Intensive and Critical Care Nursing (2013) **29**, 112—116

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/iccn

ORIGINAL ARTICLE

Nursing workload in neurological intensive care units: Cross-sectional study

Alda Ferreira Queijo[a], **Renata Soares Martins**[b], **Rafaela Andolhe**[c,*], **Elaine Machado Oliveira**[c], **Ricardo Luis Barbosa**[c], **Katia Grillo Padilha**[d]

[a] *Hospital da Beneficência Portuguesa de São Paulo, Rua Maestro Cardin, 769 Bela Vista, CEP 01323-900, São Paulo, Brazil*
[b] *Undergraduate Program, School of Nursing, University of São Paulo EEUSP, Av. Dr. Eneas de Carvalho Aguiar, 419, CEP 05403-000, São Paulo, SP, Brazil*
[c] *Graduate Program in Adult Health Nursing, School of Nursing, University of São Paulo, Av. Dr. Eneas de Carvalho Aguiar, 419, CEP 05403-000, São Paulo, SP, Brazil*
[d] *School of Nursing, University of São Paulo, Av. Dr. Eneas de Carvalho Aguiar, 419, CEP 05403-000, São Paulo, SP, Brazil*

Accepted 11 August 2012

KEYWORDS
Intensive care units;
Workload;
Nursing;
Neurology

Summary
Background: Nursing workload has been associated with quality of patient care. Thus, it is important to measure nursing workload in neurological intensive care units (neuro-ICUs).
Objective: The aims of the study were to assess nursing workload in neuro-ICUs and identify independent factors associated with nursing workload.
Method: This descriptive, cross-sectional study was conducted in two neuro-ICUs with 11 beds each (for a total of 22 beds) of a private general hospital in the city of São Paulo, Brazil. Data from the first 24 hours of admission to the neuro-ICUs from 100 consecutive patients were collected from the hospital database. The Nursing Activities Score (NAS) was used to assess nursing workload in the neuro-ICUs. Data were analysed using descriptive and inferential statistics and multiple linear regression analysis. Statistical significance was set at $\alpha = 0.05$.
Results: Patients were mostly men (52.00%), had a mean age of 55.10 years, median length of ICU stay of 2 days, and survival rate of 94.00%. Fifty-nine percent of patients were transferred from the surgical ward. Mean NAS was 65.18% (standard deviation = 6.63%) and the risk of mortality according to the Simplified Acute Physiology Score (SAPS II) and the Logistic Organ Dysfunction System (LODS) was 17.79% and 16.30%, respectively.
Conclusion: The present results are important for the effective planning and use of nursing resources according to the care needs of patients in neuro-ICUs.

* Corresponding author.
E-mail addresses: aldafq@usp.br (A.F. Queijo), rafaelaandolhe@usp.br (R. Andolhe), matussjc@yahoo.com.br (E.M. Oliveira), rluisbarbosa@usp.br (R.L. Barbosa), kgpadilh@usp.br (K.G. Padilha).

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http://dx.doi.org/10.1016/j.iccn.2012.08.001

Implications for clinical practice

- Measuring the nursing workload in the Neurological Intensive Care Units (Neuro-ICUs) contributes to forescast staff requirements in these units.
- The Nursing Activities Score (NAS) is a tool available for measuring nursing workload based on hours of nursing care in the ICUs.
- The identification of the factors associated to nursing workload in the Neuro-ICU environment is relevant not only for nursing care planning, but also for appropriate management of human resources, quality of life of health professionals and patient safety.

Introduction

An Intensive Care Unit (ICU) is a complex technological environment associated with a high level of emotional distress and workload. Thus, the use of efficient management strategies is necessary to secure the best use of resources and patient safety (Aiken et al., 2012). Nursing workload is a topic that has been widely discussed because of its impact on the quality of life of health professionals, on hospital costs associated with nurse staffing and on patient safety (Carayon and Gürses, 2005). The qualitative and quantitative assessment of nursing personnel may provide important information for the management of health care resources, helping humanize health care, increase efficiency, and reduce healthcare costs (Cucolo and Perroca, 2010). ICU head nurses must use appropriate nursing workload measurement tools that provide the information needed to negotiate successfully with hospital managers and administrators in order to ensure adequate ICU staffing (Miranda et al., 2003).

Review of the literature

The Nursing Activities Score (NAS), a modification of the Therapeutic Intervention Scoring System (TISS-28) (Miranda et al., 1996), is one of the instruments available for measuring nursing workload in ICUs based on hours of nursing care. With the new format, the NAS assesses 80.80% of nursing activities, surpassing the 43.30% assessed by the TISS-28 and describing about twice as much nursing activities in the ICU as the TISS-28. The NAS has 23 items grouped into 7 main categories. The total score indicates the percentage of nursing hours of direct care per nurse per shift (Miranda et al., 2003).

In the literature, several tools for measuring nursing workload have been proposed to determine the level of staffing required to meet the demands of patient care in the ICU (GIRT, 1991; ICNARC, 1999; Miranda et al., 1997). However, few comparative studies have examined the nursing workload according to the hours of care required by patients in general and specialised ICUs in a single hospital.

Other four studies report the use of the NAS in the ICU. In two studies conducted by a Spanish group (Adell et al., 2005, 2006), the average score was approximately 40.8% (SD = 14.1%); in a Greek study (Giakoumidakis et al., 2010), the NAS was less than or equal to 61.6%; and in a Norwegian study (Stafseth et al., 2011), the mean NAS was 96.24% (SD = 22.35%).

In Brazil, studies on nursing workload in ICUs have increased in recent years after the cross-cultural adaptation and validation of the NAS (Queijo and Padilha, 2009). Research conducted in General Intensive Critical Unit (G ICU) identified variability in the mean NAS: 52.7% (Ducci et al., 2008), 62.13% (Silva et al., 2010) and 80% (Balsanelli et al., 2009).

Despite the importance of measuring nursing workload using the NAS, there are few studies on nursing workload in general ICUs, and even fewer studies have been performed in specialty ICUs, such as neuro-ICUs. Studies conducted in general ICUs in Brazil have reported high NAS values, indicating a mean nursing workload $\geq$60.0% (Balsanelli et al., 2009; Panunto and Guirardello, 2009; Silva et al., 2010, 2011). However, lower NAS values were reported in studies conducted in Spain [mean NAS = 40.80%; standard deviation (SD) = 14.1%] (Adell et al., 2005, 2006). Only two studies on nursing workload were carried out using the NAS in specialty ICUs (cardiac surgery and cardiovascular ICUs) and reported NAS of 61.60% (Giakoumidakis et al., 2010), and over 70.0% (Ducci et al., 2008).

A study on nursing workload conducted in a neuro-ICU with 11 beds of a tertiary-care university hospital in the city of São Paulo, Brazil, reported a mean TISS-28 score of 22 (SD = 4.40), corresponding to 233.20 minutes of a 6-hour shift (360 minutes), which is equivalent to a NAS of 64.77%. In that study, the sample consisted of 51 patients with a mean age of 42 years (SD = 18.70 years), who were followed during the ICU stay (mean length of ICU stay = 9 days, SD = 14.80 days); the mortality rate was 9.80% (Padilha et al., 2007).

The possibility of measuring nursing workload in specialty ICUs, which require adequate staffing levels, and the scarcity of evidence-based studies on neuro-ICUs were the main motivation for this study. The aims of the study were to (1) determine the demographic and clinical characteristics of patients admitted to neuro-ICUs; (2) measure nursing workload using the NAS; and (3) identify factors associated with nursing workload.

Materials and methods

The data for this descriptive, cross-sectional study were obtained from a database containing information on general, cardiovascular and neurological ICU patients of a large tertiary-care general hospital in the city of São Paulo, Brazil. Patient anonymity was maintained. The hospital provides care for medical and surgical patients.

Table 1 Comparison of mean NAS values (%) with the demographic and clinical characteristics of neuro-ICU patients ($n = 100$).

Characteristics	Mean NAS (%)	SD (%)
Sex		
P-value	0.870[b]	
Men	65.38	6.49
Women	64.96	6.83
Age		
P-value	0.900[b]	
≤60 years	64.87	6.11
>60 years	65.66	7.42
Location before ICU admission		
P-value	0.079[c]	
Operating room	64.19	5.56
Emergency room	66.24	8.85
Admission unit	67.49	4.23
Other ICU	65.18	6.62
Type of admission		
P-value	0.631[b]	
Medical	65.57	7.44
Surgical[a]	64.79	5.74
Vital status at discharge		
P-value	0.038[b]	
Survivors	64.96	6.73
Nonsurvivors	68.58	3.14

[a] Elective and emergency surgeries.
[b] Mann–Whitney *U* test.
[c] Kruskal–Wallis test.

After approval from the Research Ethics Committee of the institution and after statement of responsibility signed by main researcher who was not a nursing team member, data from 100 consecutive patients admitted to two neuro-ICUs (N1-ICU and N2-ICU) between August and September of 2006 were collected. Inclusion criteria were patients of both sexes, aged ≥18 years, who had been admitted for medical or surgical treatment and had a length of ICU stay ≥24 hours. Exclusion criteria were age < 18 years, length of ICU stay <24 hours and ICU readmissions. The neuro-ICUs had 11 beds each, for a total of 22 beds. Because the two ICUs had similar characteristics, the data from both units were combined for analyses. The institution and neuro-ICUs were chosen for convenience, based on the size of the hospital (1700 beds). The nursing team working per 8-hour-shift consisted of one nurse and 10 nursing technicians in the N1-ICU, and one nurse and 8 nursing technicians in the N2-ICU.

Information collected from medical records included data from the first 24 hours of admission to the neuro-ICUs, such as age, sex, clinical history, reason for admission, location before ICU admission, severity of illness [Simplified Acute Physiology Score II (SAPS II)] (Le Gall et al., 1993), organ dysfunction [Logistic Organ Dysfunction System (LODS)] (Le Gall et al., 1996), and nursing workload (NAS) (Miranda et al., 2003). Patient data at ICU discharge, including date of discharge, vital status at discharge, patient transfer, discharge destination, and length of ICU stay (days) were also collected. Additional information was obtained from the nursing staff, when necessary.

Table 2 Correlation of NAS values with SAPS II and LODS scores, age (years) and length of ICU stay of neuro-ICU patients ($n = 100$).

	LODS	SAPS II	Age (years)	Length of ICU stay (days)
NAS				
ρ-Value	0.14	0.29	0.04	0.51
P-value	0.17	0.00	0.67	0.00

Statistical analysis

The Kolmogorov–Smirnov statistic was used to test for normality. Because NAS scores were not normally distributed, the Mann–Whitney test was used to compare NAS value distribution with the variables sex, age (age group), reason for admission, and vital status at ICU discharge, and the Kruskal–Wallis test was used in the comparison with the variable location before ICU admission. The Spearman correlation coefficient was used to determine the correlation between NAS values and SAPS II and LODS scores, age and length of ICU stay. Multiple linear regression analysis with stepwise forward selection (Kleibaum et al., 1997) was used to identify the variables associated with nursing workload in the neuro-ICUs.

Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 13.0 for Windows (SPSS Inc., Chicago, IL, USA). All statistical tests were performed at a significance level of $\alpha = 0.05$.

Results

Patients admitted to the neuro-ICUs were mostly men (52.00%), had a mean age of 55.10 years (SD = 18.60 years) and were transferred from the operating room (59.00%).

The percentages of elective medical and surgical admissions were the same (50.00%); mean length of ICU stay was 5.10 days [SD = 4.90 days, median = 2 days; lower quartile (P25) = 1 day; upper quartile (P75) = 5 days; maximum = 26 days]; and the survival rate at ICU discharge was 94.00%. Mean severity of illness was 32.17 and risk of mortality was 17.79%, according to the SAPS II; and organ dysfunction and risk of mortality were 3.57 and 16.30%, respectively, according to the LODS.

The mean nursing workload (NAS) was 65.18% (SD = 6.63%). A statistically significant difference ($P = 0.038$) was found only between nursing workload and vital status at ICU discharge (Table 1). There was a correlation between nursing workload (NAS) and SAPS II values ($\rho = 0.29$, $P = 0.000$) and length of stay ($\rho = 0.51$, $P = 0.000$), as shown in Table 2. These variables were used in the multiple linear regression analysis with stepwise forwards selection. Only variables that were statistically significant ($P < 0.05$) in univariate analysis were retained in the model (Table 3).

The resulting linear regression model was given by NAS = 61.40 + 0.163 × SAPS II-0.053 × age, showing that for every one point increase in severity of illness there was a 16.30% increase in nursing workload (NAS), while an increase

Table 3 Results from multiple linear regression analysis with stepwise forwards selection for variables associated with nursing workload (NAS) in neuro-ICUs.

Variable	β	95% CI (β)	*P*-value	Adjusted R^2
SAPS II	0.163	[0.091;0.236]	0.000	0.58
Age	−0.053	[−0.102;0.004]	0.035	

of one year in patient age resulted in a 5.30% reduction in nursing workload.

Discussion

Studies on nursing workload based on hours of nursing care and affecting factors are of fundamental importance in ICU management, particularly in neuro-ICU management.

The participants in this study were mostly young adults with low severity of illness; most patients had undergone medical or surgical treatment, were transferred from the operating or emergency room, had a median length of ICU stay of 2 days, and had low mortality rate. These findings are similar to those of other studies in which the participants were also mostly men (52.00%) (Ducci et al., 2008; Panunto and Guirardello, 2009; Sousa et al., 2009; Souza et al., 2008) the mean age was 55.00 years (SD = 18.60 years) (Panunto and Guirardello, 2009; Stafseth et al., 2011), and there was a predominance of patients transferred from the operating room (59.00%) (Ducci et al., 2008; Panunto and Guirardello, 2009) followed by patients from the emergency room (29.00%). On the other hand, the severity of illness (17.79%) and mortality (6%) was lower in our sample compared to those reported for general and neurological ICUs (Gonçalves and Padilha, 2007).

The characteristics of the our sample may be attributed to the fact that most patients had undergone elective surgeries and that the primary reasons for admission were tumours of the central nervous system, disc herniation, brain aneurysm, and trauma. Trauma was mainly the result of traffic accidents in which young adults comprise most of the victims, according to Brazilian studies (Sousa et al., 2009). Our results revealed a high nursing workload (NAS = 65.18%; SD = 6.63%) associated with the profile of the patients, although higher values have been reported for general ICUs (NAS = 96.24%) (Stafseth et al., 2011) cardiovascular ICUs (NAS = 73.70%) (Ducci et al., 2008) and general and neurological ICUs (NAS = 69.90%) (Gonçalves and Padilha, 2007).

Still, one can argue that the nursing workload at the neuro-ICUs was high since 5.21 hours of direct nursing care were provided per 8-hour shift [NAS(8 h) = 100%]. This result shows the mean number of hours (5.21 hours) spent by a professional in the direct care of only one patient during an 8-hour shift in the neuro-ICUs, and that this professional can help another professional care for a different patient during the remaining 2.8 hours of the shift.

Univariate analysis revealed that the only factor associated with nursing workload was vital status at ICU discharge, meaning that non-survivors required more direct nursing care than survivors, with a mean NAS of 68.58% ($P = 0.038$). A similar study conducted in general and neurological ICUs found that nursing workload was associated not only with vital status at ICU discharge but also with length of ICU stay ($P = 0.00$) (Gonçalves and Padilha, 2007).

The analysis of the impact of other factors on the number of hours of direct nursing care showed that severity of illness (SAPS II) and age (years) were associated with nursing workload. However, it was observed that although increased severity of illness was associated with increased nursing workload, the increase in patient age was associated with a reduction in nursing workload (Table 3).

The correlation between SAPS II and NAS values suggests that, as the patient's clinical condition worsened, there was an increase in the time spent in medical and nursing interventions, observing the patient, and monitoring vital signs and laboratory results, resulting in increased nursing workload. A study that has evaluated nursing workload and severity of illness using the NAS and the Acute Physiology and Chronic Health Enquiry (APACHE II) in 148 patients admitted to a general ICU of a public hospital reported a correlation between the two variables ($r = 0.82$), which is consistent with our results (Sousa et al., 2009).

The finding that age is inversely associated with nursing workload in neuro-ICUs may be explained by the fact that the ICU staff may divert more attention and therapeutic resources to younger patients, thus resulting in increased nursing workload; however, further studies are necessary to confirm this hypothesis.

In conclusion, severity of illness and age were the only factors associated with nursing workload in neuro-ICUs. Most patients were young adult who had undergone medical or surgical treatment and were transferred from the operating or emergency room. Severity of illness and mortality rate were low in this sample.

Despite the important contributions, we acknowledge some limitations to our study, including the fact that it was conducted with a convenience sample in one hospital only. Moreover, the number of studies on the use of the NAS in neuro-ICUs is not large enough to allow comparisons. Still, the results suggest that personnel management should be based on a more rational approach for planning ICU nurse staffing according to the specific characteristics of the patients and nursing workload necessary to ensure safe and high-quality care.

Conclusion

Based on the demographic and clinical characteristics of 100 patients admitted to neuro-ICUs and on the assessment of nursing workload, we observed some implications for practice. Patients had a mean age of 55.10 years (SD = 18.60 years), were mostly men (52.00%), had been transferred from the operating room (59.00%), and had a survival rate of 94.00%. The mean length of ICU stay of 5.10 days (SD = 4.90 days, median = 2 days) and the risk of mortality obtained using the SAPS II and LODS was 17.79% and 16.30%, respectively.

Besides, the mean nursing workload (measured by the NAS) was 65.81% (SD = 6.63%), meaning that 5.21 hours were spent on direct nursing care per patient during an 8-hour shift.

Finally, severity of illness (assessed by the SAPS II) and age were the only factors associated with nursing workload; severity of illness was directly associated and age was inversely correlated with nursing workload.

Conflict of interests

None. There was no external funding for this study.

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