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Factors Related to the Implementation of Developmental Care in the Neonatal Intensive Care Unit

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ABSTRACT
Environmental stressors in the Neonatal Intensive Care Unit (NICU), such as noise, lighting, and invasive treatments, can interfere with premature infants' physiological responses, behavior, development, sleep, and central nervous system organization. Therefore, this study aims to analyze the relationship between nurses' factors (age, work experience, education level, and training) and their implementation of developmental care in the NICU. This quantitative study used a correlational analysis method with a cross-sectional design. The sampling technique applied was consecutive sampling, involving 70 NICU nurses as respondents. The inclusion criteria required that participants be nurses who had worked in the NICU for a minimum of 6 months and expressed willingness to participate in the study. The exclusion criteria included nurses who were on medical leave or currently unwell. Data were collected through a nurse characteristics questionnaire and a developmental care application questionnaire. The data were then analyzed using bivariate analysis with the Pearson test and multivariate analysis through linear regression. The results showed a significant relationship between age ($p = 0.04$), length of work experience ($p = 0.03$), and training ($p < 0.0001$) with the implementation of developmental care. However, education level was not significantly related to developmental care implementation ($p = 0.873$). The factor most strongly associated with the implementation of developmental care was nurse training (highest correlation coefficient = 0.426). There is a significant relationship between age, work experience, and nurse training in the implementation of developmental care in NICU settings. Among these factors, training plays the most crucial role in boosting nurses' confidence in applying developmental care practices.

Keyword: Developmental Care, NICU, Nurse

1. Introduction

Prematurity remains the leading cause of mortality and morbidity among neonates in NICUs worldwide (Ahmed & Mohammed, 2019). According to 2022 data from the World Health Organization (WHO), premature birth is responsible for 60–80% of newborn deaths. In Indonesia, the prevalence of premature infant mortality is 28.2% (Kementerian Kesehatan, 2022). Premature infants are particularly vulnerable due to their underdeveloped physiological systems, necessitating specialized attention and intensive care within NICUs (Ahmed & Mohammed, 2019). Furthermore, Lee et al.'s research indicates that approximately 65% of infants in the NICU require such specialized care (Permanasari & Rustina, 2021).

The NICU environment is crucial for reducing mortality rates and supporting infant survival through the use of advanced technology and standardized care techniques (Héon et al., 2022). However, this environment can also present significant stressors, including excessive noise, bright lighting, and invasive procedures. These

factors can disrupt the physiological responses of infants, leading to pain, stress, and behavioral issues (Cassiano et al., 2023). Such stressors may also contribute to developmental delays, sleep disturbances, and disruptions in the organization of the central nervous system (El-Metwally & Medina, 2020). The long-term consequences of environmental stress in the NICU can be severe, encompassing conditions such as cerebral palsy, hearing loss, vision impairment, growth retardation, and developmental disorders. These outcomes affect 25% of these children by age two and 40% by age ten (Soleimani et al., 2020). To mitigate the adverse effects of excessive stimuli in NICUs, developmental care practices have been introduced as a key intervention.

Developmental care is a care approach designed to mitigate the negative impact of iatrogenic interventions on neonatal development within the intensive care setting (Lee & Cho, 2023). Its primary goals are to reduce stress, support healthy behavioral responses, promote physiological stability, maintain regular sleep patterns, and foster infants' neurological growth and maturation (Soleimani et al., 2020).

Nurses play a crucial role in delivering developmental care to premature infants in the NICU, making it an essential component of nursing practice in this environment. However, research by Mislashari et al. revealed that many nurses still lack awareness of developmental care practices when caring for premature infants (Mirlashari et al., 2019). Furthermore, Burrows (2020) noted that not all nurses are supportive of developmental care, as it can be time-consuming and challenging to implement in the NICU. Conversely, factors such as strong professional efficacy and a high sense of optimism have been shown to positively influence the implementation of developmental care (Park & Kim, 2019). Personal factors, including limited knowledge of developmental care, nurse-to-patient ratios, long shifts, educational level, and work experience, also impact its application (Zhang et al., 2016).

In the hospitals of the Bangka Belitung Islands Province, nursing care for premature infants currently focuses primarily on addressing physical and emergency needs, with limited attention given to developmental aspects. Additionally, there are no established procedures that prioritize developmental care as a strategy to reduce stress in the NICU. Given this gap, identifying the factors that influence the implementation of developmental care in the NICU is critical for improving outcomes for premature infants. Therefore, this study aims to analyze the relationship between nurses' personal factors (age, work experience, education level, and training) and their implementation of developmental care in the NICU.

2. Methods

This quantitative study employed a correlational, cross-sectional research design to examine the relationship between nurses' personal factors and their implementation of developmental care in the NICU. The independent variables included age, educational level, length of service, and training experience, while the dependent variable was the implementation of developmental care.

A total of 70 NICU nurses participated in this study, selected via consecutive sampling. The initial sample size was calculated to be 64 respondents, using Dahlan's (2014) formula for correlational analytical studies. To mitigate potential respondent attrition, the sample size was increased by 10%, resulting in a final sample of 70 participants. The consecutive sampling technique involved enrolling all subjects who met the inclusion criteria until the target sample size was achieved. The inclusion criteria stipulated that participating nurses must have a minimum of six months of work experience in the NICU and provide informed consent to participate.

Data collection commenced after obtaining ethical clearance and the necessary research permits. The researcher first secured permission from the head of each NICU. Subsequently, the purpose, benefits, and procedures of the study were explained to prospective participants. Each respondent was allotted 20 minutes to independently complete a questionnaire covering individual characteristics and the implementation of developmental care. The collected data were then analyzed using the Statistical Package for the Social Sciences (SPSS). The research was conducted in the NICU facilities of five hospitals on Bangka Island: Depati Hamzah Hospital, Dr. (H.C) Ir. Soekarno Hospital, Muhaya Mother and Child Hospital, Bakti Timah Hospital, and Depati Bahrin Regional Hospital.

The instruments utilized in this research comprised a personal factors questionnaire for the nurses (including age, length of work, education level, and training) and a developmental care application questionnaire. The latter was scored on a 5-point Likert scale, with responses such as 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always. The developmental care questionnaire was adapted from the study by (Permanasari & Rustina, 2021) and assessed the alignment of nurses' activities with four standard areas of developmental care. This instrument consisted of 52 questions, categorized as follows: individual infant care (17 questions, items 1-17), a supportive environment (10 questions, items 18-27), family-centered care (17 questions, items 28-44), and collaborative practices (8 questions, items 45-52).

A validity test of the developmental care questionnaire yielded values ranging from 0.501 to 0.775. As the corrected item-total correlation (r) for each item exceeded the critical r-table value of 0.3961, the questionnaire was deemed valid. Furthermore, a reliability test produced a Cronbach's Alpha coefficient of 0.967, indicating high internal consistency and reliability of the instrument.

Data analysis involved several statistical procedures. Bivariate analysis was conducted using the Pearson correlation test to examine the relationships between nurses' age, length of work, and the implementation of developmental care. An independent samples t-test was employed to investigate the relationships between education level, training, and the implementation of developmental care. Subsequently, multivariate analysis was performed using linear regression to identify the factor that most significantly influenced the implementation of developmental care.

Ethical approval for this study was granted by the Health Research Ethics Commission of 'Aisyiyah University of Yogyakarta (Approval Number: 3671/KEP-UNISA/V/2024), ensuring the protection and welfare of all respondents.

3. Results

The research findings are presented below. Table 1 details the characteristics of the respondents and provides a descriptive analysis of the implementation of developmental care in the NICU.

Table 1 Respondent characteristics and the implementation of developmental care

Characteristic	**Frequency**	**Percentage (%)**	**Mean (SD)**	**Median (Min-max)**
Education Level				
Vocational	43	61,4		
Professional	27	38,6		
Training				
Never attended training	40	57,1		
Have attended training	30	42,9		
Age			33,9 (5,84)	34 (24-47)
Length of Work			8,14 (4,96)	6 (1-20)
Implementation of Developmental Care			170,4 (22,79)	169 (102-208)

Table 1 indicates that among the 70 respondents, a majority of the nurses (61.4%) possessed a vocational education level. Furthermore, 42.9% of the nurses reported having attended training in developmental care. The mean age of the NICU nurses was 33.9 years, with a mean work experience of 8.14 years. The average score for the implementation of developmental care by nurses in the NICU was 170.4 (SD = 22.79).

Table 2 The Relationship between education level, nurse training, age, and length of work with the implementation of developmental care in the NICU

Variable	***Implementation of Developmental Care***		
	Mean (SD)	***R***	***P value***
Education Level			0,873
Vocational	170,72 (22,59)		
Professional	169,81 (16,52)		
Training			<0,001
Never attended training	162,03 (23,44)		
Have attended training	181,5 (16,52)		
Age		0,236	0,04
Length of Work		0,252	0,03

The findings presented in Table 2 reveal a statistically significant relationship between several variables and the implementation of developmental care. Specifically, age (p=0.04), length of work experience (p=0.03), and prior training (p<0.001) were all significantly associated with the implementation of developmental care. However, the level of education was not found to be significantly related to the implementation of developmental care (p=0.873).

In this study, variables with a p-value of less than 0.25, namely age (p=0.04), length of work (p=0.03), and training (p<0.001), were included in a multivariate analysis. The multivariate analysis was conducted using a linear regression test with the backward elimination method.

Table 3 Multivariate analysis test results for training, education, age, and length of work domains with the implementation of developmental care

Variable	B	Beta	*p-value*	T	R^2
(Constant)	133.33		<0.001		
Age	1.033	0.265	0.179	0.316	0.169
Length of Work	-0.771	-0.168	0.416	0.286	
Training	19.39	0.424	0.001	0.828	

Variables with a p-value > 0.05, namely length of work (p=0.416) and age (p=0.179), were excluded from the model due to their lack of a statistically significant association with the implementation of developmental care. These variables were removed sequentially, beginning with the variable with the highest p-value.

Table 4 Dominant factor related to the implementation of developmental care

Variable	B	Beta	*p-value*	T	R^2
(Constant)	162.025		<0.001		
Training	19.475	0.426	<0.001	1.000	0.169

Table 4 shows that training is the most dominant factor associated with the implementation of developmental care, exhibiting the highest standardized beta coefficient ($\beta = 0.426$, $p < 0.001$). The beta coefficient of 0.426 indicates a positive correlation, suggesting that more frequent participation in training by nurses is associated with a higher level of implementation of developmental care in the NICU.

4. Discussion

Developmental care is an independent and integrated nursing practice that supports the attachment between parents and infants by simulating the intrauterine environment as closely as possible to maintain physiological stability for optimal growth and development. Key interventions include family support, nutritional management, sleep management, and the minimization of pain, stress, and excessive sensory stimulation (Lee & Cho, 2023). One established model is the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), which is implemented by nurses in the NICU. The NIDCAP model emphasizes controlled environmental stimulation, parent-infant interaction, parental involvement in care, and the provision of breast milk (Klein et al., 2021). The implementation of developmental care in the present study encompasses four domains: individualized infant care, a developmentally supportive environment, family-centered care, and collaborative practices.

The average age of the nurses in this study was 34 years, and a significant relationship was found between nurse age and the implementation of developmental care in the NICU. The correlation coefficient of 0.236 indicates a weak, positive correlation, suggesting that older nurses tend to implement developmental care more effectively. This finding aligns with research by Armina et al. (2018), which also demonstrated a significant relationship between nurse age and the application of developmental care. Similarly, a study by Julianti et al. (2021) identified a correlation between the age of nurses and their care practices for premature infants in the NICU.

Nurses of a more advanced age and in their productive years are likely to possess greater experience, maturity, and a stronger sense of responsibility when providing care to premature infants. Furthermore, older nurses may have a broader perspective and exhibit greater openness to evolving care practices, such as developmental care, which can contribute to higher-quality service delivery. As nurses age, their attitudes towards practices like kangaroo mother care tend to improve in conjunction with their psychological maturation and evolving mindset. Correspondingly, skills and knowledge also tend to increase with age

(Adiana et al., 2021). Age can be a proxy for experience, influencing the range and basis of a nurse's actions and affecting the quality of their performance in delivering nursing care. Consequently, as nurses get older, their sense of responsibility towards their duties often increases due to their accumulated experience. The age range of 20–40 years is typically considered the peak period for physical development and the application of knowledge and skills (Furroidah et al., 2023).

The average length of service for nurses in the NICU is eight years. A positive correlation exists between the duration of a nurse's work experience and the effectiveness of their developmental care implementation. This study found a significant relationship between the length of nurses' employment and their application of developmental care in the NICU. These findings align with previous research by Julianti et al. (2021), which identified a similar correlation between work experience and the care of premature infants. Furthermore, Griffiths et al. (2024) confirmed that extended work experience substantially influences a nurse's ability to provide developmental care. Over time, nurses accumulate skills and knowledge, enhancing their capacity to care for premature babies. As noted by Furroidah et al. (2023), the longer nurses work, the more proficient they become in understanding the environmental conditions and the established work systems

The analysis also revealed a strong relationship between nurse training and the implementation of developmental care in the NICU. Practical training programs are essential for increasing nurses' confidence in applying developmental care to premature infants (Park & Kim, 2019). Research by Charafeddine et al. (2020), demonstrated that developmental care training positively impacts the skills of NICU nurses. Specifically, it improves their ability to reduce excessive stimulation, interpret infant behavior, manage developmental and sleep needs, prevent infection, provide appropriate nutrition, and manage pain (Talus et al., 2023). Training not only enhances nurses' competencies but also boosts their self-confidence in delivering developmental care (Suryandari et al., 2021).

Consistent with these findings, studies by Lee & Cho (2023) have shown that developmental care training programs lead to improved knowledge and practice among NICU nurses. To implement developmental care effectively, it is imperative that neonatal intensive care unit nurses possess a comprehensive understanding and sufficient knowledge in this area. The application of modern educational approaches, including both offline and online formats, can help nurses improve their skills and knowledge. Consequently, nurses must acquire adequate knowledge and understanding through training to provide high-quality care and facilitate the discharge of infants with minimal complications (Jalali et al., 2022).

The majority of nurses in the perinatology unit held a vocational education (D3 Nursing), which satisfies the minimum staffing requirements. The analysis revealed no significant difference between the educational levels of the nurses, a finding consistent with research by Park & Kim (2019), which also found no correlation between a nurse's level of education and the implementation of developmental care in the NICU. Consequently, nurses with both vocational and professional education share equal responsibility for providing care to premature infants.

Several key factors influence the implementation of developmental care, including professional efficacy, nurses' perceptions of its importance, and a task-oriented organizational culture. High professional effectiveness and a strong sense of optimism regarding their abilities positively impact nurses' performance. However, while many nurses recognize the importance of developmental care, not all consistently engage in its practices (Kim & Shin, 2014). Furthermore, the organizational culture, defined by its norms and role expectations, plays a significant role. A task-oriented culture, in particular, has been shown to support developmental care practices in NICUs (Park & Kim, 2019). Therefore, effective management and hospital administration are crucial for fostering an organizational culture that promotes nurses' well-being and enhances healthcare delivery (Yuyun et al., 2024).

The most significant factor influencing the implementation of developmental care in the NICU was identified as nurse training, which demonstrated the highest correlation coefficient (0.426). This finding aligns with research by Hong & Son (2020), which emphasizes the necessity of systematic developmental care training for NICU nurses. Such training enhances their perceptions of care and provides the necessary support within the work environment to improve performance. Training not only promotes neuroprotection and increases self-confidence but also enhances skills and peer interactions (Suryandari et al., 2021).

Improved nursing skills directly influence practices in the NICU and positively impact professional performance. According to Sathish et al. (2019), developmental care training programs boost nurses' knowledge and ability to minimize environmental stressors, involve families, optimize positioning, reduce stress and pain, maintain sleep, and improve nutrition for premature babies. By increasing knowledge through training, nurses' perceptions of developmental care improve, which in turn supports better implementation in the NICU setting (Hong & Son, 2020). Ultimately, the integration of individualized developmental care

practices into the planning, implementation, and evaluation of care for preterm or high-risk newborns will contribute to the holistic and systematic care of infants and reduce inconsistencies in practice (Incekar et al., 2024)

5. Conclusion

The study concludes that a significant relationship exists between nurses' age, length of service, and training, and the implementation of developmental care in the NICU. Among these variables, nurse training was identified as the most influential factor. It plays a crucial role in enhancing the confidence and skills of nurses, which in turn improves the quality of developmental care provided and overall nursing performance in the NICU.

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