Nutrition 34 (2017) 65–70

Contents lists available at ScienceDirect

Nutrition

journal homepage: www.nutritionjrnl.com

Applied nutritional investigation

Undernutrition as independent predictor of early mortality in elderly cancer patients

Renata B. Martucci Ph.D. [a,b,*], Mariana V. Barbosa B.S. [c], Cristiane A. D'Almeida M.Sc. [a], Viviane D. Rodrigues M.Sc. [a], Anke Bergmann Ph.D. [d], Nivaldo B. de Pinho M.Sc. [e], Luiz Claudio S. Thuler Ph.D. [f]

[a] Nutrition and Dietetic Service, Cancer Hospital Unit I, National Cancer Institute José Alencar Gomes da Silva, Rio de Janeiro, Brazil
[b] State University of Rio de Janeiro, Rio de Janeiro, Brazil
[c] Post Graduate in Medical Science, State University of Rio de Janeiro, Rio de Janeiro, Brazil
[d] Carcinogenesis Molecular Program, Research Center, National Cancer Institute José Alencar Gomes da Silva, Rio de Janeiro, Brazil
[e] Technical Support Division, Cancer Hospital Unit I, National Cancer Institute José Alencar Gomes da Silva, Rio de Janeiro, Brazil
[f] Clinical Research Division, Research Center, National Cancer Institute José Alencar Gomes da Silva, Rio de Janeiro, Brazil

ARTICLE INFO

Article history:
Received 10 March 2016
Accepted 23 September 2016

Keywords:
Cancer
Aging
Survival
Nutrition assessment
Undernutrition

ABSTRACT

Objectives: The aim of this study was to evaluate the 1-y survival of elderly patients with cancer and the association between undernutrition and mortality.
Methods: This was a cohort study with elderly patients ages ≥65 y admitted between September and October 2014. A nutritionist performed a Mini Nutritional Assessment-Short Form (MNA-SF) assessment during 48 h of hospital admission and collected data about potential confounding variables (comorbidities, stage of cancer, treatment in the previous 3 mo, and reason for hospitalization). Vital status was determined from the medical records or public records office. Overall survival was estimated using the Kaplan–Meier method. Cox regression was performed to estimate unadjusted hazard ratios. Variables with $P < 0.20$ by univariate analysis were selected for multivariate analysis. $P < 0.05$ was considered statistically significant.
Results: Of the 136 patients (mean age, 73.1 y; 52.2% men), 29.4%, 41.2%, and 29.4% were classified as normal, at risk for undernutrition, and undernutrition, respectively, according to the MNA-SF. The mortality rate was 31.6% after 12 mo. One-year mortality was higher among the undernourished patients, followed by patients at risk for undernutrition. After adjustment for confounding variables, the multivariate regression Cox model showed that being undernourished according to the MNA-SF increased the risk for death at 1 y (hazard ratio, 5.59; 95% confidence interval, 1.8–17.3; $P < 0.001$).
Conclusion: The results showed that the MNA-SF can be a useful tool in identifying elderly patients at higher risk for 1-y mortality.

Introduction

Cancer is associated with aging and its incidence and mortality increases with age. Approximately 60% of all cancers and 70% of cancer-specific mortality occur in individuals over the age of 65 y [1]. The world has experienced an irreversible demographic transition that will result in increasingly elderly populations and, as the population ages, health care becomes more complex. In this context, the management of cancer in this group of patients constitutes an increasingly common feature in oncology practice, and the demand for treatment will increase in the coming decades [1–3].

RBM was responsible for the conception and design of the study; collection, analysis, and interpretation of data; drafting and revision of the manuscript; and approval of the final version. MVB was responsible for the collection, analysis, and interpretation of data; drafting of the manuscript; and approval of the final version. CAD, VDR, and NBP were responsible for the collection of data and approval of the final version of the manuscript. AB was responsible for the conception and design of the study; revision of the manuscript; and approval of the final version. LCST was responsible for the conception and design of the study; analysis and interpretation of data; revision of the manuscript; and approval of the final version. The authors have no conflicts of interest to declare.

* Corresponding author. Tel.: 55 21 3207 1345.
E-mail address: Renata.martucci@inca.gov.br (R. B. Martucci).

http://dx.doi.org/10.1016/j.nut.2016.09.011
0899-9007/© 2016 Elsevier Inc. All rights reserved.

The challenge in finding the best health care is the individual diversity of the elderly population, the presence of comorbidities, losses in functionality and cognitive function, and changes in nutritional and psychological states. Nevertheless, in clinical practice these patients often are treated as a single homogeneous group and the limitations and risks or benefits of treatment are sometimes not considered in clinical decisions, this being one of the reasons for higher mortality rates. The prediction of outcomes, particularly survival, is essential in choosing the best treatment for elderly patients with cancer [2–5].

Association of aging and cancer increases nutritional risk. In Europe, about one-third of elderly patients admitted to the hospital are undernourished. Undernutrition is associated with higher morbidity and mortality, poor quality of life, reduced tolerance to oncologic therapy, and poor efficacy of chemotherapy [6–9]. One of the major challenges in the care of elderly cancer patients is early detection of undernutrition.

The European Society of Parenteral and Enteral Nutrition recognizes the Mini Nutritional Assessment-Short Form (MNA-SF) as the screening tool to be used in care of the elderly. In individuals identified by screening as being at risk for undernutrition, this diagnosis should be based on objective methods (anthropometry, including body composition, biochemical indicators, and data related to eating capability); however, there is no consensus on the cutoff points for different ages or regional variability [10]. Also, little is known about the usefulness of this tool to predict prognosis, postoperative complications and mortality.

Gioulbasanis et al. [6] studied 594 overweight and obese patients with metastatic cancer. According to complete Mini Nutritional Assessment (MNA), almost 50% were at risk for undernutrition and 12% were already undernourished. A significant difference in overall survival (OS) was found between groups and undernourished patients had significant lower OS (3.2–9.6 mo). MNA was the only independent predictor of OS in this cohort [6]. In a prospective study, poor MNA scores were associated with receiving less than four cycles of chemotherapy and with increased hazard ratios (HR) for mortality in patients with colorectal cancer who were >70 y with palliative chemotherapy [7]. A recent prospective study showed that a poor MNA score was a predictor of early death in cancer patients >70 y treated with first-line chemotherapy [8].

The risk for mortality is usually two times higher among undernourished patients compared with cancer patients aged ≥70 y who are not undernourished, as assessed by complete MNA [4,11]. To our knowledge, there is no data available showing that undernutrition diagnosed by MNA-SF is a negative prognostic factor in elderly cancer patients.

The MNA-SF fulfills screening and nutritional evaluation criteria. It is validated for patients aged ≥65 y, and can be applied by professional dietitians, nurses, or doctors. It then becomes a simple and useful tool in clinical practice, quickly identifying an early risk for undernutrition or undernutrition in elderly patients [12,13].

Investigating whether undernutrition assessed by the MNA-SF predicts early mortality can help oncologists decide the appropriate treatment of elderly patients with cancer. The aim of this study was to evaluate the 1-y survival of elderly patients with cancer and the association between undernutrition and mortality.

Material and methods

The Luso-Brazilian Survey of the Old-aged Oncology Nutrition was a multicenter, prospective cohort study that included men and women ages ≥65 y, with malignant tumors, regardless of location and stage of the disease, who were admitted to the participant's hospitals during September and October 2014. For the present study, we used all consecutive elderly cancer patients (N = 350) admitted to Cancer Hospital Unit I—the National Cancer Institute, Brazil, which was the coordinating center of the study. Patients were excluded if they were unable to answer the questionnaire or were not capable of providing the necessary information, or did not agree to sign the consent form (n = 214; 61.1%). Informed consent was obtained from all study participants before inclusion. The protocol was approved by the appropriate ethics committee (n. 956.512/2015).

Nutritional assessment and data collection

For each patient, during the first 48 h of hospital admission, a nutritionist performed the MNA-SF, and also collected demographic and clinical variables, such as sex, age, weight, height, body mass index (BMI), calf circumference (CC), presence of comorbidities, actual use of tobacco or alcohol (yes or no), tumor site, tumor stage (initial or advanced), reason for hospitalization (surgical or clinical), cancer treatment in the past 3 mo (yes or no), hospital length of stay, death during hospitalization, and up to 1 y.

The original MNA-SF was a combination of six questions from the full MNA, regarding decline in food intake, weight loss in the previous 3 mo, mobility, actual disease/distress, psychological situation, and additional anthropometric measures (BMI or CC). Brazilian Portuguese MNA was demonstrated to have sufficient evidence of validity, including sensitivity and specificity, construct, and criterion validity [12]. In the present study, the MNA-SF was applied during hospital admission for cancer treatment, so we considered that all the patients had acute disease or distress. Psychological situation was determined from the medical records (medical diagnosis of dementia, depression, and Alzheimer disease). The MNA-SF has a three-category scoring classification: 14 to 12 normal nutritional status, 11 to 8 risk for undernutrition, and 7 to 0 undernutrition [13].

Weight (kg) was measured on an electronic digital scale (Filizola) with a 180-kg capacity. The patients were positioned on the center of the scale in an upright position with arms extended laterally, barefoot, and wearing light clothing. Height (cm) was measured using the vertical stadiometer of the scale. BMI was calculated as weight (kg) divided by height (m^2) and nutritional status was determined according to the Pan-American Health Organization for the elderly [14]. Fifty-six patients (41.2%) were unable to stand on the scale.

CC was evaluated with the patient sitting or lying with the knee and ankle at a 90-degree angle, with the tape placed in a horizontal position at the maximum circumference of the calf [15].

Undernutrition was defined as fulfilling one or more of the following criteria: BMI <23 kg/m^2 [14], CC <31 cm [15], or an MNA-SF score ≤7 of 14 [13].

Tumor sites were classified according to International Classification of Diseases: oral cavity and pharynx, digestive system, respiratory system, skin (including melanoma), male genital system, urinary system, hematologic tumors (lymphoma, leukemia, and myeloma), and other tumors (bone and joints, female genital system, brain and other nervous system, and the endocrine system) [16].

Tumor stage was defined as initial and advanced, preferably by clinical stage and TNM system (primary tumor, regional lymph nodes, and distant metastasis) classification, depending on the tumor. Initial stage was considered: in situ (Tis or stage 0); localized extension; stage I–II; TNM T1–2, N0, and M0; or histologic grade 1 (well differentiated) and 2 (moderately well differentiated). Advanced stage was considered: regional or distant extension; stage III–IV; TNM T3–4, N1–3, and M1; or histologic grade 3 (poorly differentiated) and 4 (undifferentiated). Five patients with leukemia and myeloma remained without staging (3.7%).

Outcome

The primary outcome was 1-y OS. Vital status was determined from the medical records or public records office. Early mortality was defined as death by any cause within the first year after hospital admission.

Statistical analysis

The Kolmogorov–Smirnov test was used to test for the normality of data. Categorical variables are described as numbers and percentages and quantitative variables as mean (±SD) or median (minimum–maximum) according to their distribution. Differences in the distribution of categorical sample characteristics and MNA-SF categories were tested for significance by the χ^2 test. Differences in quantitative variables between MNA-SF categories were assessed by one-way analysis of variance.

OS was defined as the time from evaluation to death within 1 y or to the last follow-up for patients with censored data. OS was estimated using the Kaplan–Meier method, and survival curves were compared using the Log rank test for categorical variables. Cox proportional hazards regression was performed to estimate HRs and their 95% confidence intervals (CIs). Variables with $P < 0.20$ by univariate analysis were selected for multivariate analysis.

Table 1
Patient characteristics and baseline variables according MNA-SF classification

Variables	All patients (N = 136)	Normal (n = 40; 29.4%)	Risk for undernutrition (n = 56; 41.2%)	Undernutrition (n = 40; 29.4%)
	N (%)	n (%)	n (%)	n (%)
General data				
Age, y, mean (±SD)	73.1 (±6.5)	73.3 (±6.4)	73.3 (±6.6)	72.8 (±6.7)
Sex				
Male	71 (52.2)	23 (57.5)	32 (57.1)	16 (40)
Female	65 (47.8)	17 (42.5)	24 (42.9)	24 (60)
Use of tobacco				
Yes	15 (11)	36 (90)	48 (85.7)	37 (92.5)
No	121 (89)	4 (10)	8 (14.3)	3 (7.5)
Use of alcohol				
Yes	15 (11)	36 (90)	48 (85.7)	37 (92.5)
No	121 (89)	4 (10)	8 (14.3)	3 (7.5)
Comorbidities				
Yes	81 (59.6)	18 (45)	19 (33.9)	18 (45)
No	55 (40.4)	22 (55)	37 (66.1)	22 (55)
Disease information				
Tumor site				
Digestive system	54 (39.7)	17 (42.5)	21 (37.5)	16 (40)
Skin and melanoma	21 (15.4)	7 (17.5)	9 (16.1)	2 (5)
Oral cavity and pharynx	14 (10.3)	2 (5)	5 (8.9)	7 (17.5)
Respiratory system	10 (7.4)	2 (5)	3 (5.4)	5 (12.5)
Hematologic tumors	10 (7.4)	1 (2.5)	3 (5.4)	6 (15)
Male genital system	9 (6.6)	5 (12.5)	4 (7.1)	0 (0)
Urinary system	7 (5.1)	1 (2.5)	5 (8.9)	1 (2.5)
Others	11 (8.1)	5 (12.5)	6 (10.7)	3 (7.5)
Cancer stage (n = 131)				
Initial	73 (53.7)	28 (70)	36 (65.5)	9 (25)*
Advanced	58 (42.6)	12 (30)	19 (34.5)	27 (75)
Treatment in the previous 3 mo†				
No	110 (80.9)	35 (87.5)	45 (80.4)	30 (75)
Yes	26 (19.1)	5 (12.5)	11 (19.6)	10 (25)
Nutritional assessment				
BMI, kg/m^2 (n = 80), mean (±SD)	24.9 (±4.6)	27.8 (±3.8)	23.3 (±4.3)	22.8 (±3.9)‡
CC, cm, mean (±SD)	33.1 (±4.2)	35.8 (±3.3)	33.4 (±3.5)	30.2 (±4)‡
MNA-SF score, mean (±SD)	9.0 (±3.2)	12 (±0)	9.9 (±1.1)	4.8 (±1.9)‡
Hospitalization data				
Length of stay, d, median (min–max)	6.0 (1–76)	5 (1–15)	4.5 (1–24)	7.0 (1–76)
Reason for hospitalization				
Surgical	85 (62.5)	34 (85)	38 (67.9)	13 (32.5)*
Clinical	51 (37.5)	6 (15)	18 (32.1)	27 (67.5)
Outcomes				
Death during hospitalization	7 (5.1)	0 (0)	1 (1.8)	6 (15)
1-y mortality	43 (31.6)	4 (10)	14 (25)	25 (62.5)*
Survival mo, mean (±SD)	8.7 (±4.5)	11 (±2.4)	9.6 (±4)	5.2 (±4.9)‡

BMI, body mass index; CC, calf circumference; MNA-SF, Mini Nutritional Assessment-Short Form
* Statistical difference $P < 0.001$ by χ^2 test.
† Any cancer treatment 3 mo before hospitalization.
‡ Statistical difference $P < 0.001$ by one-way analysis of variance.

All statistical analyses were performed with IBM SPSS Statistics for Windows, version 20 (IBM, Armonk, NY, USA). $P < 0.05$ was considered statistically significant.

Results

Baseline characteristics of the sample divided by MNA-SF are presented in Table 1. The study included 136 patients, with a mean age of 73.1 y (±6.5 y) and median of 71 y (65–91). Most of the patients were men with tumors in the digestive system (39.7%) who were hospitalized for surgery (62.5%). The mortality rate was 31.6% at 12 mo, and the mean survival time was 8.7 mo (±4.5 mo). Of the patients, 29.4%, 41.2%, and 29.4% were classified as normal, at risk for undernutrition, and undernutrition by MNA-SF, respectively. According to nutritional assessment, the average BMI of the sample corresponds to the normal weight classification, and the average CC also is classified as normal. However, assessing the MNA-SF, 71% of the patients were classified as being at nutritional risk or undernourished (Table 1).

Of the patients with oral cavity and respiratory tract cancer, 50% were classified as undernourished by the MNA-SF. The majority (75%) of undernourished patients had advanced stage cancer ($P < 0.001$). Fifty-three percent of patients who were hospitalized for medical reasons ($P < 0.001$) and 47% of those with advanced disease ($P < 0.001$) also were undernourished, according to the MNA-SF. One-year mortality was higher among those patients who were classified as undernourished, followed by patients at risk for malnutrition ($P < 0.001$; Table 1).

Table 2 shows the MNA-SF results in relation to the nutritional status of the patients. Undernourished patients had reduced food intake, greater weight loss, reduced mobility, and lower BMI and CC.

Kaplan–Meier curves for the cumulative survival according to the nutritional assessment methods are shown in Figure 1. When

Table 2
Absolute and relative frequencies of MNA-SF domains by rating group

MNA-SF domains	Nutritional status			*P* value
	Normal (n = 40; 29.4%)	Risk for undernutrition (n = 56; 41.2%)	Undernutrition (n = 40; 29.4%)	
A—Food intake declined				**<0.001**
0 = severe decrease	0 (0)	0 (0)	24 (60)	
1 = moderate decrease	0 (0)	15 (26.8)	15 (37.5)	
2 = no decrease	40 (100)	41 (73.2)	1 (2.5)	
B—Weight loss				
0 = weight loss >3 kg	0 (0)	6 (10.7)	29 (72.5)	**<0.001**
1 = does not know	0 (0)	7 (12.5)	9 (22.5)	
2 = weight loss between 1 and 3 kg	0 (0)	13 (23.2)	1 (2.5)	
3 = no weight loss	40 (100)	30 (53.6)	1 (2.5)	
C—Mobility				
0 = bed or chair-bound	0 (0)	4 (7.1)	18 (45.0)	**<0.001**
1 = able to get out bed/chair but does not go out	0 (0)	13 (23.2)	16 (40)	
2 = goes out	40 (100)	39 (69.7)	6 (15.0)	
D—Has suffered psychological stress or acute disease*				
0 = yes	40 (100)	56 (100)	40 (100)	
2 = no	0 (0)	0 (0)	0 (0)	
E—Neuropsychological problems				
0 = severe dementia or depression	0 (0)	0 (0)	1 (2.5)	0.079
1 = mild dementia	0 (0)	0 (0)	1 (2.5)	
2 = no psychological problems	40 (100)	56 (100)	38 (95.0)	
F1—Body mass index (kg/m^2)				
0 = <19	0 (0)	4 (7.1)	2 (5.0)	**<0.001**
1 = 19–21	0 (0)	7 (12.5)	3 (7.5)	
2 = 21–23	0 (0)	12 (21.4)	2 (5.0)	
3 = >23	30 (75.0)	14 (25.0)	6 (15.0)	
Not possible to measure†	10 (25.0)	19 (34.0)	27 (67.5)	
F2—Calf circumference				
0 = <31 cm	1 (2.5)	3 (5.4)	17 (42.5)	**<0.001**
3 = ≥31 cm	39 (97.5)	53 (94.6)	23 (57.5)	

MNA-SF, Mini Nutritional Assessment-Short Form
Bold *P* value: statistical difference between groups by qui-square test.
* It was considered that all the patients had acute disease or distress.
† No weight and height measurement conditions at the time of evaluation (n = 56). Calf circumference was considered for the final score of MNA-SF.

assessed by BMI, survival did not differ between the group of patients with a BMI <23 kg/m^2 (underweight) and the group with a BMI ≥23 kg/m^2 (normal weight and overweight; data not shown). The survival of those with CC <31 cm was lower, with a statistically significant difference compared with normal CC ($P = 0.004$; Fig. 1A). Regarding the classification of the patients by MNA-SF, there was a statistically significant difference in the survival ($P < 0.001$) and higher mortality among the undernourished (Fig. 1B).

By univariate Cox regression, the cancer stage, reason for hospitalization, and undernutrition as diagnosed by MNA-SF were significantly associated with the 1-y OS of patients. Other variables associated with mortality are presented in Table 3. After adjustment for potential confounding variables (comorbidities, cancer stage, treatment in the previous 3 mo, and reason for hospitalization), the multivariate regression Cox model showed that being undernourished according to the MNA-SF increased the risk for death at 1 y (HR, 5.59; 95% CI, 1.8–17.3; $P < 0.001$), and was an independent factor associated with reduced survival in elderly patients with cancer.

Discussion

In Europe, about 30 to 70% of elderly patients admitted to the hospital are undernourished; this number could be higher when studying elderly patients with cancer in developing countries [9, 17–19]. Functional impairment, undernutrition, and comorbidities are independently associated with survival of elderly patients with cancer [5,7].

Undernutrition in elderly patients can be identified using various criteria, such as BMI <23 kg/m^2 [14], CC <31 cm [15], and MNA-SF score ≤7 out of 14 [13], and can help physicians to determine the best anticancer treatment. Undernutrition can decrease treatment tolerance and intensity and increase chemotoxicity, morbidity, and mortality [5,7].

The elderly cancer patient population is a heterogeneous group, ranging from competent and active individuals to those who are undernourished and cognitively impaired [20]. Only BMI could not detect the differences between them [15]. Other parameters included in MNA-SF, such as reduced food intake, weight loss, and mobility may reflect the difference between the healthy elderly and those at nutritional risk, even when the BMI is >23 kg/m^2. In the group classified as undernourished, 60% had a severely decreased food intake, 72.5% had weight loss >3 kg, 85% had some mobility impairment. Weight and height could not be used to assess BMI in 67.5%. Fifteen percent had BMI ≥23 kg/m^2. In our study, BMI <23 kg/m^2 was not associated with increased mortality.

In the present study, no association was found between age and early mortality. This group of elderly patients with cancer had a median age of 71 y, considered low compared with international studies. Global life expectancy at birth for both sexes combined increased from 65.3 y (95% CI, 65–65.6) in 1990 to 71.5 y (95% CI, 71–71.9) in 2013, and may be lower in developing countries [21]. In the literature, studies with younger elderly (ages 75–77 y) found no correlation between age and early mortality [8], which differs from a study of patients with a median of 80 y, which found a significant association [4].

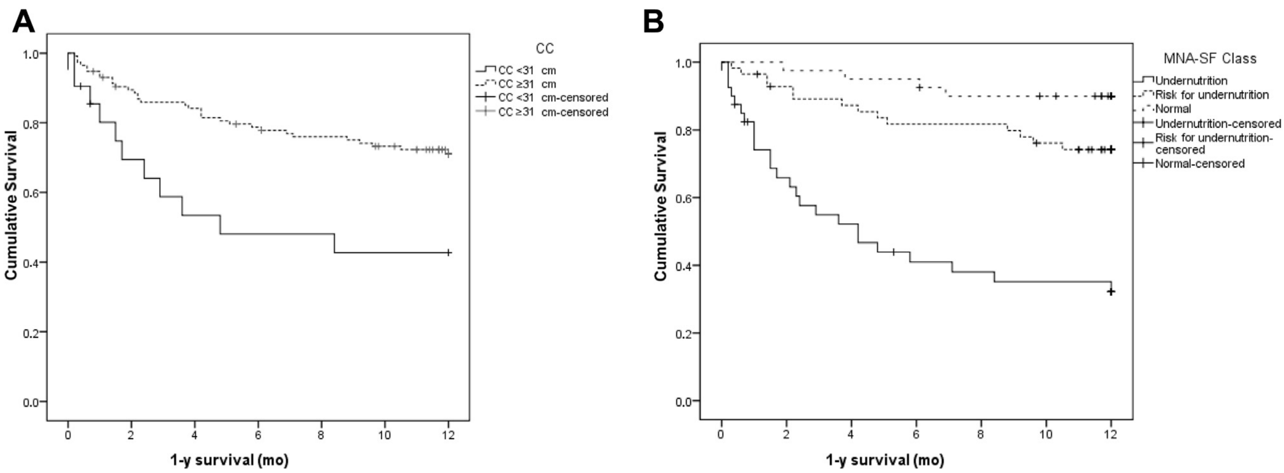

Fig. 1. Kaplan–Meier survival curves according to (A) calf circumference (CC) and (B) the Mini Nutritional Assessment-Short Form Classification (MNA-SF Class).

In the present study, the overall 1-y mortality rate was similar to international studies [4], partly due to our large number of surgical patients who had no treatment in the previous 3 mo. Although, 62% of the mortality was in undernourished patients as assessed by MNA-SF, poor MNA scores were associated with an increased mortality risk and were independently associated with increased HRs for mortality in surgical and clinical settings [7,9].

A similar and large cohort study provides the evidence that undernutrition defined as percentage weight loss in the past 6 mo or 1 mo and/or BMI and/or MNA and/or serum albumin, independently predicts 1-y mortality in elderly inpatients and outpatients with cancer [4]. Although in multivariate models, adjusted HR for undernutrition varied from 1.81 to 2.13, according to the multivariate model chosen [4], in the present study only undernutrition according to the MNA-SF had an adjusted HR of 5.59, showing that in our hospital setting, the application of MNA would be enough to predict survival in elderly cancer patients.

Table 3
Univariable and multivariable Cox regression analyses to identify factors predicting 1-y mortality

Variables	Unadjusted		Adjusted*	
	HR (95% CI)	*P* value	HR (95% CI)	*P* value
Age, y				
<71†	1.00 (referent)	0.46	1.00 (referent)	0.99
≥71	0.78 (0.4–1.4)		1.00 (0.5–1.9)	
Sex				
Male	1.00 (referent)	0.89	1.00 (referent)	0.21
Female	0.96 (0.5–1.7)		1.54 (0.8–3)	
Comorbidities				
No	1.00 (referent)	**0.03**	1.00 (referent)	0.10
Yes	0.51 (0.3–0.9)		0.58 (0.3–1.1)	
Cancer stage				
Initial	1.00 (referent)	**<0.001**	1.00 (referent)	**0.001**
Advanced	5.10 (2.5–10.5)		3.52 (1.7–7.4)	
Treatment in previous 3 mo				
No	1.00 (referent)	**0.03**	1.00 (referent)	0.81
Yes	2.07 (1.1–4.0)		1.10 (0.5–2.4)	
Reason for hospitalization				
Surgical	1.00 (referent)	**<0.001**	1.00 (referent)	**<0.001**
Clinical	5.89 (3.1–11.3)		4.37 (2.1–9.2)	
BMI				
≥23 kg/m^2	1.00 (referent)	0.92	1.00 (referent)	0.94
<23 kg/m^2	0.94 (0.3–2.8)		1.05 (0.3–3.6)	
CC				
≥31 cm	1.00 (referent)	**0.005**	1.00 (referent)	0.13
<31 cm	2.66 (1.3–5.3)		1.80 (0.8–3.9)	
MNA-SF				
Normal	1.00 (referent)	**<0.001**	1.00 (referent)	**<0.001**
Risk for undernutrition	2.78 (0.9–8.4)		2.61 (0.8–8.2)	
Undernutrition	11.09 (3.8–32.0)		5.59 (1.8–17.3)	

BMI, body mass index; CC, calf circumference; HR, hazard ratio; MNA-SF, Mini Nutritional Assessment-Short Form
Bold *P* value: statistical difference between groups by qui-square test.
* Adjusted for comorbidities, cancer stage, treatment in the last 3 mo, and reason for hospitalization).
† Median value for age.

There are potential limitations to our study. The data is derived from a previous study and the small sample size may impair the stability of the findings. This may have contributed to the fact that the risk for undernutrition rating by the MNA-SF was not statistically associated with 1-y OS, although the HR has shown an elevated risk (2.61). The inclusion of patients with a variety of tumor sites and clinical stages may have contributed to the heterogeneity of the population studied, thereby hampering the analysis. The fact that patients were included at different moments of cancer treatment (pre-, ongoing, and post treatment), which directly influences the nutritional status, can be considered another limitation of the present study. Data on causes of death were not available; therefore, whether a factor predicted specific cancer death or death from other causes could not be investigated.

Among the strong points of this study, we might consider that there is little information on the survival of elderly patients with cancer treatment in Brazil, the inclusion of patients with different stages and tumor sites increases the applicability of the results and adjustment for several important variables, such as the presence of comorbidities, helps to clarify the independent relationship between undernutrition defined by MNA-SF and mortality.

The findings are clinically important, and based on these, we propose the incorporation of the MNA-SF in oncology practice for the evaluation of elderly patients, as it can be used as a basis for the selection of treatment for each patient and to adapt therapeutic interventions to groups with lower life expectancy; in addition to the information obtained, the findings can be used to stratify or delete patients in clinical trials.

Conclusion

The search for predictive factors of survival in elderly cancer patients is not only of speculative interest but also crucial to treatment decision. An MNA-SF score <7 or undernutrition could identify patients with risk for early mortality, independent of other known predicted factors. The results show that the MNA-SF can be useful in identifying elderly patients at higher risk for 1-y mortality. We also encourage conducting further research with larger samples and specific approach about the effects of risk for undernutrition and undernutrition in elderly patients with cancer.

References

[1] Hurria A, Gupta S, Zauderer M, Zuckerman EL, Cohen HJ, Muss H, et al. Developing a cancer-specific geriatric assessment: a feasibility study. Cancer 2005;104:1998–2005.
[2] Chouliara Z, Kearney N, Stott D, Molassiotis A, Miller M. Perceptions of older people with cancer of information, decision making, and treatment: a systematic review of selected literature. Ann Oncol 2004;15:1596–602.
[3] Aaldriks AA, Maartense E, le Cessie S, Giltay EJ, Verlaan HA, van der Geest LG, et al. Predictive value of geriatric assessment for patients older than 70 years, treated with chemotherapy. Crit Rev Oncol Hematol 2011;79:205–12.
[4] Ferrat E, Paillaud E, Laurent M, Le Thuaut A, Caillet P, Tournigand C, et al. Predictors of 1-year mortality in a prospective cohort of elderly patients with cancer. J Gerontol A Biol Sci Med Sci 2015;70:1148–55.
[5] Caillet P, Laurent M, Bastuji-Garin S, Liuu E, Culine S, Lagrange JL, et al. Optimal management of elderly cancer patients: usefulness of the Comprehensive Geriatric Assessment. Clin Interv Aging 2014;9:1645–60.
[6] Gioulbasanis I, Baracos VE, Giannousi Z, Xyrafas A, Martin L, Georgoulias V, et al. Baseline nutritional evaluation in metastatic lung cancer patients: Mini Nutritional Assessment versus weight loss history. Ann Oncol 2011;22:835–41.
[7] Aaldriks AA, van der Geest LG, Giltay EJ, le Cessie S, Portielje JEA, Tanis BC, et al. Frailty and undernutrition predictive of mortality risk in older patients with advanced colorectal cancer receiving chemotherapy. J Geriatr Oncol 2013;4:218–26.
[8] Soubeyran P, Fonck M, Blanc-Bisson C, Blanc JF, Ceccaldi J, Mertens C, et al. Predictors of early death risk in older patients treated with first-line chemotherapy for cancer. J Clin Oncol 2012;30:1829–34.
[9] Bozzetti F. Why the oncologist should consider the nutritional status of the elderly cancer patient. Nutrition 2015;31:590–3.
[10] Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for undernutrition – an ESPEN Consensus Statement. Clin Nutr 2015;34:335–40.
[11] Bourdel-Marchasson I, Blanc-Bisson C, Doussau A, Germain C, Blanc JF, Dauba J, et al. Nutritional advice in older patients at risk of undernutrition during treatment for chemotherapy: A two-year randomized controlled trial. PLoS One 2014;9:e108687.
[12] Machado RS, Coelho MA, Veras RP. Validity of the Portuguese version of the mini nutritional assessment in Brazilian elderly. BMC Geriatr 2015;15:132–9.
[13] Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al. Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical tool for identification of nutritional status. J Nutr Health Aging 2009;13:782–8.
[14] Pan-American Health Organization. Multicenter survey: health, welfare and aging in Latin America and the Caribbean. Preliminary report. Washington, DC: Author; 2001.
[15] Canaan Rezende FAC, Queiroz Ribeiro A, Priore SE, Castro Franceschini Sdo C. Anthropometric differences related to genders and age in the elderly. Nutr Hosp 2015;32:757–64.
[16] National Cancer Institute. Surveillance, Epidemiology and End Results Program. Recode ICD-O-3/WHO 2008 Definition. Available at: http://seer.cancer.gov/siterecode/icdo3_dwhoheme/index.html. Accessed October 7, 2016.
[17] Agarwal E, Miller M, Yaxley A, Isenring E. Undernutrition in the elderly: a narrative review. Maturitas 2013;76:296–302.
[18] Fernández López MT, Fidalgo Baamil O, López Doldán C, Bardasco Alonso ML, de Sas Prada MT, Lagoa Labrador F, et al. Prevalence of undernutrition in not critically ill older inpatients. Nutr Hosp 2015;31:2676–84.
[19] Cereda E, Pedrolli C, Zagami A, Vanotti A, Piffer S, Opizzi A, et al. Nutritional screening and mortality in newly institutionalized elderly: a comparison between the geriatric nutritional risk index and the mini nutritional assessment. Clin Nutr 2011;30:793–8.
[20] Vigano A, Morais JA. The elderly patient with cancer: a holistic view. Nutrition 2015;31:587–9.
[21] GBD 2013 DALYs and HALE CollaboratorsMurray CJ, Barber RM, Foreman KJ, Abbasoglu Ozgoren A, Abd-Allah F, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. Lancet 2015;386:2145–91.