








## RESEARCH ARTICLE

# Nurse workload, missed nursing care, and the contributing factors in the Neonatal Intensive Care Unit in a limited resource setting: A case from Indonesia [version 1; peer review: awaiting peer review]

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## Open Peer Review

**Approval Status** AWAITING PEER REVIEW

Any reports and responses or comments on the article can be found at the end of the article.

## Abstract

**Background:** Nurses who are in charge of the Neonatal Intensive Care Units (NICUs) have a different workload and work assignments compared to other units. Evidence suggests that higher nurse workloads will increase the risk of missed nursing care. Missed nursing care in the NICU will eventually worsen the neonatal prognosis. This is a major problem in developing countries, which currently still have a high neonatal mortality rate.

**Methods:** This was a cross sectional study using questionnaires to collect data from 48 nurses who work in Dr. Soetomo Hospital NICU from April 15<sup>th</sup> 2021 to July 25<sup>th</sup> 2021. The collected data was then processed with descriptive statistics, meanwhile the correlation between workload with missed nursing care was analyzed with Pearson and Spearman correlation.

**Results:** The total mean of NICU nurse workload score according to the NASA-TLX (National Aeronautics and Space Administration Task Load Index) was 68.36, indicating a moderate overall workload, with effort as the highest component. Overall, 91.67% of the nurses had missed at least 1 out of 21 basic neonatal nursing care components. Labor resource factor was the most frequent missed nursing care

factor, in which urgent patient situations were the most frequent problem. There was no significant correlation between the total nurse workload and the frequency of any missed nursing care ( $P=0.536$ ).

**Conclusions:** Effort was the biggest component of the NICU nurse total workload. The most frequently missed nursing care was giving emotional support for the patient's parents and/or family. Labor resource factor was the most frequent problem which caused missed nursing care. However, there is no statistically significant correlation between the total workload with the frequency of missed nursing care.

### Keywords

nurse workload, missed nursing care, nurse, neonate, NICU nurse

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## Introduction

Neonatal period, which is the first 28 days of life, is an extremely important period for children's survival. With the majority of neonatal deaths happening in the first week of life, newborns are facing many high risks of dying in this vulnerable period (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Globally, there were around 2.4 million neonatal deaths in 2019, in which a high portion of it comes from low and lower middle-income countries, including Indonesia (around 60 thousand neonatal deaths in 2019) (<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>). Several contributing factors are preterm birth, infections and birth defects (<https://data.unicef.org/topic/child-survival/neonatal-mortality>).

The Neonatal Intensive Care Unit (NICU) is a specialized area in the hospital that provides advanced technologies and trained healthcare professionals for the treatment of high-risk newborns from prematurity, low birth weight, and specific health condition (respiratory problem, heart problem, infection, or birth defects) (<https://www.stanfordchildrens.org/en/topic/default?id=the-neonatal-intensive-care-unit-nicu-90-P02389>). According to a study conducted from 2009 until 2010 in Nepal, as a developing country, among the aforementioned conditions, respiratory distress was shown as the most common neonatal condition which led to NICU admission.<sup>1</sup> Despite being expensive and not easily accessible, the NICU is an extremely important unit that can not only save lives but can also help in increasing the survival rates for neonates.

The NICU as a setting with higher nurse-to-patient ratio has a different nurse workload and assignment compared to other units. Although most NICU infants are low-acuity, around 12% of the high acuity infants will need higher staffing ratio (around 0.95) compared to lower acuity infants (around 0.33). This nurse shortage, which will increase the nurse workload, can lead to care being delayed or omitted which will increase infant mortality.<sup>2,3</sup> A study conducted in a Midwestern academic medical center showed that the workload of NICU nurses based on the subjective workload rating of National Aeronautics and Space Administration Task Load Index (NASA-TLX), was significantly associated with missed nursing care.<sup>4</sup> Missed care is theorized to be linked with poor work environments and staffing.<sup>4-6</sup>

Higher quality care for infants and their parents in the NICU will provide them with better outcomes. Life threatening conditions, such as neonatal infections, can be prevented with a high quality of care, including appropriate hand hygiene and central-line care practice.<sup>7-10</sup> Preparation of families for discharge given by the nurse is crucial to ensure that parents could manage their infant's care after being discharged from the NICU. High quality care for infants and their parents in the NICU will provide them with better outcomes.<sup>11</sup> In contrast, misses in nurse care will cause poor outcomes for infants hospitalized in the NICU which were already at high risk.<sup>6,12</sup> Although neonatal care has improved considerably in developing countries, there are still several unresolved challenges remaining when compared to developed countries.<sup>13</sup> Poor infrastructure, resource limitation, and a lack of referral systems are several problems faced by the developing countries in providing optimal neonatal care.<sup>13,14</sup> The prognosis for infants admitted to the NICU in developing countries remains poor, with limited evidence indicating a mortality rate between 0.2 to 64.4%.<sup>15</sup> This high mortality rate is related to a higher prevalence of newborn infections in developing countries compared with developed countries.<sup>16-18</sup> A systematic literature review by Kermani *et al.* (2020) identified 90 risk factors associated with neonatal mortality in the NICU, which are categorized into 25 maternal factors, 59 neonatal factors, and 6 organizational factors.<sup>19</sup> Several factors associated with neonatal mortality include scarcity of trained health care personnel, overcrowding of the neonatal units, late onset and slow advance of feeding, use of formula instead of breastfeeding, failure to comply with handwashing recommendations, and excessive use of antibiotics.<sup>18,20,21</sup> With the majority of the neonatal deaths coming from the developing country, there is an urgency to implement the appropriate interventions to reduce the number of missed nursing care in the NICU. Therefore, there is a need to inform the implementation of such interventions, especially regarding the current existing missed NICU nursing care and factors associated with it in a limited resource setting.

This study aims to evaluate the NICU nurse workload, the frequency of missed NICU nursing care, and the other contributing factors associated with missed NICU nursing care in developing countries by analyzing data obtained from 48 nurses working in Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. We hypothesized that nurses with higher subjective workload (NASA-TLX) would significantly miss more care.

## Methods

### Ethical considerations

Ethical clearance was granted from IRB Dr. Soetomo General Hospital by letter of exemption 0335/LOE/301.4.2/II/2021. Written informed consent was obtained from participating nurses.

### Study design, data, and sample

This was a cross-sectional study using questionnaires to collect data from the nurses working in the Neonatal Intensive Care Unit (NICU) of Dr. Soetomo General Hospital, a central referral hospital in East Java, Indonesia. Registered NICU

nurses were defined if they had completed unit orientation, had provided direct patient care, and were actively employed in the NICU. All of the defined NICU nurses were found to be eligible to participate in our study. Hence, a total sampling frame was determined to establish the final study size of 48 nurses. Participants were recruited via direct solicitations in the department of pediatrics of Dr. Soetomo General Hospital. The study participants, split into three groups, were gathered in a room to be given the information regarding the study and the instruction on how to fill in the [NASA-TLX questionnaires](#). Then the questionnaires were given to participants by a trained research assistant after enough information had been given.

The questionnaires were split into three sections, which were: a) nurse workload, b) frequency of miss in nurse care, and c) factor contributing to miss care. Nurse workload was assessed using the paper version of the NASA-TLX.<sup>22,23</sup> The questions were translated to Indonesian language and went through several processes of validity testing, including the testing to clarify whether there were any mistranslation or loss of meaning during the translation, testing for the questions clarity, and testing for any bias regarding the translated questions. There were six components measured by the NASA-TLX, which consists of mental demands, physical demands, time pressure, effort to accomplish goals, performance, and frustration. Total workload scores were then calculated by the sum of the adjusted rating (weight  $\times$  raw rating) divided by 15. The scores for overall workload scores ranged from 0 (low) to 100 (high). The second and third part of the questionnaire were taken from the MISSCARE Survey-English.<sup>24</sup> Its content validity index was 0.87 with test-retest validity ( $r=0.88$ ,  $p<0.001$ ). The survey consists of 21 items of essential neonatal nursing care and the reason for missed nursing care divided into three categories (communication, material resources, and labor resources). The MISSCARE Survey was translated into Indonesian language through several processes to ensure no compromise in any loss of meaning during the translation. The translated survey was subsequently disseminated to an expert panel in order to evaluate the internal validity. The survey was also disseminated to 10 nurses for external face validity to evaluate their interpretation and understanding of each item. Missed nursing care was assessed by asking nurses to report the omission frequency of the 21 neonatal nursing care practices. The frequency was divided based on a Likert type scale, which are: always missed, frequently missed, occasionally missed, rarely missed, and never missed. The responses were then dichotomized into missed or not missed for each of the 21 items. In the third part, the nurses were asked to assess and chose the reasons for missed nursing care in their unit among the presented options in the questionnaire. For each question, the nurses had to report the frequencies of each factor for missed nursing care (always happened, frequently happened, occasionally happened, rarely happened, never happened). Both the frequencies of the missed nursing care and the reason for missed nursing care were answered depending on the participants memory. The other covariables included nurse age and educational degree (3-year associate's degree, 4-year associate's degree, bachelor's degree, or higher). Out of all 48 nurses working in the NICU, 100% participated in this survey.

## Data analysis

Descriptive analysis was conducted using [Microsoft® Excel](#) v16.0 software and subsequently presented in a table which consists of participant characteristics, the distribution of the workload, the frequency of the missed nursing care, and the contributing factor frequency of the missed nursing care. The subscale of the workload would be presented in a graphic figure. The data analysis for this study was done with the [IBM SPSS Statistics](#) v 25.0 (RRID: SCR\_016479). Descriptive statistics were used to describe the sample characteristics, the frequency of missed nursing care items, and the frequency of the reason for missed nursing care. Test of normality for the total workload data was done using the Shapiro-Wilk test. The analysis utilized Pearson's correlations to measure the association between the total workload with the total of any missed care and Spearman rank correlations were calculated to assess the association between the total workload with each of the 11 missed care items;  $\alpha$  was corrected to 0.05.

## Results

### Descriptive findings

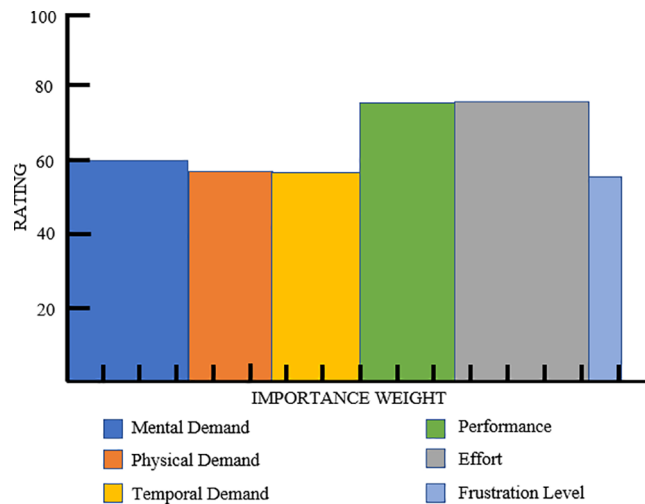
Out of the 48 nurses who participated in this study, all were female (100%).<sup>25</sup> The oldest participant was 56 years old. All participants submitted the surveys after getting enough information regarding the questions with 0% missing data. The majority of the nurse participants graduated with an associate's degree (72.9%), and only a small percentage had a master's degree (2.1%) ([Table 1](#)).

From the first part of the questionnaire, the NASA-TLX score could be calculated. The mean overall workload score based on NASA-TLX was 68, with 96 as the highest score (range, 42 to 96; median 67.33) out of 100 ([Table 1](#)). A higher NASA-TLX score indicated a higher overall workload experienced by the participants. The distribution of the six subscales can be seen in [Figure 1](#). The width of the subscale bars showed the importance of each factor, which were reflected as its weight and the height represents the magnitude/rating of each factor. Out of all the subscales, effort had the highest importance with the mean value of 3.625 and the highest magnitude/rating (mean value of 75.83). Meanwhile, frustration level has the lowest importance (mean value of 0.89) and lowest magnitude/rating (mean value 55.42).

**Table 1. Nurse participants and workload characteristics.**

Characteristic	N(%)/mean ± SD (Min-Max)	
Age	40.33 ± 7.68 (26-56)	
Education	3-year Associate's degree	35 (72.9)
	4-year Associate's degree	1 (2.1)
	Bachelor's degree	11 (22.9)
	Master's degree	1 (2.1)
NASA-TLX Overall workload score	68.36 ± 11.83 (42-96) <sup>a</sup>	

Abbreviations: NASA-TLX, National Aeronautics and Space Administration Task Load Index.  
<sup>a</sup>Scores range from 0 (low) to 100 (high).



**Figure 1. The distribution of the weighted workload score.** The rating represents the magnitude of a load factor in a given task. Then, overall workload score for each subject can be obtained by multiplying each rating by the weight given to that factor by that subject. The sum of the weighted ratings for each task is then divided by 15 (the sum of the weights).

From the survey, 44 out of 48 (91.67%) participating nurses reported to omit at least one of the nursing care items. The percentage of missed care items by each nurse ranged from 4.76% to 61.9%, with a mean value of 27.92% and median value of 23.81%. The distribution of the missed nursing care can be seen in Table 2. From the report, most of the missed care items were either rarely missed or occasionally missed. From all the nursing care items, nurses most often missed giving emotional support to parents and/or family (33 [68.75%]) and performing bedside glucose monitoring as ordered (33 [68.75%]). Patients' assessments performed each shift was the least frequent nursing care to be missed (1 [2.1%]), beside mouth care (2 [4.2%]) and handwashing (2 [4.2%]).

The reason for missed nursing care was divided into three parts, consisting of communication factors, material resources factors, and labor resources factors (Table 3). Overall, from the communication factors, the problems either rarely or occasionally happened. The most frequent problem from the communications was tension or communication breakdown with other ancillary/support departments (30 [62.5%]). The least frequent problem was inadequate handoff from the previous shift or sending unit (5 [10.42%]). From the material resources factors, the majority of the problems also happened rarely or occasionally. Supplies/equipment not functioning properly when needed were the most frequent problems from the material resources factor (35 [72.72%]). Meanwhile in the labor resources factor, overall, the problems happened occasionally or frequently. Out of all the problems, urgent patient situations were the most frequent problem (47[97.92%]), followed by unexpected rise in patient volume and/or acuity on the unit (46 [95.83%]). Overall, the problems under labor resources factors had the highest frequency out of all the other factors for the missed nursing care to happen.

**Table 2. Distribution of missed nursing care.**

Missed nursing care	Response N (%)					Missed
	Rarely missed	Occasionally missed	Frequently missed	Always missed	Missed	
Ambulation three times per day or as ordered	11 (22.9)	9 (18.8)	7 (14.6)	0 (0)	27 (56.25)	
Turning patient every 2 hours	12 (25)	1 (2.1)	0 (0)	0 (0)	13 (27.1)	
Feeding patient when the food is still warm	4 (8.3)	2 (4.2)	0 (0)	0 (0)	6 (12.5)	
Setting up meals for patients	3 (6.3)	4 (8.3)	2 (4.2)	3 (6.3)	12 (25)	
Medications administered within 30 minutes before or after scheduled time	7 (14.6)	10 (20.8)	3 (8.3)	0 (0)	20 (41.67)	
Vital signs assessed as ordered	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Monitoring intake/output	1 (2.1)	1 (2.1)	0 (0)	0 (0)	2 (4.2)	
Full documentation of all necessary data	3 (6.3)	0 (0)	0 (0)	0 (0)	3 (6.3)	
Parents/Family teaching about procedures, tests, and other diagnostic studies	8 (16.7)	14 (29.2)	5 (10.4)	3 (6.3)	30 (62.5)	
Emotional support to parents and/or family	15 (31.3)	13 (27.1)	5 (10.4)	0 (0)	33 (68.75)	
Patient bathing/skin care	2 (4.2)	0 (0)	1 (2.1)	0 (0)	3 (6.25)	
Mouth care	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Handwashing	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (4.2)	
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	6 (12.5)	3 (6.3)	3 (6.3)	0 (0)	12 (25)	
Bedside glucose monitoring as ordered	7 (14.5)	18 (37.5)	7 (14.6)	1 (2.1)	33 (68.75)	
Patient assessments performed each shift	1 (2.1)	0 (0)	0 (0)	0 (0)	1 (2.1)	
IV/central line site care and assessments according to hospital policy	5 (10.4)	0 (0)	0 (0)	0 (0)	5 (10.4)	
Response to call light is initiated within 5 minutes	7 (14.6)	1 (2.1)	0 (0)	1 (2.1)	9 (18.75)	
PRN medication request acted on within 15 minutes	9 (18.8)	5 (10.4)	0 (0)	0 (0)	14 (29.17)	
Assess effectiveness of medications	7 (14.6)	2 (4.2)	2 (4.2)	1 (2.1)	12 (25)	
Assist with toileting needs within 5 minutes of request	9 (18.8)	5 (10.4)	2 (4.2)	0 (0)	16 (33.33)	

Abbreviations: IV, intravenous; PRN, pro re nata.

**Table 3. Frequency of reason for missed nursing care.**

Reason for missed nursing care	Response N (%)						Frequency <sup>a</sup>
	Never happened	Rarely happened	Occasionally happened	Frequently happened	Always happened		
<b>A. Communication - Overall</b>							
(The method of making patient assignments)Unbalanced patient assignments	40 (83.3)	5 (10.4)	3 (6.3)	0 (0)	0 (0)	8 (16.67)	
Inadequate handoff from previous shift or sending unit	43 (89.6)	4 (8.3)	0 (0)	0 (0)	1 (2.1)	5 (10.42)	
Other departments did not provide the care needed (e.g. physical therapy did not ambulate)	26 (54.2)	3 (6.3)	13 (27.1)	3 (6.3)	3 (6.3)	22 (45.83)	
Lack of backup support from team members	29 (60.4)	7 (14.6)	10 (20.8)	0 (0)	2 (4.2)	19 (39.58)	
Tension or communication breakdowns with other ancillary/support departments	18 (37.5)	12 (25)	12 (25)	4 (8.3)	2 (4.2)	30 (62.5)	
Tension or communication breakdowns within the nursing team	27 (56.3)	10 (20.8)	8 (16.7)	0 (0)	3 (6.3)	21 (43.75)	
Tension or communication breakdowns with the medical staff	26 (54.2)	12 (25)	7 (14.6)	0 (0)	3 (6.3)	22 (45.83)	
Nursing assistant did not communicate that care was not done	31 (64.6)	8 (16.7)	7 (14.6)	0 (0)	2 (4.2)	17 (35.42)	
Caregiver off unit or unavailable	27 (56.3)	1 (2.1)	15 (31.3)	2 (4.2)	3 (6.3)	21 (43.75)	
<b>B. Material Resources - Overall</b>							
Medications not available when needed	19 (39.6)	10 (20.8)	15 (31.3)	0 (0)	4 (8.3)	29 (60.42)	
Supplies/equipment not available when needed	17 (35.4)	12 (25)	16 (33.3)	0 (0)	3 (6.3)	31 (64.58)	
Supplies/equipment not functioning properly when needed	13 (27.1)	7 (14.6)	24 (50)	2 (4.2)	2 (4.2)	35 (72.92)	
<b>C. Labor Resources - Overall</b>							
(Level of staffing) Inadequate number of staff	7 (14.6)	10 (20.8)	18 (37.5)	9 (18.8)	4 (8.3)	41 (85.42)	
Urgent patient situations (e.g., a patient's condition worsening)	1 (2.1)	7 (14.6)	20 (41.7)	16 (33.3)	4 (8.3)	47 (97.92)	
Unexpected rise in patient volume and/or acuity on the unit	2 (4.2)	4 (8.3)	22 (45.8)	13 (27.1)	7 (14.6)	46 (95.83)	
Inadequate number of assistive personnel (e.g., nursing assistants, techs, unit secretaries, etc.)	17 (35.4)	3 (6.3)	16 (33.3)	7 (14.6)	5 (10.4)	31 (64.58)	

<sup>a</sup>Frequency = Rarely + Occasionally + Frequently + Always Happened.



**Table 4. Correlation of total workload with missed nursing care outcomes.**

Outcome	Workload Measures NASA-TLX total Workload, Correlation coefficient (P value)
Any missed care	0.092 (0.536)
Ambulation three times per day or as ordered	0.329 (0.022)*
Turning patient every 2 hours	0.212 (0.149)
Feeding patient when the food is still warm	0.159 (0.280)
Setting up meals for patients	0.245 (0.093)
Medications administered within 30 minutes before or after scheduled time	0.156 (0.291)
Vital signs assessed as ordered	-0.096 (0.515)
Monitoring intake/output	-0.184 (0.209)
Full documentation of all necessary data	0.071 (0.629)
Parents/Family teaching about procedures, tests, and other diagnostic studies	-0.093 (0.528)
Emotional support to parents and/or family	-0.019 (0.895)
Patient bathing/skin care	0.093 (0.528)
Mouth care	-0.087 (0.558)
Handwashing	0.132 (0.372)
Teaching parents/family about plans for their baby care after discharge and when to call after discharge	-0.226 (0.123)
Bedside glucose monitoring as ordered	-0.123 (0.404)
Patient assessments performed each shift	0.184 (0.210)
IV/central line site care and assessments according to hospital policy	-0.167 (0.255)
Response to call light is initiated within 5 minutes	-0.019 (0.897)
PRN medication request acted on within 15 minutes	-0.015 (0.920)
Assess effectiveness of medications	0.047 (0.752)
Assist with toileting needs within 5 minutes of request	-0.128 (0.387)

Abbreviations: IV, intravenous; NASA-TLX, National Aeronautics and Space Administration Task Load Index; PRN, pro re nata.

\* $p < 0.05$ ,  $\alpha$  corrected for false discovery rate.

### Workload and missed care

The correlation of total workload with missed nursing care outcome can be seen in Table 4. The correlation of total workload measured with NASA-TLX with any missed care was analyzed with Pearson correlation, meanwhile the correlation of total workload with each of the missed nursing care items was analyzed with Spearman correlation. Out of all the missed nursing care items, only missed in ambulation care showed significant worsening effects with higher workload (correlation coefficient 0.329  $p = 0.022$ ). The other 21 models showed no statistically significant correlation with the total workload.

### Discussion

Contrary to our hypothesis, we found no statistically significant correlation between the total workload with the frequency of missed nursing care. However, current evidence indicates otherwise. A similar study conducted by Tubbs-Cooley, *et al.* (2019) found that NASA-TLX, as a subjective workload rating, had a statistically significant correlation with all the missed nursing care items assessed in their study.<sup>4</sup> Lake *et al.* (2018) also showed that nurses with higher workloads, higher acuity assignments, and poorly organized work environments were significantly associated with an increase in missed nursing care.<sup>26</sup> This might happen due to the reporting bias presented in the data collection process, in which the participants failed to accurately recall the nursing care items they missed. Age, education, and nurse work experience factors could also affect the result.

Considering the high number of neonatal mortality rates in developing countries, our study holds a great value to determine the source of one of the problems in neonatal care. We also found that there is still a limited amount of studies



on the workload and missed nursing care in the NICU, especially in developing countries. From our study, we found that the mean of the total workload score calculated with the NASA-TLX score is considered to be high. The subscale that showed the highest importance is the effort factor. Similar results are also present in a previous study regarding nurse workload in the Intensive Care Unit done in a hospital in Aceh, Indonesia.<sup>27</sup> Higher effort means higher requirement to work harder in order to achieve the necessary level of performance.<sup>23</sup> This finding could be related with the high demand in the NICU to monitor and provide appropriate treatment for intensive care neonates.<sup>28</sup> Meanwhile, frustration level showed the lowest importance subscale in our analysis. Frustration level regarded as the least contributing factor to the NICU nurse's workload could be correlated with the other high workload demand dimension not giving them enough space to think about the working condition. A multivariate regression conducted by Wang *et al.* (2016) showed that the age of senior nurses was positively correlated with work-related frustration.<sup>29</sup> This finding is contradictory with previous evidence which showed that nurses with longer experience exhibit a lower frustration level in regard with their adaptation level with the workplace pressure and task.<sup>27,30</sup> Overload of patient information due to the usage of electronic health records (EHR) was also shown to potentiate a higher level of frustration among nurses.<sup>31,32</sup>

Out of all the nurse care items done in the NICU, we found that the most frequently missed nursing care was giving emotional support to the patient's parents and/or family and bedside glucose monitoring as ordered. While the least frequent cares to be missed in this study were patient assessment each shift, mouth care, and handwashing. Consistent with several previous studies, giving emotional support is still one of the most frequent care items to be missed, although in this study we found an even greater proportion compared to the previous studies.<sup>5,33</sup> The high work demand in the NICU left the nurses with little time to do their tasks, this sometimes lead them to postpone some tasks deemed to be less "important", such as the psycho-social task including giving emotional support to the parents and/or family of the neonates.<sup>34,35</sup> Regarding bedside glucose monitoring, other studies presented opposite results, in which bedside glucose monitoring is part of the least frequent care to be missed.<sup>5,36</sup> Neonatal hypoglycemia is the most common metabolic disturbance in neonates, hence why hypoglycemia screening is a crucial consideration, especially in high-risk infants.<sup>37</sup> An extreme level of low blood glucose can cause several life-threatening conditions in neonates, such as apnea, irritability, lethargy, seizures, and even brain damage.<sup>38</sup> Failure to do bedside glucose monitoring as ordered can result in a dangerous situation to the neonates and hence, it is really important to increase the awareness of the consequences of omission<sup>39</sup> and to provide better bedside glucose monitoring devices<sup>40,41</sup> to reduce the morbidity caused by missed nursing care. Conversely, the top three least frequent missed nursing care could be related to the fact that they are too obvious to be missed and are routinely audited by the nursing units.<sup>36</sup> In regard to the increasing hospital quality, several protocols, such as hand hygiene, can also affect the nurse to prioritize some care over the others based on incentives or disincentives.<sup>5</sup>

For the other contributing factors to missed nursing care, labor resources factor is the most frequent problem, followed by the material resources factor and communication factor. The most frequent reasons are urgent patient situations and unexpected rise in patient volume and/or acuity. This finding is consistent with several previous studies.<sup>5,33,35,36</sup> Although labor resources hold the biggest portion in contributing to missed nursing care, interventions that exclusively focus on labor resources may not be enough to decrease the incidence of missed nursing care.<sup>4</sup> Intervention to ensure better teamwork, communication, as well as less excessive workload, better personnel deployment, and better flows in patient acuity and volume is needed to minimize the incidence of missed nursing care.<sup>36</sup> Improving the teamwork of the NICU team can ensure better safety for the patient, including better infection control, as well as reducing the error in giving intensive treatment to the neonates, such as neonatal resuscitation.<sup>42,43</sup> Regarding material resource factor, the most frequent challenge is when the provided supplies/equipment are not functioning properly when needed. A study by Perry and Malkin (2011) found that there were around 38.3% out of service medical equipment in developing countries.<sup>44</sup> The main reasons behind this equipment error were lack of training, poor health technology management, and poor infrastructure. Proper interventions are needed to solve this problem to increase the NICU nurse work-effectiveness.<sup>45</sup>

### Strengths and limitation

This study has several limitations. First, there is a limited size of samples in our analysis, hence it may not hold a sufficient power to detect any significant correlation between the various outcomes and workload measures. Second, the data collecting process requires nurses to assess missed nursing care based on the memory of their own experience which is highly susceptible to bias. In addition, the data was collected only once, conversely to the previous study that collected the data from each shift. There is also a possibility that the response to the questions is influenced by social aspect bias, thus the answer to the missed care might be under-represented rather than the actual situation. However, it is worthy to mention that this study had a high response rate, in which 100% of the nurses working in the NICU of the study hospital site participated in this study and filled out the survey after getting a proper explanation. This study was conducted in one of the biggest tertiary hospitals in Indonesia, therefore the findings of this study might be generalizable in similar settings. Further replication of this study in another setting within a developing country with larger samples and more collected data is required to support the role of nurse workload in missed nursing care.

## Conclusion

In our analysis, there was a high overall workload of NICU nurses. The effort factor was found to have the highest importance compared to the other subscales of nurse workload index. The most frequent forms of missed nursing care were giving emotional support to parents and/or family and bedside glucose monitoring. Although we found no statistically significant correlation between total workload and any missed nursing care, total workload exhibited significant correlation with missed ambulation (three times per day or as ordered). Labor resources factor was the other most important factor in regard to missed nursing care, especially in an urgent patient situation and unexpected increase in patient volume and/or acuity. However, labor-focused intervention might not be enough to resolve the problem. Intervention to ensure better teamwork, communication, and also better technology and medical equipment maintenance for a better workplace environment is necessary to increase the work productivity of NICU nurses.

## Data availability

### Underlying data

Figshare: Nurse Workload, Missed Nursing Care, and the Contributing Factors in the Neonatal Intensive Care Unit in a Limited Resource Setting: A Case from Indonesia. <https://doi.org/10.6084/m9.figshare.18096383>.<sup>25</sup>

This project contains the following underlying data:

- Raw Data\_NASA-TLX and MISSCARE Survey.xlsx (This file contains data regarding nurses' responses on the NASA-Task Load Index for assessing workload and the MISSCARE Survey for assessing frequency and factors contributing to missed nursing care)

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0)

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