RESEARCH ARTICLE

Effects of kangaroo mother care (KMC) combined with infant touch on physical and neurological development in premature infants

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Abstract

Objective: To assess the effects of kangaroo mother care combined with infant touch on the physical and neurological development of premature infants.

Method: The randomised controlled trial was at the Maternity and Child Care Centre, Qinhuangdao, China, from January 2023 to January 2024, and comprised premature paediatric inpatients who were randomised into intervention group A and control group B. Those in group B were given routine neonatal intensive care unit care, and were provided with sufficient visual, tactile, auditory and vestibule stimulation and infant touch. Those in group A were additionally given kangaroo mother care. The indicators of physical development, complications during hospitalisation, and monitoring of neurological development were compared between the groups. Data was analysed using SPSS 22.

Results: Of the 100 patients, 50(50%) were in group A; 31(62%) boys and 19(38%) girls with mean gestational age 32.1±2.5 weeks. The other 50(50%) patients were in group B; 30(60%) boys and 20(40%) girls with mean gestational age 32.0±2.5 weeks (p>0.05). Post-intervention, body weight, length and head circumference in group A were higher than those in group B (p<0.05). Primitive reflex, passive muscular tension, behavioural ability, general reaction and active muscular tension in group A were all higher than those in group B (p<0.05). The incidence of complications during hospitalisation in group A were slightly lower compared to group B, but the difference was not statistically significant (p>0.05).

Conclusion: Kangaroo mother care combined with infant touch significantly improved physical and neurological parameters.

Keywords: Kangaroo mother care, Premature infant, Infant touch, Physical development, Neurodevelopment.

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Introduction

The birth rate of premature infants is on the increase in most countries and regions worldwide. The current number of premature infants in China ranks second in the world, and the incidence of premature births in China is about 7-8%.[1,2] As the birth rate of premature infants gradually increases, their survival rate also increases significantly, but their disability rate shows no significant decrease. Premature infants are prone to delayed growth and development and brain damage due to the immature development of the central nervous system, with cerebral palsy as a common complication. Kangaroo mother care (KMC) can improve the survival rate of premature infants, promote their growth and development, facilitate exclusive breastfeeding, and shorten the length of hospital stay (LOS), which have a positive effect in maintaining stable body temperature, reducing mortality of premature infants, improving neonatal cerebral blood flow, as well as promoting synapse formation in the nervous system, and the development of overall nervous system.[3-6] In addition, clinical observations have found that infant touch can promote the physical and neurological development of premature infants, improve immune function, reduce pain thresholds, decrease feeding intolerance and respiratory pauses, increase blood oxygen saturation, as well as help prevent hypoxic brain injury.[7,8] The current study was planned to assess the effects of KMC combined with infant touch on the physical and neurological development of premature infants.

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Patients and Methods

The randomised controlled trial (RCT) was conducted at the Maternity and Child Care Centre, Qinhuangdao, China, from January 2023 to January 2024, and comprised premature paediatric inpatients who were randomised into intervention group A and control group B. After approval from the institutional ethics review committee, the sample size was calculated based on expected mean weight gain difference between groups to be 200±300g[9] with α=0.05, β=0.20 and 10% dropout rate. During the study period, non-probabilistic continuous sampling method was adopted to screen all preterm infants. Those included were premature infants with a gestational age of 28-36+6 weeks, a birth weight of <2,500g, a post-birth 5-min Appearance-Pulse-Grimace-Activity-Respiration (APGAR) score of 8-10, and with stable vital signs. Those having birth weight <1,000g and chromosomal disorders, such as neonatal hypoxic-ischaemic encephalopathy, neonatal respiratory distress syndrome, severe intrauterine organ dysfunction and genetic metabolic diseases, congenital malformations, and trisomy 21 syndrome were excluded.

After taking informed consent from both parents of all the children, the subjects were randomised into intervention group A and control group B using computer-generated number tables. The allocation sequences of opaque and variable blocks were generated through SAS 9.4 PROC PLAN. And a sealed envelope system was used. Neonatal intensive care unit (NICU) nurses opened the envelopes in sequence to obtain the grouping information.

Due to the nature of KMC intervention, requiring active parental participation in skin contact, the parents were aware of the grouping, but were told to avoid communicating the details of the intervention with other subjects. The evaluators, however, were blinded to the grouping. These included neonatologists who did the neurodevelopmental assessment using the Neuro-Behavioural Neonatal Assessment (NBNA) tool.[10] This was done to reduce measurement bias. Likewise, statistical analysts were also blinded to the grouping, and they were handed the data under anonymous grouping codes.

During the nursing process, a monitor was used to constantly monitor vital signs. There was no noise in the environment, and the sound intensity was kept at <60dB. The room was dimly lit, and the room temperature was controlled at 22-24^{o}C with a relative humidity of 55-65%.

Group B controls were given routine NICU care. After birth, the newborns were put on sheets of cloth and wrapped immediately to keep them warm. Neonatal disease screening was conducted to exclude congenital metabolic diseases, and sufficient visual, tactile, auditory and vestibular stimulation, and infant touch was provided to the premature infants. The touch was generally performed 1h after feeding in the following order: face-chest-abdomen-limbs-back, 4-6 times each region, 10-15 min/time, 2 times/d. The touch intervention was continued until discharge, and also at home after discharge.

Those in intervention group A were additionally given KMC. Education on relevant nursing knowledge was provided to the parents of premature infants, including KMC steps and precautions during the nursing process. The growth and development of group A infants were evaluated by professional neonatologists to determine whether KMC could be performed. Prior to KMC, it was ensured that the condition of the premature infants was stable without respiratory problems, and they could maintain spontaneous breathing after being weaned off the ventilator. In addition, standby rescue equipment was ensured. After putting on diapers, the premature infants were placed prone on their mothers' naked chests with heads between bilateral breasts. Subsequently, the premature infants were secured in hospital-made kangaroo-type nursing clothes, allowing them to have intimate contact with their mothers in a comfortable position, 1h/time, 2 times/d. KMC was performed at a fixed time point and continued until discharge. After discharge, the mothers of the newborns were taught to continue KMC at home.

Neurodevelopmental assessment was conducted at 40 weeks corrected age using NBNA to evaluate the intervention's early effects. Subsequent developmental progress was monitored through standard clinical examinations rather than repeat NBNA testing.

Data was analysed using SPSS 22. Normally distributed measurement data was expressed as mean±standard deviation, and was compared between the groups using the independent sample t-test. Count data was expressed as frequencies and percentages, and inter-group comparisons were done using the chi-square test and Fisher's exact probability test. P<0.05 was considered statistically significant.

Results

Of the 100 patients, 50(50%) were in group A; 31(62%) boys and 19(38%) girls with mean gestational age 32.1±2.5 weeks. The other 50(50%) patients were in group B; 30(60%) boys and 20(40%) girls with mean gestational age 32.0±2.5 weeks. At baseline, there were no significant differences between the groups (p>0.05) (Table 1).

At 40 weeks corrected age, group A showed significantly greater improvements in weight, length and head circumference compared to group B (p<0.05) and these differences persisted at 3 months corrected age for all parameters (p<0.05) (Table 2).

The scores of general reaction, primitive reflex, passive muscular tension, behavioural ability and active muscular tension post-intervention in group A were higher than those in group B (p<0.05) (Table 3).

The incidence of complications during hospitalisation, such as sepsis, necrotising enterocolitis (NEC), periventricular leukomalacia (PVL), intraventricular haemorrhage (IVH) and bronchopulmonary dysplasia (BPD), in group A were

Table-1: Baseline characteristics (n=100).

Group	Gestational age (w)	Gender Male/Female	Weight (g)	Height (cm)	Head circumference (cm)	Causes of Prematurity (Spontaneous preterm labour/ Premature rupture of membranes/ Maternal complications/ Foetal indications)
Observation group	32.1±2.5	31/19	1587.30±476.26	42.16±2.26	30.91±2.25	31/12/5/2
Control group	32.0±2.5	30/20	1598.80±484.06	42.04±2.22	30.98±1.12	30/14/4/2
χ^2/*t*-test	0.341	0.040	0.120	0.255	0.325	0.392
p-value	*p*>0.05	*p*>0.05	*p*>0.05	*p*>0.05	*p*>0.05	*p*>0.05

Table-2: Intergroup comparison of physical development at a corrected gestational age of 40 weeks and 3 months.

Group	At a corrected gestational age of 40 weeks			At a corrected gestational age of 3 months		
	Body weight (g)	**Length** (cm)	**Head circumference** (cm)	**Body weight** (g)	**Length** (cm)	**Head circumference** (cm)
Observation group	3606.40±379.8	51.10±0.91	36.16±2.66	6550.20±374.32	60.67±1.38	41.61±0.65
Control group	3448.00±339.82	50.07±1.38	34.15±0.92	6174.40±378.61	59.32±1.41	40.17±0.87
t-test	2.20	4.40	5.05	4.99	4.85	9.36
p-value	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05

Table-3: Intergroup comparison of NBNA scores at a corrected gestational age of 40 weeks.

Group	General reaction	Primitive reflex	Active muscular tension	Passive muscular tension	Behavioural ability	Total score
Observation group	5.36±0.48	5,46±0.53	8.08±0.69	8.02±0.68	9.68±0.74	36.60±1.80
Control group	4.62±0.53	4.64±0.59	6.44±0.57	6.36±0.72	8.20±0.53	30.26±1.24
t-tesst	7.282	7.418	12.835	11.798	11.457	20.44
p-value	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05	*p*<0.05

Table-4: Intergroup comparison of complications during hospitalisation.

Group	Sepsis (n)	NEC (n)	PVL (n)	BPD (n)	Total cases
Observation group	5	6	8	11	30
Control group	6	7	8	13	34
χ^2	-	-	-	-	0.714
p-value	-	-	-	-	0.05

NEC: Necrotising enterocolitis, PVL: Periventricular leukomalacia, BPD: Bronchopulmonary dysplasia.

slightly lower compared to group B, but the difference was not statistically significant (*p*>0.05) (Table 4).

Discussion

According to the World Health Organisation (WHO), the global incidence of premature births is 5-18%, with an average of approximately 11.1%.[11] Premature infants generally have a low birth weight, immature development of various organs and functions in the body, and low immunity, so they are prone to various diseases, which increases their incidence and mortality rates.[12,13] Therefore, the growth and development of premature infants after birth, as well as the development of the nervous system, are very important. Touch intervention is a contact intervention implemented in touch and massage,[14,15] which can produce a series of physiological effects through touch, thus making newborns feel safe, reducing crying, improving sleep quality, and further promoting growth and development.[16-18] Neonatal neurobehavioral evaluation is beneficial for early intellectual development. By touching the newborn's skin orderly and skillfully, stimulation is transmitted through skin receptors to the central nervous system, which promotes neurological and growth development.

KMC is widely applied to neonatal care in obstetrics and gynaecology, which is easy to manage, and can easily receive support and cooperation from the mothers. It can be implemented at any time, and has achieved significant effects in clinical applications. Through standardised KMC procedures, nosocomial infections can be effectively prevented,[19] pulmonary ventilation can be improved, and the ventilator time for premature infants can be shortened.[20] With skin-to-skin contact, premature infants can maintain a constant body temperature and vital signs, which promotes their sleep, head circumference, body length, weight and intellectual development, further promoting their growth and development, enhancing their immunity and reducing mortality rates. KMC combined with infant touch ultimately increases neonatal contact, fully utilising the human sensory organs to stimulate different skin receptors, transmitting tactile stimulation to the brain, and gradually promoting neurological and intellectual development.[21]

In the present study, the body weight, length and head circumference of premature infants in the KMC group were all higher than those in the control group at a corrected gestational age of 40 weeks and 3 months, and the differences were statistically significant (p<0.05), indicating that KMC combined with infant touch could promote physical development of premature infants, which is consistent with the meta-analysis results of Kostandy RR et al.[22]

The scores of general reaction, primitive reflex, passive muscular tension, behavioural ability and active muscular tension in the current KMC group were all higher than those in the control group (p<0.05). The incidence of complications during hospitalisation, however, was not significantly different between the groups (p>0.05).

The current study has limitations, such as a small sample size and no long-term follow-up. Studies with larger sample size and longer follow-up duration are needed to validate the current findings. Another limitation is the single-time-point NBNA assessment at 40 weeks. While this captured the immediate intervention effects, future studies should include serial NBNA evaluations to document longitudinal neurodevelopmental trajectories.

Conclusion

KMC combined with infant touch promoted the physical growth of premature infants, improved neurological assessment scores, and ultimately had positive impact on intellectual and emotional-intellectual development. Besides, it contributed to a more intimate interpersonal relationship, thereby improving their long-term quality of life and reducing the impact of abnormal neurological behaviours.

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Conflict of Interest: None.

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Author Contribution:

HY & QD: Design and final approval. Huichan Yang and Qiuying Du are both considered as co-first authors.

HZ & MG: Data collection, analysis and final approval.

QY & YM: Writing and final approval.