Missed nursing care and its influencing factors among neonatal intensive care unit nurses in South Korea: a descriptive study

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Purpose: Preventing missed care is important in neonatal intensive care units (NICUs) due to neonates' vulnerabilities. This study examined missed care and its influencing factors among NICU nurses. **Methods:** Missed care among 120 Korean NICU nurses was measured using a cross-culturally adapted online questionnaire. The frequency of missed care for 32 nursing activities and the significance of 23 reasons for missed care were collected. **Results:** All participants had missed at least 1 activity, missing on average 19.35 activities during a typical work-day. The most common missed item was "provide developmental care for the baby". The most common reason for missed care was "emergency within the unit or deterioration of one of the assigned patients". The final regression model explained 9.6% of variance in missed care. The average daily number of assigned patients receiving inotropes or sedation over the last month influenced the total number of missed care items. **Conclusion:** Missed care was affected by nurses' workload related to the number of patients taking medication. Frequently missed activities, especially those related to developmental care, require patience and time, conflicting with safety prioritization and inadequate working conditions. NICU nurses' working conditions should be improved to ensure adequate time for nursing activities.

Key words: Nursing care; Neonatal intensive care unit; Safety; Workload; Time management

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INTRODUCTION

Patient safety is an issue of the utmost importance for nurses. To ensure patient safety, nursing care quality, which is positively correlated with patient safety, must constantly be improved. Nursing care quality may in part be measured through missed nursing care [1], which refers to the commonly encountered phenomenon of nurses omitting or delaying a necessary part of their work [2].

Missed care may ultimately lead to decreased patient satisfaction, increased medication errors, and patient readmission [3]. Prevention of missed care is especially important in the neonatal intensive care unit (NICU) since neonates are extremely vulnerable to lapses in safety. They cannot verbally express their symptoms, and their condition can deteriorate rapidly under insufficient surveillance [4]. Therefore, accumulated incidents of missed care can have a detrimental impact on an infant's growth and development in the long term [4]. For example, delayed oral feedings have been linked to longer hospital stays [5]. Even missed comfort activities may undermine the social-emotional development of extremely preterm infants [6]. Thus, to ensure a high degree of nursing quality for infants, missed care must not be tolerated in the NICU.

Research on missed care inside the NICU is needed since it is the first step required to strengthen safety within the NICU. Research on missed care in the NICU may function as a probing mechanism and as a summary report of which NICU practices most require intervention [7]. For example, if oral feedings are missed more often compared to other activities inside the NICU, a follow-up study could be conducted to confirm the mechanisms and solutions related to delayed oral

feedings.

Multiple international studies have examined missed nursing care in the NICU. Studies measuring the overall prevalence of missed care found that 36% to 52% of pediatric and neonatal nurses missed at least one nursing task during their most recent shift [8-10]. Studies on the frequency of missing individual items have shown that infant comfort care was among the most commonly missed types of care compared to other nursing tasks [11]. In the existing body of literature in Korea, studies on missed care have been conducted mostly in adult settings [12,13]. Studies conducted in the NICU have focused on individual activities, such as developmental care, outside the comprehensive context of other NICU activities [14,15].

Existing studies have demonstrated that the types of missed tasks and their frequency can vary across countries according to differences in organizational factors, nursing education programs, and nurses' average length of clinical experience [16]. This implies that the results of an analysis of missed care can be contingent on the specific traits of Korean nurses, such as having less break time and a higher nurse-to-patient ratio [17-19], both of which are significant antecedents to missed nursing care [13,20]. Therefore, this study aimed to investigate missed care in Korean NICUs.

The purpose of this study was to conduct a cross-sectional analysis of the current state of missed nursing care and its influencing factors among Korean NICU nurses. The specific aims of this study were to examine the following among Korean NICU nurses: 1) the frequency of missed nursing care for 32 individual nursing activities, 2) the significance of 23 reasons for missed nursing care, 3) the overall frequency of missed nursing care, and 4) the factors that influenced the overall frequency of missed nursing care.

METHODS

Ethics statement: This study was approved by the institutional review board of Seoul National University (No. 2105/003-013). Informed consent was obtained from the participants.

1. Study Design

This descriptive study investigated the current state of missed nursing care among Korean NICU nurses and factors that influenced missed nursing care.

2. Setting and Samples

The target population of this study was NICU nurses in Korea. The inclusion criteria were (a) being a registered nurse currently working in an NICU in Korea, (b) having a minimum of 1 year of clinical experience, and (c) being a legal adult over 18 years of age. The exclusion criterion was that participants could not be head nurses, educating nurses, or trainee nurses since they do not provide direct nursing care.

The sample size was obtained using G*Power 3.1.9.6.[21]. Given multiple linear regression, an α-value of .05, a power of 80%, a conventional medium effect size of .15, and eight predictors (total clinical experience, NICU experience, number of hospital beds, average daily number of assigned patients over the last month, average daily number of assigned patients on ventilator care over the last month, average daily number of assigned patients receiving inotropes or sedation over the last month, average birth weight of daily assigned patients over the last month, and average gestational age of daily assigned patients over the last month), the a priori sample size was calculated to be 109 participants. Given an expected incomplete response rate of 10%, 120 participants were recruited. Among the 120 sets of questionnaires that were distributed to the participants, 118 were used in the analysis. Two sets of responses were eliminated since the clinical experience of these participants did not fulfill the inclusion criterion requiring at least 1 year of clinical experience. Post hoc power analysis was conducted to assess the appropriateness of the actual collected sample size (N=118). The power was .81 (effect size f^2=.086; calculated by $f^2=R^2/(1-R^2)$, where R^2=.079).

3. Ethical Considerations

This research was approved by the institutional review board of the researchers' affiliated institution (No. 2105/003-013). It was clearly stated that participation was not mandatory even if one received the survey link from a close acquaintance. The anonymity of the participants was guaranteed by transcribing all data using codes.

4. Measurements and Instruments

1) Demographic variables

The questionnaire included basic demographic variables. It also included items that could reflect participants' nursing workload, including the average daily number of assigned patients over the last month, the average daily number of assigned patients on ventilator care over the last month, the average daily number of assigned patients receiving inotropes or sedation over the last month, the average birth weight of daily assigned patients over the last month, and the average gestational age of daily assigned patients over the last month.

2) Missed care

Tubbs-Cooley et al.[8] created the Survey Developed to Assess the Frequency of and Reasons for Missed Nursing Care in Neonatal Intensive Care Units (MCNICU) based on an instrument by Kalisch and Williams [22] that measures missed nursing care in adult inpatient settings(MISSCARE survey). The Cronbach's α value of the MISSCARE survey was .70 to .85 for the 3 factors revealed in factor analysis [22].

The MCNICU by Tubbs-Cooley et al. [8] consists of part A (35 items) and part B (24 items). The current study used a translated and cross-culturally adapted Korean version of the MCNICU (MCNICU-K) to measure missed care. The cross-cultural adaptation process was undertaken with permission from the author of the original survey, adhering to the steps of published guidelines, including forward translation, synthesis of translations, backward translation, feedback and equivalence testing, and pre-testing and expert committee review [23]. During this process, equivalence between the original and back-translated versions was achieved, and the validity of the translated instrument was confirmed by a panel of experts (consisting of an NICU head nurse, an NICU educating nurse, and eight NICU staff nurses with a wide range of clinical experience). In this study, the Cronbach's α values for the MCNICU-K overall, part A, and part B were .93, .91, and .94, respectively.

Some items were modified during the translation process to accurately reflect the cultural characteristics of Korean NICUs. Two items from part A ("attendance at daily rounds," "code readiness data assessed once per shift or per protocol") and one item from part B ("nursing assistant did not communicate that care was not provided") were deleted, as these items had low relevance to staff nurses' duties in Korean NICUs. In addition, two items from part A ("preparation for discharge" and "education on home management of illnesses") were merged into one item ("provide detailed home nursing care education for parents upon discharge/transfer") since the content of these items overlapped in actual clinical practice. As a result, 32 items were included in part A and 23 items were included in part B of the MCNICU-K.

The item-level content validity index for all items of the MCNICU-K was .80 or higher. This exceeded the minimum level of .78 suggested by Polit et al.[24]. The scale-level content validity index based on the averaging calculation method of the MCNICU-K was .96. This exceeded the minimum level of .90, which was also suggested by Polit et al.[24].

The participants were instructed to give responses based on their own clinical activities during a typical day at work. Part A measured the frequency of missing 32 necessary nursing care items and included responses of "never missed", "rarely missed", "occasionally missed", or "frequently missed". These responses were first scored on a scale of 1 to 4, which was used to calculate the mean Likert score for each item. The items were then dichotomized and coded with binary values based on the analysis methods of previous studies [20]. Items that were missed at least once (rarely missed to frequently missed) were coded as 1, and items that were never missed were coded as 0. The individual frequency of missed care for each item was ranked based on binary coding. The overall frequency of missed care was calculated by counting the total number of missed care items (items coded as 1) for each participant.

Part B measured the reasons for missed nursing care across 23 items, rated as "no impact", "small impact", "considerable impact", or "very large impact". The responses were first scored from 1 to 4 to calculate the mean Likert score of each item. To rank the items, the responses were dichotomized as either significant (small impact to very large impact) or insignificant.

5. Data Collection and Research Procedures

Data collection lasted for 10 days, from May 21 to June 1, 2021. Data were collected using the snowballing method of convenience sampling. Google survey links (https://forms.gle/5YVzqFSEtb1oP9gh8) were first distributed by the researcher to 15 NICU nurses who worked in various regions of South Korea.

The initial participants read a recruitment letter that was sent with the survey link, and those who were willing to participate accessed the link to complete the questionnaires. Upon completion of the survey, the initial participants shared the survey link with other NICU nurses among their acquaintances, thus achieving a snowballing effect. Online recruitment was discontinued as soon as the survey number reached 120.

Incentives were provided to the participants in appreciation of their participation.

6. Data Analysis

Analysis was conducted using SPSS 25.0 for Windows (IBM Corp., Armonk, NY, USA). Results were considered statistically significant at a level of $p < .050$. First, the demographic characteristics of the sample were examined using descriptive statistics. Missed care was analyzed in three respects: 1) the frequency of missed nursing care for 32 individual nursing activities, 2) the significance of 23 reasons for missed nursing care, and 3) the overall frequency of missed nursing care (percentage of nurses who missed at least 1 task and the average of the total number of missed care items). Second, the t-test and one-way analysis of variance (ANOVA) was conducted between the total number of missed care items and each of the demographic characteristics. The Levene test was

used to determine the equality of variance between the subgroups of each demographic variable. Third, multiple regression analysis (using the enter method) was conducted to determine which of the significant variables from the t-test and ANOVA significantly influenced the total number of missed care items.

RESULTS

1. Characteristics of the Participants

The participants' characteristics are shown in Table 1. The average age of the sample was 28.5 years (standard deviation [SD]=4.7 years). The average length of clinical experience in the NICU was 57.8 months (4.8 years), with a wide range (SD=42.9 months) from a minimum of 12 months (1 year) to a maximum of 261 months (21.8 years). A total of 92.6% of participants had been assigned an average of three or more patients in a single shift during the last month (mean=3.38, SD=.80). They also looked after an average of 1.51 ventilated patients (SD=.78) and 1.2 patients receiving inotropes or sedation (SD=.79) per shift during the past month.

2. Individual Frequencies of Missed Nursing Care

Table 2 shows the frequency of missed individual care items in order of missed frequency (the total rate of responses ranging from rarely missed to frequently missed). The most frequently missed care item was "provide developmental care for the baby", which was missed by 93.2% of nurses. This was followed by "provide emotional support for guardians or family members"(88.1%), "relay all important information about the baby during handover"(86.4%), "have parents participate in the baby's care"(83.1%), and "perform hand hygiene during the 5 moments of hand hygiene"(82.2%).

The least frequently missed care items were "routinely monitor input/output as prescribed"(23.7%), "assess vital signs every 4 hours or as prescribed"(27.1%), "carry out prescribed tests/gather necessary samples"(29.6%), "apply oxygen or adjust oxygen concentration as prescribed"(33.1%), "bathe the baby"(33.9%), and "provide feedings at prescribed intervals"(33.9%).

3. Significance of Reasons for Missed Nursing Care

Table 3 shows the reasons for missed nursing care in order of their impact (the total rate of responses ranging from small to very large impact). All participants (100.0%) replied that "emergency within the unit or deterioration of one of the assigned patients" and "various interruptions during work" were small, considerable, or very large reasons for missed nursing care. The next most-cited items were "shortage of nurses" (99.1%), "too many admissions or discharges" (99.1%), and "increase in the number of patients" (98.3%).

4. Overall Frequency of Missed Nursing Care According to Demographic Characteristics

All participants missed at least one nursing activity during work. The average total number of missed care items was 19.35 items out of 32, with a range of 1 to 32 items. Table 4 shows the results of the t-test and one-way ANOVA, which were conducted to determine whether the total number of missed care items differed according to any of the 12 demographic characteristics collected in this study (gender was excluded from the analysis due to the extreme distribution of participants between subgroups). Only two variables were related to the total number of missed care items: the number of hospital beds (t=2.03, p=.045) and the average daily number of assigned patients receiving inotropes or sedation over the last month (t=2.07, p=.040). Meanwhile, the average daily number of assigned patients on ventilator care over the last month (t=0.39, p=.695) did not have a significant influence on missed nursing care.

5. Influencing Factors Related to the Overall Frequency of Missed Nursing Care

Multiple regression analysis (using the enter method) was conducted to determine which of the significant variables from the t-test and ANOVA influenced the total number of missed care items. Table 5 shows the parameters of the resulting regression model. This model explained 9.6% of variance in missed nursing care (the total number of missed care items)(R^2=.096, F=5.66, p=.005). The average daily number of assigned patients receiving inotropes or sedation over the last month (β=.26, p=.006) was the only significant influencing factor related to the total number of missed care items. The number of hospital beds (β=.12, p=.195) was not a significant influencing factor.

Multicollinearity was excluded by confirming the model's tolerance (.96), variance inflation factor (1.04), and condition index (1.00-8.42). In addition, the Durbin-Watson statistic (2.22) showed that there was no autocorrelation within the model. As another method for assessing the fit of the regression model, the assumptions of multiple regression (normality and homoscedasticity of residuals) were tested. The normality of the residuals was contradicted by the Shapiro-Wilk test (z=.97, p=.012), while the homoscedasticity of the residuals was confirmed by the Breusch-Pagan test (F=0.28, p=.756).

Table 1. Demographic Characteristics of the Participants (*N*=118)

Characteristics	Categories	n (%)	M±SD	Min-Max
Age (year)	$20-29$ $30-39$ ≥ 40	84 (71.2) 30 (25.4) 4 (3.4)	28.5±4.7	
Gender	Female Male	117 (99.2) 1 (0.8)	–	
Marital status	Not married Married	95 (80.5) 23 (19.5)	–	
Education	College Graduate school	109 (92.4) 9 (7.6)	–	
Monthly income (1,000,000 KRW)	$2.0-2.9$ $3.0-3.9$ $4.0-4.9$ ≥ 5.0	10 (8.5) 97 (82.2) 7 (5.9) 4 (3.4)	–	
Number of hospital beds	≤ 9 $10-19$ $20-29$ ≥ 30	3 (2.5) 30 (25.4) 10 (8.5) 75 (63.6)	–	
Total clinical experience (month)	$12-35$ $36-59$ $60-83$ ≥ 84	29 (24.6) 37 (31.4) 30 (25.4) 22 (18.6)	64.2±54.1	12-360
NICU experience (month)	$12-35$ $36-59$ $60-83$ ≥ 84	34 (28.8) 40 (33.9) 23 (19.5) 21 (17.8)	57.8±42.9	12-261
Number of assigned patients* (n=108) [†]	2 3 4 5 6	8 (7.4) 57 (52.8) 31 (28.7) 11 (10.2) 1 (0.9)	3.38±0.80	
Number of assigned patients on ventilator care* (n=106) [†]	0 1 2 3 4	6 (5.7) 48 (45.2) 40 (37.8) 11 (10.4) 1 (0.9)	1.51±0.78	
Number of assigned patients receiving inotropes or sedation* (n=110) [†]	0 1 2 3	15 (13.6) 60 (54.6) 25 (22.7) 10 (9.1)	1.20±0.79	
GA of assigned patients (week[+day])*	<30 $30-34^{+6}$ $35-37^{+6}$ ≥ 38	27 (22.9) 72 (61.0) 16 (13.6) 3 (2.5)	–	
Birth weight of assigned patients (kg)*	<0.75 $0.75-0.99$ $1.00-1.24$ ≥ 1.25	8 (6.7) 32 (27.1) 39 (33.1) 39 (33.1)	–	

*Average number over the last month; [†]Missing values were excluded; GA, gestational age; KRW, Korean won; NICU, neonatal intensive care unit.

Table 2. Frequencies of Missed Individual Nursing Care Items (*N*=118)

Items	Response				
	Sum			Never	M±SD
	Frequently	Occasionally	Rarely		
	n (%)	n (%)	n (%)	n (%)	
Provide developmental care for the baby	18 (15.3)	110 (93.2) 51 (43.2)	41 (34.7)	8 (6.8)	2.67±0.82
Provide emotional support for guardians or family members	13 (11.0)	104 (88.1) 49 (41.5)	42 (35.6)	14 (11.9)	2.52±0.85
Relay all important information about the baby during handover	2 (1.7)	102 (86.4) 34 (28.8)	66 (55.9)	16 (13.6)	2.19±0.68
Have parents participate in the baby's care	18 (15.3)	98 (83.1) 29 (24.6)	51 (43.2)	20 (16.9)	2.38±0.94
Perform hand hygiene during the 5 moments of hand hygiene	3 (2.6)	97 (82.2) 32 (27.1)	62 (52.5)	21 (17.8)	2.14±0.73
Complete documentation of provided nursing care within working hours	9 (7.6)	93 (78.8) 42 (35.6)	42 (35.6)	25 (21.2)	2.30±0.89
Provide oral care for babies	32 (27.1)	92 (78.0) 33 (28.0)	27 (22.9)	26 (22.0)	2.60±1.11
Adhere to standard precautions for infection control	4 (3.4)	92 (78.0) 34 (28.8)	54 (45.8)	26 (22.0)	2.14±0.79
Provide pain care using pharmaceutical or non-pharmaceutical methods	1 (0.8)	87 (73.7) 23 (19.5)	63 (53.4)	31 (26.3)	1.95±0.70
Always provide oral feeding as much as possible for babies who can tolerate oral feeding	0 (0.0)	85 (72.0) 30 (25.4)	55 (46.6)	33 (28.0)	1.97±0.73
Reassess the baby when follow-up is necessary	0 (0.0)	80 (67.8) 10 (8.5)	70 (59.3)	38 (32.2)	1.76±0.60
Provide detailed home nursing care education for parents upon discharge/transfer	1 (0.8)	78 (66.1) 17 (14.4)	60 (50.9)	40 (33.9)	1.82±0.70
Assess the effects of medications within 30–60 minutes of administration*	0 (0.0)	78 (66.1) 16 (13.6)	62 (52.5)	40 (33.9)	1.80±0.66
Assess/reassess pain according to unit protocol	7 (5.9)	76 (64.4) 23 (19.5)	46 (39.0)	42 (35.6)	1.96±0.89
Administer medications within 30 minutes of scheduled time	0 (0.0)	75 (63.6) 19 (16.1)	56 (47.5)	43 (36.4)	1.80±0.70
Assess the baby's skin and manage wounds according to unit protocol or as needed	0 (0.0)	75 (63.6) 19 (16.1)	56 (47.5)	43 (36.4)	1.80±0.70
Assess and disinfect/dress peripheral line insertion sites according to unit protocol	0 (0.0)	71 (60.2) 17 (14.4)	54 (45.8)	47 (39.8)	1.75±0.69
Accurately check medical devices and medications connected to the baby when duty starts	0 (0.0)	71 (60.2) 15 (12.7)	56 (47.5)	47 (39.8)	1.73±0.68
Promptly respond to alarms	0 (0.0)	71 (60.2) 12 (10.2)	59 (50.0)	47 (39.8)	1.70±0.65
Perform general physical assessment every 4 hours or as prescribed	0 (0.0)	69 (58.5) 21 (17.8)	48 (40.7)	49 (41.5)	1.76±0.74

*e.g. inotropes, sedation, prostaglandins, ibuprofen; I/O, input and output; PRN, pro re nata.

Table 2. Frequencies of Missed Individual Nursing Care Items (continued) (*N*=118)

Items	Response				M±SD
	Sum			Never	
	Frequently	Occasionally	Rarely		
	n (%)	n (%)	n (%)	n (%)	
Assess and disinfect/dress central line insertion sites according to unit protocol	0 (0.0)	68 (57.6) 12 (10.2)	56 (47.4)	50 (42.4)	1.68±0.65
Always adhere to the 5 rights of medication administration	0 (0.0)	66 (55.9) 9 (7.6)	57 (48.3)	52 (44.1)	1.64±0.62
Change the baby's position every 2–4 hours	0 (0.0)	63 (53.4) 14 (11.9)	49 (41.5)	55 (46.6)	1.65±0.68
Share with the doctoral team important test results, vital signs, etc.	1 (0.8)	60 (50.8) 4 (3.4)	55 (46.6)	58 (49.2)	1.56±0.61
Administer PRN medications as prescribed	1 (0.8)	55 (46.6) 5 (4.3)	49 (41.5)	63 (53.4)	1.53±0.62
Co-sign or check high-risk medications according to protocol	1 (0.8)	53 (44.9) 12 (10.2)	40 (33.9)	65 (55.1)	1.57±0.71
Bathe the baby	0 (0.0)	40 (33.9) 12 (10.2)	28 (23.7)	78 (66.1)	1.44±0.67
Provide feedings at prescribed intervals	0 (0.0)	40 (33.9) 5 (4.2)	35 (29.7)	78 (66.1)	1.38±0.57
Apply oxygen or adjust oxygen concentration as prescribed	0 (0.0)	39 (33.1) 10 (8.5)	29 (24.6)	79 (66.9)	1.42±0.65
Carry out prescribed tests/gather necessary samples	0 (0.0)	35 (29.6) 1 (0.8)	34 (28.8)	83 (70.4)	1.31±0.48
Assess vital signs every 4 hours or as prescribed	0 (0.0)	32 (27.1) 4 (3.4)	28 (23.7)	86 (72.9)	1.31±0.53
Routinely monitor I/O as prescribed	0 (0.0)	28 (23.7) 2 (1.7)	26 (22.0)	90 (76.3)	1.25±0.48

*e.g. inotropes, sedation, prostaglandins, ibuprofen; I/O, input and output; PRN, pro re nata.

DISCUSSION

In nursing, because the total work time is fixed, more time spent on a single activity means there is less time for other activities. Thus, nurses prioritize direct care and safety-related care over less urgent care-related tasks [16,25]. Accordingly, in this study, as well as in existing studies [8,12,20], the least frequent missed care items were related to patient safety ("routinely monitor input/output as prescribed", "assess vital signs every 4 hours or as prescribed", and "carry out prescribed tests/gather necessary samples"). In other words, the frequently missed items in this study ("provide developmental care for the baby", "provide emotional support for guardians or family members", and "relay all important information about the baby during handover") may have been items that were viewed by nurses as time-consuming and less urgent in terms of patient safety, for which

reason they were considered to be low-priority [16,25].

In this study, "provide developmental care for the baby" was missed more frequently than any other NICU activity. Developmentally supportive care is central to neonatal nursing, embodying the ideals of caregiving such as enhancing infant comfort, reducing care-related trauma, and providing care that is contingent on the infant's sleep-wake state [7]. These infant-centered strategies require patience and time. Thus, in the fast-paced reality of the clinical nursing field characterized by the prioritization of safety, a lack of time, and inadequate working conditions [14,15], NICU nurses may feel developmental care to be laborious [26].

Most investigations on developmental care suggest education targeting nurses' knowledge, attitudes, and perceptions about developmental care as a solution [14,15]. However, education is necessary when nurses' levels of knowledge and perception are low. The fact that developmental care was the

Table 3. Impact of Reasons for Missed Nursing Care (*N*=118)

Items	Response				M±SD
	Sum			None	
	Very large	Considerable	Small		
	n (%)	n (%)	n (%)	n (%)	
Emergency within the unit or deterioration of one of the assigned patients	64 (54.2)	118 (100.0) 44 (37.3)	10 (8.5)	0 (0.0)	3.46±0.65
Various interruptions during work	31 (26.3)	118 (100.0) 50 (42.4)	37 (31.3)	0 (0.0)	2.95±0.76
Shortage of nurses	54 (45.8)	117 (99.1) 43 (36.4)	20 (16.9)	1 (0.9)	3.27±0.77
Too many admissions or discharges	30 (25.4)	117 (99.1) 60 (50.8)	27 (22.9)	1 (0.9)	3.01±0.72
Increase in the number of patients (excess admissions)/ or overall severity within unit	57 (48.3)	116 (98.3) 48 (40.7)	11 (9.3)	2 (1.7)	3.36±0.72
Conflict or communication errors with the doctoral team	30 (25.4)	114 (96.6) 49 (41.5)	35 (29.7)	4 (3.4)	2.89±0.83
Imbalance of patient assignments according to workload	23 (19.5)	112 (94.9) 51 (43.2)	38 (32.2)	6 (5.1)	2.77±0.82
Lack of help from coworkers in the same duty	15 (12.7)	111 (94.1) 48 (40.7)	48 (40.7)	7 (5.9)	2.60±0.79
Medical devices did not work	54 (45.8)	111 (94.1) 36 (30.5)	21 (17.8)	7 (5.9)	3.16±0.92
Necessary materials or devices were not available	41 (34.7)	110 (93.1) 43 (36.4)	26 (22.0)	8 (6.9)	2.99±0.92
Other departments did not perform the required work	21 (17.8)	108 (91.5) 47 (39.8)	40 (33.9)	10 (8.5)	2.67±0.87
Insufficient handover from the previous duty/unit/hospital	16 (13.6)	107 (90.7) 36 (30.5)	55 (46.6)	11 (9.3)	2.48±0.85
Was not acquainted with medical devices/medications/other procedures or protocols	32 (27.1)	107 (90.7) 48 (40.7)	27 (22.9)	11 (9.3)	2.86±0.93
Necessary medications were not available	34 (28.8)	105 (88.9) 43 (36.4)	28 (23.7)	13 (11.1)	2.83±0.97
Failed to manage time among various nursing care tasks	7 (5.9)	102 (86.4) 24 (20.3)	71 (60.2)	16 (13.6)	2.19±0.74
Conflict or communication errors with other departments	7 (5.9)	102 (86.4) 42 (35.6)	53 (44.9)	16 (13.6)	2.34±0.79
The recipient of nursing intervention/education was absent	7 (5.9)	100 (84.7) 21 (17.8)	72 (61.0)	18 (15.3)	2.14±0.74
Shortage of nursing assistants	13 (11.1)	98 (83.1) 32 (27.1)	53 (44.9)	20 (16.9)	2.32±0.89
Conflict or communication errors within the nursing team	14 (11.8)	97 (82.2) 33 (28.0)	50 (42.4)	21 (17.8)	2.34±0.91
Could not identify priorities in the baby's care plan	13 (11.1)	94 (79.7) 35 (29.7)	46 (38.9)	24 (20.3)	2.31±0.92
Did not think the care was necessary	8 (6.7)	83 (70.3) 25 (21.2)	50 (42.4)	35 (29.7)	2.05±0.89
Parents did not come to see the baby	5 (4.2)	75 (63.6) 16 (13.6)	54 (45.8)	43 (36.4)	1.86±0.81
The use of the EMR was difficult	15 (12.7)	70 (59.3) 20 (16.9)	35 (29.7)	48 (40.7)	2.02±01.0

EMR, electronic medical records.

Table 4. Difference in the Total Number of Missed Care Items by Demographic Characteristics (*N*=118)

Characteristics	Categories	Total number of missed care items				
		n	M±SD	t or F	*p*	Levene (*p*)
Age (year)	≤29	84	19.23±7.59	0.26	.793	1.19 (.278)
	≥30	34	19.65±8.53			
Marital status	Not married	95	19.64±7.49	0.83	.409	3.28 (.073)
	Married	23	18.13±9.22			
Education	College	109	19.48±7.69	0.62	.267	1.87 (.174)
	Graduate school	9	17.78±9.85			
Monthly income (1,000,000 KRW)	<4.0	107	19.21±7.53	0.61	.271	3.76 (.055)
	≥4.0	11	20.73±10.78			
Number of hospital beds	≤19	33	17.03±8.38	2.03	.045	0.72 (.397)
	≥20	85	20.25±7.48			
Total clinical experience (month)	≤38	41	20.34±7.25	0.77	.464	1.42 (.246)
	39–65	37	18.14±8.02			
	≥66	40	19.45±8.28			
NICU experience (month)	≤36	41	19.83±7.88	0.37	.692	0.63 (.536)
	37–60	39	18.46±7.37			
	≥61	38	19.74±8.38			
Number of assigned patients* (n=108)[†]	≤3	65	18.69±8.12	0.98	.329	0.41 (.522)
	≥4	43	20.18±7.27			
Number of assigned patients on ventilator care* (n=106)[†]	≤1	54	18.87±8.01	0.39	.695	0.24 (.625)
	≥2	55	19.47±7.97			
Number of assigned patients receiving inotropes or sedation* (n=110)[†]	≤1	75	18.07±8.09	2.07	.040	0.82 (.367)
	≥2	35	21.40±7.31			
GA of assigned patients (week[+day])*	<30	27	18.41±7.31	1.67	.192	0.77 (.464)
	30–34[+6]	72	20.33±7.63			
	≥35	19	16.95±9.03			
Birth weight of assigned patients (kg)*	<1	40	20.08±6.31	0.79	.430	9.43 (.003)
	≥1	78	18.97±8.53			

*Average number over the last month; [†]Missing values were excluded; GA, gestational age; KRW, Korean won; NICU, neonatal intensive care unit.

Table 5. Factors Influencing the Total Number of Missed Care Items

Variables	B	SE	β	t	*p*	TOL	VIF
(Constant)	12.83	2.68	–	4.78	<.001	–	–
Number of hospital beds	1.01	0.78	.12	1.30	.195	.96	–
Number of assigned patients receiving inotropes or sedation* (n=110)	2.60	0.94	.26	2.78	.006	.96	1.04
	F=5.66, *p*=.005, R²=.096, Adjusted R²=.079, DW=2.22						

*Missing values were excluded; DW, Durbin-Watson; SE, standard error; TOL, tolerance; VIF, variance inflation factor.

most frequently missed item in this study, even though Korean NICU nurses perceived developmental care to be important [15], suggests that interventions to enhance developmental care should adopt a new approach. Interventions focusing on work system-related factors rather than education may be more effective at enabling nurses to carry out the necessary developmental care. Such interventions may include efforts to improve nurse staffing and infant-to-nurse ratios in the NICU and to develop strategies for unit managers to effectively plan patient assignments [14].

"Shortage of nurses", "too many admissions or discharges", and "increase in the number of patients" were all included as major reasons for missed care in this study. This further supports the proposal that the performance of developmental

care may benefit from systematic changes. In addition, all study participants agreed that the reasons for missed care with the largest impact were "emergency within the unit or deterioration of one of the assigned patients" and "various interruptions during work", both of which reflect workflow disruptions. When emergencies or interruptions occur, the time it takes for a nurse to successfully prepare medications, administer medications, and complete documentation increases significantly. This leads to increased medication errors and takes time away from other nursing activities, resulting in missed care [27].

Interruptions may also explain why the number of patients on inotropes or undergoing sedation therapy was associated with an increased overall frequency of missed nursing care. In the NICU, inotropes or sedatives are usually administered via continuous infusion using pumps. Pumps are major sources of alarms in the NICU. An increase in non-urgent or unidentifiable alarms can interrupt nurses' workflow, increasing the risk of missed care [28].

Moreover, in the NICU, inotropic or sedative therapies are often applied simultaneously with mechanical ventilation because ventilation causes stress and pain for neonates. In these cases, the level of sedation varies for each neonate [29]. Compared to heavily sedated patients, slightly sedated patients on ventilator care are more difficult to look after, possibly due to ventilator fighting, variable conditions, and more alarms [30]. This can be especially true in the NICU, where infants are more prone to inconsolable crying and lack self-control abilities. Such an increase in caregiver workload can negatively affect missed care. Notably in this study, the average daily number of assigned patients on ventilator care was not a significant influencing factor related to overall missed nursing care. This may be due to a lack of distinction between different levels of sedation for patients on ventilator care. Future studies should investigate the influence of ventilator care moderated by sedation levels on missed nursing care.

This study has several limitations. First, the meaning of developmental care in this study should be interpreted with caution. Unlike other studies [14], this study did not use an instrument designed specifically to measure developmental care. Thus, developmental care as conceptualized in this study may differ from developmental care in other studies. Second, the participants in this study may not have reflected the real-life composition of Korean NICU nurses since the participants most likely shared the survey link with nurses working in the same hospital. This is an innate limitation of the snowballing method. Third, the final regression model explained only 9.6% of the variance in missed care, which implies that many other antecedents must also be taken into

consideration in future studies. Lastly, there may have been limitations for participants in responding to several items, such as those related to parents and guardians, due to the current coronavirus disease 2019 outbreak and visitation restrictions.

CONCLUSION

This study is significant because it addressed the lack of studies on missed care in Korean NICUs by generating data to fill this gap in the nursing literature. Through this study, missed care was found to be prevalent among Korean NICU nurses. Patients on specific types of medications may be a source of more intensive workload for NICU nurses, thus resulting in more missed care. Furthermore, this study also raised questions on how well certain types of nursing care, especially developmental care, are carried out in the NICU. Since safety is a top priority for nurses in managing their work, less urgent and time-consuming tasks are the most likely to be omitted. This suggests that NICU nurses' working conditions need to be improved so that they have adequate time to carry out overlooked nursing activities. Ultimately, this study can serve as a foundation for the development of interventions tailored to the specific characteristics of Korean NICUs, contributing to neonatal patient safety.

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Conceptualization: all authors; Data collection, Formal analysis: Soohyun Kim; Writing-original draft: Soohyun Kim; Writing-review and editing: all authors; Final approval of published version: all authors.

Conflict of interest

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Data availability

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REFERENCES

1. Ball JE, Murrells T, Rafferty AM, Morrow E, Griffiths P. 'Care left undone' during nursing shifts: associations with workload and perceived quality of care. BMJ Quality and Safety. 2014;23(2): 116-125. https://doi.org/10.1136/bmjqs-2012-001767

2. Kalisch BJ, Landstrom GL, Hinshaw AS. Missed nursing care: a concept analysis. Journal of Advanced Nursing. 2009;65(7): 1509-1517. https://doi.org/10.1111/j.1365-2648.2009.05027.x

3. Recio-Saucedo A, Dall'Ora C, Maruotti A, Ball J, Briggs J, Meredith P, et al. What impact does nursing care left undone have on patient outcomes? Review of the literature. Journal of Clinical Nursing. 2018;27(11-12):2248-2259. https://doi.org/10.1111/jocn.14058

4. Coughlin ME. Vulnerability of the premature and hospitalized infant. In: Coughlin ME, editor. Transformative nursing in the NICU: trauma-informed age-appropriate care. New York, NY: Springer Publishing Company; 2014. p. 15-27.

5. Tubbs-Cooley HL, Pickler RH, Meinzen-Derr JK. Missed oral feeding opportunities and preterm infants' time to achieve full oral feedings and neonatal intensive care unit discharge. American Journal of Perinatology. 2015;32(1):1-8. https://doi.org/10.1055/s-0034-1372426

6. Gonya J, Feldman K, Brown K, Stein M, Keim S, Boone K, et al. Human interaction in the NICU and its association with outcomes on the Brief Infant-Toddler Social and Emotional Assessment (BITSEA). Early Human Development. 2018;127:6-14. https://doi.org/10.1016/j.earlhumdev.2018.08.010

7. McNeil ME, D'Agata A. Touch a life, impact a lifetime: trauma-informed care in the NICU. In: Kenner C, Altimier LB, Boykova MV, Editors. Comprehensive neonatal nursing care. 5th ed. New York, NY: Springer Publishing Company; 2022. p. 733-752.

8. Tubbs-Cooley HL, Pickler RH, Younger JB, Mark BA. A descriptive study of nurse-reported missed care in neonatal intensive care units. Journal of Advanced Nursing. 2015;71(4):813-824. https://doi.org/10.1111/jan.12578

9. Lake ET, De Cordova PB, Barton S, Singh S, Agosto PD, Ely B, et al. Missed nursing care in pediatrics. Hospital Pediatrics. 2017;7(7): 378-384. https://doi.org/10.1542/hpeds.2016-0141

10. Lake ET, Staiger DO, Cramer E, Hatfield LA, Smith JG, Kalisch BJ, et al. Association of patient acuity and missed nursing care in U.S. neonatal intensive care units. Medical Care Research and Review. 2018;77(5):451-460. https://doi.org/10.1177/1077558718806743

11. Rochefort CM, Rathwell BA, Clarke SP. Rationing of nursing care interventions and its association with nurse-reported outcomes in the neonatal intensive care unit: a cross-sectional survey. BMC Nursing. 2016;15:46. https://doi.org/10.1186/s12912-016-0169-z

12. Cho SH, Lee JY, You SJ, Song KJ, Hong KJ. Nurse staffing, nurses prioritization, missed care, quality of nursing care, and nurse outcomes. International Journal of Nursing Practice. 2020;26(1): e12803. https://doi.org/10.1111/ijn.12803

13. Kim KJ, Yoo MS, Seo EJ. Exploring the influence of nursing work environment and patient safety culture on missed nursing care in Korea. Asian Nursing Research. 2018;12(2):121-126. https://doi.org/10.1016/j.anr.2018.04.003

14. Hong H, Son HM. Factors influencing developmental care performance among neonatal intensive care units nurses. Child Health Nursing Research. 2020;26(2):131-139. https://doi.org/10.4094/chnr.2020.26.2.131

15. Lee HN, Park JH, Cho H. Developmentally supportive care among neonatal intensive care unit nurses in South Korea: knowledge, perceived importance, perception, and perceived competence. Advances in Neonatal Care. 2021. https://doi.org/10.1097/ANC.0000000000000943

16. Blackman I, Papastavrou E, Palese A, Vryonides S, Henderson J, Willis E. Predicting variations to missed nursing care: a three-nation comparison. Journal of Nursing Management. 2018;26(1): 33-41. https://doi.org/10.1111/jonm.12514

17. Bae SH, Hwang SW, Lee G. Work hours, overtime, and break time of registered nurses working in medium-sized Korean hospitals. Workplace Health and Safety. 2018;66(12):588-596. https://doi.org/10.1177/2165079918769683

18. Cho SH, Lee JY, You SJ, Song KJ, Hong KJ. Nurse staffing, nurses prioritization, missed care, quality of nursing care, and nurse outcomes. International Journal of Nursing Practice. 2019;26(1): e12803. https://doi.org/10.1111/ijn.12803

19. Min A, Yoon YS, Hong HC, Kim YM. Association between nurses' breaks, missed nursing care and patient safety in Korean hospitals. Journal of Nursing Management. 2020;28(8):2266-2274. https://doi.org/10.1111/jonm.12831

20. Tubbs-Cooley HL, Mara CA, Carle AC, Mark BA, Pickler RH. Association of nurse workload with missed nursing care in the neonatal intensive care unit. JAMA Pediatrics. 2019;173(1):44-51. https://doi.org/10.1001/jamapediatrics.2018.3619

21. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods. 2007;39(2):175-191. https://doi.org/10.3758/bf03193146

22. Kalisch BJ, Williams RA. Development and psychometric testing of a tool to measure missed nursing care. Journal of Nursing Administration. 2009;39(5):211-219. https://doi.org/10.1097/NNA.0b013e3181a23cf5

23. Sousa VD, Rojjanasrirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. Journal of Evaluation in Clinical Practice. 2011;17(2):268-274. https://doi.org/10.1111/j.1365-2753.2010.01434.x

24. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Research in Nursing and Health. 2007;30(4):459-467. https://doi.org/10.1002/nur.20199

25. Masten M, Sommerfeldt S, Gordan S, Greubel E, Canning C, Lioy J, et al. Evaluating teamwork in the neonatal intensive care unit: a survey of providers and parents. Advances in Neonatal Care. 2019;19(4):285-293. https://doi.org/10.1097/ANC.0000000000000604

26. Mosqueda R, Castilla Y, Perapoch J, De la Cruz J, Lopez-Maestro M, Pallas C. Staff perceptions on Newborn Individualized Developmental Care and Assessment Program (NIDCAP) during its implementation in two Spanish neonatal units. Early Human Development. 2013;89(1):27-33. https://doi.org/10.1016/j.earlhumdev.2012.07.013

27. Sassaki RL, Cucolo DF, Perroca MG. Interruptions and nursing workload during medication administration process. Revista Brasileira de Enfermagem. 2019;72(4):1001-1006. https://doi.org/10.1590/0034-7167-2018-0680

28. Rasooly IR, Kern-Goldberger AS, Xiao R, Ponnala S, Ruppel H, Luo B, et al. Physiologic monitor alarm burden and nurses' subjective workload in a children's hospital. Hospital Pediatrics. 2021;11(7):703-710. https://doi.org/10.1542/hpeds.2020-003509

29. McPherson C. Sedation and analgesia in mechanically ventilated preterm neonates: continue standard of care or experiment? Journal of Pediatric Pharmacology and Therapeutics. 2012;17(4):351-364. https://doi.org/10.5863/1551-6776-17.4.351

30. Everingham K, Fawcett T, Walsh T. 'Targeting' sedation: the lived experience of the intensive care nurse. Journal of Clinical Nursing. 2014;23(5-6):694-703. https://doi.org/10.1111/jocn.12058