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## Original Article

# Nutritional Status and Support in Hospitalized Patients with Neurological Diseases: A Cross-sectional Survey

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## Abstract

**Background and objectives:** Proper nutritional management has been shown to reduce complications and lead to better clinical outcomes. However, inaccurate nutritional screening and assessment, inappropriate nutrition support, and deviations from suggested guidelines were observed in clinical practice. We aimed to investigate the nutritional status and support of hospitalized patients with neurological diseases to identify deficiencies in nutritional assessment and treatment.

**Methods:** A self-designed questionnaire, developed through a literature review, group discussions, and expert consultation, was converted into an electronic form to conduct a cross-sectional survey in a tertiary-level general hospital. The patients' basic information and the first nutrition assessment were filled out upon admission. The final nutrition assessment were logged at discharge, transfer out, or death. Two-person cross-entry was used to ensure the accuracy of data input.

**Results:** A total of 620 patients were enrolled in this study. Of these, 24.4% were at nutritional risk upon admission, and 22.7% were identified as at nutritional risk in the final assessment. There were no statistically significant differences in nutritional status between the first and final assessments, except for serum albumin concentration. A total of 118 patients (19.0%) received nutrition therapy. Complications occurred in 35 (45.5%) patients treated with enteral nutrition and 29 (30.5%) patients treated with parenteral nutrition.

**Conclusions:** The incidence of nutritional risk in inpatients with neurological diseases enrolled in this study was relatively low. However, nutritional treatment in this study was not sufficiently standardized. Nurses are needed to receive relevant professional training to improve quality of nutritional interventions.

**Keywords:** Nutritional status; Nutritional assessment; Nutritional support; Inpatients; Neurological diseases; Cross-sectional survey; China.

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## Introduction

Patients with neurological diseases are prone to malnutrition or nutritional risks because nervous system diseases primarily affect elderly patients. Additionally, patients with neurological diseases are more likely to experience dysphagia, paralysis, immobility, unconsciousness, and various neuropsychological disturbances, all of which can influence nutritional intake and increase the risk of malnutrition.[1–5]

Malnutrition refers to a lack of energy, protein, or other essential nutrients, leading to adverse effects such as reduced physical and psychological function and impaired clinical outcomes.[4,6] Studies have shown that malnutrition increases patients' risk of

readmission, morbidity, disability, both short-term and long-term mortality, longer hospital stays, higher incidence of complications, and increased hospitalization costs.[7–10]

Appropriate application of nutritional therapies, including oral nutritional supplements (ONS), enteral nutrition (EN), and parenteral nutrition (PN), can reduce mortality and improve other clinical outcomes in patients at nutritional risk or those who are malnourished.[6,11,12] Proper nutritional management has been shown to reduce complications and lead to better clinical outcomes. Correct nutritional evaluation and the right nutritional interventions are essential for monitoring patients' conditions and treating diseases, as researchers have suggested.[3,13]

However, inaccurate nutritional screening and assessment, inappropriate nutrition support, and practices contrary to recommended guidelines have been observed in clinical settings. Therefore, a comprehensive survey is needed to increase medical staff's awareness about malnutrition and improve the quality of nutritional care.[12]

Union Hospital, Tongji Medical College, Huazhong University of Science and Technology (Wuhan Union Hospital), the oldest large-scale comprehensive teaching hospital under the National Health Commission in central China, is also one of the first national Grade 3A hospitals. The hospital currently has a total of 6,994 beds, which could provide a sufficient number of participants for our study. Therefore, our study aimed to investigate the nutritional status and nutritional support of inpatients with neurological diseases at Wuhan Union Hospital. This will help medical staff understand the prevalence of malnutrition or nutritional risk and assess the implementation of nutritional treatment and care. Thus, deficiencies in nutritional assessment and treatment can be identified, and recommendations can be made to improve the quality of nutritional interventions.

## Materials and methods

### *Subjects*

This cross-sectional study was carried out in January 2021 at Wuhan Union Hospital, a national Grade 3A hospital in Hubei Province, China. All patients in this hospital who met the inclusion criteria were enrolled in the study. The inclusion criteria were: (1) aged over 18 years; (2) diagnosed with a neurological disease; (3) hospital stay longer than one day. The exclusion criteria were: (1) incomplete hospitalization information; (2) missing information. A total of 644 questionnaires were collected, of which 620 were valid. The effective response rate was 96.3%.

### *Information collection*

The questionnaire was self-developed through literature review, group discussion, and expert consultation to record the nutritional conditions of patients. It consisted of seven parts: The patients' basic information included bed number, admission number, gender, age, disease diagnosis, motility, body temperature, and activities of daily living assessment scale; the first nutrition assessment consisted of body weight, height, nutritional risk screening (NRS-2002), malnutrition assessment (Subjective Global Assessment (SGA)/Patient-Generated Subjective Global Assessment (PG-SGA)/short-form Mini Nutritional Assessment (MNA-SF)/ Nutritional Screening (NUTRIC)/Malnutrition Universal Screening Tool (MUST), albumin (ALB), and pre-albumin (PAB); the nutrition support part investigated the type and amount of the first nutrition support for patients; the nursing practice of tube feeding investigated infusion way, tool, method, nursing, and complications, the parenteral nursing practice consisted of infusion way, method, and complications, the content of the final nutrition assessment is the same as the first, and the outcome indicators record hospital stays and clinical complications.

### *Data collection*

Before the formal survey, we invited nurses to pre-complete the questionnaire, and they indicated that it could be conveniently completed. During the official investigation, the questionnaire was converted into an electronic form, and a quick response (QR) code and a link were generated for distribution via the Internet. The well-trained, registered nurses independently managing beds in the ward participated in the survey. They scanned the QR code or clicked the link to record the information of the investigated patients online through the electronic questionnaire, based on the patients' medical records. The questionnaire could not be submitted until all questions were answered, and the investigators could review and revise their entries before submission. Two-person cross-entry was used to ensure the accuracy of data input, and the collected data were backed up and maintained by a dedicated person.

The patients' basic information and the first nutrition assessment were filled out upon admission. The nutrition support was completed within 24 h after the first nutritional treatment. The nursing practices for tube feeding and parenteral nursing practice were recorded during nutrition therapy. The final nutrition assessment and the outcome indicators were logged at discharge, transfer out, or death.

### *Statistical analysis*

The data were analyzed using Statistical Product and Service Solutions (SPSS) version 26.0 (Chicago, Illinois, United States). The Kolmogorov-Smirnov test was used to test the normal distribution of variables. The measurement data with a normal distribution were expressed as mean values and standard deviations, and Student's t-test was used for comparison. Continuous variables without normal distribution were described by the median and interquartile range and compared using a nonparametric test. Count data were reported as absolute numbers and percentages (%) and compared using the Chi-squared ($\chi 2$) test or Fisher's exact test. All tests were conducted at $\alpha = 0.05$.

### *Ethical statement*

The study complied with the principles of the Helsinki Declaration and was approved by the Ethics Committee of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei Province, China (No. 0605). All participants gave their informed consent.

## Results

### *Participant characteristics*

The final sample consisted of 620 hospitalized patients with neurological diseases, with a median age of 63 (55, 71) years and a median height of 165 (106, 171) cm. The characteristics of patients at admission are detailed in Table 1.

### *Nutritional status*

There were no statistically significant differences in body weight, body mass index (BMI), NRS-2002 ratings, the use of nutrition assessment tools, or the concentration of serum PAB between ad-

**Table 1. Characteristics of patients at admission (N = 620)**

| Categories | n | % |
|---|---|---|
| Age (years old) | | |
| 18–39 | 19 | 3.1 |
| 40–59 | 218 | 35.2 |
| 60–79 | 346 | 55.8 |
| ≥80 | 37 | 6.0 |
| Gander | | |
| Male | 391 | 63.1 |
| Female | 229 | 36.9 |
| Motility | | |
| Bedridden | 257 | 41.5 |
| Walk with assistance | 165 | 26.6 |
| Walk without assistance | 198 | 31.9 |
| Body temperature (forehead) | | |
| Normal | 609 | 98.2 |
| Fever (>37.3°C) | 11 | 1.8 |
| Barthel index score | | |
| Severe dependence: ≤40 points | 194 | 31.3 |
| Moderate dependence: 41–60 points | 92 | 14.8 |
| Slight dependence: 61–99 points | 185 | 29.8 |

mission and the final assessment. However, there were statistical differences in the concentration of serum ALB between admission and the final assessment. According to the NRS-2002 criteria, 24.4% of patients were at nutritional risk upon admission, while 22.7% of them were at nutritional risk in the final assessment. The nutritional status of the patients is shown in Table 2.

There were statistically significant differences in age, body weight, BMI, ALB, PAB, body temperature, physical activity, Barthel index score, and length of hospitalization between patients without nutritional risk and those with nutritional risk. Only 12.7% of participants underwent a nutrition assessment both on admission and at the final nutrition assessment.

### *Nutrition support*

#### Oral natural dietary

In this study, the first oral natural dietary types for patients included five categories: liquid for 78 (12.6%), semi-liquid for 28 (4.5%), soft food for 73 (11.8%), general food for 390 (62.9%), and others for 15 (2.4%) patients, while 36 (5.8%) patients had no food. Among the 584 (94.2%) patients who ate, the first simple diet self-assessment was carried out, as shown in Table 3.

#### Medical nutrition therapy

In this study, 118 (19.0%) patients were treated with medical nutrition therapy: ONS 1, total enteral nutrition 18, total parenteral nutrition 39, ONS+EN 4, ONS+PN 1, EN+PN 15, and ONS+EN+PN 40. Among these 118 patients, 46 (39.0%) were treated with ONS, 77 (65.3%) with EN, and 95 (80.5%) with PN. The total volume (mL) of EN and PN in the first 24 h was 500 (500, 1,000) and 450 (250, 700), respectively, with statistical significance ($P < 0.01$). The types of nutritional preparations for different nutritional therapies are shown in Table 4.

#### Enteral nutrition practice

Table 5 shows detailed information about the nursing practice of tube feeding for the 77 patients who received EN in this study. Complications occurred in 35 (45.5%) patients, including gastrointestinal complications in 34 cases (97.1%), metabolic complications in 20 cases (57.1%), mechanical complications in 16 cases (45.7%), and infection complications in 20 cases (57.1%). We also found that 66 (85.7%) patients had dysphagia.

#### Parenteral nursing practice

For the 95 patients treated with PN in this study, the most common infusion way was through the peripheral vein (76 patients, 80.0%), followed by peripherally inserted central catheter (25 patients, 26.3%), central venous catheter (10 patients, 10.5%), venous port access (eight patients, 8.4%), and indwelling needle (one patient, 1.1%). The preferred infusion method was intermittent drip (56 patients, 58.9%), followed by continuous drip (49 patients, 51.6%) and continuous pump drops (15 patients, 15.8%). Complications occurred in 29 patients, including catheter-related complications in 24 cases (82.8%), metabolic complications in 17 cases (58.6%), gastrointestinal complications in 21 cases (72.4%), and infection complications in 16 cases (55.2%). Additionally, 29 (30.5%) patients reported the impact of PN on activities, and 21 (22.1%) patients' sleep was affected.

### *Outcome indicators*

A total of 98 patients (15.8%) underwent surgical treatment. The median hospital stays and postoperative days were nine (6, 14) and 11 (5.75, 19), respectively. Only five patients (0.8%) developed pressure ulcers, and six patients (0.2%) had clinical complications (infection/venous thrombus embolism).

## Discussion

Our results showed that the estimated BMI ($P < 0.05$), ALB ($P < 0.05$), and PAB ($P < 0.05$) concentrations were significantly lower in participants at risk of malnutrition compared to participants without a risk of malnutrition. Similar results were observed in a systematic review and meta-analysis of older adults.[14] This implies that, although ALB and PAB are no longer recommended by the Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition to identify malnutrition due to the influence of not only nutritional status but also other factors such as inflammation, infection, and liver damage,[15–17] these blood biomarkers could still aid medical staff in assessing patients' nutritional status when combined with other clinical signs and symptoms.

The results showed that all patients underwent basic nutritional assessments, including the measurement of body weight and height, as well as nutritional risk screening using the NRS-2002, developed by Kondrup *et al*.,[18] which helps medical staff assess nutritional risk but does not determine nutritional status. Five common tools were used for nutritional assessment in this survey; however, only three of these tools are designed to indicate nutritional status: SGA,[19] PG-SGA,[20] and MNA-SF.[21] Moreover, in this study, only 13.2% and 13.4% of participants underwent nutritional assessment at the first and final assessments, respectively, and only 12.7% of participants had nutrition assessments both upon

**Table 2. Nutritional status of patients**

| Categories | | First assessment | | Final assessment | | *P*-value |
|---|---|---|---|---|---|---|
| | | n | % | n | % | |
| Body weight(kg) | | 65(60, 72) | | 65(59, 71) | | 0.212[a] |
| BMI (mean ± SD) (kg/m$^2$) | | 23.95 ± 3.17 | | 23.73 ± 3.89 | | 0.294[b] |
| Patients evaluable | | 494 | | 443 | | |
| Underweight (<18.5) | | 20 | 4.0 | 17 | 3.8 | |
| Normal weight (18.5–24.9) | | 296 | 59.9 | 280 | 63.2 | |
| Overweight (25–29.9) | | 160 | 32.4 | 132 | 29.8 | |
| Obesity (≥30) | Obesity grade I (30–34.9) | 17 | 3.4 | 13 | 2.9 | |
| | Obesity grade II (35–39.9) | 1 | 0.2 | 1 | 0.2 | |
| | Obesity grade III (≥40) | 0 | 0.0 | 0 | 0.0 | |
| | Total | 18 | 3.6 | 14 | 3.1 | |
| NRS-2002 ratings (points) | | | | | | 0.547[c] |
| Patients evaluable | | 620 | | 620 | | |
| <3 | | 469 | 75.6 | 479 | 77.3 | |
| ≥3 | | 151 | 24.4 | 141 | 22.7 | |
| Nutrition assessment | | | | | | 0.787[d] |
| Patients evaluable | | 620 | | 620 | | |
| SGA | Grade A | 10 | 1.6 | 7 | 1.1 | 0.293[d] |
| | Grade B | 1 | 0.2 | 3 | 0.5 | |
| | Grade C | 1 | 0.2 | 0 | 0 | |
| | Total | 12 | 1.9 | 10 | 1.6 | |
| PG-SGA | 0–1 points | 3 | 0.5 | 2 | 0.3 | 0.429[d] |
| | 2–3 points | 0 | 0 | 2 | 0.3 | |
| | 4–8 points | 0 | 0 | 0 | 0 | |
| | ≥9 points | 0 | 0 | 0 | 0 | |
| | Total | 3 | 0.5 | 4 | 0.6 | |
| MNA-SF | 0–7 points | 2 | 0.3 | 1 | 0.2 | – |
| | 8–11 points | 0 | 0 | 0 | 0 | |
| | 12–14 points | 0 | 0 | 0 | 0 | |
| | Total | 2 | 0.3 | 1 | 0.2 | |
| NUTRIC | 0–5 points | 6 | 1.0 | 7 | 1.1 | 1.000[d] |
| | 6–10 points | 2 | 0.3 | 1 | 0.2 | |
| | Total | 8 | 1.3 | 8 | 1.3 | |
| MUST | 0 points | 32 | 5.2 | 32 | 5.2 | 1.000[c] |
| | 1 point | 0 | 0 | 0 | 0 | |
| | ≥2 points | 25 | 4.0 | 25 | 4.0 | |
| | Total | 57 | 9.2 | 57 | 9.2 | |
| Other assessment tool | | 0 | 0 | 3 | 0.5 | – |
| Not assessment | | 538 | 86.8 | 537 | 86.6 | |
| ALB, median (IQR), (g/L) | | 39.30(36.68, 42.58) | | 37.52(34.60, 40.80) | | <0.01[a] |

*(continued)*

**Table 2.** *(continued)*

| Categories | First assessment | | Final assessment | | *P*-value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Patients evaluable | 422 | | 183 | | |
| <35 | 58 | 13.7 | 50 | 27.3 | |
| 35–55 | 358 | 84.8 | 130 | 71.0 | |
| >55 | 6 | 1.4 | 3 | 1.6 | |
| PAB, median (IQR), (mg/L) | 226.00(183.25, 265.00) | | 218.20(165.25, 265.00) | | 0.413[a] |
| Patients evaluable | 356 | | 136 | | |
| <280 | 291 | 81.7 | 110 | 80.9 | |
| 280–350 | 45 | 12.6 | 13 | 9.6 | |
| >350 | 20 | 5.6 | 13 | 9.6 | |

[a]non-parametric test, [b]Student's t-test, [c]Chi-squared (χ2) test, [d]Fisher's exact test. ALB, albumin; BMI, body mass index; IQR, interquartile range; MNA-SF, short-form Mini Nutritional Assessment; MUST, Malnutrition Universal Screening Tool; NRS-2002, Nutritional Risk Screening 2002; NUTRIC, Nutritional Screening; PAB, pre-albumin; PG-SGA, Patient-generated Subjective Global Assessment; SD, standard deviation; SGA, Subjective Global Assessment.

**Table 3. Patients' first simple diet self-assessment (N = 584)**

| Score | n | % |
|---|---|---|
| 1: Three meals of clear liquid food, no meat, and lack of oil. | 68 | 11.6 |
| 2: Three semi-liquid meals, no meat, and a lack of oil. | 27 | 4.6 |
| 3: One general meal, two semi-liquid meals, basically no meat, and less oil. | 50 | 8.6 |
| 4: Two general meals, one semi-liquid meal, less meat, and less oil. | 223 | 38.2 |
| 5: Three general meals, staple food: meat, eggs, milk, vegetables, and sufficient oil. | 216 | 37.0 |

admission and at the final assessment. This might be because clinicians carried out nutritional treatment based more on clinical symptoms and laboratory indicators at the time, reducing the emphasis on formal nutritional assessment. These findings suggest that only a small portion of patients with nutritional risk underwent nutritional assessment, which should be performed in all patients at risk of malnutrition.[21] Further nutritional assessments using appropriate tools for patients with nutritional risk should be strengthened to determine their accurate nutritional status, enabling clinicians to gather more information and provide targeted nutritional therapy.[19,22]

As shown in Table 2, except for ALB concentration, there was no significant difference in the nutritional status of patients between admission and the final assessment. The median ALB concentrations were within the normal range at both the initial and final assessments, but were higher at admission. In contrast to our findings, a separate Chinese survey reported that body weight, BMI, and the concentrations of PAB and ALB were significantly lower at discharge compared to admission, and that the nutritional risk of patients at discharge was higher than at admission.[23] However, both studies revealed that the nutritional status of patients at discharge was not improved, and that nutritional support did not change patients' nutritional status. This suggests that clinicians should place more importance on addressing patients' nutritional status and providing intervention not only at admission but also at discharge, in order to improve patients' nutritional condition and clinical outcomes.[23,24]

Our study showed that 151 patients had nutritional risk, but only 38.4% (58) of them received medical nutrition therapy. Addition-

**Table 4. Types of nutrition preparation for nutrition therapies in the first time**

| ONS (N = 46) | | EN (N = 77) | | PN (N = 95) | |
|---|---|---|---|---|---|
| Types | n (%) | Types | n (%) | Types | n (%) |
| Whole protein | 19(41.3) | Whole protein | 46(59.8) | A single bottle of amino acids | 45(47.4) |
| Short peptide | 15(32.6) | Short peptide | 16(20.8) | A single bottle of fat milk | 13(13.7) |
| Amino acid | 21(45.7) | Amino acid | 19(24.7) | amino acid + fat milk | 38(40.0) |
| | | Rice flour | 3(3.9) | All-in-one (commercial recipe) | 17(17.9) |
| | | Homogenate meal | 1(1.3) | All-in-one (self-configurated) | 7(7.37) |
| | | Configurated by the hospital nutrition department | 1(1.3) | | |

EN, enteral nutrition; ONS, oral nutritional supplements; PN, parenteral nutrition.

**Table 5. Nursing practice of tube feeding (N = 77)**

| Categories | | n | % |
|---|---|---|---|
| Infusion way | Oral tube feeding | 3 | 3.9 |
| | Nasogastric tube | 71 | 92.2 |
| | Naso-intestinal tube | 2 | 2.6 |
| | Jejunal feeding tube | 1 | 1.3 |
| Infusion tool | Special feeder | 23 | 29.9 |
| | Injection syringe | 38 | 49.4 |
| | Special nutrition pump | 45 | 58.4 |
| | Infusion pump | 1 | 1.3 |
| Infusion method | Split bolus injection | 47 | 61.0 |
| | Intermittent drip | 13 | 16.9 |
| | Continuous drip | 17 | 22.1 |
| | Continuous pump drops | 38 | 49.4 |
| Nursing practice | Confirm tube position | 77 | 100.0 |
| | Monitor gastric residue | 66 | 85.7 |
| | Monitor blood glucose regularly | 61 | 79.2 |
| | Heat nutrient solution | 69 | 89.6 |
| | Raise the head of the bed | 77 | 100.0 |
| | Control speed | 75 | 97.4 |
| | Flush tube timely | 60 | 77.9 |

ally, 118 patients received nutritional support, but 60 (50.8%) of them did not have nutritional risk. However, the guidelines recommend that only patients who are undernourished or at nutritional risk can benefit from nutritional treatment.[25,26] Thus, our results indicated that the nutritional treatment in the participating hospital in this study was not sufficiently standardized, and there were still some misunderstandings among clinical medical staff regarding the indications for nutritional therapy. Furthermore, nutritional support for patients with neurological diseases has not been given adequate attention by most medical staff. Other surveys reported similar findings regarding the inappropriate use of nutritional support in clinical practice.[27,28] All of these studies emphasize the need for greater attention to the indications for nutritional treatment in order to reduce its improper application.

The results indicated that PN (80.5%) was the most common form of nutrition therapy in this study, although the enteral route, which is more physiological, has a trophic effect on the intestinal mucosa, and can reduce bacterial overgrowth and translocation,[26,29] is recommended to be used early as a priority when tolerated by the intestinal tract.[30] The results of two other Chinese surveys were similar to those of our study,[12,27] indicating that many Chinese doctors prefer to use PN rather than EN for patients requiring nutritional therapy. This phenomenon may be due to PN often being considered an "easier way" to deliver nutrients than EN for doctors in China.[27] Another reason may be that EN requires the reintroduction of tubes, such as gastric tubes or intestinal tubes, and patients with neurological disorders are prone to unplanned extubation.[31]

Our results revealed that complications occurred in 35 (45.5%) patients receiving EN and 29 (30.5%) patients treated with PN, with the rate being lower than in other studies.[32,33] Gastrointestinal complications (97.1%) were the most common in EN, while catheter-related complications (82.8%) were the most common in PN. This suggests that for EN patients, more attention should be paid to gastrointestinal intolerance symptoms, such as constipation, diarrhea, nausea, and vomiting, as these can aggravate neurosurgical patients' water and electrolyte disorders. For PN patients, more attention should be given to local swelling, pain, and other symptoms related to phlebitis, in order to reduce the occurrence of these complications and improve patients' quality of life.[34,35]

Studies have shown that nursing measures such as monitoring gastric residue, regular monitoring of blood glucose, and regular tube flushing can improve the prognosis of EN patients.[36–38] However, not all nursing measures for tube feeding were implemented in every patient receiving EN in our study. Only the nursing measures confirming catheter position and raising the head of the bed were carried out in all patients, suggesting that nurses should pay more attention to tube feeding care and implement a variety of measures to improve patients' nutritional conditions and quality of life.[39]

## Limitations

Our study has the following limitations. Firstly, the nature of our research was a cross-sectional design, which limited the ability to interpret causal relationships between the general characteristics and nutritional status of patients. Secondly, the descriptive analysis in this research could not explain the degree to which general factors influence the nutritional status of patients. Thirdly, all participants were from the same hospital, which may restrict the representativeness of the sample and the generalizability of our findings. Future studies could design multi-factor analyses to explore the influencing factors of nutritional status, and national surveys could be con-

ducted to draw more general conclusions or compare the nutritional status across different regions, hospitals, or departments.

## Conclusions

The incidence of nutritional risk was less than 25% among hospitalized patients with neurological diseases in this study. Further nutritional assessments of patients at nutritional risk should be intensified to determine their accurate nutritional status and therapy needs. The nutritional intervention nursing in this study was not sufficiently standardized, and more emphasis should be placed on the nursing of tube feeding. Nurses are needed to receive relevant professional training to improve quality of nutritional interventions.

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## Conflict of interest

YXZ has been an editorial board member of *Neurosurgical Subspecialties* since 2024. The author declares no other conflicts of interest.

## Author contributions

All authors contributed to the study conception and design. Material preparation, data collection (YJW, PY, YC, ZYX, RY), data analysis and interpretation, the first draft of the manuscript (YLW, YXZ), supervision (JHY, SYL), reading and approving the final manuscript (RY, SYL). All authors commented on previous versions of the manuscript.

## Ethical statement

The study complied with the principles of the Helsinki Declaration and was approved by the Ethics Committee of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei Province, China (No.0605). All participants gave their informed consent.

## Data sharing statement

The datasets generated for this study are available upon request from the corresponding author.

## References

[1] Streicher M, Wirth R, Schindler K, Sieber CC, Hiesmayr M, Volkert D. Dysphagia in Nursing Homes-Results From the NutritionDay Project. J Am Med Dir Assoc 2018;19(2):141–147.e2. doi:10.1016/j.jamda.2017.08.015, PMID:29030310.

[2] Burgos R, Bretón I, Cereda E, Desport JC, Dziewas R, Genton L, *et al*. ESPEN guideline clinical nutrition in neurology. Clin Nutr 2018;37(1):354–396. doi:10.1016/j.clnu.2017.09.003, PMID:29274834.

[3] Tsagalioti E, Trifonos C, Morari A, Vadikolias K, Giaginis C. Clinical value of nutritional status in neurodegenerative diseases: What is its impact and how it affects disease progression and management? Nutr Neurosci 2018;21(3):162–175. doi:10.1080/1028415X.2016.1261529, PMID:27900872.

[4] Li F, Liu YW, Wang XF, Liu GW. Evaluation of malnutrition in patients with nervous system disease. Expert Rev Neurother 2014;14(10):1229–1237. doi:10.1586/14737175.2014.957184, PMID:25192880.

[5] Hafsteinsdóttir TB, Mosselman M, Schoneveld C, Riedstra YD, Kruitwagen CL. Malnutrition in hospitalised neurological patients approximately doubles in 10 days of hospitalisation. J Clin Nurs 2010;19(5-6):639–648. doi:10.1111/j.1365-2702.2009.03142.x, PMID:20500305.

[6] Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff SC, *et al*. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr 2017;36(1):49–64. doi:10.1016/j.clnu.2016.09.004, PMID:27642056.

[7] Ruiz AJ, Buitrago G, Rodríguez N, Gómez G, Sulo S, Gómez C, *et al*. Clinical and economic outcomes associated with malnutrition in hospitalized patients. Clin Nutr 2019;38(3):1310–1316. doi:10.1016/j.clnu.2018.05.016, PMID:29891224.

[8] Schuetz P, Seres D, Lobo DN, Gomes F, Kaegi-Braun N, Stanga Z. Management of disease-related malnutrition for patients being treated in hospital. Lancet 2021;398(10314):1927–1938. doi:10.1016/S0140-6736(21)01451-3, PMID:34656286.

[9] Liu H, Jiao J, Zhu M, Wen X, Jin J, Wang H, *et al*. Nutritional Status According to the Short-Form Mini Nutritional Assessment (MNA-SF) and Clinical Characteristics as Predictors of Length of Stay, Mortality, and Readmissions Among Older Inpatients in China: A National Study. Front Nutr 2022;9:815578. doi:10.3389/fnut.2022.815578, PMID:35145987.

[10] Kamal F, Fazal MI, Cheema MA. Nutritional Status of Patients Admitted in a General Surgical Ward at a Tertiary Hospital of Punjab. J Coll Physicians Surg Pak 2016;26(4):334–335. PMID:27097711.

[11] Kaegi-Braun N, Germann S, Faessli M, Kilchoer F, Dragusha S, Tribolet P, *et al*. Effect of micronutrient supplementation in addition to nutritional therapy on clinical outcomes of medical inpatients: results of an updated systematic review and meta-analysis. Eur J Clin Nutr 2022;76(7):964–972. doi:10.1038/s41430-021-01061-7, PMID:35046563.

[12] Sun H, Zhang L, Zhang P, Yu J, Kang W, Guo S, *et al*. A comprehensive nutritional survey of hospitalized patients: Results from nutritionDay 2016 in China. PLoS One 2018;13(3):e0194312. doi:10.1371/journal.pone.0194312, PMID:29566016.

[13] de Luis DA, Izaola O, de la Fuente B, Muñoz-Calero P, Franco-Lopez A. [NEURODEGENERATIVE DISEASES; NUTRITIONAL ASPECTS]. Nutr Hosp 2015;32(2):946–951. doi:10.3305/nh.2015.32.2.9252, PMID:26268132.

[14] Zhang Z, Pereira SL, Luo M, Matheson EM. Evaluation of Blood Biomarkers Associated with Risk of Malnutrition in Older Adults: A Systematic Review and Meta-Analysis. Nutrients 2017;9(8):829. doi:10.3390/nu9080829, PMID:28771192.

[15] White JV, Guenter P, Jensen G, Malone A, Schofield M, Academy Malnutrition Work Group. S.P.E.N. Malnutrition Task Force, A.S.P.E.N. Board of Directors. Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). JPEN J Parenter Enteral Nutr 2012;36(3):275–283. doi:10.1177/0148607112440285, PMID:22535923.

[16] Fan Y, Sun Y, Man C, Lang Y. Preoperative Serum Prealbumin Level and Adverse Prognosis in Patients With Hepatocellular Carcinoma After Hepatectomy: A Meta-Analysis. Front Oncol 2021;11:775425. doi:10.3389/fonc.2021.775425, PMID:34746015.

[17] Keller U. Nutritional Laboratory Markers in Malnutrition. J Clin Med 2019;8(6):775. doi:10.3390/jcm8060775, PMID:31159248.

[18] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr 2003;22(3):321–336. doi:10.1016/s0261-5614(02)00214-5, PMID:12765673.

[19] Correia MITD. Nutrition Screening vs Nutrition Assessment: What's the Difference? Nutr Clin Pract 2018;33(1):62–72. doi:10.1177/0884533617719669, PMID:28727954.
[20] Cong M, Song C, Xu H, Song C, Wang C, Fu Z, *et al*. The patient-generated subjective global assessment is a promising screening tool for cancer cachexia. BMJ Support Palliat Care 2022;12(e1):e39–e46. doi:10.1136/bmjspcare-2020-002296, PMID:32826265.
[21] Reber E, Gomes F, Vasiloglou MF, Schuetz P, Stanga Z. Nutritional Risk Screening and Assessment. J Clin Med 2019;8(7):1065. doi:10.3390/jcm8071065, PMID:31330781.
[22] Cortés-Aguilar R, Malih N, Abbate M, Fresneda S, Yañez A, Bennasar-Veny M. Validity of nutrition screening tools for risk of malnutrition among hospitalized adult patients: A systematic review and meta-analysis. Clin Nutr 2024;43(5):1094–1116. doi:10.1016/j.clnu.2024.03.008, PMID:38582013.
[23] Zhu MW, Wei JM, Chen W, Yang X, Cui HY, Zhu SN, *et al*. [Dynamic investigation of nutritional risk in patients with malignant tumor during hospitalization]. Zhonghua Yi Xue Za Zhi 2018;98(14):1093–1098. doi:10.3760/cma.j.issn.0376-2491.2018.14.009, PMID:29690722.
[24] Zhu M, Wei J, Chen W, Yang X, Cui H, Zhu S, *et al*. Nutritional Risk and Nutritional Status at Admission and Discharge among Chinese Hospitalized Patients: A Prospective, Nationwide, Multicenter Study. J Am Coll Nutr 2017;36(5):357–363. doi:10.1080/07315724.2017.1304293, PMID:28548607.
[25] Wang HM, Wang TJ, Huang CS, Liang SY, Yu CH, Lin TR, *et al*. Nutritional Status and Related Factors in Patients with Gastric Cancer after Gastrectomy: A Cross-Sectional Study. Nutrients 2022;14(13):2634. doi:10.3390/nu14132634, PMID:35807815.
[26] McClave SA, Taylor BE, Martindale RG, Warren MM, Johnson DR, Braunschweig C, *et al*. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). JPEN J Parenter Enteral Nutr 2016;40(2):159–211. doi:10.1177/0148607115621863, PMID:26773077.
[27] Zhou X, Wu X, Deng B, Huang L. Comparative Survey on Nutrition Risk and Nutrition Support Among Hospitalized General Surgery Patients Over a 7-Year Period. JPEN J Parenter Enteral Nutr 2020;44(8):1468–1474. doi:10.1002/jpen.1784, PMID:32026491.
[28] Dou L, Wang X, Cao Y, Hu A, Li L. Relationship between Postoperative Recovery and Nutrition Risk Screened by NRS 2002 and Nutrition Support Status in Patients with Gastrointestinal Cancer. Nutr Cancer 2020;72(1):33–40. doi:10.1080/01635581.2019.1612927, PMID:31079488.
[29] Ellison JS. Enteral feeding programs and hyperoxaluria: Is there a missing link? J Pediatr Urol 2022;18(6):744–745. doi:10.1016/j.jpurol.2022.06.025, PMID:35871041.
[30] Talebi S, Zeraattalab-Motlagh S, Vajdi M, Nielsen SM, Talebi A, Ghavami A, *et al*. Early vs delayed enteral nutrition or parenteral nutrition in hospitalized patients: An umbrella review of systematic reviews and meta-analyses of randomized trials. Nutr Clin Pract 2023;38(3):564–579. doi:10.1002/ncp.10976, PMID:36906848.
[31] Javed R, Mahadev K, Gowda H. Reducing unplanned extubation in tertiary NICU: a quality improvement project. Arch Dis Child Educ Pract Ed 2024. doi:10.1136/archdischild-2023-326753, PMID:38697824.
[32] Suzuki K, Sugiyama R, Katano T, Shigehara H, Takagiwa T, Katafuchi I, *et al*. The safety of rapid administration of enteral nutrition in acute stroke patients. J Neurol Sci 2022;437:120270. doi:10.1016/j.jns.2022.120270, PMID:35483238.
[33] Evans J, Green D, Gibson F, O'Connor G, Lanigan J. Complications and outcomes of gastrostomy versus nasogastric tube feeding in paediatric allogeneic bone marrow transplant: A prospective cohort study. Clin Nutr ESPEN 2023;55:58–70. doi:10.1016/j.clnesp.2023.02.022, PMID:37202085.
[34] Solana MJ, Manrique G, Fernández R, Slocker M, García M, Redondo S, *et al*. Nutritional status and nutrition support in critically ill children in Spain: Results of a multicentric study. Nutrition 2021;84:110993. doi:10.1016/j.nut.2020.110993, PMID:33109454.
[35] Mundi MS, Mohamed Elfadil O, Hurt RT, Bonnes S, Salonen BR. Management of long-term home parenteral nutrition: Historical perspective, common complications, and patient education and training. JPEN J Parenter Enteral Nutr 2023;47(Suppl 1):S24–S34. doi:10.1002/jpen.2424, PMID:36468330.
[36] Koontalay A, Sangsaikaew A, Khamrassame A. Effect of a Clinical Nursing Practice Guideline of Enteral Nutrition Care on the Duration of Mechanical Ventilator for Critically Ill Patients. Asian Nurs Res (Korean Soc Nurs Sci) 2020;14(1):17–23. doi:10.1016/j.anr.2019.12.001, PMID:31899383.
[37] López-Gómez JJ, Delgado García E, Primo-Martín D, Simón de la Fuente M, Gómez-Hoyos E, Jiménez-Sahagún R, *et al*. Effect of a diabetes-specific formula in non-diabetic inpatients with stroke: a randomized controlled trial. Nutr Diabetes 2024;14(1):34. doi:10.1038/s41387-024-00292-4, PMID:38816400.
[38] Song M, Zhao P, Hu W. Application Effect of Intra-Abdominal Pressure Monitoring System in Early Enteral Nutrition Nursing of ICU Patients. Contrast Media Mol Imaging 2022;2022:3545278. doi:10.1155/2022/3545278, PMID:35169392.
[39] Wang M, Gu X, Yu J, Zhang Y, Chen S. A clinical appraisal of the different types of enteral nutrition support and humanized nursing among cerebral apoplexy ICU patients on mechanical ventilation. Am J Transl Res 2021;13(8):9472–9478. PMID:34540068.