.Whichone is the appropriate training program of the individual and social abilities for babies of 10 to 12 months（ABC）
A Toilet training: You should train the child to sit on the basin. The bedpan should be easily recognized and be located in a fixed position
B Life cooperation: Teach a child to do something in daily life. For example, when dressing him, ask him to extend his arm, and tell him to "stretch out here (the sleeve).""Give him his shoes and ask him to put his foot in his shoe, and let him have his own spoon and eat himselves."
C Play together: Train children to play with friends, such as climbing (running) together, playing ball.
D Train the child: Drink water from an adult's cup.
6.Which one proves that the mother's breast milk supply is abundant（ABC）
A The breast is full. When the baby is being fed, and you can hear several or dozens of times sounds of swallowing milk
B After breastfeeding, the baby can sleep quietly or play.The baby has two or three times a day, which is golden and thick.
C Weight gains gradually, and physical development is good
D Weight of baby does not increase or increase invisibly, the amount of stool is little
7.The main nursing points of the red buttock（ABC）
A The diaper should be made of soft water-absorbent pure cotton cloth and should not use rough cloth to make diapers
B Wash and change the diaper frequently and change it immediately after getting wet. After defecation, wash his or her buttock with warm water and dry it after washing
C If local skin reddens, you can apply tannin ointment evenly to the affected area
D Lighting therapy, 2 times a day, 60 minutes each time
8.Which one is appropriate for the neonatal red buttock degree（ABD）
A Ⅰ local skin flushes accompanied by a small number of rash on a small scale
B Ⅱ degree the skin flushes on a large scale, the rash is broken and accompanied by peeling
C Ⅱ degree local skin flushes on a small scale, the rash is broken and accompanied by peeling
D Ⅲ degree Skin flushes on a large scale with skin rash, skin has a large area of erosion, exfoliation and percolation

**Electronic Supplement Material 5:** Meta-Analysis infant and parent outcomes

### Meta-analysis infant outcomes – Neonatal Behavioral Neurological Assessment

There are three Chinese studies (total n=213) measuring behavioral outcomes using the same instrument; the Neonatal Behavioral Neurological Assessment (NBNA). Heterogeneity test showed sufficient level of homogeneity among the studies ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.04, P=0.982).[23,26,28] Thus, we used the FEM to consolidate the effect value. Figure ESM 5.1 provides the pooled MD=0.63 (95%CI: -0.14;1.40). The NBNA scores in the FCC group were higher than the standard care (SC) group, but not statistically significant (P=0.108).

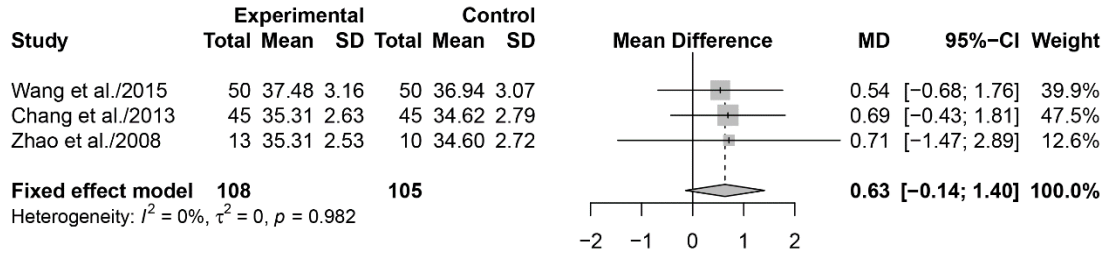


**Fig. ESM 5.1 Neonatal behavioral neurological assessment**

### Meta-analysis parent outcomes – Anxiety

Parent's anxiety was measured in three studies (two English; one Chinese).[16,23,34] Two studies used the State Anxiety Inventory index[16,34] and one study the Self-Rating Anxiety Scale[23]; the SMD was applied. Meta-analysis was performed at three time points (admission T1; discharge T2; follow-up after discharge T3), FEM was used due to heterogeneity tests at admission ($I^2$=28%, $\tau^2$=<0.01, $\chi^2$=2.77, P=0.251); discharge ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.40, P=0.526); follow-up ($I^2$=0%, $\tau^2$=0, $\chi^2$=1.58, P=0.453) (Fig. ESM 5.2). At admission time (T1), the anxiety scores in the FCC group were less than the SC group but not significant (SMD=0.07; 95%CI: -0.03;0.16, P=0.175). At discharge (T2), the FCC group showed no differences with the SC group (SMD=0.01, 95%CI: -0.24;0.25, P=0.957). At follow-up (T3), the parents in the FCC

group showed significantly less anxiety than the SC group (SMD=-0.19, 95%CI: -0.28;-0.09, P<0.001).

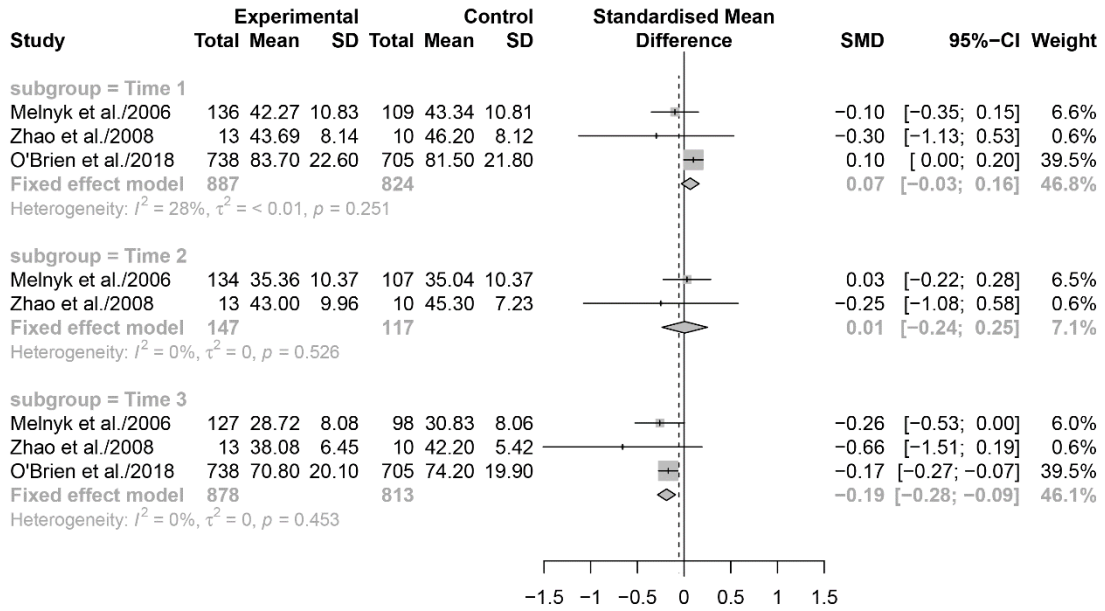


**Fig. ESM 5.2 Anxiety**

**Meta-analysis parent outcomes – Depression**

Parent's depression was used as an outcome measure by two studies using the Self-rating Depression Scale and the Beck Depression Inventory.[16,23] The same three time points were used as in the anxiety analysis and FEM was used because the studies were homogeneous; at admission T1 ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.35, P=0.557); discharge T2 ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.00, P=0.996); follow-up ($I^2$=44%, $\tau^2$=0.09, $\chi^2$=1.80, P=0.180) (Fig. ESM 5.3). Only at follow-up T3, the FCC group had significantly less depression than those in the SC group (SMD=-0.37, 95%CI: -0.63;-0.12, P=0.004). The other time points showed no significant differences (TI: SMD=-0.12, 95%CI: -0.36;0.13, P=0.345; T2: SMD=-0.37, 95%CI: -0.63;-0.12, P=0.434).

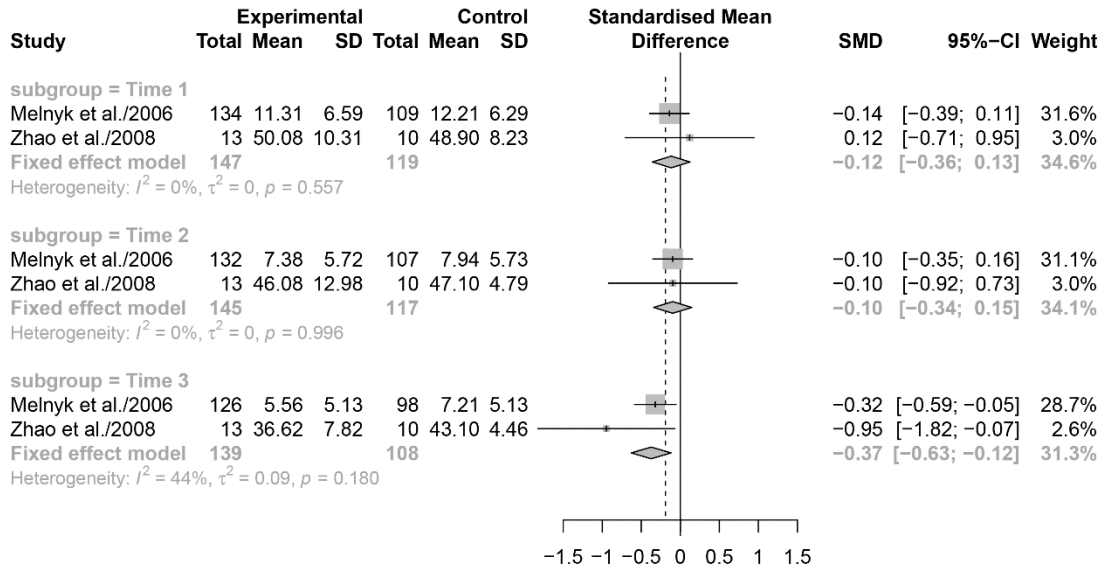


**Fig. ESM 5.3 Depression**

## Meta-analysis parent outcomes – Stress

Parental stress was measured in three studies using the Parental Stressor Scale:NICU.[16,20,34] The studies measured parental stress only once and the time points were reported as: day 21, 2-4 days after the intervention, at NICU discharge. The MD was applied in the meta-analysis. Heterogeneity test showed a sufficient level of homogeneity among the studies ($I^2$=0%, $\tau^2$=0, $\chi^2$=0.23, P=0.892). FEM resulted in MD=-0.20 and 95%CI: -0.26;-0.13 representing that stress in the FCC group was significantly lower than in the SC group (P<0.001) (Fig. ESM 5.4).

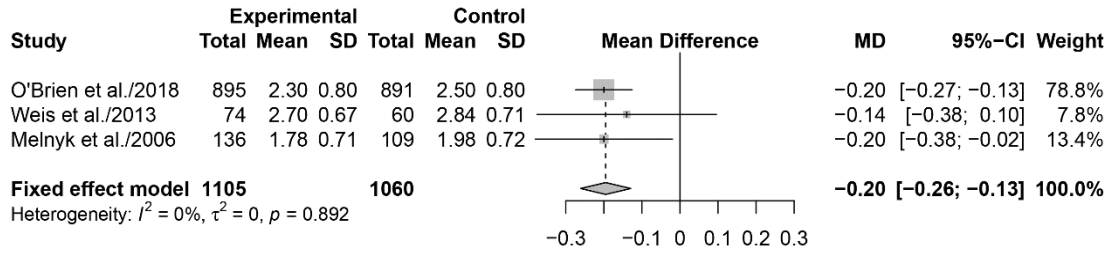


**Fig. ESM 5.4 Stress**