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Nursing workload associated with neonatal mortality risk: a cross-sectional study

Carga de trabalho de enfermagem associada ao risco de mortalidade neonatal: um estudo transversal

Carga de trabajo de enfermería relacionada al riesgo de mortalidad neonatal: un estudio transversal

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ABSTRACT

Objectives: to analyze the association between nursing workload and neonatal mortality risk in newborns admitted to the Neonatal Intensive Care Unit. **Methods:** this is an observational, cross-sectional study conducted from January 2019 to January 2020. **Results:** the sample consisted of 399 newborns, 55.4% male, Nursing Activities Score mean of 67.5%, and Score for Neonatal Acute Physiology Perinatal Extension mean of 17.7, revealed itself as a predictor of the risk of death, while gestational age, length of hospitalization, and the first-minute Apgar established a protective relationship. The correlation between workload and neonatal mortality was low (r= 0.23, p=0.0009). **Conclusions:** the workload of the nursing team is not associated with the risk of mortality in the Neonatal Intensive Care Unit, as measured by the Nursing Activities Score.
Descriptors: Patient Acuity; Workload; Mortality; Neonatal Nursing; Safety Management.

RESUMO

Objetivos: analisar a associação entre a carga de trabalho de enfermagem e o risco de mortalidade neonatal em recém-nascidos internados em Unidade de Terapia Intensiva Neonatal. **Métodos:** trata-se de um estudo observacional, do tipo transversal, realizado no período de janeiro de 2019 a janeiro de 2020. **Resultados:** a amostra constituiu-se de 399 recém-nascidos, sendo 55,4% do sexo masculino, *Nursing Activities Score* médio de 67,5%, *Score for Neonatal Acute Physiology Perinatal Extension* médio de 17,7 e mostrou-se como preditor para risco de óbito, enquanto a idade gestacional, tempo de internação e Apgar do primeiro minuto estabeleceram uma relação protetora. A correlação entre carga de trabalho e o risco de mortalidade neonatal, foi baixa (r= 0,23, p=0.0009). **Conclusões:** a carga de trabalho da equipe de enfermagem, mensurada pelo "Nursing Activities Score", não está associada ao risco de mortalidade no âmbito da Unidade de Terapia Intensiva Neonatal.
Descritores: Gravidade do Paciente; Carga de Trabalho; Mortalidade; Enfermagem Neonatal; Gestão da Segurança.

RESUMEN

Objetivos: analizar la relación entre la carga de trabajo de enfermería y el riesgo de mortalidad neonatal en recién nacidos internados en Unidad de Cuidados Intensivos Neonatal. **Métodos:** estudio observacional, del tipo transversal, realizado en el período de enero de 2019 a enero de 2020. **Resultados:** la muestra se constituyó de 399 recién nacidos, siendo 55,4% del sexo masculino, *Nursing Activities Score* mediano de 67,5% y *Score for Neonatal Acute Physiology Perinatal Extension* mediano de 17,7, se mostró como pronosticador para riesgo de óbito, mientras la edad gestacional, tiempo de internación y Apgar del primero minuto establecieron una relación protectora. La correlación entre carga de trabajo y el riesgo de mortalidad neonatal fue baja (r= 0,23, p=0.0009). **Conclusiones:** la carga de trabajo del equipo de enfermería, mensurada por el *Nursing Activities Score*, no está relacionada al riesgo de mortalidad en el ámbito de la Unidad de Cuidados Intensivos Neonatal.
Descriptores: Gravedad del Paciente; Carga de Trabajo; Mortalidad; Enfermería Neonatal; Administración de la Seguridad.

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INTRODUCTION

Nursing has a direct and continuous connection with patients and families, and the team is responsible for planning care and ensuring safety. With such a function, the number of tasks and responsibilities increase continuously and causes an accumulation of activities for the professional[1].

There was a change in the focus of care work since the mention of the World Health Organization (WHO) in 2002, World Health Alliance for Patient Safety in 2004, and several other pronouncements and projects that addressed an incentive to improvements on the topic addressed to measures that provide patient safety to promote the reduction of adverse events (AEs) in the direct and indirect relationship with the hospitalized individual. Thus, the workload of the nursing team professionals was subjected to the need for further studies to ensure a better quality of care[1-2].

In this context, the Neonatal Intensive Care Unit (NICU) stands out since it involves comprehensive and specialized care for newborns and their parents or guardians, involving high risks[3].

The nursing workload should also be considered an effective action to improve nursing care, considering the quality of health care, patient safety, and the qualification of the professionals involved[1].

In 1996, the Therapeutic Intervention Scoring System (TISS) was created, which has been modified for neonatal care as Neonatal Therapeutic Intervention Scoring System (NTISS), to measure the workload of the nursing team. The objective was to evaluate the severity of the neonatal patient and the nursing workload during the first 24 hours of hospitalization through several therapeutic interventions[4]. In 2003, a large study was conducted that generated modifications and evolved into the Nursing Activities Score (NAS) as a dependable, valid, and stable instrument[1]. The NAS provides the percentage of time spent by professionals in direct patient care over the course of 24 hours[5-8].

This instrument assists the organization and planning of nursing care and improves communication due to its significant importance in transmission and registration. It is based on the sum of points, which represents the time (in percentage) that patient needed from the nursing staff in the last 24 hours. To calculate the rate in time, each point equates to 14.4 minutes of direct patient care; this allows the identification of the necessary hours of nursing care and, therefore, a better team organization dynamics[5-7].

Originally, NAS was performed in adult intensive care units. However, it was adapted and validated by Bochembuzio for use in the NICU in 2007 due to the great attention provided to neonatal patients: he used a tutorial on the homogeneous application of the instrument in neonatal care[4].

The NAS is composed of 23 items divided into seven categories: basic activities, ventilatory support, cardiovascular support, renal support, neurological support, metabolic support, and specific interventions[5-8].

In studies conducted in an adult intensive care unit, the knowledge between the relationship of nursing staff workload and patient severity resulted in the validation of NAS as a predictor of mortality[9-10].

Within the neonatal units, clinical severity has been described since 1993 by different measurement scores. In this study, we opted for the use of SNAPPE II (Score for Neonatal Acute Physiology Perinatal Extension) because it is the instrument used by the Brazilian Neonatal Research Network and the Vermont Oxford Network[11-12].

Knowing the severity of neonates admitted to the NICU allows for clinically estimating the risk of in-hospital mortality and also considering and correlating therapeutic actions, length of hospitalization, and costs to contribute to the clinical and managerial decision-making of nurses[13].

The literature on the subject is scarce, and there is a gap in knowledge about the relationship between severity indices and the workload of the nursing team in neonatal units. Thus, the question is: is there an association between the workload of the nursing team and the risk of neonatal mortality, as evidenced by SNAPPE II, in newborns (NB) admitted to the NICU?

The study hypothesizes that the workload of the nursing team is directly associated with the severity of the patient and may be a predictor of mortality in the NICU.

OBJECTIVES

To analyze the association between nursing workload and neonatal mortality risk, as evidenced by SNAPPE II, in newborns admitted to the NICU.

METHODS

Ethical aspects

This is a subproject of the doctoral project entitled "Impact of nursing workload for staff sizing and its association with adverse event reporting". It was approved by the Research Ethics Committee of the responsible institution, meeting the national and international standards of ethics in research with human beings, according to resolution 466/12.

Design, period, and place of the study

This is an observational, cross-sectional study, guided by the tool Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), conducted from January 2019 to January 2020 in the Neonatal Intensive Care Unit (NICU) of a high-complexity reference hospital in the countryside of the state of São Paulo.

The NICU of the study is classified as Type II NICU. Founded in 1986, it currently has 16 exclusive beds and is inserted in the largest public institution linked to the Unified Health System of the region to which it belongs, being responsible for the referenced care of 68 municipalities.

Sample and criteria of inclusion

The study used a non-probabilistic convenience sample. It included all 399 newborns admitted to the NICU who remained hospitalized for more than 24 hours during the study period.

Study protocol

Data collection was based on management reports provided by the NICU and the institution's computerized system.

The study used the independent variables sex, hours of life at the time of hospitalization, gestational age, birth weight, type of delivery, origin, diagnosis at the time of hospitalization, length of hospitalization, outcome, and NAS. NAS is routinely conducted just once in evening time by a unit's professionally trained nurse. All the variables mentioned are recorded in the Electronic Patient Record (EPR) and were extracted by the IT service of the institution at the request of the researchers.

Dependent variable was SNAPPE II, performed with data from the first 24 hours of admission of the NB to the NICU by the medical team. It considers the following parameters: blood pressure, temperature, urinary output, serum pH, and PaO2/FiO2 ratio, scoring the worst moment during the period. In addition, it considers the presence of multiple seizures and birth weight, classifies as small for gestational age, and Apgar at the fifth minute of life[11-12]. The NICU's management reports provided the SNAPPE II data.

Analysis of results and statistics

The study organized data in a spreadsheet in the Excel program® and initially submitted it to descriptive statistics. Then, the logistic regression model was applied to identify the association of independent variables with mortality rates, indicating risk factors and protective factors correlated through Pearson's correlation. The software used for statistical analysis was SAS® 9.4 for Windows. The results were categorized and presented in tables and figures, and the analyzes were considered statistically significant if the value of *p* was less than 5%.

RESULTS

The sample consisted of 399 newborns, who remained hospitalized in the study unit for more than 24 hours, as characterized according to Table 1.

The principal diagnoses found were respiratory disorders (67.5%), followed by metabolic disorders (8.5%) and neonatal infections (6.5%) (Table 2).

For the hospitalization outcome, the study observed a total of 352 discharges (88.2%), 42 deaths (10.5%), and five occurrences (1.3%) without data recording in the medical records.

Regarding the workload of the nursing team, the study identified a mean NAS of 67.5% with a variation between 31.8% and 120.5% and a standard deviation of 17.7% in the first 24 hours of hospitalization Gravity, measured through the application of SNAPPE II, presented mean from 17.7 points with a range between 0 and 107 and a standard deviation of 23.8.

The study adjusted a logistic regression model to discover the factors that interfere with mortality, considering SNAPPE II, NAS of the first 24 hours of admission, gestational age in weeks (GA), days of life, first- and fifth-minute Apgar, length of hospitalization, and weight as explanatory variables; and death as an outcome.

The SNAPPE II score presented a risk relationship for the occurrence of death, and for each point of the score, there was an increase in the risk of death of 4.5%. Regarding the GI variables (OR = 0.679), first-minute Apgar (OR = 0.594) and length of hospitalization (OR = 0.928) demonstrated a protective relationship, reducing by 30%, 40%, and 7% the risk of death, respectively, according to the evaluated unit (Table 3).

The study performed Pearson's correlation between the NAS and SNAPPE II variables to analyze the workload of the nursing team and severity, demonstrating a significant correlation (r = 0.23, p = 0.0009), but low, representing a direct relationship between the variables (Figure 1).

Table 1 - Descriptive measures for sample characterization, Botucatu, São Paulo, Brazil, 2020

Characteristics	n	%
Sex		
Female	178	44.6
Male	221	55.4
Origin		
JA/OC	254	63.7
IRC	57	14.3
ER	26	6.5
NICU	42	10.5
Not informed	20	5.0
Type of delivery		
Caesarean section	250	62.7
Vaginal	125	31.3
Not informed	24	6.0
	Mean±SD	
Days of life	2.4±6.3	
Gestational age (weeks)	35.1±4.1	
Weight (grams)	2.448.4±954.8	
First-minute Apgar	6.1±2.8	
Fifth-minute Apgar	8.1±1.6	
Length of hospitalization (days)	13.7±16.8	

JA – Joint Accommodation; CO – Obstetric Center; IRC – Internal Regulation Center; ER – Emergency Room; NICU – Neonatal Intermediate Care Unit.

Table 2 - Description of the principal diagnoses observed in the sample, Botucatu, São Paulo, Brazil, 2020

Principal diagnoses	n	%
Respiratory disorders	269	67.5
Metabolic disorders	34	8.5
Neonatal infections	26	6.5
Cardiocirculatory disorders	23	5.8
Neurological disorders	20	5.0
Gastrointestinal disorders	20	5.0
Genitourinary disorders	4	1.0
Congenital malformation	3	0.7
Total	399	100.0

Table 3 - Adjustment of the logistic regression model for death according to the variables

Variables	Estimate	Standard Error	*p*	*Odds Ratio*	IC 95%
Intercept	8.0726	4.8738	0.0977	-	-
SNAPPE II	0.0439	0.016	0.0062*	1.045	1.013 - 1.078
24 h NAS	0.00919	0.0276	0.739	1.009	0.956 - 1.065
Gestational age	-0.3866	0.1573	0.014*	0.679	0.499 - 0.925
Weight	0.0009	0.0007	0.1989	1.001	1 .000 - 1.002
Apgar (1min)	-0.5204	0.2095	0.013*	0.594	0.394 - 0.896
Apgar (5min)	0.3232	0.3276	0.3239	1.382	0.727 - 2.625
Hospitalization length	-0.0748	0.027	0.0057*	0.928	0.880 - 0.978
Days of life	-0.5969	1.0256	0.5606	0.551	0.074 - 4.109

p < 0.05.

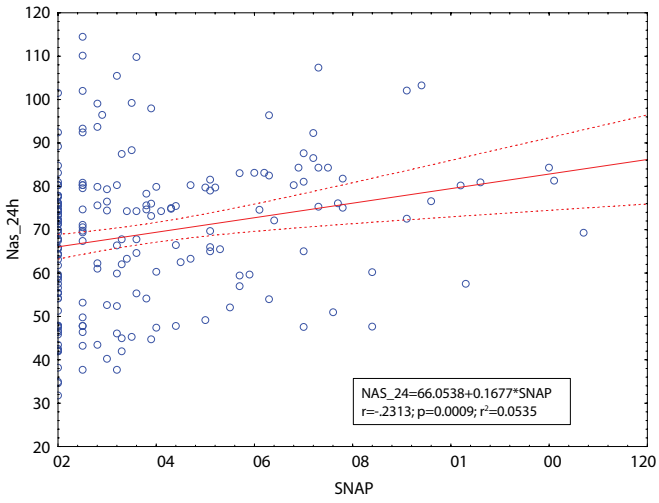

Figure 1 - Graphical representation of Pearson's correlation between SNAPPE II and NAS

DISCUSSION

Based on the results, the study found a higher number of male hospitalized patients (55.3%), premature, with a mean gestational age (GA) of 35.1 weeks and a mean weight of 2,448.4 grams.

The GI is similar to pre-existing studies in the literature, with the majority of males; however, the average weight found in this study is higher than that presented in other studies[14-15].

The proportion of the type of delivery identified in the study was 62.7% for cesarean section and 31.3% for vaginal delivery, which is in line with the rate found in Brazil in a study conducted by the WHO in 2016[16]: the country had the second-highest cesarean section rate on the planet (55%), second only to the Dominican Republic (56%) and distancing itself from the ideal rate proposed in 1985 by the WHO, which should be between 10% and 15%.

Concerning the length of hospitalization, the study found an average of 13.7 days, lower than that found in an investigation conducted in the neonatal ICU of the General Hospital of Caxias do Sul, State of Rio Grande do Sul[17]. There the mean found was 19 days and higher than the mean observed in another study at the University Hospital of the University of São Paulo (HU-USP)[4], averaging nine days.

The Apgar score is a valuable tool for predicting mortality[18-21]. The classification range 7-10 represents a healthy patient, but when this value is below seven, it means a more severe condition that requires more eminent assistance[22]. In the study, the Apgar score had an average of 6.1 in the first minute, representing a more critical common condition; and 8.0 in the fifth minute, with an improvement in the clinical picture.

As for the outcome of hospitalization, the research found a mortality rate of 10.6%, close to that cited in Brazilian studies, which have a rate of 9.1%[4] and 8.2%[17], and lower than the rate observed in neonatal ICU in Guinea-Bissau, West Africa[23], a rate of 19.6%.

The principal diagnoses found were respiratory disorders (67.5%), followed by metabolic disorders (8.5%) and neonatal infections (6.5%). This result differs from a study conducted in the Federal District[14], in which the majority had a diagnosis of prematurity, followed by cardiological and neurological disorders; and another in Paraná[15], in which prevailed prematurity, followed by respiratory conditions and hypoglycemia.

Through the logistic regression of the variables, the study observed a relationship of protection to death with the variables GA, first-minute Apgar, and length of hospitalization, which means that the higher the value, the lower the mortality rate. This reality is in line with the literature, which points to prematurity as one of the most relevant factors associated with neonatal mortality[24].

In an integrative review[25], one of the principal clinical factors scored as influencers of death was respiratory distress and asphyxia, with a low Apgar score. These data were similar to the results of the study in the State of Rio Grande do Sul[17].

The longer hospitalization time reflects on the development of the NB due to the premature profile of the sample, i.e., the longer patient stays in the unit implies better motor development and positive evolution of the clinical picture[26].

The SNAPPE II presented a risk related to death: the higher its value, the higher the mortality. It converges with its true meaning of use described by Richardson in 1993 in its creation, proving to be an effective instrument as an indicator of death[12].

The workload of the nursing team evidenced a mean in the first 24 hours of hospitalization of 67.5%. When searching the literature, the comparison with other studies is impossible since the measurement of the daily NAS of the unit, in general during a specific period, differs from this present study, in which the workload analyzed was exclusive to each NB on their first day of hospitalization.

In a study conducted in the Federal District[14] in 2017, NAS was measured for 30 days, resulting in an average of 49.25%. In another study conducted in São Paulo[27] in 2013, the average was 86.78% during nine days.

The severity measured by the SNAPPE II instrument — considering 0 as usual risk and its elevation as increased risk of death — presented an average of 17.77 points, with a variation between 0 and 107, with higher severity values when compared to the study carried out in Porto Alegre[28], with resulting values between 5 and 74; and also showed a lower average compared to another survey, carried out in the State of Ceará in 2017[11], with a value of 27.

When the SNAPPE II calculated the correlation between nursing workload and mortality risk, it identified a direct but low significance ($r = 0.23$, $p = 0.0009$). This relationship between workload and mortality risk means that when an increase in the severity of the clinical picture of the patient occurs, and there is a higher workload of the nursing team, which can influence mortality rates.

Richardson, when developed the study for the validation of SNAP (previous version of SNAPPE II) in 1993, performed the correlation between severity and nursing workload and obtained a moderate correlation ($r = 0.59$, $p < 0.001$)[12].

This correlation, when performed in adult ICU, displays variable values ranging from low ($r = 0.45$) to high correlation ($r = 0,82$), using APACHE II, an instrument with a purpose similar to that of SNAPPE II for measuring the gravity of patient, which can clinically estimate the mortality risk in adults[10,29].

In the experience of the researchers, the results could be explained by the fact that newborns with lower severity need more physical interventions, such as the application of Kangaroo methodology and the use of non-invasive ventilation devices that require periodic adjustments, short-and medium-term venous access, mobilization and feeding, as well as greater attention in the care of family members with the practice of health education; that is, all this may require more

time from the team[30]. Also, in the first 72 hours of life, for premature infants and extremely underweight newborns, minimal manipulation is recommended in order to provide neuroprotection and a lower incidence of practices that generate clinical stress to the patient[31].

Thus, the low relationship found in this study demonstrates that workload is not associated with the risk of neonatal mortality. That is, in the NICU, the degree of dependence and work demand of the nursing team does not reflect the severity of the patient.

Study limitations

The limitations were: an impossibility of comparison and generalization of the results presented since the research did not find studies in the field of neonatology, and data collection took place in a single center.

Contributions to the field of Nursing

Knowing the nursing workload and patient severity facilitates unit management, promoting effectiveness in the dynamics and constitution of the nursing team. In the literature, few studies relate these variables within the scope of neonatology, which highlights the great relevance of the present study, with robust sample representativeness, for the scientific community.

CONCLUSIONS

This study showed that the workload of the nursing team, measured by the NAS, is not associated with the mortality risk in the NICU. However, it is essential to jointly use measurement instruments, such as the NAS and SNAPPE II, to improve the quality and effectiveness of the work dynamics of the nursing team. It is recommended conducting studies that address the workload of the nursing team in the area of neonatology to expand knowledge and improve care for sick newborns.

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