

Study on the Impact of Developmental Care on the Growth, Development and Sleep Quality of Premature Infants

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Abstract: Objective: To explore the positive role of developmental care measures in promoting the growth and development of premature infants, and analyze their specific effects on improving the sleep duration and quality of premature infants. Methods: A total of 80 premature infants who met the inclusion criteria were selected by convenient sampling method and divided into an experimental group and a control group, with 40 cases in each group. The experimental group received comprehensive nursing intervention of developmental care during the nursing process; the control group adopted the traditional conventional nursing model. Results: There was no statistically significant difference in various physical indicators between the two groups of premature infants before nursing intervention. After nursing intervention, the scores of intellectual development level, psychomotor development index and various physical indicators of premature infants in the experimental group were significantly higher than those in the control group, and the difference was statistically significant. Conclusion: The implementation of developmental care for premature infants can significantly improve their various developmental indicators, which can not only effectively promote the rapid development of premature infants' mental and physical growth, but also improve their sleep quality.

Keywords: Premature infants; Developmental care; Growth and development of premature infants

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1. Introduction

Premature birth has always been a public health issue of great concern in the medical field. According to clinical statistics, the number of premature infants in China is about 1.2–1.5 million every year, with an incidence rate of 8–10%^[1]. Since China relaxed the two-child policy in 2015, the incidence rate of premature infants has shown a significant upward trend^[2]. Studies have found that the growth and development of premature infants are faced with various problems such as neonatal respiratory distress syndrome, neonatal pneumonia, and infection, and they also face difficulties such as neurological dysfunction and growth retardation in the later growth and development

process^[3]. Due to the practical difficulties of premature infants such as low survival rate and poor prognosis, the families of premature infants bear a heavy burden, which also has a certain impact on the social medical system. The developmental care nursing model is a nursing intervention system based on medical theories. The intervention and monitoring of premature infants based on developmental care will help the prognosis and later growth and development of premature infants. Exploring non-pharmacological intervention methods and treatment measures suitable for premature infants can play a positive role in reducing the incidence of complications and improving the prognosis for the growth and development of premature infants, and also provide a scientific basis for the overall care of premature infants.

2. Materials and methods

2.1. Research materials

2.1.1. Selection of subjects

A convenience sampling method was adopted in this study. Premature infants born between October 2023 and October 2024 (in chronological order of date of birth) and admitted to the Department of Obstetrics and Gynecology of a hospital in Baiyin City were selected as the research subjects. A total of 80 premature infants who met the study inclusion criteria were enrolled: the first 40 infants were assigned to the experimental group, and the remaining 40 to the control group.

The gestational age of premature infants in the control group was (30.35 ± 0.68) weeks; The gestational age of premature infants in the observation group was (30.32 ± 1.32) weeks. Statistical analysis was conducted on the two groups of data from the dimensions of mental state, physical condition, and sleep. The results showed no statistically significant differences between the two groups in these dimensions ($p = 0.92 > 0.05$, $p = 0.48 > 0.05$), indicating that the two groups had the same initial research conditions and baseline^[2]. To improve the quality of care for premature infants and prevent various infections, the infants in the two groups were managed by two separate teams of primary nurses, where nurses in both teams had the same professional titles, years of service, and nursing experience. Meanwhile, the premature infants were admitted to premature infant care units with identical hardware conditions but different ward numbers for nursing and care.

2.1.2. Inclusion criteria

- (1) Diagnostic criteria for premature infants: The research subjects must meet the medical diagnostic criteria for premature infants. Infants born before 37 weeks of gestation were selected, and all premature infants must be admitted to the hospital within 24 hours after birth to ensure timely medical intervention and observation.
- (2) Ethical approval and informed consent: Prior to the start of the study, the research was approved by the hospital's Ethics Committee to ensure that the study design and implementation complied with ethical standards. The guardians of the premature infants consented to their children's participation in the study and signed the informed consent form.
- (3) Apgar score of premature infants: The Apgar score of the premature infants at birth ranged from 7–10, meeting the basic conditions for participation in the study^[3].

2.1.3. Exclusion criteria

- (1) Congenital diseases or major malformations: Premature infants diagnosed with congenital diseases or major malformations were excluded from the study to avoid interfering with the accuracy of the research

results.

- (2) Genetic or metabolic diseases: Premature infants with genetic diseases or metabolic diseases were also excluded from the study.
- (3) Guardians' refusal to participate: If the guardians of the premature infants refused to participate in the study or chose to withdraw after being informed of the potential risks, the premature infant was excluded from the study.

2.2. Research methods

2.2.1. Research methodology

This study selected and included sample sizes based on the fetal birth time periods. The specific methods are as follows.

- (1) Basic information of premature infants. Researchers collected basic information of premature infants, including gestational age at birth, gender, height, weight, head circumference, body temperature, and more. Based on this information, the research subjects were divided into a control group and an experimental group. The control group received routine nursing measures, while the experimental group received developmental care nursing. Various physical and mental indicators of the premature infants in both groups were recorded respectively.
- (2) Formulation of nursing plans. The nursing plan for the experimental group covered feeding needs, medication time nursing, sleep patterns and habits and more. Responsible nurses were instructed to continuously record sleep logs for 14 days^[4]. Meanwhile, non-nutritive sucking was provided to the premature infants: 10 minutes before nasogastric feeding, a pacifier was placed in the infant's mouth, with 5–10 sessions per day and 10 minutes per session^[5]. During the nursing process, invasive operations were reduced, and the frequency of invasive operations was strictly controlled to minimize adverse stimuli to the infants. In the ward, efforts were made to reduce the volume of medical equipment, control the talking volume of medical staff, and minimize the impact of noise on the infants. When the infants were awake and calm, their heads, backs, and other parts were gently touched, and their abdomens were massaged to improve their comfort.
- (3) Data collection methods. Unified training was provided to the participating nurses. Responsible nurses recorded detailed data during the nursing process, and the data were archived in both paper and digital formats. Charge nurses scored the Psychomotor Development Index (PDI) and recorded the score of each indicator. Then, researchers uniformly summarized the scoring results to obtain statistical results for individual dimensions. Specifically, the results of individual dimensions such as muscle tone and primitive reflexes were recorded, and the sum of these results was used to obtain the Psychomotor Development Index. For the Mental Development Index (MDI), based on the Neonatal Behavioral Neurological Assessment (NBNA), scoring results such as arousal state, responses to sound and touch were recorded, and the statistical results for individual dimensions were obtained through summarization.

2.2.2. Observation indicators

In this study, the nursing conditions of the two groups of children were observed, and the results were recorded to obtain data such as the Mental Development Index, Psychomotor Development Index, head circumference index, weight index, and length index of the premature infants. At the same time, the sleep duration of the two groups of

children was recorded regularly during the study^[6]. In addition, the study analyzed the relationship between these indicators and sleep duration to evaluate the potential impact of sleep on children's development.

2.2.3. Statistical analysis method for result data

Before the experiment, normality test ($p > 0.05$) and homogeneity of variance test ($p > 0.05$) were first conducted on the collected data. The significance level of the tests was set at $\alpha = 0.05$ to ensure that the samples conformed to a normal distribution and met the requirement of homogeneity of variance. If the requirements were not met, the Wilcoxon signed-rank test was used. Then, the paired-samples t -test was used to detect intra-group differences, and the independent-samples t -test was used to analyze inter-group differences.

3. Results

By conducting a comparative analysis of the observation data from the two groups of children, significant differences were found between the experimental group and the control group in multiple developmental dimensions. After the intervention, the experimental group of infants showed significantly better performance than the control group in terms of sleep duration, body weight, head circumference index, psychomotor development index (PDI), and mental development index (MDI).

Before the intervention, there were no statistically significant differences between the two groups of premature infants in sleep duration, body length index, body weight, head circumference index, PDI, MDI, and other indicators ($p > 0.05$).

After the nursing intervention, the premature infants in the experimental group exhibited extremely significant improvements in mental development index (39.27 ± 0.42) and body weight gain (2499.72 ± 104.19) ($p < 0.001$), indicating that this nursing model can effectively support the neural and psychological development of premature infants. Although the difference in body length index between the two groups of premature infants did not reach a significant level ($p = 0.17 > 0.05$), both groups showed an upward trend.

The study found that the differences in the measurement results of each dimension before and after the intervention were statistically significant in both groups. Since the study data required multiple tests across multiple dimensions, the Bonferroni correction was used in the study^[7]. Except for the body length index, the other dimensions remained statistically significant after correction. The study used the magnitude of the reported effect size (Cohen's d) as the evaluation indicator (as shown in **Table 1**). Among the indicators, body weight, head circumference, and psychomotor development index suggested that the intervention had a large improvement effect on these indicators, with a strong effect ($d \geq 0.8$) and clear clinical significance. The mental development index showed a moderate improvement effect, with a moderate effect ($0.5 \leq d < 0.8$), which still has clinical value; while the body length index had a weak effect ($d < 0.5$).

Table 1. Comparison of various dimensions before and after intervention between the two groups of children

Indicator	Group	Before Intervention (Mean $\pm$ SD)	After Intervention (Mean $\pm$ SD)	Intragroup Difference (Before vs. After Intervention)	Intergroup <i>p</i> -value (Before Intervention)	Intergroup <i>p</i> -value (After Intervention)	Effect size (Cohen's <i>d</i>)
Sleep Time Index	Control	20.20 $\pm$ 1.58	17.6 $\pm$ 0.82	$t = 10.31, p < 0.001^{***}$	0.229	< 0.05	-0.62 (Medium Effect)
	Experimental	20.26 $\pm$ 1.69	16.64 $\pm$ 0.87	—, $p < 0.001^{***}$			
Body Length Index	Control	34.08 $\pm$ 0.79	34.94 $\pm$ 0.79	—, $p < 0.001^{***}$	0.457	0.07	0.23 (Weak Effect)
	Experimental	34.21 $\pm$ 0.67	35.23 $\pm$ 0.67	$t = -7.63, p < 0.001^{***}$			
Body weight	Control	2100.92 $\pm$ 98.36	2359.11 $\pm$ 111.54	$t = -10.81, p < 0.001^{***}$	0.387	< 0.001 ^{***}	0.84(Strong Effect)
	Experimental	2106.58 $\pm$ 155.76	2499.72 $\pm$ 104.19	$t = -14.81, p < 0.001^{***}$			
Head circumference Index	Control	28.30 $\pm$ 0.30	29.08 $\pm$ 0.33	$t = -10.8, p < 0.001^{***}$	0.393	< 0.001 ^{***}	0.85(Strong Effect)
	Experimental	28.32 $\pm$ 0.47	29.50 $\pm$ 0.31	$t = -15, p < 0.001^{***}$			
Psychomotor Development Index	Control	6.36 $\pm$ 0.54	9.69 $\pm$ 0.39	—, $p < 0.001^{***}$	0.724	< 0.001 ^{***}	1.05(Strong Effect)
	Experimental	6.54 $\pm$ 0.58	10.53 $\pm$ 0.23	—, $p < 0.001^{***}$			
Mental development Index	Control	29.82 $\pm$ 0.97	38.53 $\pm$ 0.42	— ^① , $p < 0.001^{***}$	0.828	< 0.001 ^{***}	0.67 (Medium Effect)
	Experimental	29.93 $\pm$ 0.54	39.27 $\pm$ 0.42	—, $p < 0.001^{***}$			

“①—” indicates the use of the Wilcoxon signed-rank test.

In addition, after the intervention, the sleep duration of the children in the experimental group (16.64 ± 0.87 hours) was significantly lower than that in the control group (17.6 ± 0.82 hours), indicating that the developmental care model can effectively improve the sleep quality of premature infants. However, the sleep duration of premature infants usually decreases gradually with growth and development, and this trend is similar to that of full-term infants. This is because as the gestational age and corrected age increase, the synaptic connections in the brain gradually improve, and the dependence on long-term sleep decreases, this is also a manifestation of the normal development of the nervous system. Since the sleep cycle of neonates is relatively short, the total sleep duration decreases as the month age increases^[8]. Therefore, low-birth-weight infants require more sleep to support growth, but as their weight reaches the standard, their sleep duration gradually approaches the normal range. Following this logic, the absolute value of the reported effect size (Cohen's *d*) was used as the evaluation indicator^[9]. The developmental care model had a moderate effect on the sleep quality of premature infants, and the reduction in sleep duration in the experimental group was more significant than that in the control group.

4. Conclusion

This study shows that the premature infants in the experimental group had significantly greater improvements in the Mental Development Index (MDI) and body weight compared with those in the control group, indicating that this nursing model can effectively promote the rapid development of premature infants' mental capacity

and physical fitness^[10]. Since the experimental group and the control group received the same nutritional intake during the clinical practice, there was no significant difference in the body length index between the two groups of newborns. However, in other dimensions, the performance of the experimental group was significantly better than that of the control group. The control group had no significant impact on the sleep activities of premature infants, so its effect on improving their sleep status was limited. This finding emphasizes the unique role of the developmental care model in promoting the healthy growth of premature infants. The study further proves that the developmental care model not only contributes to the rapid development of the nervous system and mental capacity but also effectively promotes the improvement of sleep behavior and related indicators.

Disclosure statement

The authors declare no conflict of interest.

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