Association between pre-operative nutritional status and total length of hospital stay in neurological surgical patients

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Highlights

- Preoperative nutritional risk increased hospital length of stay.
- Malnutrition was associated with longer hospitalization after neurosurgery.
- Age, comorbidities, and ASA classification influenced hospital stay.
- Early nutritional screening may improve postoperative outcomes.

Abstract

Objective: To evaluate the association between preoperative nutritional risk and total length of hospital stay in patients undergoing neurological surgery.
Methods: This retrospective cohort study analyzed medical records of patients hospitalized for elective neurological surgeries between January and May 2023 and January and May 2025. Adult and older patients of both sexes were included. Nutritional risk was assessed using the Nutritional Risk Screening tool (NRS-2002), and nutritional status was evaluated according to AND-ASPEN criteria. Associations between nutritional risk, malnutrition, age, comorbidities, ASA classification, and total length of hospital stay were analyzed using Student's t-test, Mann–Whitney test, Kruskal–Wallis test with Dunn's post hoc, Pearson's chi-square test, Spearman's correlation, and multivariate regression analysis, with a significance level of 5%.
Results: A total of 334 patients were evaluated, with a predominance of females (53%). The main comorbidities were hypertension (44.9%), cancer (24.6%), and diabetes mellitus (17.1%). Most patients did not present nutritional risk (53.6%). Patients at nutritional risk were older, had a higher prevalence of chronic diseases, worse clinical condition according to the ASA classification, higher prevalence of malnutrition, and longer hospital stay. The median length of hospital stay was 8 (5–16) days and was significantly longer among patients at nutritional risk (16 [8–28] days) compared to those without risk (6 [4–8] days; $p<0.001$). Similarly, patients with moderate or severe malnutrition had longer hospital stays compared to well-nourished patients ($p<0.001$). Nutritional risk and malnutrition were independently associated with length of hospital stay.
Conclusion: Preoperative nutritional status is significantly associated with hospital length of stay in neurological surgical patients, highlighting the importance of early nutritional screening and appropriate interventions to reduce complications and optimize postoperative recovery.

Keywords: Neurological surgery; Length of hospital stay; Nutritional status; Preoperative care; Nutritional risk screening

Introduction

Malnutrition is a frequent condition in hospitalized patients and is associated with worse clinical outcomes, including longer hospital stays and compromised disease prognosis [1]. Population aging has contributed to the increased prevalence of neurological diseases, such as dementia and stroke. These conditions frequently result in functional limitations, dysphagia, and reduced food intake, favoring the deterioration of nutritional status [2]. Evidence indicates that poor nutritional status, associated with the presence of comorbidities and functional dependence, is directly related to prolonged hospital stays [3,4].

In Brazil, the IBRANUTRI multicenter study demonstrated that approximately 48% of hospitalized patients presented with malnutrition, with 12% classified as having severe malnutrition [5]. In neurological patients, this scenario is equally concerning, since cognitive alterations, motor difficulties, and swallowing disorders compromise food intake and worsen nutritional status [6]. Studies with surgical patients show a high prevalence of nutritional risk, especially in the elderly and in more complex surgeries, with this risk being associated with increased length of stay and mortality [7].

Neurological surgeries represent high-risk procedures, characterized by an intense inflammatory response and a hypermetabolic state in the postoperative period, which favor protein catabolism, muscle mass loss, delayed healing, and increased susceptibility to infections [8,9]. Although strategies such as the ERAS and ACERTO protocols propose reducing preoperative fasting, clinical practice still reveals prolonged periods of fasting, which contribute to the worsening of hospital malnutrition and delay surgical recovery [10-12].

Early nutritional screening using the Nutritional Risk Screening (NRS-2002), combined with the diagnostic assessment of malnutrition using the AND-ASPEN criteria, allows for the identification of at-risk patients and the targeting of appropriate nutritional interventions, contributing to better clinical outcomes [13-15]. However, studies that specifically evaluate the influence of preoperative nutritional status on the length of hospital stay in patients undergoing neurological surgery are still scarce, representing a significant gap in the literature.

The hypothesis is that patients at nutritional risk or diagnosed with malnutrition have longer hospital stays compared to eutrophic patients. Thus, the overall objective of this study was to investigate the association between preoperative nutritional status and length of hospital stay in patients undergoing neurological surgery. As specific objectives, the relationships between nutritional risk, malnutrition, age, comorbidities, and ASA classification with the total length of stay were analyzed.

Methods

This is a retrospective observational study, with secondary analysis of a database of patients undergoing neurological surgery, linked to the project "Evaluation of preoperative fasting time and nutritional risk of surgical patients hospitalized in a Hospital in Southern Brazil", approved by the Research Ethics Committee (CAAE No. 57570522.2.0000.5335), with exemption from the Informed Consent Form as it involves secondary data.

Adults and elderly individuals of both sexes, hospitalized for neurological surgeries in a tertiary hospital of the Santa Casa de Misericórdia Hospital Complex in Porto Alegre (RS), between January and May 2023 and January and May 2025, were included. Pediatric patients and those with hospitalization of less than 48 hours were excluded.

Nutritional risk was assessed using the Nutritional Risk Screening (NRS-2002) and nutritional status using the AND-ASPEN criteria. Clinical conditions were obtained from medical records, including surgical risk classification according to the American Society of Anesthesiologists (ASA). Total length of hospital stay was the primary outcome. Quantitative variables were described by mean and standard deviation or median and interquartile range, and categorical variables by absolute and relative frequencies. For comparisons, Student's t-test, Mann-Whitney test, Kruskal-Wallis test with Dunn test, and Pearson's chi-square test were used. Associations with length of stay were assessed by Spearman correlation and multivariate linear regression, with a 95% confidence interval. A significance level of 5% ($p \leq 0.05$) was adopted. Analyses were performed using SPSS software version 27.0.

All data were analyzed anonymously, in accordance with CNS Resolutions No. 466/2012 and No. 510/2016.

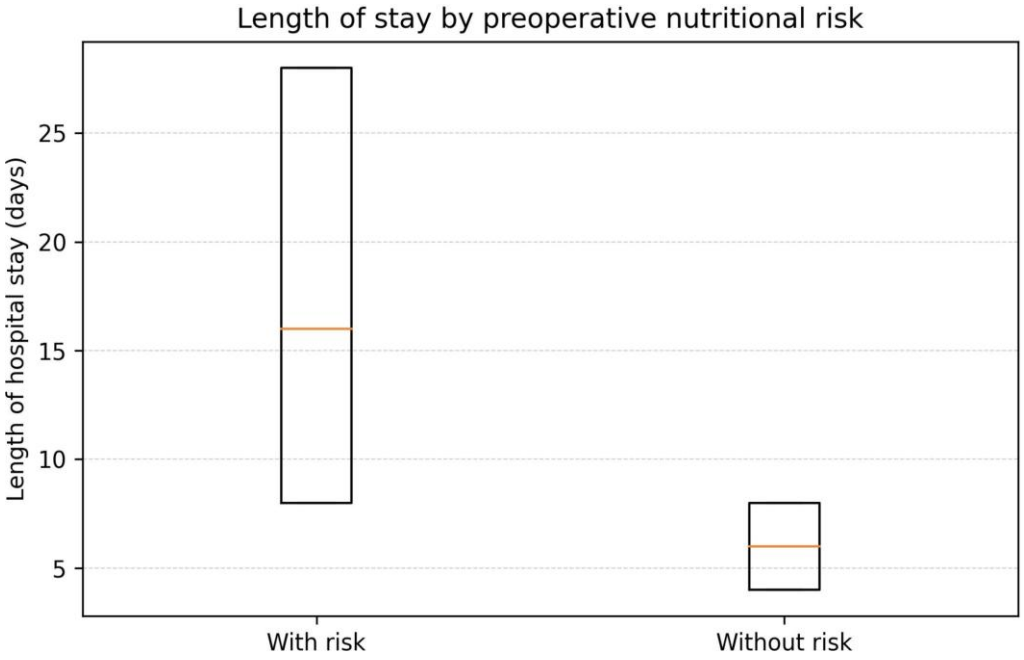
Results

A total of 334 patients were evaluated, with a mean age of 52.8±10.4 years, predominantly female (53%). The main comorbidities observed were hypertension (44.9%), cancer (24.6%), and diabetes mellitus (17.1%). Neurological surgeries included spinal procedures, intracranial and spinal tumor resections, aneurysm clipping, and other neurosurgical interventions.

Regarding surgical risk, 44.9% of patients were classified as ASA II, 36.2% as ASA I, and 18.9% as ASA III. According to the NRS-2002, 46.4% presented nutritional risk, while 53.6% did not. According to AND-ASPEN, 24% of patients presented some degree of malnutrition.

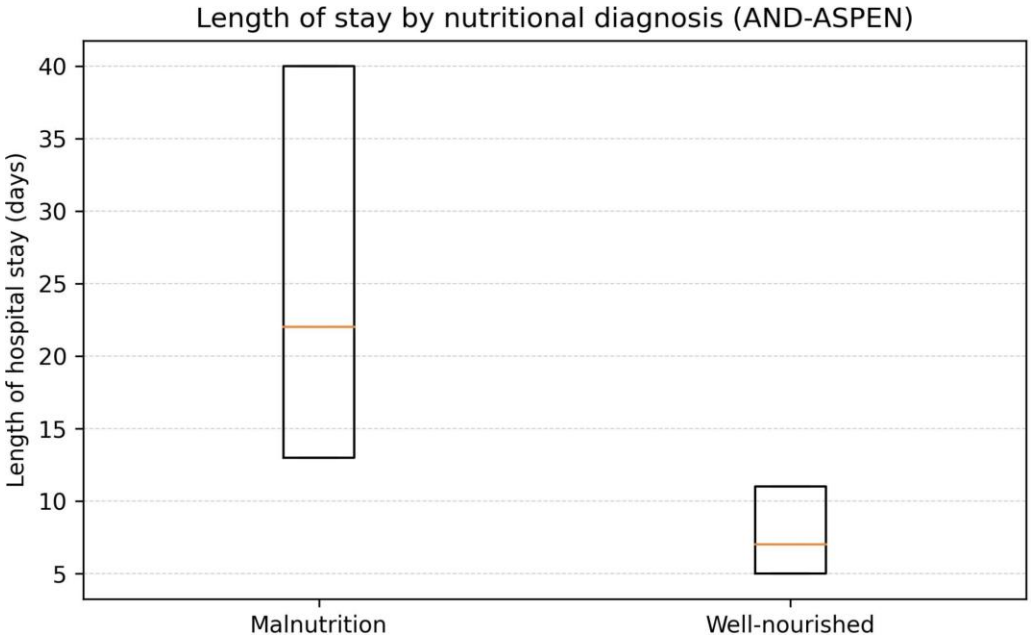
The median total length of hospital stay in the studied sample was 8 (5–16) days. Patients at nutritional risk had significantly longer hospital stays compared to those without risk (16 [8–28] vs. 6 [4–8] days; p<0.001), as illustrated in **Figure 1**.

Figure 1: Length of hospital stay according to preoperative nutritional risk (NRS-2002).



Similarly, patients with moderate or severe malnutrition remained hospitalized for longer compared to eutrophic patients (22 [13–40] vs. 7 [5–11] days; p<0.001), as shown in **Figure 2**.

Figure 2: Length of hospital stay according to preoperative nutritional diagnosis (AND-ASPEN).



It was also observed that individuals at nutritional risk were significantly older, had a higher prevalence of comorbidities, a worse clinical classification according to the ASA index, and a higher frequency of malnutrition, as shown in **Table 1**, all of which were associated with increased length of hospital stay ($p<0.001$).

Table 1: Sample characteristics (n=334).

Variables	Value
Age (years), mean ± SD	52.8 ± 10.4
Sex – n (%)	
Female	177 (53,0)
Male	157 (47,0)
Comorbidities, n (%)	
Diabetes mellitus	57 (17.1)
Hypertension	150 (44.9)
Cancer	82 (24.6)
Surgical procedure, n (%)	
Discectomy	23 (6.9)
Intracranial tumor resection	153 (45.8)
Aneurysm clipping	35 (10.5)
Spinal arthrodesis	74 (22.2)
Laminectomy	10 (3.0)
Spinal cord tumor resection	7 (2.1)
Cranioplasty	8 (2.4)
External ventricular drain (EVD)	14 (4.2)
Spinal cord decompression	10 (3.0)
ASA classification, n (%)	
I	121 (36.2)
II	150 (44.9)
III	63 (18.9)
Nutritional risk (NRS-2002), n (%)	
Yes	155 (46.4)
No	179 (53.6)
Nutritional diagnosis (AND-ASPEN), n (%)	
Well-nourished	254 (76.0)
Moderate malnutrition	58 (17.4)
Severe malnutrition	22 (6.6)
Length of stay (days), median (P25 – P75)	8 (5 – 16)

*Abbreviations: ASA, American Society of Anesthesiologists; EVD, external ventricular drain; SD, standard deviation. Variables with normal distribution were expressed as mean ± standard deviation, non-normal variables as median (P25–P75), and categorical variables as n (%). 1 Student's t-test; 2 Pearson's chi-square test; 3 Mann-Whitney test. *Statistically significant association according to adjusted residuals at the 5% significance level.*

Patients with moderate or severe malnutrition were older, had a higher prevalence of diabetes mellitus, hypertension, neoplasms, ASA III classification, and longer hospital stays ($p<0.05$). As shown in **Table 2**, the length of stay was significantly longer among older patients, diabetics, hypertensive patients, those with cancer, and those with ASA III classification ($p<0.001$).

Table 2: Association between length of hospital stay and other variables.

Variables	Length of stay Median (P25–P75)	p
Age (years)	r_s=0.207	<0.001
Sex		0.110
Female	8 (5 – 15)	
Male	9 (5 – 19)	
Pathologies		
Diabetes mellitus		<0.001
Yes	18 (11 – 36)	
No	7 (5 – 13)	
Hypertension		<0.001
Yes	15 (8 – 24)	
No	6 (4 – 10)	
Cancer		<0.001
Yes	14 (8 – 24)	
No	7 (5 – 15)	
Surgical procedure		0.286
Discectomy	6 (4 – 11)	
Intracranial tumor resection	8 (6 – 16)	
Aneurysm clipping	8 (5 – 18)	
Spinal arthrodesis	8 (5 – 18)	
Laminectomy	12 (7 – 43)	
Spinal cord tumor resection	8 (7 – 32)	
Cranioplasty	5 (4 – 19)	
External ventricular drain (EVD)	8 (5 – 19)	
Spinal cord decompression	16 (8 – 39)	
ASA classification		<0.001
I	5 (4 – 7)[a]	
II	10 (7 – 17)[b]	
III	20 (13 – 39)[c]	

Note: Spearman's correlation was used for age. Group comparisons used Mann-Whitney or Kruskal-Wallis with Dunn's post hoc, as appropriate.

After adjusting for confounding factors, age, diabetes mellitus, hypertension, ASA III, nutritional risk, and diagnosis of moderate or severe malnutrition remained associated with length of hospital stay ($p<0.05$). The mean increase in length of stay was 0.2 days per year of age, 5.59 days in patients with diabetes, 4.81 days in hypertensive patients, and 6.84 days in ASA III patients.

Discussion

The study demonstrated that nutritional risk assessed by the NRS-2002 and nutritional diagnosis according to AND-ASPEN criteria are directly associated with increased length of hospital stay in neurosurgical patients.

These findings reinforce evidence already described in the literature, which shows that surgical patients with nutritional risk have a higher frequency of postoperative complications, longer hospital stays, and worse clinical outcomes. In this context, early nutritional screening has been recommended as an essential strategy to identify patients at risk and implement timely nutritional interventions in the perioperative period.

In addition, advanced age, presence of comorbidities, and ASA classification II or III were also related to a longer hospital stay. Eutrophic patients had shorter hospital stays compared to malnourished patients, showing a significant increase in hospital stay among those with moderate or severe malnutrition. These findings corroborate the literature and reinforce the importance of early nutritional assessment using validated tools.

Among the study's strengths is its small sample size, while the main limitations include its single-center nature and the lack of data on preoperative fasting and nutritional support. Despite this, the results confirm the association between preoperative nutritional status and prolonged hospital stay, highlighting the relevance of nutritional screening as part of perioperative care in neurosurgical patients.

Conclusions

Preoperative nutritional status proved to be an important determinant of hospital stay length in neurosurgical patients, along with clinical factors such as age, comorbidities, and ASA II or III classification. Patients with nutritional risk and moderate or severe malnutrition had significantly longer hospital stays. These findings reinforce the importance of early nutritional screening and assessment for identifying at-risk patients and implementing timely nutritional interventions, contributing to better clinical recovery and reduced hospital stay.

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