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Prevalence of Malnutrition Risk and the Impact of Nutrition Risk on Hospital Outcomes: Results From nutritionDay in the U.S.

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Abstract

Background: Malnutrition risk estimates vary greatly, and no robust data on the association between food intake and outcomes exist for hospitals in the United States (U.S.). This study aimed to determine the prevalence of malnutrition risk and to evaluate the impact of food intake on mortality using the nutritionDay in the U.S. dataset. *Methods:* This study analyzed data from 2009 to 2015 for all adult patients from participating hospitals. Prevalence of malnutrition risk was determined by mapping self-reported nutritionDay survey questions to the Malnutrition Screening Tool (MST). Fine and Gray competing-risk analysis with clustering was used to evaluate the impact of nutrition risk and food intake on patients' 30-day in-hospital mortality, while controlling for age, mobility, and other disease-related factors. *Results:* Analysis included data from 9959 adult patients from 601 wards. The overall prevalence of malnutrition risk (MST score ≥ 2) was 32.7%. On nutritionDay, 32.1% of patients ate a quarter of their meal or less. Hospital mortality hazard ratio was 3.24 (95% CI: [1.73, 6.07]; P-value < 0.001) for patients eating a quarter compared with those who ate all their meal and increased to 5.99 (95% CI: [3.03, 11.84]; P-value < 0.0001) for patients eating nothing despite being allowed to eat. *Conclusion:* This study provides the most robust estimate of malnutrition risk in U.S. hospitalized patients to date, finding that approximately 1 in 3 are at risk. Additionally, patients who have diminished meal intake experience increased mortality risk. These results highlight the ongoing issue of malnutrition in the hospital setting. (*JPEN J Parenter Enteral Nutr.* 2019;0:1–9)

Keywords
adult; nutrition assessment; nutrition support practice

Clinical Relevancy Statement

Many hospital patients have malnutrition or are at risk of malnutrition, which often leads to poorer outcomes for both the patient and the healthcare system. To date, limited data is available on United States (U.S.) hospital patients in regards to the prevalence of malnutrition and malnutrition risk, nutrition care during the hospital stay,

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Conflicts of interest: A. C. Sauer and S. Goates are employees and stockholders for Abbott Nutrition; A. Laviano is a member on the Advisory Committees or Review Panels at Nestlé Health Science, Nutricia, and Smartfish and participates in speaking and teaching at Baxter and Abbott Nutrition; M. Hiesmayr is a member on the Advisory Committees or Review Panels at Nestlé Health Science and Fresenius and participates in speaking and teaching at Nestlé Health Science, Fresenius, and Baxter; K. M. Mogensen is a member of ThriveRx nutrition advisory board, speaker for Baxter international conference for advancing nutrition, and a member of Pfizer malnutrition advisory board and A. Malone, G. Gewirtz, I. Sulz, and S. Moick declare no conflicts of interest.

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and the impact of hospital food intake on outcomes. Leveraging data from large national datasets, like nutritionDay in the U.S., can provide this important data that may assist hospital practitioners and clinicians in focusing their nutrition care practices with the goal to ultimately improve patient outcomes during and after a hospital stay.

Introduction

Hospital malnutrition is a public health problem globally, affecting approximately 30%–50% of patients.[1-4] Often patients enter the hospital malnourished or at risk of malnutrition and experience nutrition decline during their stay, placing them at higher risk for adverse outcomes following hospital discharge.[5] In the United States (U.S.), the problem of hospital malnutrition has been an issue for decades and remains a concern today. Hospital malnutrition is not a new concept and was first brought to light in 1974 when Butterworth called for new clinical practices aimed at proper diagnosis and treatment of malnourished hospital patients.[6] Furthermore, in 1974 and 1976, Dr. Bistrian and colleagues conducted nutrition surveys in the surgical and general medical wards of a U.S. hospital and found that protein-calorie malnutrition was common in these patients and present in 50% and 44% or greater, respectively.[7,8]

Despite the availability of validated nutrition screening tools to assess nutrition risk, non-validated tools continue to be used, and malnutrition risk continues to be under-recognized.[9] Moreover, estimates of malnutrition risk in hospitalized patients vary greatly.[10,11] This variation exists as most estimates of malnutrition risk are based on selected vs broad patient populations. Poor nutrition status and malnutrition have been shown to be adversely associated with several functional, clinical, and economic outcomes, including elevated risk of comorbid complications, longer length of stay, more frequent readmissions, higher mortality, and increased healthcare costs when compared with patients who are adequately nourished.[12-22]

Globally, there is a plethora of research on the prevalence of malnutrition and malnutrition risk in the hospital setting, particularly from Europe and Australia. However, there is limited recent data regarding the prevalence of hospital malnutrition in the U.S. A few studies have shown prevalence rates of malnutrition between 48% and 53% in U.S. hospitals, but these are in small patient populations or limited geographic locations and do not reflect national prevalence estimates of malnutrition and malnutrition risk across the U.S. hospital system.[5,20,23] One recent study from 2017 utilizing a web-based data capture system demonstrated a prevalence of malnutrition risk of approximately 30% in over 100,000 adult U.S. hospital patients.[24] Additionally, Weiss et al showed that in 2013, there were 1.95 million hospital stays that involved malnutrition in the U.S., representing 7.1% of non-maternal and non-neonatal stays.[25] Furthermore, in 2018, Hudson et al showed that of almost 4000 U.S. hospital patients referred for nutrition assessment, 66.88% met the criteria for moderate or severe malnutrition per the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition (ASPEN) consensus criteria.[22] The limited data on malnutrition prevalence in U.S. hospitals demonstrates a need for more robust data collection processes across the U.S.

The nutrition care of patients during a hospital stay has not been extensively researched in U.S. hospitals. This remains the case today despite the estimation that nationally the annual cost burden of disease-associated malnutrition is over $15.5 billion.[26] In 2015, the Malnutrition Committee of ASPEN proposed that addressing malnutrition in hospitalized patients should be a national goal to improve the quality of patient care, improve clinical outcomes, and reduce costs.[27] Few studies to date have shown consistent results in regard to processes for nutrition screening, malnutrition diagnosis, nutrition intervention, and discharge care.[9,24,28] Patel and colleagues published survey data in 2014 highlighting current nutrition care processes in U.S. hospitals and demonstrating that most hospitals performed nutrition screening within 24 hours of admission and had processes in place for nutrition assessment; however, the results also showed that there is considerable heterogeneity in both the use of nutrition screening tools and malnutrition diagnosis and coding.[9] Furthermore, Corkins et al showed that only 3.2% of all U.S. hospital discharges in 2010 had a diagnosis for malnutrition and that among patients with a malnutrition diagnosis in U.S. hospitals, only 13.4% received either enteral nutrition or parenteral nutrition during the hospital stay.[28] Similar results were demonstrated by Sherry et al in a sample of over 100,000 U.S. hospital patients. These investigators highlighted wide variation in nutrition screening tool usage, malnutrition diagnosis, and discharge nutrition care.[24]

Additionally, research shows that patients' food intake is often compromised during hospitalization and that nutrition status subsequently deteriorates.[5,29,30] Although the association between hospital food intake and patient outcome is well established in countries outside the U.S., no such data currently exist for the U.S.[29,31,32]

nutritionDay is a worldwide initiative to fight malnutrition in healthcare institutions. On a specific day every year, hospitals and nursing homes across the globe participate in a 1-day cross-sectional audit to collect their units' anonymous data on nutrition care processes and patients' anonymous data on their food intake and well-being. nutritionDay was started in 2004 through expertise from the European Society of Clinical Nutrition and Metabolism (ESPEN), and in 2005 a pilot study was conducted in 5 countries. Presently, nutritionDay worldwide is conducted in 64 countries in over 7000 healthcare institutions and in over 240,000 patients and residents globally. nutritionDay has been financially

supported by ESPEN since 2006. nutritionDay in the U.S. is the U.S.-based arm of nutritionDay worldwide. nutritionDay in the U.S. provides a large dataset and can provide robust data on malnutrition risk and impact of hospital food intake on outcomes in U.S. hospitals. nutritionDay results have been widely collected and reported globally. In 2009, Hiesmayr et al showed that more than half of hospital patients in Europe did not eat their full meal (either lunch or dinner) and that decreased food intake on nutritionDay or during the previous week was an independent risk factor for hospital mortality.[29] Similar results evaluating food intake during hospitalization and its impact on mortality as well as hospital length of stay have been reported with nutritionDay results in various countries.[32-36] Furthermore, a descriptive analysis of data from 9 consecutive nutritionDay samples (2006–2014) in 91,245 patients in 56 countries showed that the proportion of patients who ate their full meal varied from 24.7% to 61.5% across the regions and that the factors most strongly associated with reduced food intake on nutritionDay were reduced intake during the previous week, confinement to bed, female sex, younger age, older age, and low body mass index (BMI).[37]

The aims of this study are to assess the prevalence of malnutrition risk for a variety of patient types and to evaluate the impact of hospital food intake on 30-day in-hospital mortality in the patients of the nutritionDay in the U.S. database admitted between 2009 and 2015 to participating hospitals.

Methods

We included all adult patients with age 18 or older from the nutritionDay in the U.S. database (http://www.nutritionday.org) admitted to participating non–intensive care unit (ICU) hospital wards in the U.S. between 2009 and 2015. Patients in ICU wards within the hospitals were not included. The nutritionDay in the U.S. database is based on a cross-sectional data collection from all patients present in a participating hospital ward who consented to active participation. Data were collected with 3 questionnaires addressing ward structure and patient demographics as well as nutrition history, status, and care. The questionnaires were completed by the patient, caregiver, and/or hospital staff. Hospital outcome was collected 30 days after nutritionDay. All data were entered into a protected online database of the Center for IT Systems & Communications of the Medical University Vienna (https://cemsiis.meduniwien.ac.at/) in which neither hospitals nor patients can be identified. All analysis was done after decoding with R 3.3.1 or STATA 15.1 (College Station, Texas, USA).

Malnutrition risk or malnutrition diagnosis is not directly captured in nutritionDay, but the database contains nutrition-related questions that allow the ability to estimate the prevalence of malnutrition risk. To assess the prevalence of malnutrition risk, patients' self-reported responses to nutritionDay in the U.S. survey questions can be utilized. Patients were asked "Have you lost weight unintentionally within the last three months?" and "If yes, how many pounds/kilograms did your weight decrease?" Patients were also asked to give their reason for eating less, with options including "loss of appetite," "problems with swallowing/chewing," "nausea," and "others." In combination, these questions can be mapped to the Malnutrition Screening Tool (MST) developed by Ferguson et al, a validated predictor of malnutrition risk in hospitalized patients.[38] Patients were determined to be at risk of malnutrition if their responses mapped to a score of 2 or higher on the MST. Malnutrition risk prevalence was determined for the entire nutritionDay in the U.S. population, as well as specific subgroups defined by hospital ward specialty.

Meal intake was recorded by patients on a questionnaire using simple categories (all, about a half, about a quarter, nothing) such as those used by Olin et al.[39] Meal intake was recorded on 1 specified day for the lunch and/or dinner meal, usually on nutritionDay. A symbolic plate was used to visualize a meal in addition to the written categories and the instruction stated on the sheet: "Please tick a circle for each meal to indicate how much you ate today." See Figures S1–S5 for nutritionDay in the U.S. surveys.

Information on dying or being discharged home within 30 days, 30-day mortality, transfers to other hospitals, and readmission to the same hospital, as well as hospital unit characteristics, were provided by the hospital unit volunteer responsible for nutritionDay data collection.

nutritionDay in the U.S. operates under nutritionDay worldwide, and each individual participating hospital is requested to obtain their own Institutional Review Board approval prior to participating in nutritionDay.

Statistics

Descriptive statistics are based on univariate proportions with 95% confidence intervals, median with interquartile range (IQR), or mean with standard deviation (SD). Whenever appropriate, missing data categories are presented according to the STrengthening the Reporting of OBservational studies in Epidemiology recommendations (https://www.strobe-statement.org/ accessed May 1, 2018) for reporting epidemiological data. Sensitivity analysis was based on data from wards recruiting at least 60% of their patients at nutritionDay and reporting at least 80% of the patients' outcomes.

Malnutrition risk prevalence is reported as the proportion of patients meeting the MST criteria for malnutrition risk and is reported by unit specialty and for the entire population with 95% confidence intervals.

Factors impacting mortality risk were assessed using the Fine and Grey method for competing risk, using length of

stay after nutritionDay and 30-day in-hospital mortality.[40] Because of the small number of events (patients dying), logistic regression for death in the hospital within 30 days was also performed. Clinical wards were considered as repeated factors in both to account for the clustering of patients in all models and to account for the cross-sectional bias models that were always adjusted for length of stay prior to nutritionDay. The variables "eaten on nutritionDay," "have you lost weight," "can you walk alone," and "eaten last week" were considered as key factors for mortality. Demographics and measures of disease severity including age, gender, BMI, ward specialty, any prior ICU stay, prior surgery, or needed help for the questionnaire as well as all possible comorbidities and affected organs were considered as possible confounders.

First univariate Fine and Gray competing risk regression analysis was performed for key factors as well as control variables. If significant ($P < 0.1$), the control variables were used in addition to the key factors in a multivariate analysis. Backwards selection (with a P-value threshold of 0.01) was used to define the final model in each analysis.

Results

Demographics

The overall nutritionDay in the U.S. adult population consisted of 9959 patients on 601 wards from 245 U.S. hospitals. Patients were approximately equally divided by gender, with 53% being female. Mean age of the participants was 64 years (IQR 52–76). The average BMI was 29.19 kg/m^2 (SD 8.15), with 66.2% of patients having a BMI of 25 kg/m^2 or greater. The most common comorbidities were diabetes (28.8%), cardiac insufficiency (23.2%), and others (46.5%). Specialties with the most patients included internal/general (48.3%), internal/cardiology (14.7%), internal/oncology (7.6%), and general surgery (7.4%). The total length of stay was a median of 7 days (IQR 4–13) and a mean of 11.6 days (SD 13.3). This total length of stay is biased because of the design of the study that by nature includes more patients with a prolonged length of stay and excludes patients still in the hospital at outcome assessment because their total length of stay is unknown.[41] Length of stay prior to conducting the nutritionDay survey was a median of 3 days (IQR 2–7) and a mean of 6.4 days (SD 8.2). In terms of functional ability, 31.4% of patients (n = 3125) needed assistance with walking. Patient demographics of control variables are shown in Table 1, hospital variables are shown in Table 2, and patient demographics of key factors are shown in Table 3.

Malnutrition Risk

MST score was calculated in 9489 patients (95% of total patient sample). Statistics on risk factors per the MST are shown in Table 3. The overall prevalence of malnutrition risk (MST score ≥2) was 32.7%. The prevalence of malnutrition risk was highest in infectious disease (46.1%) and long-term care (45.8%) and lowest in orthopedic surgery (23.7%) wards. The distribution of MST scores is shown in Figure 1. The proportion of patients with MST scores ≥2 by specialty is shown in Figure 2.

Food Intake on nutritionDay

More than half of all patients on nutritionDay did not eat their full meal (lunch and/or dinner). On nutritionDay, 36.5% of patients ate their entire meal, 25.8% ate half their meal, 25.2% ate about a quarter of their meal or nothing, and 6.9% of patients were not allowed to eat. The distribution of food intake on nutritionDay is shown in Table 3.

Food Intake and Mortality

There appears to be a negative relationship between meal consumption and 30-day hospital mortality. In the multivariate Fine and Gray competing risk analysis (see Table 4), patients who ate about a quarter of their meal had a mortality hazard ratio (HR) of 3.24 (95% CI: [1.73, 6.07]; $P < 0.001$) compared with those who ate all their meal. This mortality HR rose to 5.99 (95% CI: [3.03, 11.84]; $P < 0.0001$) for patients who were allowed to consume food but ate nothing. Those who were not allowed to eat had a mortality HR of 4.38 (95% CI: [2.00, 9.58]; $P < 0.001$). The association between food intake and mortality is shown in Table 4. Logistic regression with clustering and sensitivity analysis showed similar results from the Fine and Gray competing risk regression model with clustering.

Nutrition Support

In the patients participating in nutritionDay in the U.S., there is a high percentage (22.7%–37.8%) who received a special diet. In terms of nutrition support, there was a low percentage of use of protein/energy supplements (PES) either alone or in combination with hospital food or a special diet. In those eating nothing, only 5.7% received hospital food and PES, only 5.3% received a special diet and PES, and only 0.3% received PES alone. The percentage of artificial nutrition (eg, enteral, parenteral, or combined enteral and parenteral nutrition) was highest in those who were not allowed to eat at 13.7%. See Table 5 for nutrition support by meal intake.

Discussion

The nutritionDay in the U.S. database, collected through the efforts of hundreds of volunteers and the nutritionDay in the U.S. organization and national coordinator, allows the prevalence of malnutrition risk to be estimated at 32.7% of

Table 1. Patient Demographics.

Variable	Valid Values	N	%	Mean ± SD/Median + IQR
Gender (female)	9902	5278	53.3%	
Age	9953			64 IQR 52–76
BMI	9711			29.19 ± 8.15
<18.5 kg/m^2		466	4.8%	
18.5–25 kg/m^2		2813	29.0%	
25–30 kg/m^2		2659	27.4%	
30–35 kg/m^2		1830	18.8%	
>35 kg/m^2		1943	20.0%	
Comorbidity				
Any comorbidity (yes)	9959	7649	76.8%	
Diabetes (yes)	9959	2868	28.8%	
Stroke (yes)	9959	697	7.0%	
COPD (yes)	9959	1374	13.8%	
Myocardial infarction (yes)	9959	478	4.8%	
Cardiac insufficiency (yes)	9959	2310	23.2%	
Other (yes)	9959	4631	46.5%	
Specialty				
Internal/general		4812	48.3%	
Internal/gastroenterology		289	2.9%	
Internal/oncology		759	7.6%	
Internal/cardiology		1467	14.7%	
Internal/infectious diseases		104	1.0%	
Internal/geriatrics		223	2.2%	
Neurology		89	0.9%	
Psychiatry		79	0.8%	
General surgery, orthopedic surgery and neurosurgery		1236	12.4%	
Trauma		186	1.9%	
Long-term care		52	0.5%	
Others		663	6.7%	

BMI, body mass index; COPD, chronic obstructive pulmonary disease; IQR, interquartile range.

Table 2. Patient Hospital Variables.

Variable	Valid Values	N	%	Mean ± SD/Median + IQR
Any ICU stay (yes)	9504	1036	10.9%	
Had surgery (yes)	9959	2988	30.0%	
Readmitted (yes)	9959	1264	12.7%	
Can you walk alone				
Yes		5643	56.7%	
With assistance		3125	31.4%	
No		667	6.7%	
Missing		524	5.3%	
Length of stay				Mean: 11.6 ± 13.3 Median: 7 IQR 4–13
Length of stay before nutritionDay survey	9941			Mean: 6.4 ± 8.2 Median: 3 IQR 2–7

ICU, intensive care unit; IQR, interquartile range.

all non-ICU patients present in the hospital for the years 2009–2015. This estimate is based on nearly 10,000 patients from 601 wards from 13 different medical specialties and thus constitutes one of the largest datasets on U.S. hospital patients. This estimate of malnutrition risk is similar to the results of a recently published quality improvement program, demonstrating a 30% malnutrition risk in hospital patients.[24]

Table 3. Patient Demographics of Risk Factors and Food Intake on nutritionDay.

Variable	Valid Values	% Median + IQR
Eaten last week		
Normal	3941	39.6%
Less than normal	2101	21.1%
Less than half of normal	1800	18.1%
Less than quarter of normal	1603	16.1%
Missing	514	5.1%
Have you lost weight		
No	4354	43.7%
No, gained	818	8.2%
Yes	3740	37.6%
Don't know	586	5.9%
Missing	461	4.6%
Duration since admission	9941	3 IQR 5
Meal eaten on nutritionDay		
All	3639	36.5%
Half	2572	25.8%
Quarter	1799	18.1%
Nothing	703	7.1%
Not allowed	684	6.9%
Missing	562	5.6%

IQR, interquartile range.

Meal consumption in the U.S. on nutritionDay appears to be similar to that of other countries. Less than half (36.5%) consumed their entire meal on nutritionDay compared with 33.8% in an analysis of the European nutritionDay data.[29] In this sample, 7.1% consumed nothing despite being allowed to eat, compared with 4.6% in the European data.[29]

The analysis demonstrates a clear connection between hospital food intake and mortality. Patients who did not eat despite having permission to do so had a mortality HR of 5.99 [CI 3.03, 11.84] compared with those who ate all their meal. This result appears stronger in the U.S. population than the European population, where the corresponding mortality HR is 2.71 [CI 1.88, 3.91].[29] Those who ate a quarter of their meal in the U.S. dataset had a mortality HR of 3.24 [CI 1.73, 6.07] compared with the corresponding mortality HR in the European data set of 1.97 [1.42, 2.71].[29]

Furthermore, over half of patients on an unrestricted/regular hospital diet consumed one-quarter or less of their meal on nutritionDay. Patients prescribed unrestricted diets are often perceived as lower risk than patients requiring special diets, so it is important to recognize that patients may eat poorly regardless of their diet prescription. The clinician should keep this in mind as part of the screening, assessment, and intervention process for optimal nutrition care.

The data also reveal some interesting and potentially concerning patterns in nutrition practice. Among those who were allowed to eat but ate nothing, only 14.7% received PES or artificial nutrition (in addition to hospital food or a special diet that was not consumed). Similarly, in those who consumed a quarter of their meal, only 13.8% received PES or artificial nutrition in addition to normal food. These results are concerning as they may reflect a lack of recognizing patients who are eating poorly and as a result

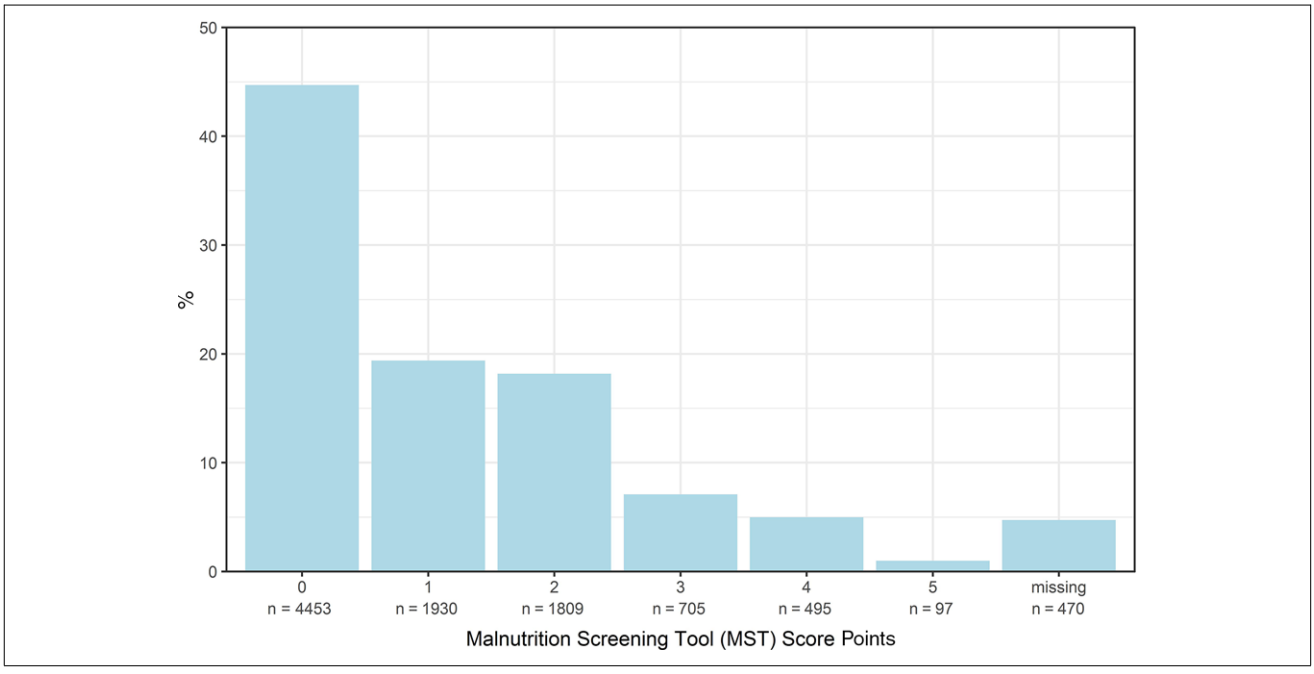

Figure 1. Malnutrition Screening Tool (MST) score and malnutrition risk.

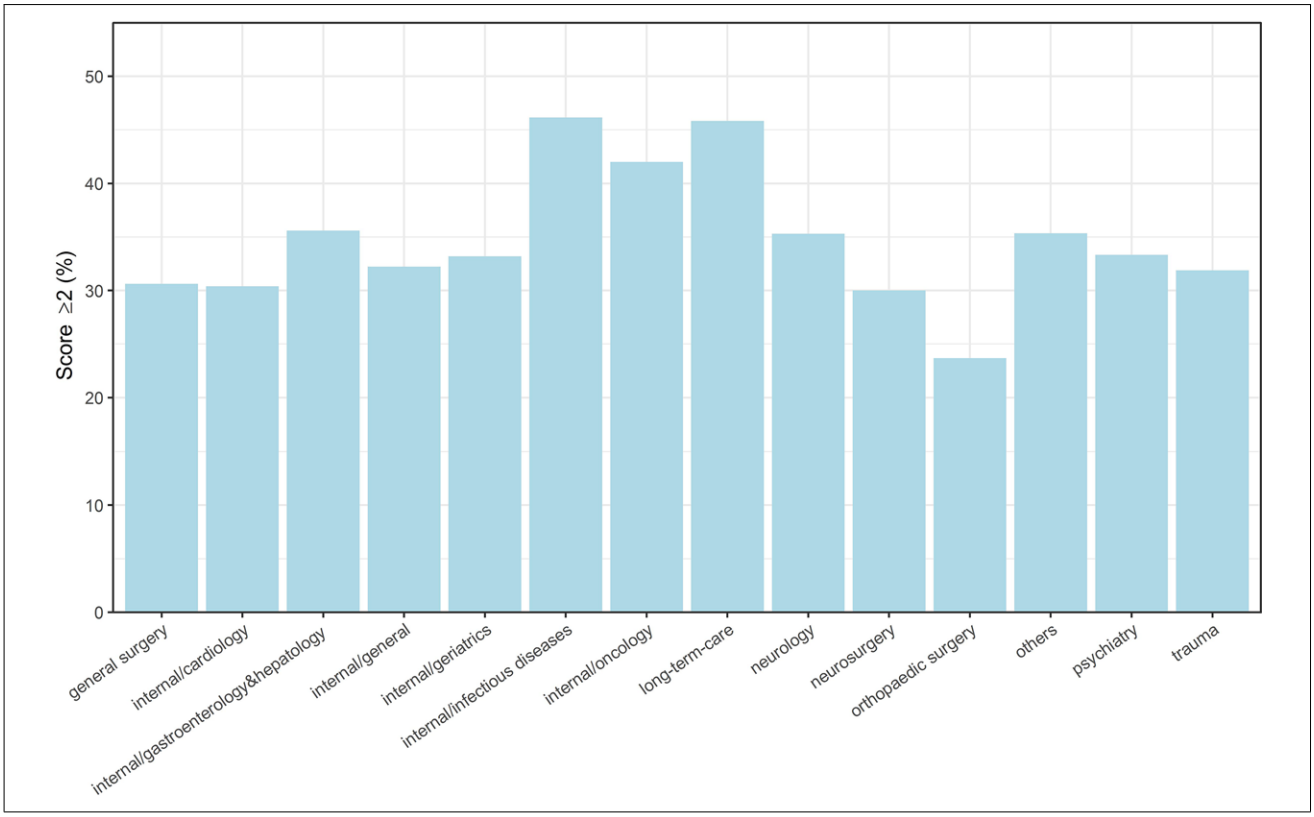

Figure 2. Proportion of patients with a high Malnutrition Screening Test (MST) score (≥2) for different specialties (for specialties with >50 patients).

Table 4. Association Between Quantity Eaten on nutritionDay and 30-Day Hospital Mortality Adjusted for Mobility, Any ICU Stay, Affected Organ Lung and Having Cancer, Previous Surgery, and Age As Well As Length of Stay Before nutritionDay.

		Multivariate	
Variable	Level	HR + 95% CI	*P*-Value
Eaten today	All	Reference	
	Half	1.27 [0.62, 2.59]	0.5100
	Quarter	3.24 [1.73, 6.07]	0.0002
	Nothing	5.99 [3.03, 11.84]	0.0000
	Not allowed	4.38 [2.00, 9.58]	0.0002
	Missing	3.56 [1.20, 10.58]	0.0200

HR, hazard ratio; ICU, intensive care unit.

a missed opportunity to implement adequate nutrition intervention. These results are in fact lower than the 13.4% use of artificial nutrition in patients with a malnutrition diagnosis as reported by Corkins et al reflecting only enteral and parenteral nutrition and not PES.[28] This nutritionDay in the U.S. data includes PES usage. When PES is excluded from comparison, artificial nutrition (enteral and parenteral nutrition) was provided in only 0.8% and 3.4% of those who consumed a quarter or none of their meal, respectively. This low usage of PES suggests a significant opportunity to maximize the use of PES in patients with poor meal intake and to implement artificial nutrition sooner, particularly in patients with malnutrition or at high risk for malnutrition. Additionally, this data is significant in light of a recent publication stating that nutrition support in hospital patients should be avoided in medical inpatients as no specific benefits were found[42] but disregards the fact that nonelective readmissions were reduced by almost 30%. Nutrition support has not consistently and robustly demonstrated improvement of outcomes in hospital patients across all studies because of poor methodology and underpowered studies. In 2016, a large randomized, controlled trial demonstrated that specialized oral nutrition supplementation in malnourished older hospitalized adults resulted in a decrease in 90-day mortality;[43] however, additional well-designed studies are needed to clarify this issue. The nutritionDay in the U.S. data does not allow for assessment of the impact of nutrition support on survival as the data cannot reflect all aspects of severity of disease. However, this nutritionDay in the U.S. data highlights that malnutrition risk is frequent and clinically relevant, and nutrition support is underutilized in hospital patients.

Table 5. Nutrition Support Provided by Meal Intake.

Variable	Hospital Food	Special Diet	Hospital Food and PES	Special Diet and PES	PES	Artificial Nutrition	Nothing
Eaten all	37.9%	37.8%	2.5%	2.6%	0.1%	0.5%	2.0%
Eaten half	40.0%	34.4%	4.4%	3.9%	0.4%	0.5%	2.2%
Eaten quarter	36.9%	33.3%	5.8%	6.6%	0.6%	0.8%	2.0%
Eaten nothing	35.3%	28.4%	5.7%	5.3%	0.3%	3.4%	1.8%
Not allowed to eat	19.7%	22.7%	1.6%	2.0%	0.4%	13.7%	2.8%
Missing	24.9%	25.6%	4.6%	4.1%	0.7%	8.7%	12.5%

PES, protein/energy supplement; special diet, eg, lactose-free, sodium-free.

The strengths of this study include the large sample size of U.S. hospital patients, the breadth of nutrition care data elements, and the input from the patient and/or caregiver. This study is subject to several limitations. Most importantly, as an observational study, conclusions cannot be drawn as to any causal relationship between hospital food intake and mortality. Additionally, as hospital units choose to participate in the nutritionDay in the U.S., our sample may exhibit self-selection that could, in turn, bias the results. Self-selection may also occur at the patient level, as less healthy patients may not be able to provide consent. Additionally, data are self-reported by patients and not objectively measured. This study is cross sectional, and therefore patients with longer lengths of stay are more likely to be included in the study sample by design.

Conclusion

nutritionDay in the U.S. provides much needed data on nutrition care and food intake in U.S. hospital patients. The results of this study provide the most robust estimate of malnutrition risk in hospitalized U.S. patients to date, finding that approximately 1 in 3 are at risk. This rate of malnutrition risk shows that hospital malnutrition remains a problem in U.S. hospital patients. In addition, the data demonstrate that patients who have diminished intake experience increased mortality risk and do not always receive optimal nutrition intervention. These results highlight the ongoing issues of poor oral intake and malnutrition risk in the hospital setting and the need for optimal nutrition care to improve outcomes, including mortality.

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Statement of Authorship

A. C. Sauer, S. Goates, G. Gewirtz, S. Moick, and M. Hiesmayr contributed to the conception and design of the research; S. Goates, G. Gewirtz, I. Sulz, S. Moick, and M. Hiesmayr contributed to the acquisition and analysis of the data; A. C. Sauer, S. Goates, A. Malone, K. M. Mogensen, G. Gewirtz, I. Sulz, S. Moick, A. Laviano, and M. Hiesmayr contributed to the interpretation of the data; and A. C. Sauer and S. Goates drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

Supplementary Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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