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Knowledge and beliefs regarding kangaroo care of nurses in neonatal intensive care units in China

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Knowledge and beliefs regarding kangaroo care of nurses in neonatal intensive care units in China

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Kangaroo Care in NICUs in China: A National Survey

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20 **Disclaimers**

21 All the authors confirmed that they have reviewed and declared this manuscript entitled
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39 No conflict of interest has been declared by the authors.
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43 No additional data are available
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48 **Abstract**

49 **Objectives:**

50 Kangaroo Care (KC), a well-established parent-based intervention of neonatal intensive
51 care units (NICU), positively benefits infants and their parents. A modified version of KC
52 called intermittent skin-to-skin care is routinely offered to infants who need neonatal
53 intensive care in resource-rich countries. However, despite the documented advantages,
54 lack of knowledge and reluctance to implement KC still prevail among several NICU
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nurses in China. Therefore, our aim was to investigate the current knowledge, beliefs and practices regarding kangaroo care of NICU nurses in China using the Kangaroo Care Questionnaire

Methods:

A quantitative descriptive survey was designed. This questionnaire comprised 90 items which were classified according to the four domains of knowledge, practice, barriers and perception. Data were analysed using SPSS 20.0 and content analysis was used to summarize the data derived from the open-ended questions.

Results:

The survey involved 861 neonatal nurses from maternity and general hospitals across China. Findings showed that 47.7% (n=411) of the nurses experienced implementing KC whereas 52.3% (n=450) had not experienced implementing KC. Neonatal nurses in the 'Experienced KC' group showed an overall better understanding of KC and its benefits with a higher 'correct response' rate than those in the 'Not Experienced KC' group. In the 'Experienced KC' group, over 90% considered KC as beneficial to parent-baby relationship and attachment whereas over 80% believed that KC positively affected the outcomes of preterm infants. The 'Not Experienced KC' group perceived more barriers to KC implementation than the 'Experienced KC' group.

Conclusion:

Although the majority of nurses working in NICUs in China are aware of the benefits of KC, there remain substantial barriers to its routine use in practice. Education for both staff and parents is necessary as is the provision of appropriate facilities and policies to support parents in providing this evidence-based intervention.

Key words: Kangaroo Care; Clinical Practice; Quality in Health Care;

Strengths and Limitations of This Study

-This study is a first national survey to specifically investigate the current knowledge, practice, barriers and perception of neonatal nurses in NICUs regarding KC.

-This study provides the insight into the potential barriers of implementation of KC in NICUs in China.

-The participants of this study were only neonatal nurses whereas other healthcare professionals were not included in our study.

-This study did not obtain the information on parents' perceptions of KC which may be an important factor to influence in the implementation of KC.

Introduction

Kangaroo mother care (KMC) is an established, powerful and easy-to-use method for promoting the health and well-being of preterm and full-term infants¹ The key features of KMC are as follows: early, continuous and prolonged skin-to-skin contact between mother and baby; exclusive breastfeeding (ideally); initiated in hospitals but can be continued at home; small babies discharged early; adequate support and follow-up for home-based mothers; and a gentle and effective method because it avoids agitation which is common in busy wards housing preterm infants. However, KMC requires a very strict protocol².

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3 Moreover, KC differs from KMC. To stress the difference, KMC is defined as skin-to-skin
4 and chest-to-chest holding (i.e. sometimes called skin-to-skin contact) of the diaper-clad
5 infant by a parent. By contrast, a modified version of KC called intermittent skin-to-skin
6 care (SSC) is currently offered in resource-rich countries to infants who need neonatal
7 intensive care; it is also offered to infants who require ventilator support or were born
8 extremely premature³. Unlike KMC, SSC is the practice of holding an infant upright on a
9 parent's chest in a manner that provides maximum bare skin ventral contact, thereby giving
10 newborn the opportunity to adjust outside the womb. Ideally, SSC is carried out
11 immediately after birth and as often as parents can during the first few days of the infant.

12
13 In Western countries, KC is a widespread standardised protocol-based care system for
14 premature infants⁴. KC is widely known as a beneficial intervention to significantly
15 improve the development of premature infants^{5,6}. More than 50% of all hospitals in South
16 Africa practice KC in some form or another⁷.

17
18 The World Health Organization (WHO) reported an average preterm birth rate of 7.1% in
19 China, which makes the country second to India in terms of highest number of preterm
20 births (i.e. more than 250,000 in 2010)⁸. Little is known about KC in China before 2016,
21 especially since it is not commonly practiced in NICUs. By contrast, KC has been
22 implemented in NICUs for several years in Western countries where it is recognised as an
23 evidence-based solution to reduce mortality and improve the health outcomes of babies in
24 high- and low-income countries.

25
26 Several studies have recognised the importance of neonatal care (including KC) delivered
27 by parents^{9,10}. Although KC has been applied for 25 years in several countries¹⁰, it is still
28 relatively new in Chinese NICUs. A retrospective cohort study¹¹ reported that the top three
29 barriers are issues related to NICU physical facility, negative impressions by staff about the
30 practice and fear of injuring infants during KC. In China, the frequently cited barrier to KC
31 is the National Health Policy which stipulates an infection control mechanism; that is,
32 parents are not allowed to enter NICU wards during the their infants' entire stay which
33 inhibits parent–infant interaction and affecting infant outcomes. Denying parent access to
34 infants in NICUs is a standard practice in majority of Chinese hospitals. Visitation is not
35 permitted or strictly limited, and thus, NICU care for a number of neonates is provided by
36 health care professionals with limited parent participation¹². Nonetheless, although hospital
37 policies generally do not support KC, a few high-level maternity hospitals have started to
38 implement KC in their NICUs as a pilot study.

39
40 Education of nursing staff regarding KC has been shown to be critical for its successful
41 implementation¹³. There is very little reporting on the knowledge and practice of KC in
42 Chinese journals⁸.

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44 The purpose of our study was to investigate neonatal nurses' knowledge and beliefs
45 regarding KC practice in NICUs in China.
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50 **Methods**

51 ***Study Design and Participants***

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53 This study was conducted to investigate the level of neonatal nurses' knowledge and beliefs
54 on KC practice in NICUs across China by using an adapted and translated version of the
55 Kangaroo Care Questionnaire initially designed by Engler et al.¹³.
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Instruments

The instrument was adapted from the English version of Kangaroo Care Survey (KCS) initially developed by Engler and Ludington¹⁴, then the original version was translated to Chinese, and finally back-translated into English to check for any differences between the two versions. A pilot study was then undertaken with a convenience sample (n=68) in order to determine the relevance of the items to Chinese clinical context and time taken to complete the survey.

The Mainland Chinese version of the KCS is a 90 item (quantitative, 79 items ; qualitative, 11 items) questionnaire revised for this study. As all nurses work full time in China, thus, 9 questions regarding to working patterns were deleted. The questionnaire includes four scales relating to: Knowledge (17 items), Practice (18 items), Barriers (20 items) and Perceptions (24 items). Items include the use of the five-point summated rating scales and true/false responses.

Basic demographic (anonymous) data were collected including gender, level of nursing education and level of neonatal intensive care where the respondents worked. Engler et al¹³ reported the questionnaire's reliability by conducting a Cronbach's Alpha reliability coefficient for each scale. The reliability and validity of the Mainland Chinese version of the Kangaroo Care Questionnaire was acceptable with a Cronbach's alpha coefficient of 0.891 for the entire scale (Table 1)

Table 1: Reliability Data for Chinese Version of Kangaroo Care Scales and Subscales

Scales	Subscales	No. Items	Cronbach's Alpha
Perceptions		24	0.753
Knowledge		17	0.827
Barriers		20	0.938
Practice	General	11	0.912
	Ventilator Practice	7	0.926
Total		79	0.891

Research Setting & Participants

The email list of the Chinese Association of Maternal and Child Health Care was used to send the online survey to the director of nursing in each hospital, who were asked to send on to neonatal nurses were working in NICU.

The questionnaire was sent to hospitals in 32 provinces across China in February 2017 and April 2017. The questionnaire was completed online via SoJump online survey software. Completed questionnaires were collected and securely stored.

All returned surveys were stored in a secure online database.

Statistical analysis

Questionnaire data were transferred to a secure computerised database for analysis. Quantitative analysis of survey responses was undertaken using SPSS version 20.0.

Categorical variables were presented as number of participants (percentage). Data were analysed with the use of Chi-square for multinomial and Fisher exact (two-tail) test. Two-sided $P < 0.05$ were regarded as significant. Content analysis was employed for the open-ended questions.

Ethical considerations

The study protocol was approved by the Ethics Committee of Women's Hospital, School of Medicine, Zhejiang University. Clinical governance approvals were granted for each of the hospitals included in the survey.

Results

Demographic characteristics of participants

A total of 900 surveys with an invitation to participate and a link to the survey were sent to nurse unit managers of NICUs in hospitals in 32 provinces in China. Of the 900 questionnaires, 861 were returned as fully answered surveys with a response rate of 95.7%. Of the 861 respondents, 411 neonatal nurses experienced delivering KC while the remaining 450 nurses reported never implementing KC in their NICUs. Findings also showed that 45% ($n=391$) of respondents worked in dedicated maternity hospitals whereas 54.6% ($n=470$) worked in maternity units of general hospitals. In addition, 60% ($n=518$) of respondents earned an education university degree. As shown in Table 2, the majority of nurses were female in the 26–40 age range and worked in level II nurseries (i.e. provided high-dependence care).

Table 2: Descriptive Characteristics of Participants

Descriptive Characteristics	Number of Nursing Staff ($n=861$), n(%)
<i>Gender</i>	
Male	5 (0.6)
Female	856 (99.4)
<i>Age</i>	
18-25 years old	172 (19.9)
26-30 years	307 (35.7)
31-40 years	275 (31.9)
41-50 years	85 (9.9)
51-60 years	22 (2.6)
<i>Highest Education Level</i>	
College Degree	316 (36.7)
Bachelor's Degree	507 (58.9)
Master's Degree	11 (1.3)
Other*	27 (3.1)
<i>NICU Level</i>	
Level III	196 (22.7)
Level II	431 (50.1)
Level I	234 (27.2)

*Other: includes Doctoral Degree ($n=2$); Postgraduate Certificate ($n=25$);

Total neonatal nurses had not experienced KC=450

Total neonatal nurses experienced KC=411

Nursing Knowledge of Kangaroo Care

The first question in the survey asked respondents to indicate if they had experienced implementing KC. A total of 411 (47.7%) respondents affirmed; they were labelled as the 'Experienced KC' group. In the domain of Nursing Knowledge, the 'Experienced KC' group showed better understanding of KC and its benefits, and they obtained higher 'correct responses' on seven items (No. 1, 2, 3, 6, 7, 10 and 16) compared with those neonatal nurses who reported they had never practiced KC in their NICU (i.e. 'Not Experienced KC' group) (Table 3). Majority of the nurses in the 'Experienced KC' group correctly answered that KC promoted quiet sleep (94.6%), increased mother's milk supply (85.4%) and improved breathing patterns (74.9%). Only 57% in the 'Not Experienced KC' group correctly identified reduction in apnoea. In addition, 70% of respondents in the 'Not Experienced KC' group (versus 82% in the 'Experienced KC' group) provided the correct response to the item concerning participation by babies with peripheral IVs.

Table 3: Knowledge of Kangaroo Care

Table 3: Knowledge of Kangaroo Care*	Correct Response Experienced KC (n=411) n (%)	Correct Response Not experienced KC (n=450) n (%)	P Value
Babies appear to be contented in KC.	378 (91.7)	322 (71.6)	< 0.001
Babies on oxygen therapy experience a decrease in oxygen saturation.	153 (37.2)	99 (22.0)	< 0.001
Babies on phototherapy can participate in KC.	248 (60.3)	88 (19.6)	< 0.001
Babies on vasopressors should NOT engage in KC.	126 (30.7)	174 (38.7)	0.174
Babies typically experience more bradycardic episodes during KC.	46 (11.2)	41 (9.1)	0.154
Babies with peripheral IVs can participate in KC.	338 (82.2)	318 (70.7)	0.516
KC has been shown to improve breathing patterns in preterm babies by reducing apnoea.	308 (74.9)	257 (57.1)	0.062
KC is contraindicated in babies less than 28 weeks gestation.	100 (24.3)	132 (29.3)	0.714
KC is contraindicated in babies weighing less than 1000 grams.	116 (28.2)	158 (35.1)	0.097
KC is now considered safe as an alternative approach to care for medically stable, continuing care preterm babies.	351 (85.4)	338 (75.1)	0.971
Most babies experience a decrease in temperature during KC.	45 (10.9)	63 (14.0)	0.166
Published reports of clinical observations indicate that the rate of accidental extubation is higher with KC than with traditional methods of holding.	170 (41.3)	222 (49.3)	0.176
Research has indicated that babies who receive KC increase their mother's milk supply.	351 (85.4)	371 (82.4)	0.072
Research indicates that KC promotes quiet sleep.	389 (94.6)	406 (90.2)	0.559

Research shows that babies with arterial lines should NOT engage in KC.	160 (38.9)	162 (36.0)	0.553
The most physiologically stressful part of KC for the baby is the transfer to the parent's chest.	181 (44.0)	157 (34.9)	0.003
There is an increased risk of infection in the baby with KC.	148 (36.0)	189 (42.0)	0.627

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

$P < 0.05$ was considered statistically significant

Practice of Kangaroo Care

The respondents in the 'Experienced KC' group reported high levels of comfort to facilitate KC for babies with specific conditions or receive certain treatment interventions, as described in the Practice domain of the questionnaire. Differences were observed between the groups for items related to intravenous catheters, NCPAP and percutaneous central lines, in which more respondents in the 'Experienced KC' group than in the 'Not Experienced KC' group (Table 4) having felt 'Somewhat/Very Comfortable' at 71.3% versus 62.6%, 46.7% versus 33.3% and 61.6% versus 45.4%, respectively.

Table 4: Practice Issues in providing KC (Specific treatments and Conditions)

Table 4: Practice Issues in providing KC* (Specific treatments and Conditions)	Very/Somewhat Uncomfortable Experienced KC (N=411), n (%)	Very/Somewhat Uncomfortable Not experienced KC (N=450), n (%)	P Value
Intravenous catheters	30 (7.3)	42 (9.3)	0.943
During the perioperative period	84 (20.4)	95 (21.1)	0.479
Endotracheal intubation	143 (34.8)	209 (46.4)	0.005
High-frequency jet or oscillator ventilation	186 (45.3)	240 (53.4)	0.359
Nasal cannula oxygen	70 (17.0)	114 (25.4)	0.868
Nasal continuous positive airway pressure (NCPAP)	100 (24.3)	160 (35.6)	0.222
Percutaneous central lines	56 (13.6)	110 (24.4)	0.001
Phototherapy	151 (36.7)	193 (42.9)	0.841
Umbilical arterial catheters	142 (34.6)	171 (38.0)	0.657
Umbilical venous catheters	130 (31.6)	160 (35.5)	0.698
Vasopressors	105 (25.5)	141 (31.3)	0.712

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

$P < 0.05$ was considered statistically significant

Barriers to implementing Kangaroo Care

The Barriers domain of the questionnaire included items related to work environment (including workload and physical environment) and family engagement in KC. Table 5 lists the barriers identified by respondents as 'Somewhat/Very Influential' in implementing KC. A high number of respondents in the 'Not Experienced KC' group identified fear of accidental extubation, inability to provide adequate family time during KC, KC adding burden to workload and KC interfering with care delivery as factors affecting the

implementation of KC.

More neonatal nurses in the 'Not Experienced KC' group than in the 'Experienced KC' also cited the following barriers as 'Somewhat/Very Influential': difficulty assessing baby readiness for KC; fear of safety of KC for babies below a certain weight; inability to provide adequate family time during KC; inconsistency in KC practice; a nurse's feeling that KC adds burden to workload; and parents' discomfort with exposing chest during KC.

Table 5: Barriers to Implementing Kangaroo Care

Table 5: Barriers to Implementing Kangaroo Care*	Somewhat/Very Influential Experienced KC (n=411), n (%)	Somewhat/Very Influential Not experienced KC (n=450), n (%)	P value
Senior nurses' reluctance to allow KC	206 (50.2)	243 (54.0)	0.123
Belief that technology (e.g., incubators) is more beneficial to babies that care a parent can provide	180 (43.8)	214 (47.6)	0.471
Difficult providing privacy for families during KC	216 (52.6)	263 (58.4)	0.056
Difficulty assessing babies readiness for KC	188 (45.7)	257 (57.2)	0.001
Family reluctance to initiate KC	297 (72.3)	323 (71.7)	0.370
Family reluctance to participate in KC	297 (72.3)	333 (74.0)	0.184
Fear of accidental extubation	278 (67.6)	334 (74.2)	0.453
Fear of arterial or venous line dislodgement	276 (67.2)	330 (73.3)	0.932
Fear of safety of KC for babies below a certain weight	252 (61.4)	325 (72.2)	0.083
Inability to provide adequate time to families during KC	253 (61.6)	320 (71.1)	0.117
Inconsistency in the practice of KC	228 (55.5)	298 (66.2)	0.156
Medical staff reluctance to allow KC	296 (72.0)	340 (75.5)	0.155
Nurses' belief that KC is used for babies who are NOT developmentally ready for it	232 (56.4)	275 (61.1)	0.730
Nurses' feeling that KC adds a burden to their workload	242 (58.9)	317 (70.4)	0.187
Nurses' feeling that KC makes it difficult to administer care	255 (62.0)	323 (71.7)	0.758
Nursing staff reluctance to participate in KC	281 (68.3)	328 (72.9)	0.760
Parents' discomfort with exposing their chest during KC	250 (60.8)	306 (68.0)	0.338
Parents' presence in the NICU for extended periods of time	194 (47.2)	268 (59.5)	0.014
Parents' provision of too much stimulation to their baby during KC	188 (45.7)	221 (49.2)	0.430
Staff's lack of exposure to parents participating in KC	232 (56.4)	276 (61.3)	0.761

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

P<0.05 was considered statistically significant

Perceptions of Kangaroo Care

The group comparison on neonatal nurses' perceptions of KC indicated convergence on some items and divergence on others (Table 6). Both groups agreed on KC statements related to encouraging parenting roles, enhancing attachment between parent and baby, benefitting preterm babies, helping parents become confident caregivers and improving outcomes for babies. There was less agreement between the groups on other items. The respondents in the 'Experienced KC' group (21.7%) were less in agreement with the statement that KC keeps nurses too tied to the bedside as compared to the 'Not Experienced KC' group (34.4%). Similarly, only 23.3% of respondents in the 'Experienced KC' group agreed with the statement that KC interferes with task completion as opposed to only 37.4% of the 'Not Experienced KC' group. Furthermore, 66.2% of the 'Not Experienced KC' group also agreed that 'modern day NICUs are NOT the place for KC' whereas only 43.5% of the 'Experienced KC' group agreed with the statement.

Table 6: Nurse's Perceptions about Kangaroo Care

Table 6: Nurse's Perceptions about Kangaroo Care*	Disagree Experienced KC n (%)	Disagree Not experienced KC n (%)	P value	Agree Experienced KC n (%)	Agree Not experienced KC n (%)	P value
All preterm babies should be allowed to participate in KC regardless of gestational age.	68 (16.5)	68 (15.1)	0.776	241 (58.7)	225 (50.0)	0.824
All preterm babies should be allowed to participate in KC regardless of weight.	73 (17.8)	72 (16.0)	0.373	228 (55.4)	209 (46.4)	0.622
Babies receiving IV fluids should NOT be allowed to participate in KC.	285 (69.3)	241 (53.6)	0.161	46 (11.2)	71 (15.7)	0.035
Babies who are intubated should NOT be allowed to participate in KC.	193 (47.0)	170 (37.8)	0.782	127 (30.9)	163 (36.2)	0.770
Babies with umbilical catheters should NOT be allowed to participate in KC.	195 (47.4)	168 (37.3)	0.307	108 (26.3)	138 (30.7)	0.426
KC encourages the parenting role.	11 (2.7)	16 (3.6)	0.410	371 (90.2)	372 (82.6)	0.454
KC enhances the attachment process between parent and baby.	11 (2.7)	12 (2.7)	0.356	374 (91.0)	383 (85.1)	0.458
KC increases the quality of care on our unit.	20 (4.9)	41 (9.1)	0.022	322 (78.3)	277 (61.6)	0.002
KC interrupts patient caregiving.	222 (54.0)	173 (38.4)	0.636	81 (19.7)	121 (26.9)	0.526
KC should be available only to breastfeeding mothers.	292 (71.0)	264 (58.7)	0.326	62 (15.1)	82 (18.2)	0.532
KC is NOT feasible with some patients.	110 (26.8)	70 (15.6)	0.760	192 (46.7)	245 (54.4)	0.959
KC keeps nurses too tied to the bedside.	167 (40.6)	100 (22.3)	0.012	89 (21.7)	155 (34.4)	0.014
KC should be offered to all parents in the NICU.	74 (18.0)	84 (18.6)	0.216	231 (56.2)	237 (52.7)	0.199
KC will benefit preterm babies.	13 (3.2)	16 (3.5)	0.753	366 (89.0)	379 (84.3)	0.751
KC will help parents feel more confident in caring for their preterm baby.	10 (2.4)	10 (2.2)	0.771	367 (89.3)	373 (82.9)	0.846
KC will improve the baby's outcome.	13 (3.2)	16 (3.5)	0.715	344 (83.7)	356 (79.2)	0.443
KC will interfere with the completion of my tasks.	177 (43.1)	100 (22.2)	0.485	96 (23.3)	168 (37.4)	0.197
Learning about KC will help me be a better nurse.	21 (5.1)	27 (6.0)	0.603	329 (80.1)	317 (70.4)	0.551
Modern-day NICUs are NOT the place for KC.	115 (28.0)	50 (11.1)	0.000	179 (43.5)	299 (66.2)	0.001
Nurses look forward to introducing KC to a new parent.	13 (3.2)	24 (5.3)	0.013	342 (83.2)	319 (70.9)	0.003

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2							
3	Our patients have adequate time for parent-baby	109 (26.5)	100 (22.2)	0.771	153 (37.2)	214 (47.6)	0.973
4	contact without the use of KC.						
5	The increased amount of time required to prepare	169 (41.1)	112 (24.8)	0.567	107 (26.0)	165 (36.8)	0.371
6	a baby for a KC session is out of proportion to						
7	the benefits.						
8	The teamwork required between nurses and	13 (3.2)	11 (2.4)	0.312	355 (86.3)	353 (78.5)	0.726
9	parents when doing KC is worth the effort.						
10	There is NOT enough flexibility in the NICU to	80 (19.5)	49 (10.9)	0.122	218 (53.0)	277 (61.5)	0.306
11	allow parents extended visits (more than 2 hours)						
12	for KC.						

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

Experienced KMC (n=411) ;Not experienced KMC (N=450)

P<0.05 was considered statistically significant

Discussion

Initially conceptualised as a low-cost mechanism for caring preterm babies in resource-poor countries¹⁵, KC was later recognised as a parent-based intervention with a wide range of benefits for small and sick babies¹⁶. The recognition of the moral, ethical and evidence-based impetus for supporting family-centred care in NICUs¹⁷ has led to the intervention to be widely implemented in high-dependency neonatal units, much more with technology-dependent babies in neonatal intensive care. In South Africa, more than 50% of all hospitals practice KC in some form or another¹⁸. Only nearly 50% of respondents in this study have reported previous experience in KC, a percentage that is much lower than the 82% of neonatal nurses who practice KC in the United States¹⁹.

While KC is widely accepted in Western countries as a routine component of NICU care delivery for preterm infants, KC in Chinese NICUs is practiced infrequently. Previous research has identified the challenges associated with KC implementation, and these include nurses' knowledge and perceived barriers to implementation²⁰. To advance the implementation of this evidence-based intervention in China, a survey was conducted to identify current NICU nurses' knowledge, practice and perceptions regarding KC.

Our study is similar to other studies on a number of aspects. Our results showed that even without formal KC training, majority of neonatal nurses in the 'Experienced KC' group achieved better knowledge and understanding of the benefits and effects of KC than those who did not have any experience on KC; this finding is similar to those in the works of Engler¹³ and Solomons and Rosant¹⁸. Our results also verified the uncertainty of nurses toward the inclusion and exclusion criteria of KC practice and initiation, especially for those preterm infants receiving specific treatments or with specific conditions. In our survey, many of the nurse respondents in both groups felt ambiguous toward KC implementation (e.g. for preterm infants with specific treatments and conditions) because of lack of KC training that could have enhanced knowledge and practical skills. This finding was similar to those reported by²¹ in which nurses were uncertain to implement KC for infants with intubation, under phototherapy or with an umbilical line in situ. Almutairi's quasi-experiment study indicated nurses' knowledge and skills with KC improved after receiving continuing education²². Specific KC including simulation training for neonatal nurses may be a mechanism for increasing the confidence of nursing staff and thus improving KC promotion and implementation in the NICU.

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3 While research evidence demonstrates the benefits of KC for infants, parents, staff and
4 healthcare organizations, KC practice in NICUs is not widespread in China⁸.

5 Although KC is a key intervention in newborn health initiatives, there has been limited
6 information available on the barriers to KC practice that parents and neonatal nurses can
7 not fully practice KC in China.

8
9 Our study identified a number of barriers including lack of consistent guidelines and
10 standards for KC, reluctance on the part of medical staff to support KC due to safety fears,
11 and a hospital policy of denying parents access to NICU. Seidman's systematic review²³
12 proposed that resource-related barriers (lack of clear guidelines/education) and
13 sociocultural barriers (concerns about medical conditions/care) negatively affected nurses;
14 these points were also raised in our study.

15
16 Meanwhile, other studies proposed lack of knowledge and skills as the main barrier to KC
17 implementation^{21 24-27}. "Medical staff reluctance to allow KC" was cited as a significant
18 barrier by a number of respondents to our survey. Other studies has also reported staff
19 resistance as a KC important barrier²⁶⁻²⁹. Resistance of medical staff is mainly associated
20 with the fear of harming infants and lack of experience and specific education of KC.

21
22 An inappropriate physical environment was another important barrier identified in our
23 study and consistent with those from the research of Eichel³⁰ and Pratomo²⁸. Most NICUs
24 in China do not have sufficient space for parents to implement KC. The shortage of nurse
25 staff in Chinese NICUs compounds the problem of resourcing implementation of KC³¹.
26 Xin Zhang's cross-sectional exploratory study³² stated that better nurse-patient ratio was
27 the strongest factor for a nurse being likely to implement KC in NICUs.

28
29 Perhaps the most significant barrier to routine implementation of KC in China is the policy
30 limiting parental visitation, despite the existing evidence that demonstrates parent visitation
31 won't increase the rates of nosocomial infection, bronchopulmonary dysplasia,
32 intraventricular hemorrhage, necrotizing enterocolitis and retinopathy of prematurity¹².
33 Similar to the policy challenge in China, Blomqvist's study²⁶ in Sweden demonstrated that
34 the restricted parents' opportunities as NICU's routine was also an important barrier to
35 perform KC in NICUs. Lee's study²⁵ in the US also indicated that lack of visitation from
36 parents was a challenge to implement KC in NICUs.

37
38 Although several similarities were highlighted, a number of differences were also observed
39 between our study and past research related to the Barrier Scale of our questionnaire. In our
40 study, while respondents in the 'Not Experienced KC' group perceived KC as an added
41 burden to their workload; however, this was not highlighted in the 'Experienced KC' group.
42 In the research of³³, all of the respondents expressed a strong sense of frustration with
43 increased workloads and low staffing levels, which then disallowed the respondents to find
44 time to effectively facilitate KC. In addition, a systematic review of barriers and enablers of
45 KMC²⁹ mentioned cultural issues and financing problem; these items were excluded in our
46 study. Namnabati³⁴ also proposed that experienced physicians implement KC in NICUs; by
47 contrast, the age factor was not obvious in our study on Chinese NICUs.

48
49 Furthermore, perceptions may be a much more important factor in the successful
50 implementation of KC in NICUs as opposed to knowledge and practice. Knowledge alone
51 does not change practice, but perceptions strongly influence action. In evaluating beliefs
52 regarding the general concepts and benefits of KC, the results of our study demonstrated
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3 that neonatal nurses in ‘Experienced KC’ and ‘Not Experienced KC’ groups held similar
4 strong beliefs on the importance of KC. In other words, neonatal nurses in both groups
5 showed definite positive attitude and perception toward KC, its advantages and its
6 appropriateness. The misunderstandings about KC were apparent only in the ‘Not
7 Experienced KC’ group; in this group, neonatal nurses lacked formal KC education and
8 were easily misguided by their assumptions on KC.
9

10 Overall, many of the neonatal nurses in both groups in our study agreed that KC promotes
11 parent–baby attachment and parental confidence, as well as physical health of infants.
12 However, concerns were raised about the environment to implement KC, duration of KC
13 and workload of neonatal nurses.
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16 **Recommendations for Policy, Practice, Education and Research**

17 The comprehensive two-child policy and wide use of assisted reproductive technology in
18 China has resulted in the rapid increase of preterm birth in recent years. Given this specific
19 situation, KC seems to be a convenient, economical and effective method; it is also highly
20 suitable for preterm infants. On the basis of the results of our study, the following are
21 recommended for clinical practice:
22

- 23 - The limited parental visitation in Chinese NICUs should be changed. Visitation hours
24 should be extended to guarantee KC implementation.
- 25 - Hospitals should improve their environment, such widening ward spaces and arranging
26 personnel allocation, to promote the implementation of KC.
- 27 - Nursing simulation training programs and interactive workshops on KC may be needed to
28 improve nurses’ knowledge, skills and confidence in the implementation of safe and
29 effective KC with preterm infants. With regard to staff, experience and resource in Chinese
30 hospitals, a Chinese guideline for preterm birth and KC implementing should be
31 considered.
- 32 - Only a few research has been conducted on KC implementation in China. Researchers
33 should be encouraged to closely monitor KC delivery to premature infants. Different
34 barriers can affect KC implementation in many ways (e.g. effect of different education
35 methods on nurses’ knowledge of KC, implementation of KC and changes of outcomes of
36 newborn in NICUs). Therefore, considerable research is needed to investigate the current
37 application, as well as to clarify the perceptions and knowledge of parents and medical
38 staffs, of KC in Chinese NICUs.
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44 **Conclusion**

45 This study is the first to describe the knowledge and perceptions of neonatal nurses in
46 China, with respect to kangaroo care. Substantial barriers including parent visiting policies
47 and provision of formal education on the benefits and applicability of KC were identified.
48 These barriers should be addressed immediately if preterm infants and their families in
49 China are to receive evidence-based and parent-centred care.
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56
57
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Abbreviations and Symbols

KC- Kangaroo Care

NICU- Neonatal Intensive Care Units

SSC- Intermittent Skin-to-Skin Care

KCQ- Kangaroo Care Questionnaire

KCS-Kangaroo Care Survey

Authors' Contribution

The specific work of each author in this study was as follows:

Yao Zhang: Participation in the whole work; drafting of the article; data analysis;

Qingqi Deng: Collecting data; translating the survey;

Binghua Zhu: Data analysis;

Qiufang Li: Implementing survey;

Fang Wang: Implementing survey;

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Linda Johnston: Perception and design; final approval of the version to be published.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	4
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	3
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4
		(b) Indicate number of participants with missing data for each variable of interest	4
Outcome data	15*	Report numbers of outcome events or summary measures	4
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4-5
		(b) Report category boundaries when continuous variables were categorized	4-5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	4-5
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6-8
Generalisability	21	Discuss the generalisability (external validity) of the study results	6-8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	8-9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Neonatal intensive care nurses' knowledge and beliefs regarding kangaroo care in China: A national survey

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24 **Disclaimers**

25 All the authors confirmed that they have reviewed and declared this manuscript entitled
26 "Neonatal intensive care nurses' knowledge and beliefs regarding kangaroo care in China:
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30
31
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44 **Conflict of Interest declaration**

45 No conflict of interest has been declared by the authors.

Abstract**Objective:**

Kangaroo Care, a well-established parent-based intervention in neonatal intensive care units, with documented benefits for infants and their parents. However, in China there remains a lack of knowledge and a reluctance to implement kangaroo care in hospitals. Therefore, our aim was to investigate the current knowledge, beliefs, and practices regarding kangaroo care among NICU nurses in China using the 'Kangaroo Care Questionnaire'.

Methods:

A quantitative descriptive survey was designed. This questionnaire comprised 90 items classified according to four domains: knowledge, practice, barriers, and perception. Data were analysed using SPSS 20.0, and content analysis was used to summarize data derived from open-ended questions.

Results:

The survey involved 861 neonatal nurses from maternity and general hospitals across China. 861 were returned fully answered, for a response rate of 95.7%. The findings showed that 47.7% (n=411) of the nurses had participated in implementation of KC. Neonatal nurses in the 'Experienced in KC' group showed an overall better understanding of KC and its benefits with a higher 'correct response' rate than those in the 'Not Experienced in KC' group. In the 'Experienced in KC' group, over 90% considered KC beneficial to parent-baby relationship and attachment, and over 80% believed that KC positively affected outcomes of preterm infants. The 'Not Experienced in KC' group perceived more barriers to KC implementation than the 'Experienced in KC' group.

Conclusion:

Although the majority of nurses working in NICUs in China are aware of the benefits of KC, there remain substantial barriers to its routine use in practice. Education for both staff and parents is necessary, as is the provision of appropriate facilities and policies to support parents in providing this evidence-based intervention.

Strengths and Limitations of This Study

- This study is the first national survey in China to investigate current knowledge, practice, barriers, and perceptions of nurses in NICUs regarding KC.
- This study provides insight into potential barriers to implementation of KC in NICUs in China.
- The participants of this study included only neonatal nurses; other healthcare professionals were not included.
- This study did not obtain information on parents' perceptions of KC, which may be an important influential factor.

Introduction

Kangaroo mother care (KMC) is an established, powerful, and easy-to-use method for promoting the health and well-being of preterm and full-term infants¹. The key features of KMC are as follows: early, continuous and prolonged skin-to-skin contact between mother and baby; exclusive breastfeeding (ideally); initiated in hospitals but can be continued at home; small babies discharged early; adequate support and follow-up for home-based mothers; and a gentle and effective method, in that it reduces agitation, which is common in busy wards housing preterm infants. KMC requires a very strict protocol²; in contrast, Kangaroo Care (KC) is a broader term defined as skin-to-skin and chest-to-chest holding (sometimes called skin-to-skin contact) of the diaper-clad infant by a parent. A modified version of KC called intermittent skin-to-skin contact (SSC) is currently offered in resource-rich countries to infants who need neonatal intensive care; it is also offered to infants who require ventilator support or were born extremely premature³. In contrast to KC, SSC is the practice of holding an infant upright on a parent's chest in a manner that provides maximum bare-skin ventral contact, thereby giving the newborn the opportunity to adjust outside the womb. Ideally, SSC is carried out immediately after birth and as often as parents can do it during the first few days of infants' lives.

In Western and some non-Western countries, KC is a widespread, standardised, protocol-based care system for premature infants⁴. KC is widely known as a beneficial intervention to significantly improve the development of premature infants^{5,6}. Over 82% of neonatal nurses practiced KC in their NICUs in the United States⁷. More than 50% of all hospitals in South Africa also practice KC in some form or another⁸. However, KC is applied much less in China.

The World Health Organization (WHO) reports an average preterm birth rate of 7.1% in China, which makes the country second to India in terms of highest number of preterm births (i.e. more than 250,000 in 2010)⁹. Gregson⁹ in 2016 reported that kangaroo mother care is little known in China, but that with assistance from an international charity, UK midwives have helped to take kangaroo care into China. KC remains novel and uncommon in China, however, and there is very little about this practice in Chinese peer-reviewed journals, even though KMC is recognized globally as an evidence-based solution for reducing mortality and improving health outcomes for babies in both high- and low-income countries. Also, there is no formal, standard KC training/education or relevant guidelines across China, only a few informal training programmes provided.

Several studies have recognised the importance of neonatal care (including KC) delivered by parents^{10,11}. Although KC has been applied for around 25 years in several countries¹¹, it is still relatively new in Chinese NICUs. A retrospective cohort study¹² reported that the top three barriers to its implementation are issues related to physical facilities in NICUs, negative impressions about the practice among staff, and fear of injuring infants during KC. In China, the most frequently cited barrier to KC is the National Health Policy, which stipulates as an infection-control mechanism that parents are not allowed to enter NICU wards during their infants' entire stay a policy which inhibits

parent–infant interaction and affects infant outcomes. Denying parents access to infants in NICUs is a standard practice in majority of Chinese hospitals. Visitation is not permitted or is strictly limited, and thus, NICU care for most neonates is provided by healthcare professionals, with sharply limited parent participation¹³. Nonetheless, although hospital policies generally do not support KC, a few high-level maternity hospitals have started to implement KC in their NICUs for pilot study.

Education of nursing staff regarding KC has been shown to be critical for its successful implementation¹⁴. However, there is very little reporting on knowledge about and practice of KC in China⁹. The purpose of our study was to investigate nurses' knowledge and beliefs regarding KC practice in NICUs in China.

Methods

Study Design and Participants

This study was conducted to investigate neonatal nurses' knowledge and beliefs on KC practice in NICUs across China, using an adapted and translated version of the 'Kangaroo Care Questionnaire' designed by Engler and Ludington.¹⁴

Instruments

As noted, the instrument was adapted from the English version of the Kangaroo Care Questionnaire (KCQ) initially developed by Engler and Ludington¹⁵; then, the original version was translated into Chinese and back-translated into English to check for any difference between the two versions. A pilot study was undertaken with a convenience sample (n=68) in three public women's hospitals in Zhejiang province in order to determine the relevance of the items to the Chinese clinical context and to ascertain time taken to complete the survey. According to the results of pilot study, our Chinese version of the KCQ is a 90-item questionnaire (79 quantitative items; 11 qualitative items) revised for this study. As all Chinese nurses work full time, 9 questions regarding to working patterns were deleted. The questionnaire includes four (sub)scales respectively relating to Knowledge (17 items), Practice (18 items), Barriers (20 items), and Perceptions (24 items). Some quantitative items are answered on a five-point rating scale and others with true/false responses.

Basic demographic data were collected anonymously, including gender, level of nursing education, and level of neonatal intensive care provided where the respondent worked. Engler et al.¹⁴ ensured the questionnaire's reliability by calculating a Cronbach's alpha reliability coefficient for each scale, as did we.

The reliability and validity of the Mainland Chinese version of the Kangaroo Care Questionnaire were acceptable, with a Cronbach's alpha of 0.891 for the entire scale, and per subscale, Perceptions (0.753), Knowledge (0.827), Barriers (0.938), and Practice (0.919).

Research Setting & Participants

The email list of the Chinese Association of Maternal and Child Health Care was used to send the online survey to the director of nursing in each hospital; directors were asked to

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3 send it on to neonatal nurses working in their NICUs. These nurses had not received formal
4 education on KC before.

5 The questionnaire was sent to 73 hospitals in 32 provinces across China in February
6 2017 and April 2017. The questionnaire was completed online via SoJump online survey
7 software. Completed questionnaires were collected and stored in a secure online database.
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10 ***Statistical Analysis***

11 Quantitative analysis of survey responses was undertaken using SPSS version 20.0.
12 Categorical variables were presented as number of participants (percentage). Data were
13 analysed with Chi-squared for multinomial and (two-tailed) Fisher exact test. Two-sided
14 $P < 0.05$ was regarded as significant. Content analysis was employed for the open-ended
15 questions.
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18 ***Ethical Considerations***

19 The study protocol was approved by the Ethics Committee of Women's Hospital,
20 School of Medicine, Zhejiang University. Clinical governance approvals were granted for
21 each of the hospitals included in the survey.
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25 ***Patient and Public Involvement***

26 Previous published literature has identified that greater family involvement in the
27 delivery of care to their infant in the NICU reduces the stress and distress of the parent,
28 promotes bonding, improves breastfeeding and reduces length of admission. Despite the
29 WHO recommendations for instituting KMC early in the NICU stay, many hospitals still
30 fail to implement this practice. This survey was undertaken with NICU nurses by using a
31 revised version of Kangaroo Care Questionnaire in China to gain an understanding of their
32 knowledge of KC and their perspectives on the barriers to implementation. The focus of
33 this study was on NICU nurses using a previously validated survey instrument. Families of
34 NICU babies and their babies were not involved in this study (included the recruitment to
35 and conduct of the study). The results of the study will be disseminated to the NICUs that
36 participated in the study. The next phase of this study will be to explore parent views of
37 KMC.
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42 **Results**

43 ***Demographic Characteristics of Participants***

44 A total of 900 surveys (with an invitation to participate and a link to the survey) were
45 sent to nurse unit managers of NICUs in hospitals in 32 provinces in China; 861 were
46 returned fully answered, for a response rate of 95.7%. Of the 861 respondents, 411 had
47 experienced delivery of KC. We defined the standard for "Experienced in KC" as
48 implementation of at least 20 cases of KC in the last 12 months, which is widely
49 recognized as a standard for experience with clinical procedures by the Chinese
50 Association of Maternal and Child Health Care (the only authorized maternal and child
51 healthcare organization in China).
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54 The findings showed that 45% (n=391) of respondents worked in dedicated maternity
55 hospitals whereas 54.6% (n=470) worked in maternity units of general hospitals.
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In addition, 60% (n=518) of respondents had earned a university degree in nursing. As shown in Table 1, the majority of nurses were females in the 26–40 age range who worked in level II nurseries (i.e. provided high-dependence care). Moreover, a majority of respondents were from Northern and Eastern China; 16.1% (n=139) from Northern China and 23.5% (n=202) from Eastern China.

Table 1: Descriptive Characteristics of Participants

Descriptive Characteristics	Number of Neonatal Nurses	Number of Neonatal Nurses
	in Experienced in KC (n=411), n(%)	in No Experienced in KC (n=450), n(%)
Gender		
Male	4 (1.0)	1 (0.2)
Female	407 (99.0)	449 (99.8)
Age		
18–25 years old	91 (22.1)	81 (18.0)
26–30 years	149 (36.3)	158 (35.1)
31–40 years	124 (30.2)	151 (33.6)
41–50 years	39 (9.4)	46 (10.2)
51–60 years	8 (2.0)	14 (3.1)
Highest Education Level		
Associate's Degree	147 (35.8)	169 (37.6)
Bachelor's Degree	251 (61.1)	256 (56.9)
Master's Degree	5 (1.2)	6 (1.3)
Other*	8 (1.9)	19 (4.2)
Hospital Type		
General Hospital	169 (41.1)	301 (66.9)
Maternity Hospital	242 (58.9)	149 (33.1)
NICU Level		
Level III	136 (33.1)	60 (13.3)
Level II	155 (37.7)	276 (61.3)
Level I	120 (29.2)	114 (25.3)
Geography		
Northeastern China	68 (16.6)	60 (13.3)
Eastern China	80 (19.5)	122 (27.1)
Northern China	100 (24.3)	39 (8.7)
Central China	33 (8.0)	36 (8.0)
Southern China	42 (10.2)	80 (17.8)
Southwestern China	16 (3.9)	46 (10.2)
Northwestern China	72 (17.5)	67 (14.9)

*Other: includes Doctoral Degree (n=2); Postgraduate Certificate (n=25)

Nurses' Knowledge of Kangaroo Care

The first question in the survey asked respondents to indicate if they had experienced implementation of KC. A total of 411 (47.7%) respondents affirmed they had implemented KC for 20 times or more in the last 12 months; they were labelled the 'Experienced in KC' group. The findings showed that 58.9% (n=242) of these experienced in KC nurses worked in dedicated maternity hospitals (and the others in general hospitals). In contrast, 66.9% (n=301) of no experienced in KC nurses worked in maternity units in general hospitals (and the others in dedicated maternity hospitals). The ratio of general hospital vs. maternity hospital nurses was very similar across groups in our study. Although detailed information on informal education was not collected, we might expect that nurses working in the maternity hospitals might have more opportunity to attend (informal, in the Chinese context) lectures or training in KC, perhaps explaining these responses.

In the domain of nursing Knowledge, the 'Experienced in KC' group showed better understanding of KC and its benefits, and obtained higher rates of correct responses on seven items (No. 1, 2, 3, 6, 7, 10 and 16) compared with those neonatal nurses who reported they had never practiced KC in their NICU (the 'Not Experienced in KC' group) (Table 2). The majority of the nurses in the 'Experienced in KC' group correctly answered that KC promoted quiet sleep (94.6%), increased mother's milk supply (85.4%) and improved breathing patterns (74.9%), whereas only 57% in the 'Not Experienced in KC' group correctly identified reduction in apnoea. In addition, 70% of respondents in the 'Not Experienced in KC' group (versus 82% in the 'Experienced in KC' group) provided correct responses to the item concerning participation by babies with peripheral IVs.

Table 2: Knowledge of Kangaroo Care

Table 2: Knowledge of Kangaroo Care*	Correct Response Experienced in KC (n=411) n (%)	Correct Response Not experienced in KC (n=450) n (%)	P Value
Babies appear to be contented in KC.	378 (91.7)	322 (71.6)	< 0.001
Babies on oxygen therapy experience a decrease in oxygen saturation.	153 (37.2)	99 (22.0)	< 0.001
Babies on phototherapy can participate in KC.	248 (60.3)	88 (19.6)	< 0.001
Babies on vasopressors should NOT engage in KC.	126 (30.7)	174 (38.7)	0.174
Babies typically experience more bradycardic episodes during KC.	46 (11.2)	41 (9.1)	0.154
Babies with peripheral IVs can participate in KC.	338 (82.2)	318 (70.7)	0.516
KC has been shown to improve breathing patterns in preterm babies by reducing apnoea.	308 (74.9)	257 (57.1)	0.062

KC is contraindicated in babies less than 28 weeks gestation.	100 (24.3)	132 (29.3)	0.714
KC is contraindicated in babies weighing less than 1000 grams.	116 (28.2)	158 (35.1)	0.097
KC is now considered safe as an alternative approach to care for medically stable, continuing care preterm babies.	351 (85.4)	338 (75.1)	0.971
Most babies experience a decrease in temperature during KC.	45 (10.9)	63 (14.0)	0.166
Published reports of clinical observations indicate that the rate of accidental extubation is higher with KC than with traditional methods of holding.	170 (41.3)	222 (49.3)	0.176
Research has indicated that babies who receive KC increase their mother's milk supply.	351 (85.4)	371 (82.4)	0.072
Research indicates that KC promotes quiet sleep.	389 (94.6)	406 (90.2)	0.559
Research shows that babies with arterial lines should NOT engage in KC.	160 (38.9)	162 (36.0)	0.553
The most physiologically stressful part of KC for the baby is the transfer to the parent's chest.	181 (44.0)	157 (34.9)	0.003
There is an increased risk of infection in the baby with KC.	148 (36.0)	189 (42.0)	0.627

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

$P < 0.05$ was considered statistically significant

Practice of Kangaroo Care

The respondents in the 'Experienced in KC' group reported high levels of comfort facilitating KC for babies with specific conditions or receiving certain treatment interventions, as described in the Practice domain of the questionnaire. Differences were observed between the groups for items related to intravenous catheters, NCPAP, and percutaneous central lines: more respondents in the 'Experienced in KC' group than in the 'Not Experienced in KC' group (Table 3) felt 'Somewhat/Very Comfortable' with these interventions, at 71.3% versus 62.6%, 46.7% versus 33.3%, and 61.6% versus 45.4%, respectively.

Table 3: Practice Issues in providing KC (Specific treatments and Conditions)

Table 3: Practice Issues in providing KC* (Specific treatments and Conditions)	Very/Somewhat Uncomfortable Experienced in KC (N=411), n (%)	Very/Somewhat Uncomfortable Not experienced in KC (N=450), n (%)	P Value
	Intravenous catheters	30 (7.3)	
During the perioperative period	84 (20.4)	95 (21.1)	0.479
Endotracheal intubation	143 (34.8)	209 (46.4)	0.005
High-frequency jet or oscillator	186 (45.3)	240 (53.4)	0.359

ventilation			
Nasal cannula oxygen	70 (17.0)	114 (25.4)	0.868
Nasal continuous positive airway pressure (NCPAP)	100 (24.3)	160 (35.6)	0.222
Percutaneous central lines	56 (13.6)	110 (24.4)	0.001
Phototherapy	151 (36.7)	193 (42.9)	0.841
Umbilical arterial catheters	142 (34.6)	171 (38.0)	0.657
Umbilical venous catheters	130 (31.6)	160 (35.5)	0.698
Vasopressors	105 (25.5)	141 (31.3)	0.712

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

$P < 0.05$ was considered statistically significant

Barriers to Implementing Kangaroo Care

The Barriers domain of the questionnaire included items related to work environment (including workload and physical environment) and family engagement in KC. Table 4 lists the barriers identified by respondents as ‘Somewhat/Very Influential’ on implementation of KC. A high number of respondents in the ‘Not Experienced in KC’ group identified fear of accidental extubation, inability to provide adequate family time during KC, KC adding burden to workload, and KC interfering with care delivery as factors affecting implementation.

More neonatal nurses in the ‘Not Experienced in KC’ group than in the ‘Experienced in KC’ group also cited the following barriers as ‘Somewhat/Very Influential’: difficulty assessing baby readiness for KC; fear of safety of KC for babies below a certain weight; inability to provide adequate family time during KC; inconsistency in KC practice; a nurse’s feeling that KC adds burden to workload; and parents’ discomfort with exposing chest during KC.

Table 4: Barriers to Implementing Kangaroo Care

Table 4: Barriers to Implementing Kangaroo Care*	Somewhat/Very Influential Experienced in KC (n=411), n (%)	Somewhat/Very Influential Not experienced in KC (n=450), n (%)	P value
Senior nurses’ reluctance to allow KC	206 (50.2)	243 (54.0)	0.123
Belief that technology (e.g., incubators) is more beneficial to babies that care a parent can provide	180 (43.8)	214 (47.6)	0.471
Difficult providing privacy for families during KC	216 (52.6)	263 (58.4)	0.056
Difficulty assessing babies readiness for KC	188 (45.7)	257 (57.2)	0.001
Family reluctance to initiate KC	297 (72.3)	323 (71.7)	0.370
Family reluctance to participate in	297 (72.3)	333 (74.0)	0.184

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KC			
Fear of accidental extubation	278 (67.6)	334 (74.2)	0.453
Fear of arterial or venous line dislodgement	276 (67.2)	330 (73.3)	0.932
Fear of safety of KC for babies below a certain weight	252 (61.4)	325 (72.2)	0.083
Inability to provide adequate time to families during KC	253 (61.6)	320 (71.1)	0.117
Inconsistency in the practice of KC	228 (55.5)	298 (66.2)	0.156
Medical staff reluctance to allow KC	296 (72.0)	340 (75.5)	0.155
Nurses' belief that KC is used for babies who are NOT developmentally ready for it	232 (56.4)	275 (61.1)	0.730
Nurses' feeling that KC adds a burden to their workload	242 (58.9)	317 (70.4)	0.187
Nurses' feeling that KC makes it difficult to administer care	255 (62.0)	323 (71.7)	0.758
Nursing staff reluctance to participate in KC	281 (68.3)	328 (72.9)	0.760
Parents' discomfort with exposing their chest during KC	250 (60.8)	306 (68.0)	0.338
Parents' presence in the NICU for extended periods of time	194 (47.2)	268 (59.5)	0.014
Parents' provision of too much stimulation to their baby during KC	188 (45.7)	221 (49.2)	0.430
Staff's lack of exposure to parents participating in KC	232 (56.4)	276 (61.3)	0.761

**Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)*

P<0.05 was considered statistically significant

Perceptions of Kangaroo Care

The comparison of neonatal nurses' perceptions of KC between groups indicated convergence on some items and divergence on others (Table 5). Both groups agreed on statements that KC encouraged parenting roles, enhanced attachment between parent and baby, benefitted preterm babies, helped parents become confident caregivers, and improved outcomes for babies. There was less agreement between the groups on other items. The respondents in the 'Experienced in KC' group (21.7%) were less in agreement with the statement that KC keeps nurses too tied to the bedside as compared to the 'Not Experienced in KC' group (34.4%); similarly, only 23.3% of respondents in the 'Experienced in KC' group agreed with the statement that KC interferes with task completion as opposed to 37.4% of the 'Not Experienced in KC' group. Furthermore, 66.2% of the 'Not Experienced in KC' group agreed that 'modern day NICUs are NOT the place for KC', whereas only 43.5% of the 'Experienced in KC' group agreed with the statement.

Table 5: Nurse's Perceptions about Kangaroo Care

Table 5: Nurse's Perceptions about Kangaroo Care*	Disagree Experienced in KC n (%)	Disagree Not experienced in KC n (%)	P value	Agree Experienced in KC n (%)	Agree Not experienced in KC n (%)	P value
All preterm babies should be allowed to participate in KC regardless of gestational age.	68 (16.5)	68 (15.1)	0.776	241 (58.7)	225 (50.0)	0.824
All preterm babies should be allowed to participate in KC regardless of weight.	73 (17.8)	72 (16.0)	0.373	228 (55.4)	209 (46.4)	0.622
Babies receiving IV fluids should NOT be allowed to participate in KC.	285 (69.3)	241 (53.6)	0.161	46 (11.2)	71 (15.7)	0.035
Babies who are intubated should NOT be allowed to participate in KC.	193 (47.0)	170 (37.8)	0.782	127 (30.9)	163 (36.2)	0.770
Babies with umbilical catheters should NOT be allowed to participate in KC.	195 (47.4)	168 (37.3)	0.307	108 (26.3)	138 (30.7)	0.426
KC encourages the parenting role.	11 (2.7)	16 (3.6)	0.410	371 (90.2)	372 (82.6)	0.454
KC enhances the attachment process between parent and baby.	11 (2.7)	12 (2.7)	0.356	374 (91.0)	383 (85.1)	0.458
KC increases the quality of care on our unit.	20 (4.9)	41 (9.1)	0.022	322 (78.3)	277 (61.6)	0.002
KC interrupts patient caregiving.	222 (54.0)	173 (38.4)	0.636	81 (19.7)	121 (26.9)	0.526
KC should be available only to breastfeeding mothers.	292 (71.0)	264 (58.7)	0.326	62 (15.1)	82 (18.2)	0.532
KC is NOT feasible with some patients.	110 (26.8)	70 (15.6)	0.760	192 (46.7)	245 (54.4)	0.959
KC keeps nurses too tied to the bedside.	167 (40.6)	100 (22.3)	0.012	89 (21.7)	155 (34.4)	0.014
KC should be offered to all parents in the NICU.	74 (18.0)	84 (18.6)	0.216	231 (56.2)	237 (52.7)	0.199
KC will benefit preterm babies.	13 (3.2)	16 (3.5)	0.753	366 (89.0)	379 (84.3)	0.751
KC will help parents feel more confident in caring for their preterm baby.	10 (2.4)	10 (2.2)	0.771	367 (89.3)	373 (82.9)	0.846
KC will improve the baby's outcome.	13 (3.2)	16 (3.5)	0.715	344 (83.7)	356 (79.2)	0.443
KC will interfere with the completion of my tasks.	177 (43.1)	100 (22.2)	0.485	96 (23.3)	168 (37.4)	0.197
Learning about KC will help me be a better nurse.	21 (5.1)	27 (6.0)	0.603	329 (80.1)	317 (70.4)	0.551
Modern-day NICUs are NOT the place for KC.	115 (28.0)	50 (11.1)	0.000	179 (43.5)	299 (66.2)	0.001
Nurses look forward to introducing KC to a new parent.	13 (3.2)	24 (5.3)	0.013	342 (83.2)	319 (70.9)	0.003
Our patients have adequate time for parent-baby contact without the use of KC.	109 (26.5)	100 (22.2)	0.771	153 (37.2)	214 (47.6)	0.973
The increased amount of time required to prepare a baby for a KC session is out of proportion to the benefits.	169 (41.1)	112 (24.8)	0.567	107 (26.0)	165 (36.8)	0.371
The teamwork required between nurses and parents when doing KC is worth the effort.	13 (3.2)	11 (2.4)	0.312	355 (86.3)	353 (78.5)	0.726
There is NOT enough flexibility in the NICU to allow parents extended visits	80 (19.5)	49 (10.9)	0.122	218 (53.0)	277 (61.5)	0.306

(more than 2 hours) for KC.

**Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)*

Experienced KMC (n=411) ;Not experienced KMC (N=450)

P<0.05 was considered statistically significant

Discussion

Initially conceptualised as a low-cost mechanism to care for preterm babies in resource-poor countries¹⁶, KC was later recognised as an intervention with a wide range of benefits for small and sick babies everywhere¹⁷. The recognition of the moral, ethical, and evidence-based impetus for supporting family-centred care in NICUs¹⁸ has led the intervention to be widely implemented in high-dependency neonatal units, especially with technology-dependent babies in neonatal intensive care. Previous research globally has identified the challenges associated with KC implementation, which include nurses' (lack of) knowledge and perceived barriers to implementation¹⁹. To advance the implementation of this evidence-based intervention in China, where it is rare, a survey was conducted to identify current NICU nurses' knowledge, practice, barriers and perceptions regarding KC. This section presents the results, which show broad similarities but also some differences to other studies.

Knowledge

Our results showed that even without formal KC training, a majority of neonatal nurses from Northern and Eastern China in the 'Experienced in KC' group had better knowledge of the benefits and effects of KC than those who did not have any experience on KC, which might be because the areas of Northern and Eastern China are more developed than other areas which make nurses have more chances to get better knowledge. Another reason maybe that 'Experienced in KC' group the former had more informal education in KC before; this finding is similar to those in the works of Engler¹⁴ and Solomons and Rosant²⁰. We also verified nurses' uncertainty toward KC inclusion and exclusion criteria, especially for preterm infants receiving specific treatments or with specific conditions. Although it is undeniable that nurses working in the maternity hospitals have more opportunities to attend academic lectures and conferences on maternal-infant healthcare than those who worked in general hospitals. Many respondents in both groups felt ambiguous toward KC (e.g. for preterm infants with specific treatments and conditions) because of lack of formal KC training and hence gaps in their knowledge and practical skills, covered in the next section.

Practice

As in another study²¹, nurses were uncertain how to implement KC for infants with intubation, under phototherapy, or with an umbilical line in situ. Almutairi's quasi-experimental study indicated that nurses' knowledge and skills with KC improved after continuing education²². Specific KC education including simulation training for neonatal nurses may increase their confidence in KC and promote its implementation.

Although KC is a key intervention for newborn health, there has been limited information available on KC practice in China, and parents and neonatal nurses generally cannot practice it with confidence.

Barriers

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3 Our study identified barriers to KC implementation including lack of consistent
4 guidelines and standards, reluctance among medical staff to support KC due to safety fears,
5 and hospital policy of denying parents access to NICU. Seidman's systematic review²³
6 proposed that resource-related barriers (lack of guidelines/education) and sociocultural
7 barriers (concerns about medical conditions/care) negatively affected nurses; our study
8 supports these points. Meanwhile, other studies also proposed that lack of knowledge and
9 skills were main barriers to KC implementation^{21 24-27}, as well as medical staff reluctance
10 to allow KC²⁶⁻²⁹. Resistance of medical staff is mainly associated with fear of harming
11 infants and lack of experience and specific education in KC. These might be reasons why
12 KC has had slow uptake in Chinese hospitals despite being a proven therapy.
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15 An inappropriate physical environment was another important barrier identified in our
16 study, consistent with research from Eichel³⁰ and Pratomo²⁸. Most NICUs in China do not
17 have sufficient space or nursing staff³¹ for parents to implement KC. Xin Zhang's
18 cross-sectional exploratory study³² stated that a better nurse-patient ratio was the strongest
19 factor for a nurse's likelihood to implement KC in NICUs.
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21 Perhaps the biggest barrier to routine implementation of KC in China is the policy
22 limiting parental visitation, although visitation does not increase rates of nosocomial
23 infection, bronchopulmonary dysplasia, intraventricular haemorrhage, necrotizing
24 enterocolitis, or retinopathy of prematurity¹³. Blomqvist's study²⁶ in Sweden demonstrated
25 that lack of parental visitation also discouraged KC in NICUs there, as did Lee²⁵ in the US.
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27 Alongside these similarities, a number of differences on barriers were also observed
28 between our study and past research. In our study, respondents in the 'Not Experienced in
29 KC' group but not the 'Experienced in KC' group perceived KC as a burden 'Experienced
30 in KC' group. Chia³³ found that respondents in Australia expressed strong frustration with
31 workloads and staffing levels, which left them without time to facilitate KC. Another study,
32 on KMC²⁹, mentioned cultural issues in India and financing problems as barriers; these
33 items were not investigated in our study. Namnabati³⁴ in Iran proposed that older, more
34 experienced physicians were more likely to implement KC in NICUs; by contrast, no age
35 or general experience factor was apparent in our study.
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38 **Perceptions**

39 Perceptions may be much more important than knowledge and practice for successful
40 implementation of KC in NICUs. Knowledge alone does not change practice, but
41 perceptions strongly influence action. We found that nurses in 'Experienced in KC' group
42 both held similar beliefs on the importance, advantages, and appropriateness of KC.
43 Misunderstandings about KC were apparent in the 'Not Experienced in KC' group; where
44 nurses lacked formal or informal KC education. Although the nurses in the 'Experienced
45 Group' had not had formal training in KC but had very likely had informal training before
46 they started implementation of KC in their NICUs. However, we do think there should be a
47 formal and standard training or education in KC across China. And it would be better for
48 both groups to have more knowledge and practical skills on KC.
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51 Overall, many nurses in both groups agreed that KC promotes parent-baby attachment,
52 parental confidence, and infant health. However, concerns were raised about the deleterious
53 effects of environment on ability to implement KC, duration of KC, and nurses' workload.
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Limitations

A notable limitation of this study was that only neonatal nurses were surveyed, and other healthcare professionals excluded. Our study also did not gather information on parents' perceptions of KC, an important factor if implementation of KC is to be successful.

Recommendations for Policy, Practice, Education, and Research

The shift from a one- to a two-child policy and the wide use of assisted reproductive technology in China have resulted in rapid increase in preterm birth in recent years. In this situation, KC seems to be a convenient, economical, and effective method; it is highly suitable for preterm as well as other infants. On the basis of the results of our study, the following recommendations are made for clinical practice in China:

- The limits on parental visitation in Chinese NICUs should be changed; visitation hours should be extended to foster KC implementation.
- Hospitals should improve their environment, such as widening ward spaces and allocating more staff, to promote the implementation of KC.
- Simulation training and interactive workshops on KC may be needed to improve nurses' knowledge, skills, and confidence in the implementation of safe and effective KC with preterm infants. Chinese guidelines for preterm birth and KC implementation should be considered.
- Only a few studies have been conducted on KC implementation in China. All NICU nurses should be encouraged to closely monitor KC delivery to premature infants. Different barriers can affect KC implementation in different ways (e.g. effect of different education methods on nurses' knowledge of KC, implementation of KC, and outcomes of KC for newborns). Considerable research is needed to investigate the current application of KC and to clarify perceptions and knowledge of KC among parents and medical staff in Chinese NICUs.

Conclusion

This study is the first to describe the knowledge and perceptions of neonatal nurses in China on kangaroo care. Substantial barriers were found to include parent visitation policies and lack of formal education for nurses on the benefits and applicability of KC. These barriers should be addressed immediately if preterm infants and their families in China are to receive evidence-based, parent-centred care routinely including KC.

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Data Sharing Statement

No additional unpublished data are available.

Abbreviations and Symbols

KC- Kangaroo Care

NICU- Neonatal Intensive Care Units

SSC- Intermittent Skin-to-Skin Care

KCQ- Kangaroo Care Questionnaire

KCS-Kangaroo Care Survey

Authors' Contribution

The specific work of each author in this study was as follows:

Yao Zhang: Participation in the whole work; drafting of the article; data analysis;

Qingqi Deng: Collecting data; translating the survey;

Binghua Zhu: Data analysis;

Qiufang Li: Implementing survey;

Fang Wang: Implementing survey;

Hua Wang: Implementing survey;

Xinfen Xu: Financial support; implementing survey;

Linda Johnston: Perception and design; final approval of the version to be published.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	4
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	3
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4
		(b) Indicate number of participants with missing data for each variable of interest	4
Outcome data	15*	Report numbers of outcome events or summary measures	4
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4-5
		(b) Report category boundaries when continuous variables were categorized	4-5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	4-5
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6-8
Generalisability	21	Discuss the generalisability (external validity) of the study results	6-8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	8-9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Neonatal Intensive Care Nurses' Knowledge and Beliefs Regarding Kangaroo Care in China: A National Survey

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25 **Disclaimers**

26 All authors confirm that they have reviewed and declare that the manuscript entitled,
27 'Neonatal Intensive Care Nurses' Knowledge and Beliefs Regarding Kangaroo Care in
28 China: A National Survey' is original, has not been published before, and is not currently
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47 **Conflict of interest declaration**

48 No conflicts of interest are declared by the authors.

Abstract

Objective:

Kangaroo Care, a well-established parent-based intervention in neonatal intensive care units, with documented benefits for infants and their parents. However, in China there remains a lack of knowledge and a reluctance to implement KC in hospitals. Therefore, our aim was to investigate the current knowledge, beliefs, and practices regarding KC among NICU nurses in China using the 'Kangaroo Care Questionnaire'.

Methods:

A quantitative descriptive survey was designed. This questionnaire comprised 90 items classified according to four domains: knowledge, practice, barriers, and perception. Data were analysed using SPSS 20.0, and content analysis was used to summarize data derived from open-ended questions.

Results:

The survey involved 861 neonatal nurses from maternity and general hospitals across China. (The response rate = 95.7%). The findings showed that 47.7% (n=411) of the nurses had participated in the implementation of KC. Neonatal nurses in the 'Experienced in KC' group showed an overall better understanding of KC and its benefits with a higher 'correct response' rate than those in the 'Not experienced in KC' group. In the 'Experienced in KC' group, over 90% considered KC beneficial to the parent-baby relationship and attachment, and over 80% believed that KC positively affected outcomes of preterm infants. The 'Not experienced in KC' group perceived more barriers to KC implementation than did the 'Experienced in KC' group.

Conclusion:

Although most nurses working in NICUs in China were aware of the benefits of KC, there remain substantial barriers to its routine use in practice. Education for both staff and parents is necessary, as is the provision of appropriate facilities and policies to support parents in providing this evidence-based intervention.

Strengths and Limitations of the Study

- This study was the first national survey in China to investigate current knowledge, practice, barriers, and perceptions of nurses in NICUs regarding KC.
- This study provides insight into potential barriers to implementation of KC in NICUs in China.
- The participants included only neonatal nurses; other healthcare professionals were not included.
- This study did not obtain information on parents' perceptions of KC, which may be a key influential factor.

Introduction

Kangaroo care (KC), which is often also called kangaroo mother care (KMC) or skin-to-skin contact (SSC), is a method of neonatal care practiced on babies. This is typically performed with preterm infants, where the diaper-clad infant is held skin-to-skin with a parent, usually the mother. In contrast, KMC requires a very strict protocol. KMC is an established, powerful, and easy-to-use method for promoting the health and well-being of preterm and full-term infants¹. The key features of KMC are as follows: early, continuous, and prolonged SSC between mother and baby; exclusive breastfeeding (ideally); initiated in hospitals but can be continued at home; small babies discharged early; adequate support and follow-up for home-based mothers; and a gentle and effective method, in that it reduces agitation, which is common in busy wards housing preterm infants². Another modified version of KC—intermittent SSC—is the practice of holding an infant upright on a parent's chest in a manner that provides maximum bare-skin ventral contact, thereby giving the newborn the opportunity to adjust to the environment outside the womb³. Ideally, SSC is performed immediately after birth and as often as parents can do it during the first few days of the infant's life. Therefore, compared with KMC and SSC, the definition of KC is broader, and it is more widely used in clinical practice.

In Western and some non-Western countries, KC is a widespread, standardised, protocol-based care system for premature infants⁴. KC is widely known as a beneficial intervention to significantly improve the development of premature infants^{5,6}. Over 82% of neonatal nurses practiced KC in their NICUs in the United States⁷. More than 50% of all hospitals in South Africa also practice KC in some form or another⁸. KC is widespread in neonatal intensive care units (NICUs) in several European countries (e.g. Belgium, Denmark, France, Italy, the Netherlands, Spain, Sweden, and the United Kingdom), which have reported encouraging results regarding parental participation (such as KC) in caring for babies⁹. However, KC is less utilized in China.

The World Health Organization (WHO) reports an average preterm birth rate of 7.1% in China, which makes the country second to India in the highest number of preterm births (i.e. more than 250,000 in 2010)¹⁰. In 2016, Gregson¹¹ reported that KC is not well known in China; however, with assistance from an international charity, UK midwives have helped promote KC in China. However, overall, KC remains uncommon in China, and there is very little about this practice in Chinese peer-reviewed journals, even though KC is recognized globally as an evidence-based solution for reducing mortality and improving health outcomes for babies in both high- and low-income countries. In addition, there is no formal, standard KC training/education or relevant guidelines across China (only a few informal training programmes are provided).

Several studies have recognised the importance of neonatal care (including KC) delivered by parents^{12,13}. Although KC has been applied for around 25 years in several countries¹³, it is still relatively new in Chinese NICUs. A retrospective cohort study¹⁴ reported that the top three barriers to its implementation are issues related to physical facilities in NICUs, negative impressions about the practice among staff, and fear of injuring infants during KC. In China, the most frequently cited barrier to KC is the National Health Policy, which stipulates as an infection-control mechanism that parents are not allowed to enter NICU wards during their infants' entire stay a policy, which inhibits

parent–infant interactions and affects infant outcomes. Denying parents access to infants in NICUs is a standard practice in majority of Chinese hospitals. Visitation is not permitted or is strictly limited; therefore, NICU care for most neonates is provided by healthcare professionals, with sharply limited parental participation¹⁵. Nonetheless, although hospital policies generally do not support KC, a few high-level maternity hospitals (the hospitals have over 500 beds which are believed to have doctors with the best medical skills and provide high-quality medical care by employing outstanding medical techniques) have started to implement KC in their NICUs for pilot study.

Education of nursing staff regarding KC has been shown to be critical for its successful implementation¹⁶. However, there is scant knowledge about the practice of KC in China¹¹. Consequently, we investigated nurses' knowledge and beliefs regarding KC practice in NICUs in China.

Methods

Study Design and Participants

This study was conducted to investigate neonatal nurses' knowledge and beliefs on KC practice in NICUs across China, using an adapted and translated version of the 'Kangaroo Care Questionnaire', which was designed by Engler and Ludington¹⁶.

Instruments

As noted, the instrument was adapted from the English version of the Kangaroo Care Questionnaire (KCQ) initially developed by Engler and Ludington¹⁷; then, the original version was translated into Chinese and back-translated into English to check for any difference between the two versions. A pilot study was undertaken with a convenience sample (n= 68) in three public women's hospitals in Zhejiang province to determine the relevance of the items to the Chinese clinical context and to ascertain time taken to complete the survey. According to the pilot study results, we utilized a revised Chinese version of the KCQ (i.e. a 90-item questionnaire; 79 quantitative items and 11 qualitative items). As all Chinese nurses work full time, 9 questions regarding working patterns were deleted. The questionnaire included four subscales: Knowledge (17 items), Practice (18 items), Barriers (20 items), and Perceptions (24 items). Some quantitative items were answered on a five-point rating scale and others with true/false responses.

Basic demographic data were collected anonymously, including gender level of nursing education, and level of neonatal intensive care provided where the respondent worked. Engler and colleagues¹⁶ ensured the questionnaire's reliability by calculating a Cronbach's alpha reliability coefficient for each scale, as did we.

The reliability and validity of the Mainland Chinese version of the KCQ were acceptable: Cronbach's alphas for the entire scale, 0.891; Perceptions, 0.753; Knowledge, 0.827; Barriers, 0.938; and Practice, 0.919.

Research Setting & Participants

The email list of the Chinese Association of Maternal and Child Health Care was used to send the online survey to the director of nursing in each hospital; directors were asked to

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3 send it on to neonatal nurses working in their NICUs. These nurses had not received formal
4 education on KC before.

5 The questionnaire was sent to 73 hospitals in 32 provinces across China in February
6 2017 and April 2017. The questionnaire was completed online via SoJump online survey
7 software. Completed questionnaires were collected and stored in a secure online database.
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10 ***Statistical Analyses***

11 Quantitative analysis of survey responses was undertaken using SPSS version 20.0.
12 Categorical variables were presented as number of participants (percentage). Data were
13 analysed with chi-squared tests for multinomial variables and Fisher's exact
14 tests(two-tailed). P-values < .05 (two-sided) were regarded as significant. Content analysis
15 was employed for open-ended questions.
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18 ***Ethical Considerations***

19 The study protocol was approved by the Ethics Committee of Women's Hospital,
20 School of Medicine, Zhejiang University. Clinical governance approvals were granted for
21 each of the hospitals included in the survey.
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25 ***Patient and Public Involvement***

26 Previous published literature has identified that greater family involvement in the
27 delivery of care to their infant in the NICU reduces the stress and distress of the parent,
28 promotes bonding, improves breastfeeding, and reduces length of admission. Despite the
29 WHO's recommendations for instituting KC early during the NICU stay, many hospitals
30 still fail to implement this practice. This survey was undertaken with NICU nurses by using
31 a revised version of the KCQ in China to gain an understanding of their knowledge of KC
32 and their perspectives on the barriers to implementation. The focus of this study was on
33 NICU nurses using a previously validated survey instrument. Families of NICU babies and
34 their babies were not involved in this study. The results will be disseminated to the NICUs
35 that participated. The next phase of this study will be to explore parents' views of KC.
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40 **Results**

41 ***Participants' Demographic Characteristics***

42 Nine-hundred surveys (with an invitation to participate and a link to the survey) were
43 sent to nurse unit managers of NICUs in hospitals in 32 provinces in China. 861 were
44 returned fully answered (response rate = 95.7%) and 411 had experienced delivery of KC.
45 We defined the standard for 'Experienced in KC' as implementation of at least 20 cases of
46 KC in the last 12 months, which is widely recognized as a standard for experience with
47 clinical procedures by the Chinese Association of Maternal and Child Health Care (the only
48 authorized maternal and child healthcare organization in China).
49

50 The findings showed that 45% (n = 391) of respondents worked in dedicated maternity
51 hospitals whereas 54.6% (n = 470) worked in maternity units of general hospitals. In
52 addition, 60% (n = 518) of respondents had earned a university degree in nursing. Key
53 demographics are shown in Table 1, the majority of nurses were females in the 26–40 age
54 range who worked in level II nurseries (i.e. provided high-dependence care). Moreover, a
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majority of respondents were from Northern and Eastern China; 16.1% (n=139) from Northern China and 23.5% (n=202) from Eastern China.

Table 1: Participants' Descriptive Characteristics

Descriptive Characteristics	Experienced in KC (n = 411), n (%)	Not experienced in KC (n = 450), n (%)
Gender		
Male	4 (1.0)	1 (0.2)
Female	407 (99.0)	449 (99.8)
Age		
18–25 years	91 (22.1)	81 (18.0)
26–30 years	149 (36.3)	158 (35.1)
31–40 years	124 (30.2)	151 (33.6)
41–50 years	39 (9.4)	46 (10.2)
51–60 years	8 (2.0)	14 (3.1)
Highest education level		
Associate's degree	147 (35.8)	169 (37.6)
Bachelor's degree	251 (61.1)	256 (56.9)
Master's degree	5 (1.2)	6 (1.3)
Other*	8 (1.9)	19 (4.2)
Hospital type		
General Hospital	169 (41.1)	301 (66.9)
Maternity Hospital	242 (58.9)	149 (33.1)
NICU level		
Level III	136 (33.1)	60 (13.3)
Level II	155 (37.7)	276 (61.3)
Level I	120 (29.2)	114 (25.3)
Geography		
Northeastern China	68 (16.6)	60 (13.3)
Eastern China	80 (19.5)	122 (27.1)
Northern China	100 (24.3)	39 (8.7)
Central China	33 (8.0)	36 (8.0)
Southern China	42 (10.2)	80 (17.8)
Southwestern China	16 (3.9)	46 (10.2)
Northwestern China	72 (17.5)	67 (14.9)

*Other: includes doctoral degree (n = 2) and postgraduate certificate (n = 25); KC = kangaroo care.

Nurses' Knowledge of Kangaroo Care

The first question in the survey asked respondents to indicate if they had experienced implementation of KC. Overall, 411 (47.7%) respondents affirmed they had implemented KC \geq 20 times in the past 12 months (i.e. 'Experienced in KC' group). The findings showed that 58.9% (n = 242) of those experienced in KC nurses worked in dedicated maternity hospitals (and the others in general hospitals). In contrast, 66.9% (n = 301) of those not experienced in KC nurses worked in maternity units in general hospitals (and the others in dedicated maternity hospitals). The ratio of general hospital vs. maternity hospital nurses was very similar across groups in our study. Although detailed information on informal education was not collected, we expect that nurses working in the maternity hospitals might have more opportunity to attend (informal, in the Chinese context) lectures or training in KC, perhaps explaining these responses.

Regarding the Knowledge domain of KC, the 'Experienced in KC' group showed better understanding of KC and its benefits, and obtained higher rates of correct responses on seven items (No. 1, 2, 3, 6, 7, 10 and 16) compared with those neonatal nurses who reported they had never practiced KC in their NICU (the 'Not Experienced in KC' group) (Table 2). The majority of the nurses in the 'Experienced in KC' group correctly answered that KC promoted quiet sleep (94.6%), increased mother's milk supply (85.4%) and improved breathing patterns (74.9%), whereas only 57% in the 'Not Experienced in KC' group correctly identified reduction in apnoea. In addition, 70% of respondents in the 'Not Experienced in KC' group (versus 82% in the 'Experienced in KC' group) provided correct responses to the item concerning participation by babies with peripheral IVs.

Table 2: Knowledge of Kangaroo Care*

Items	Correct Response in 'Experienced in KC' group (n = 411) n (%)	Correct Response in 'Not experienced in KC' group (n = 450) n (%)	P Value
Babies appear to be contented in KC.	378 (91.7)	322 (71.6)	< .001
Babies on oxygen therapy experience a decrease in oxygen saturation.	153 (37.2)	99 (22.0)	< .001
Babies on phototherapy can participate in KC.	248 (60.3)	88 (19.6)	< .001
Babies on vasopressors should NOT engage in KC.	126 (30.7)	174 (38.7)	.174
Babies typically experience more bradycardic episodes during KC.	46 (11.2)	41 (9.1)	.154
Babies with peripheral IVs can participate in KC.	338 (82.2)	318 (70.7)	.516
KC has been shown to improve breathing patterns in preterm babies by reducing apnoea.	308 (74.9)	257 (57.1)	.062
KC is contraindicated in babies less than 28 weeks gestation.	100 (24.3)	132 (29.3)	.714
KC is contraindicated in babies	116 (28.2)	158 (35.1)	.097

weighing less than 1000 grams.			
KC is now considered safe as an alternative approach to care for medically stable, continuing care preterm babies.	351 (85.4)	338 (75.1)	.971
Most babies experience a decrease in temperature during KC.	45 (10.9)	63 (14.0)	.166
Published reports of clinical observations indicate that the rate of accidental extubation is higher with KC than with traditional methods of holding.	170 (41.3)	222 (49.3)	.176
Research has indicated that babies who receive KC increase their mother's milk supply.	351 (85.4)	371 (82.4)	.072
Research indicates that KC promotes quiet sleep.	389 (94.6)	406 (90.2)	.559
Research shows that babies with arterial lines should NOT engage in KC.	160 (38.9)	162 (36.0)	.553
The most physiologically stressful part of KC for the baby is the transfer to the parent's chest.	181 (44.0)	157 (34.9)	.003
There is an increased risk of infection in the baby with KC.	148 (36.0)	189 (42.0)	.627

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999); $P < .05$ was considered significant; KC = kangaroo care; IV = intravenous.

Practice of Kangaroo Care

The respondents in the 'Experienced in KC' group reported prominent levels of comfort facilitating KC for babies with specific conditions or receiving certain treatment interventions, as described in the Practice domain of the questionnaire. Differences were observed between the groups for items related to intravenous catheters, nasal continuous positive airway pressure, and percutaneous central lines: more respondents in the 'Experienced in KC' group than in the 'Not experienced in KC' group felt 'very/somewhat comfortable' with these interventions (Table 3).

Table 3: Practice Issues in Providing KC (Specific Treatments and Conditions)*

Items	Very/somewhat uncomfortable in 'Experienced in KC' group (n = 411), n (%)	Very/somewhat uncomfortable in 'Not experienced in KC' group (n = 450), n (%)	P Value
Intravenous catheters	30 (7.3)	42 (9.3)	.943
During the perioperative period	84 (20.4)	95 (21.1)	.479
Endotracheal intubation	143 (34.8)	209 (46.4)	.005
High-frequency jet or oscillator	186 (45.3)	240 (53.4)	.359

ventilation			
Nasal cannula oxygen	70 (17.0)	114 (25.4)	.868
Nasal continuous positive airway pressure (NCPAP)	100 (24.3)	160 (35.6)	.222
Percutaneous central lines	56 (13.6)	110 (24.4)	.001
Phototherapy	151 (36.7)	193 (42.9)	.841
Umbilical arterial catheters	142 (34.6)	171 (38.0)	.657
Umbilical venous catheters	130 (31.6)	160 (35.5)	.698
Vasopressors	105 (25.5)	141 (31.3)	.712

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999); $P < .05$ was considered significant; KC = kangaroo care.

Barriers to Implementing Kangaroo Care

The Barriers domain of the questionnaire included items related to work environment (including workload and physical environment) and family engagement in KC. Table 4 lists the barriers identified by respondents as ‘somewhat/very influential’ on implementation of KC. A high number of respondents in the ‘Not experienced in KC’ group identified fear of accidental extubation, inability to provide adequate family time during KC, KC adding burden to workload, and KC interfering with care delivery as factors affecting implementation.

More neonatal nurses in the ‘Not experienced in KC’ group than in the ‘Experienced in KC’ group also cited the following barriers as ‘somewhat/very influential’: difficulty assessing baby readiness for KC, fear of safety of KC for babies below a certain weight, inability to provide adequate family time during KC, inconsistency in KC practice, a nurse’s feeling that KC adds burden to workload, and parents’ discomfort with exposing chest during KC.

Table 4: Barriers to Implementing Kangaroo Care*

Items	Somewhat/very influential in ‘Experienced in KC’ group (n = 411), n (%)	Somewhat/very influential in ‘Not experienced in KC’ group (n = 450), n (%)	P value
Senior nurses’ reluctance to allow KC	206 (50.2)	243 (54.0)	.123
Belief that technology (e.g. incubators) is more beneficial to babies than the care a parent can provide	180 (43.8)	214 (47.6)	.471
Difficult providing privacy for families during KC	216 (52.6)	263 (58.4)	.056
Difficulty assessing babies readiness for KC	188 (45.7)	257 (57.2)	.001
Family reluctance to initiate KC	297 (72.3)	323 (71.7)	.370

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3	Family reluctance to participate in	297 (72.3)	333 (74.0)	.184
4	KC			
5	Fear of accidental extubation	278 (67.6)	334 (74.2)	.453
6	Fear of arterial or venous line	276 (67.2)	330 (73.3)	.932
7	dislodgement			
8	Fear of safety of KC for babies	252 (61.4)	325 (72.2)	.083
9	below a certain weight			
10	Inability to provide adequate time to	253 (61.6)	320 (71.1)	.117
11	families during KC			
12	Inconsistency in the practice of KC	228 (55.5)	298 (66.2)	.156
13	Medical staff reluctance to allow KC	296 (72.0)	340 (75.5)	.155
14	Nurses' belief that KC is used for	232 (56.4)	275 (61.1)	.730
15	babies who are NOT			
16	developmentally ready for it			
17	Nurses' feeling that KC adds a	242 (58.9)	317 (70.4)	.187
18	burden to their workload			
19	Nurses' feeling that KC makes it	255 (62.0)	323 (71.7)	.758
20	difficult to administer care			
21	Nursing staff reluctance to	281 (68.3)	328 (72.9)	.760
22	participate in KC			
23	Parents' discomfort with exposing	250 (60.8)	306 (68.0)	.338
24	their chest during KC			
25	Parents' presence in the NICU for	194 (47.2)	268 (59.5)	.014
26	extended periods of time			
27	Parents' provision of too much	188 (45.7)	221 (49.2)	.430
28	stimulation to their baby during KC			
29	Staff's lack of exposure to parents	232 (56.4)	276 (61.3)	.761
30	participating in KC			

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999); $P < .05$ was considered significant; KC = kangaroo care; NICU: neonatal intensive care unit.

Perceptions of Kangaroo Care

The comparison of neonatal nurses' perceptions of KC between groups indicated convergence on some items and divergence on others (Table 5). Both groups agreed on statements that KC encouraged parenting roles, enhanced attachment between parent and baby, benefitted preterm babies, helped parents become confident caregivers, and improved outcomes for babies. There was less agreement between the groups on other items. The respondents in the 'Experienced in KC' group (21.7%) were less in agreement with the statement that KC keeps nurses too tied to the bedside as compared to the 'Not Experienced in KC' group (34.4%); similarly, only 23.3% of respondents in the 'Experienced in KC' group agreed with the statement that KC interferes with task completion as opposed to 37.4% of the 'Not Experienced in KC' group. Furthermore, 66.2% of the 'Not Experienced in KC' group agreed that 'modern day NICUs are NOT the place for KC', whereas only 43.5% of the 'Experienced in KC' group agreed with the statement.

Table 5: Nurse's Perceptions about Kangaroo Care*

Items	Disagree in 'Experienced in KC' group n (%)	Disagree in 'Not experienced in KC' group n (%)	P value	Agree in 'Experienced in KC' group n (%)	Agree in 'Not experienced in KC' group n (%)	P value
All preterm babies should be allowed to participate in KC regardless of gestational age.	68 (16.5)	68 (15.1)	.776	241 (58.7)	225 (50.0)	.824
All preterm babies should be allowed to participate in KC regardless of weight.	73 (17.8)	72 (16.0)	.373	228 (55.4)	209 (46.4)	.622
Babies receiving IV fluids should NOT be allowed to participate in KC.	285 (69.3)	241 (53.6)	.161	46 (11.2)	71 (15.7)	.035
Babies who are intubated should NOT be allowed to participate in KC.	193 (47.0)	170 (37.8)	.782	127 (30.9)	163 (36.2)	.770
Babies with umbilical catheters should NOT be allowed to participate in KC.	195 (47.4)	168 (37.3)	.307	108 (26.3)	138 (30.7)	.426
KC encourages the parenting role.	11 (2.7)	16 (3.6)	.410	371 (90.2)	372 (82.6)	.454
KC enhances the attachment process between parent and baby.	11 (2.7)	12 (2.7)	.356	374 (91.0)	383 (85.1)	.458
KC increases the quality of care on our unit.	20 (4.9)	41 (9.1)	.022	322 (78.3)	277 (61.6)	.002
KC interrupts patient caregiving.	222 (54.0)	173 (38.4)	.636	81 (19.7)	121 (26.9)	.526
KC should be available only to breastfeeding mothers.	292 (71.0)	264 (58.7)	.326	62 (15.1)	82 (18.2)	.532
KC is NOT feasible with some patients.	110 (26.8)	70 (15.6)	.760	192 (46.7)	245 (54.4)	.959
KC keeps nurses too tied to the bedside.	167 (40.6)	100 (22.3)	.012	89 (21.7)	155 (34.4)	.014
KC should be offered to all parents in the NICU.	74 (18.0)	84 (18.6)	.216	231 (56.2)	237 (52.7)	.199
KC will benefit preterm babies.	13 (3.2)	16 (3.5)	.753	366 (89.0)	379 (84.3)	.751
KC will help parents feel more confident in caring for their preterm baby.	10 (2.4)	10 (2.2)	.771	367 (89.3)	373 (82.9)	.846
KC will improve the baby's outcome.	13 (3.2)	16 (3.5)	.715	344 (83.7)	356 (79.2)	.443

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3	KC will interfere with the	177 (43.1)	100	.485	96 (23.3)	168	.197
4	completion of my tasks.		(22.2)			(37.4)	
5	Learning about KC will help	21 (5.1)	27 (6.0)	.603	329	317	.551
6	me be a better nurse.				(80.1)	(70.4)	
7	Modern-day NICUs are	115 (28.0)	50 (11.1)	.000	179	299	.001
8	NOT the place for KC.				(43.5)	(66.2)	
9	Nurses look forward to						
10	introducing KC to a new	13 (3.2)	24 (5.3)	.013	342	319	.003
11	parent.				(83.2)	(70.9)	
12	Our patients have adequate						
13	time for parent-baby contact	109 (26.5)	100	.771	153	214	.973
14	without the use of KC.		(22.2)		(37.2)	(47.6)	
15	The increased amount of						
16	time required to prepare a	169 (41.1)	112	.567	107	165	.371
17	baby for a KC session is out		(24.8)		(26.0)	(36.8)	
18	of proportion to the benefits.						
19	The teamwork required						
20	between nurses and parents	13 (3.2)	11 (2.4)	.312	355	353	.726
21	when doing KC is worth the				(86.3)	(78.5)	
22	effort.						
23	There is NOT enough						
24	flexibility in the NICU to	80 (19.5)	49 (10.9)	.122	218	277	.306
25	allow parents extended				(53.0)	(61.5)	
26	visits (more than 2 hours)						
27	for KC.						

*Based on the original literature review from the Kangaroo Care Questionnaire (Engle et al, 1999)

Experienced KMC (n = 411); Not experienced KMC (n = 450); P < .05 was considered significant; KC = kangaroo care; IV = intravenous; NICU: neonatal intensive care unit.

Discussion

Initially conceptualised as a low-cost mechanism to care for preterm babies in resource-poor countries¹⁸, KC was later recognised as an intervention with a wide range of benefits for small and sick babies everywhere¹⁹. The recognition of the moral, ethical, and evidence-based impetus for supporting family-centred care in NICUs²⁰ has led the intervention to be widely implemented in high-dependency neonatal units, especially with technology-dependent babies in neonatal intensive care. Previous research globally has identified the challenges associated with KC implementation, which include nurses' (lack of) knowledge and perceived barriers to implementation²¹. To advance the implementation of this evidence-based intervention in China, where it is rare, a survey was conducted to identify current NICU nurses' knowledge, practice, barriers, and perceptions regarding KC. This section presents the results, which show broad similarities but also some differences to other studies.

Knowledge

Our results showed that even without formal KC training, most neonatal nurses from Northern and Eastern China in the 'Experienced in KC' group had better knowledge of the benefits and effects of KC than those who did not have any experience on KC, which might

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3 be because the areas of Northern and Eastern China are more developed than other areas;
4 therefore, nurses have greater opportunities to advance their knowledge. Another reason
5 may be that the 'Experienced in KC' group had received informal education about KC
6 before; this assumption is similar to those of Engler¹⁶ and Solomons and Rosant²².

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8 We also verified nurses' uncertainty toward KC inclusion and exclusion criteria,
9 especially for preterm infants receiving specific treatments or with specific conditions.
10 Although it is undeniable that nurses working in maternity hospitals have more
11 opportunities to attend academic lectures and conferences on maternal–infant healthcare
12 than do those who work in general hospitals, many respondents in both groups felt
13 ambiguous toward KC (e.g. for preterm infants with specific treatments and conditions)
14 because of the lack of formal KC training; therefore, there were clear gaps in their
15 knowledge and practical skills, which is covered in the next section.
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18 **Practice**

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20 As in another study²³, nurses were uncertain how to implement KC for infants with
21 intubation, under phototherapy, or with an umbilical line in situ. Almutairi's
22 quasi-experimental study indicated that nurses' knowledge and skills with KC improved
23 after continuing education²⁴. Specific KC education including simulation training for
24 neonatal nurses may increase their confidence in KC and promote its implementation.
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26 Although KC is a key intervention for newborn health, there has been limited
27 information available on KC practice in China, and parents and neonatal nurses generally
28 cannot practice it with confidence.
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31 **Barriers**

32 Our study identified barriers to KC implementation including lack of consistent
33 guidelines and standards, reluctance among medical staff to support KC due to safety fears,
34 and hospital policy of denying parents access to NICU. Seidman's systematic review²⁵
35 proposed that resource-related barriers (e.g. lack of guidelines/education) and sociocultural
36 barriers (e.g. concerns about medical conditions/care) negatively affected nurses; our study
37 supports these points. Further, other studies also proposed that lack of knowledge and skills
38 were main barriers to KC implementation^{23 26-29}, as well as medical staff reluctance to allow
39 KC^{10 28-30}. Resistance of medical staff is mainly associated with fear of harming infants and
40 lack of experience and specific education in KC. These might be reasons why KC has had
41 slow uptake in Chinese hospitals despite being a well-supported therapy.
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44 An inappropriate physical environment was another key barrier that we identified,
45 which was consistent with research from Eichel³¹ and Prato³⁰. Most NICUs in China do
46 not have sufficient space or nursing staff³² for parents to implement KC. Xin Zhang's
47 cross-sectional exploratory study³³ stated that a better nurse–patient ratio was the strongest
48 factor for a nurse's likelihood to implement KC in NICUs.
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51 Perhaps the biggest barrier to routine implementation of KC in China is the policy
52 limiting parental visitation, although visitation does not increase rates of nosocomial
53 infection, bronchopulmonary dysplasia, intraventricular haemorrhage, necrotizing
54 enterocolitis, or retinopathy of prematurity¹⁵. Blomqvist's study²⁸ in Sweden demonstrated
55 that lack of parental visitation also discouraged KC in NICUs there, as did Lee²⁷ in the US.
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3 Alongside these similarities, several differences on barriers were also observed
4 between our study and past research. In our study, respondents in the 'Not experienced in
5 KC' group but not the 'Experienced in KC' group perceived KC as a burden. Chia³⁴ found
6 that respondents in Australia expressed strong frustration with workloads and staffing levels,
7 which left them without time to facilitate KC. Another study, addressing KMC¹⁰, mentioned
8 cultural issues in India and financial problems as barriers; however, these items were not
9 investigated in our study. Namnabati³⁵ in Iran proposed that older, more experienced
10 physicians were more likely to implement KC in NICUs; by contrast, no age or general
11 experience factor was apparent in our study.
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14 15 **Perceptions**

16 Perceptions may be more essential than knowledge and practice for successful
17 implementation of KC in NICUs. Knowledge alone does not change practice' however,
18 perceptions strongly influence action. We found that nurses in the 'Experienced in KC'
19 group both held similar beliefs on the importance, advantages, and appropriateness of KC.
20 Misunderstandings about KC were apparent in the 'Not experienced in KC' group, likely
21 because nurses lacked formal or informal KC education. Although the nurses in the
22 'Experienced Group' had not had formal training in KC but had very likely had informal
23 training before they started implementation of KC in their NICUs. However, we do think
24 there should be a formal and standard training or education in KC across China. It would be
25 better for both groups to have more knowledge and practical skills on KC.
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28 Overall, many nurses in both groups agreed that KC promotes parent–baby attachment,
29 parental confidence, and infant health. However, concerns were raised about the deleterious
30 effects of environment on ability to implement KC, duration of KC, and nurses' workload.
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33 34 **Limitations**

35 A notable limitation of this study was that only neonatal nurses were surveyed, and
36 other healthcare professionals were excluded. We also did not gather information on
37 parents' perceptions of KC, a crucial factor if implementation of KC is to be successful.
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40 41 **Recommendations for Policy, Practice, Education, and Research**

42 The shift from a one- to a two-child policy and the wide use of assisted reproductive
43 technology in China have resulted in rapid increase in preterm birth in recent years. In this
44 situation, KC seems to be a convenient, economical, and effective method; it is highly
45 suitable for preterm as well as other infants. Based on our results, the following
46 recommendations are made for clinical practice in China:

- 47 - The limits on parental visitation in Chinese NICUs should be changed; visitation hours
48 should be extended to foster KC implementation.
- 49 - Hospitals should improve their environment, such as widening ward spaces and allocating
50 more staff, to promote the implementation of KC.
- 51 - Simulation training and interactive workshops on KC may be needed to improve nurses'
52 knowledge, skills, and confidence in the implementation of safe and effective KC with
53 preterm infants. Chinese guidelines for preterm birth and KC implementation should be
54 considered.
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3 - Only a few studies have been conducted on KC implementation in China. All NICU
4 nurses should be encouraged to closely monitor KC delivery to premature infants. Distinct
5 barriers can affect KC implementation in diverse ways (e.g. effect of different education
6 methods on nurses' knowledge of KC, implementation of KC, and outcomes of KC for
7 newborns).

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9 - Considerable research is needed to investigate the current application of KC and to clarify
10 perceptions and knowledge of KC among parents and medical staff in Chinese NICUs.
11

12 **Conclusion**

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14 This was the first study to describe the knowledge and perceptions of neonatal nurses
15 in China regarding KC. Substantial barriers included parent visitation policies and lack of
16 formal education for nurses on the benefits and applicability of KC. These barriers should
17 be addressed immediately if preterm infants and their families in China are to receive
18 routine, evidence-based, parent-centred care such as KC.
19

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21
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36 **Data Sharing Statement**

37 No additional unpublished data are available.
38

39 **Abbreviations and Symbols**

40 KC- Kangaroo Care

41 KMC-Kangaroo Mother Care

42 NICU- Neonatal Intensive Care Units

43 SSC- Intermittent Skin-to-Skin Care

44 KCQ- Kangaroo Care Questionnaire

45 KCS-Kangaroo Care Survey
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49 **Authors' Contribution**

50 The specific work of each author in this study was as follows:

51 Yao Zhang: Participation in the whole work; drafting of the article; data analysis

52 Qingqi Deng: Collecting data; translating the survey

53 Binghua Zhu: Data analysis

54 Qiufang Li: Implementing survey
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3 Fang Wang: Implementing survey
4 Hua Wang: Implementing survey
5 Xinfen Xu: Financial support; implementing survey
6 Linda Johnston: Perception and design; final approval of the version to be published.
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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	4
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	3
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4
		(b) Indicate number of participants with missing data for each variable of interest	4
Outcome data	15*	Report numbers of outcome events or summary measures	4
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4-5
		(b) Report category boundaries when continuous variables were categorized	4-5
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	4-5
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6-8
Generalisability	21	Discuss the generalisability (external validity) of the study results	6-8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	8-9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.