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Two Distinct Nutritional Assessment Tools Have Dissimilar Outcomes in a Sample of Older Adult Patients With Cancer

Research Article

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Abstract: **Introduction:** Malnutrition is strongly associated with negative outcomes in aged populations with cancer. Several studies have compared the outcomes of nutritional-screening tools, but knowledge specifically covering older adult patients with cancer remains limited. The aim of this study was to compare the outcomes of two tools, the Patient-Generated Subjective Global Assessment (PG-SGA) *versus* the Mini Nutritional Assessment (MNA) for this population. **Method:** Cross-sectional study with 432 participants who consented to participate and were enrolled at admission to medical and surgical wards of a tertiary referral hospital. The participants' nutritional statuses were simultaneously assessed using the PG-SGA and the MNA, and the outcomes compared using the kappa statistical test. The Receiver Operating Characteristic Curve (ROC) was employed to calculate the MNA sensitivity, specificity, positive and negative predictive values, and was compared with PG-SGA. **Results:** Prevalence of good nourishment was observed in 62.5% and 61.1% of the participants, as detected by PG-SGA and MNA, respectively. Both tools concurred moderately (kappa = 0.453). Importantly, there were significant differences in the diagnosis of malnutrition (7.6% vs. 4.6%, p = 0.000). The MNA showed sensitivity of 72.2% and specificity of 75.9% in detecting good nourishment for the population investigated. **Conclusion:** The MNA may not present greater sensitivity, possibly due to a lack of coverage of gastrointestinal symptoms. It is a quick and efficient tool for nutritional assessment of older adult patients with cancer, but as it is more specific than sensitive, caution is recommended when identifying borderline or early malnourished individuals of this population.

Keywords: *Nutritional assessment • cancer • older adults • patient-generated subjective global assessment • mini-nutritional assessment*

1. Introduction

The incidence of cancer is increasing worldwide, and it is expected that by 2025 there will be over 20 million new cases of cancer annually[1]. The population of older adults has been identified as the most at risk; their risk is mainly attributed to epidemiologic and demographic transitions[1,2]. There is a positive association between ageing and cancer[3]. Older adults may present changes in mobility, physiological status, mood, and quality of life. Such changes are exacerbated by malnutrition and severely aggravated by a cancer diagnosis. Because the presence of other comorbidities further jeopardizes the quality of life and survival rate,[4] prognostic factors concurrent with ageing and cancer emphasize the importance of properly assessing the care provided to

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that vulnerable population as early as possible in the progression of the disease.

The assessment of nutritional status is essential in the design of nutritional strategies for this population. The main purpose is to assess the current nutritional status of the patient to provide elements for a tailored recovery strategy and to improve their quality of life[5]. As malnutrition is positively associated with poorer survival rate, lower quality of life, longer hospital stays and increased likelihood of hospital readmission,[6,7] fast and accurate tools of nutritional assessment are determining factors to increase the likelihood of better outcomes.

There are several tools of nutritional assessment currently available and tested, including the Patient-Generated Subjective Global Assessment (PG-SGA) and the Mini-Nutritional Assessment (MNA), amongst others. The PG-SGA is a validated tool for use in patients with cancer aged 18 years and older. It is inexpensive and relatively easy to apply and capable of detecting nutritional changes in its initial stages, allowing early nutritional interventions. It is useful as a reassessment in short-period intervals and has also been used as a tool for the identification of patients in the higher mortality risk groups[5 –9]. The MNA is also a validated tool and is considered by some investigators as a practical instrument, as it is useful, reliable, quick, and simple. The MNA has been used across a variety of clinical settings, including hospitals and care homes. It allows the early detection of nutritional risk and the review of tailored nutritional strategies[5,10,11].

Several studies have been published in recent years on the validation of nutritional screening tools, but very few of those have specifically focused on the study population. Whilst the PG-SGA is more often employed for the nutritional assessment of patients with cancer, the MNA is focused toward older adults. We compared the outcomes of two distinct methods of nutritional triage, which incorporate subjective and objective data for the diagnosis of the nutritional status in this population diagnosed with cancer. Given the importance of early assessment of nutritional status for survival and improved health outcomes, the aim of this investigation was to compare the results of MNA in relation to PG-SGA in their ability to predict malnutrition.

2. Materials and Methods

2.1. Enrolment

A cross-sectional investigation of older adult patients admitted to a tertiary referral hospital was performed in Salvador, Brazil between June 2013 and January 2014. They were invited to participate in the study upon hospital admission until discharge. Inclusion criteria were individuals aged 60 years or older, admitted to medical and surgical wards for treatment, with a previously confirmed diagnosis of cancer. All the participants were informed about the goals and objectives of the study, and those who agreed to participate signed the Informed Consent Form which included a clause covering 'Consent to Publish'. Patients with an associated psychiatric diagnosis and admitted for diagnostic investigations only were not enrolled. Between June 2013 and January 2014, 461 patients agreed to participate in the study; however, 29 were excluded due to incomplete data.

This study was approved by the Research Ethics Committee of the proposing institution (nº 187441/12) and by the Research Ethics Committee of the Aristides Maltez Hospital (nº 00913/12).

2.2. Data Collection

Trained registered dietitians applied both questionnaires and the anthropometric assessment in order to minimize the likelihood of errors during the interview with the patient. Standardized forms were utilized to collect and register the demographic and socioeconomic data. Clinical data, including the stage of the disease, were investigated through the patient's self-reporting and from their medical records, after obtaining their consent. Both the PG-SGA[11] and MNA[12] were applied simultaneously as tools for assessing nutritional status.

The PG-SGA, adapted by Ottery,[9] was translated into Portuguese and validated by Gonzalez et al.[11] is a tool consisting of a questionnaire administered in two sessions. The first addresses weight loss, changes in dietary intake, changes in functional capacity, and cancer-related symptoms. The second session addresses the factors associated with a diagnosis of increased metabolic demand as well as a physical examination. The three possible outcomes are 'A' for well-nourished, 'B' for suspected or moderate malnutrition, and 'C' for severely malnourished. Specifically, the outcomes of the PG-SGA were grouped into two categories: 'A' for well-nourished patients and 'B+C' for patients at risk and malnourished. This tool also assigns a numerical score, enabling an evolutionary analysis for future assessments. For the purposes of this work, however, only the outcome result will be used, as previously mentioned.

The MNA, validated by Guizoz et al.,[12] is primarily divided into four sections: anthropometric, overall, dietary assessments, and self-assessment. A score of 24 points or higher shows that the patient is well nourishment (category A). A score of 17 to 23.5 indicates risk of malnutrition (category B). Scores of 17 points or less are categorized as malnourished (category C). The outcomes of MNA were grouped into two categories, similar to PG-SGA: 'A' for well-nourished patients and 'B+C' for at-risk and malnourished patients. The anthropometric assessment section of the MNA was based on body weight, measured with portable scales (Techline®), and knee height, arm circumference, and calf circumference taken with a tape measure that is accurate down to 1 mm. The height measurement was taken according to Chumlea et al.[13] and the body mass index was calculated according to the WHO[14].

Both tools used in this work have quick versions with reduced data collection; however, for better results, the complete versions of the two tools for assessing nutritional status were used.

2.3. Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, IBM, USA) version 20.0 and the Data Analysis and Statistical Software (StataCorp, USA) were used for tabulation and data analysis. The data were subjected to descriptive and analytical statistical analyses.

In the descriptive analysis, mean ± standard deviation of the mean and absolute and relative frequencies were used to characterize the study population and to identify the nutritional status at the time of the investigation. For the analytical analysis, chi-square tests were applied to compare the proportions found in the nutritional assessment of each tool. The kappa coefficient (K) was used to evaluate the level of concurrence between the nutritional assessment tools, with values equal to 0 meaning no concurrence, between 0.0 and 0.20, slight concurrence, 0.21 to 0.40, considerable concurrence, 0.41 to 0.60, moderate concurrence, 0.61 to 0.80, substantial concurrence, and 0.81 to 1, excellent concurrence. A significance test was applied to determine if the K value was significantly higher than 0, considering the concurrence as described previously[15].

The receiver operating characteristic curve (ROC) was adopted [16,17] to identify the MNA score at which the patient should be diagnosed as malnourished. The cut-off point that separates malnourished from non-malnourished patients, by comparing with the PG-SGA score, was obtained. The PG-SGA is not viewed as the gold standard; however, it is commonly used in clinical practice with excellent results[18]. From the MNA cut-off point, we obtained the values of sensitivity, specificity, positive predictive value (PPV, probability of the patient being ill when the test is positive), and negative predictive value (NPV, probability of the patient being healthy when the test is negative) were calculated.

To identify the best predictors of nutritional status for each tool, a poisson regression analysis was conducted to estimate the prevalence ratio (PR). Bivariate analysis was calculated between the nutritional status and each covariable to identify which would be entered into the multiple model analysis. Employing a priori knowledge to choose covariates in the multivariable model, the covariables that showed a significance level lower than 0.20 were included in the multivariable analysis. In the final model, only the variables with a significance level of 0.05 or lower remained.

3. Results

This cross-sectional study included 432 subjects – 196 (45%) men and 236 (55%) women – with a previously confirmed diagnosis of cancer. The average age was 69.9 ± 7.59 for males and 68.2 ± 6.88 for females. The four most prevalent cancer diagnoses were prostate (19.9%), skin (17.1%), gastrointestinal tract (16%), and breast (15.7%). The most prevalent comorbidity was hypertension in 60.2% of cases, followed by diabetes mellitus at 17.1% of cases. Surgery was the main reason for hospital admission (98.6%) (Figure 1).

The nutritional status of 'well-nourished' was the most prevalent identified in the population, with a detection rate of 62.5% for PG-SGA and 61.1% for MNA. The prevalence of the nutritional status of 'at risk, or moderately malnourished' was 29.9% for PG-SGA, versus 34.3% for MNA, whilst the prevalence of 'severely malnourished' was 7.6% and 4.6%, respectively. The chi-squared differences between both tools within the three categories were significantly different (p = 0.000). While PG-SGA identified severely malnourished patients more often, MNA identified more patients at nutritional risk (Figure 2).

A moderate concurrence was found between PG-SGA and MNA, with a K value of 0.453 (p = 0.000) (Table 1). The lack of a strong concurrence between the tools was probably because of the differences in the results of the diagnosis of 'at risk or moderately malnourished' versus 'severely malnourished' (Table 1, Figure 2).

The area under the ROC curve was 0.825 (98% confidence interval (CI) 0.784–0.866), which is substantially greater than 0.5 and is, in fact, closer to 1, indicating that the MNA total score was effective in detecting patients with malnutrition, in comparison with PG-SGA. The cut-off point that provided the best choice between the sensitivity and specificity values was identified as 24.25 of the total MNA scores (Figure 3).

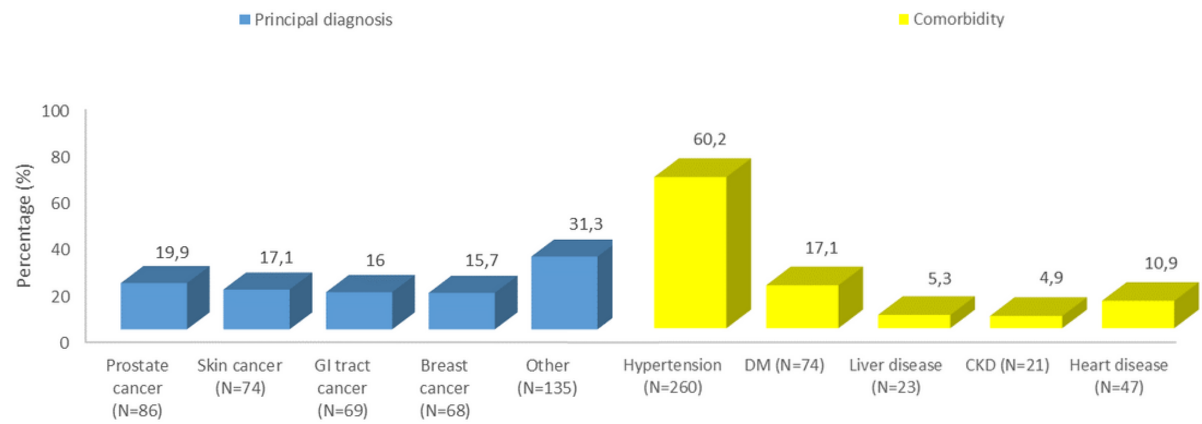


Figure 1: Main diagnosis and comorbidity of the investigated study population.
Abbreviations: GI tract: gastrointestinal tract; DM: diabetes mellitus; CKD: chronic kidney disease.

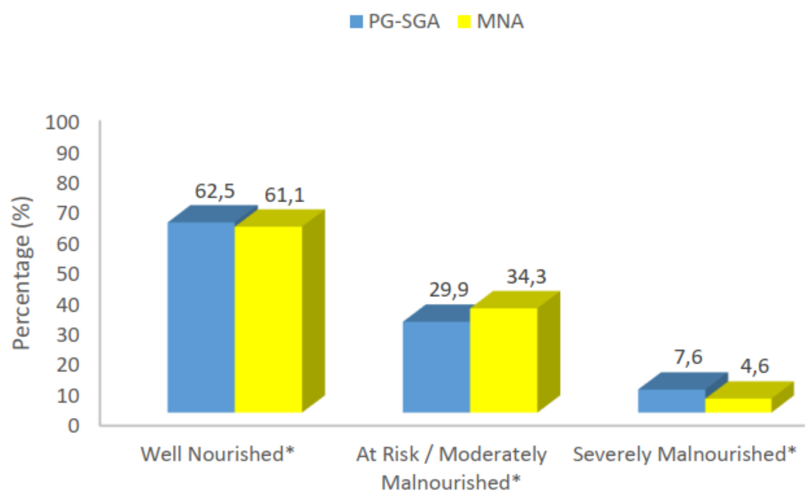
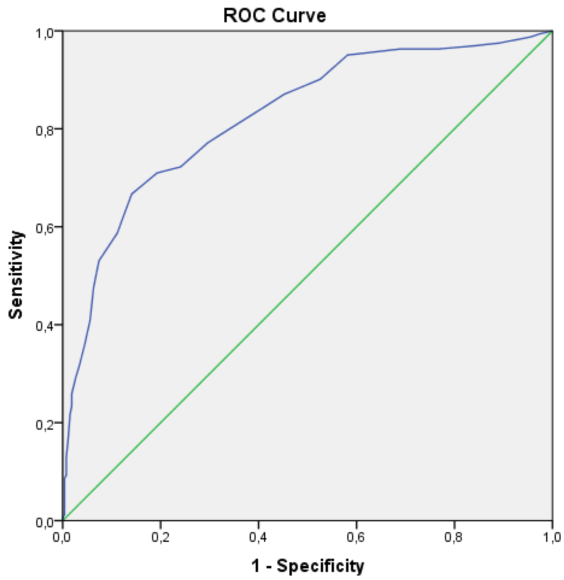


Figure 2: Comparison of the nutritional assessment outcomes between the PG-SGA and MNA tools in the population investigated.
Abbreviations: PG-SGA, Patient-Generated Subjective Global Assessment; MNA, Mini Nutritional Assessment.
*Chi-squared for the difference between the proportions, p = 0.000.

Table 1: Concurrence analysis for the categories 'Well nourished', 'At risk or moderately malnourished', and 'Severely malnourished' using the PG-SGA and MNA tools in the population investigated.

	MNA					
PG-SGA	**Well nourished N (%)**	**At risk or moderately malnourished N (%)**	**Severely malnourished N (%)**	**Total**	**Kappa(K)***	**p-value†**
Well nourished	217 (80.4%)	51 (18.9%)	2 (0.7%)	270 (62.5%)		
At risk or moderately malnourished	43 (33.3%)	81 (62.8%)	5 (3.9%)	129 (29.9%)	0.453	0.000
Severely malnourished	4 (12.1%)	16 (48.5%)	13 (39.4%)	33 (7.6%)		
Total	264 (61.1%)	148 (34.3%)	20 (4.6%)	432		

PG-SGA: Patient-Generated Subjective Global Assessment; MNA: Mini Nutritional assessment for older adults.*Kappa coefficient. †Kappa significance test



	AUC	P value*	CI (95%) Area	Cut-off point	P (%)	S (%)	S# (%)	PPV (%)	NPV (%)
MAN	0.825	0.000	(0.784–0.866)	24.25	37.5	72.2	75.9	64.3	82.0

Abbreviations: PG-SGA: Patient-Generated Subjective Global Assessment; MNA: Mini Nutritional Assessment for the older adults; ROC: Receiver Operating Characteristic Curve. *Area statistically greater than 0.5. AUC: Area under the Curve; P: prevalence; S: sensibility; S#: specificity; PPV: positive predictive value; NPV: negative predictive value.

Figure 3: Receiver operating characteristic curve (ROC) for the MNA total score employing PG-SGA as reference. Sensibility, specificity, positive and negative predictive values of the MNA, in relation to PG-SGA.

This result indicates that patients with an MNA cut-off point of 24.25 or lower were considered malnourished. These findings concur with previously determined MNA cut-off points of 24 or higher being classified as healthy.

In comparison with PG-SGA, the sensitivity of the MNA diagnostic capacity was 72.2%, which means that it detected 72.2% of malnourished patients; 75.9% of well-nourished patients were correctly detected by MNA, revealing the same percentage of specificity of the instrument. The MNA positive predictive value (PPV) was 64.3%; if a patient's cut-off was lower than 24.25, the odds of being actually malnourished were 64.3%. The MNA negative predictive value (NPV) was 82%, indicating that the odds of a patient with a total score of 24.25 or higher being, in fact, well-nourished was 82% (Figure 3).

The covariables present in the PG-SGA that act as strongest predictors of nutritional status were identified by bivariate poisson regression and are presented in Table 2. Employing the final multivariate regression model, it was found that anorexia (PR: 2.00; CI 95%: 1.4–2.87), early satiety (PR: 1.54; CI 95% 1.01–2.35), and muscle reserve deficit (RP: 4.00; CI 95%: 2.70–5.92) were significantly associated with malnutrition (Table 2).

4. Discussion

The outcomes of MNA were compared with the PG-SGA results, revealing a high proportion of well-nourished participants, with moderate concurrence between PG-SGA and MNA. When determining the prevalence of malnutrition, however, a significant difference was noticed between the outcomes of the two tools.

Previous studies investigated the level of concurrence between these tools. Cunha et al. have compared the PG-SGA with other tools like subjective global assessment (SGA) and the nutritional risk index-2002 in a population of 173 patients with cancer[19]. Velasco et al. compared four tools (nutritional risk screening, malnutrition universal screening tool, SGA, and MNA) in a population of 400 patients[20]. These results showed that MAN was the method with the lowest level of concurrence amongst the tools employed. MNA was the method with the lowest level of concurrence amongst the tools employed. Another study also directly compared PG-SGA with MNA, and the authors concluded that PG-SGA was better than MNA at identifying nutritional deficits in elderly people

Table 2: Poisson regression analysis and multiple predictors of nutritional status, as defined by the PG-SGA, calculated for the population investigated.

Covariable (symptom or manifestation)	PR_{crude} (95% CI)	*p*-value	$PR_{Adjusted}$* (95% CI)	*p*-value
Dry mouth	1.63 (1.08 – 2.47)	0.020	-	-
Taste changes	2.52 (1.59 – 3.98)	0.000	-	-
Dysphagia	2.55 (1.68 – 3.88)	0.000	-	-
Early satiety	1.81 (1.22 – 2.70)	0.003	1.54 (1.01 – 2.35)	0.043
Anorexia	3.26 (2.38 – 4.47)	0.000	2.00 (1.40 – 2.87)	0.000
Nausea	2.65 (1.67 – 4.19)	0.000	-	-
Vomiting	2.22 (1.24 – 4.00)	0.008	-	-
Constipation	1.72 (1.14 – 2.60)	0.100	-	-
Diarrhea	2.03 (0.90 – 4.60)	0.088	-	-
Dysgeusia	2.29 (1.43 – 3.65)	0.001	-	-
Pain	2.21 (1.56 – 3.14)	0.000	-	-
Muscle reserve deficit	4.98 (3.43 – 7.21)	0.000	4.00 (2.70 – 5.92)	0.000
Fat reserve deficit	3.75 (2.67 – 5.24)	0.000	-	-
Cancer present in the GI Tract	1.73 (1.20 – 2.50)	0.003		

PG-SGA: Patient-Generated Subjective Global Assessment; GI tract: Gastrointestinal tract; PR: Prevalence Ratio; CI: Confidence Interval. Malnourished (PG-SGA categories B+C) *PR adjusted by the other model variables, including (anorexia, early satiety, and muscle reserve deficit) the final multivariate regression model.

with cancer[21]. However, the investigators enrolled 47 participants with an average age of 61 years, a population much smaller and younger than the one investigated in the research reported here. It was found in this work that PG-SGA was more effective in identifying higher prevalence of severely malnourished patients, whilst the MNA was able to identify more patients in the 'at risk and malnourished' category. The differences identified were statistically significant, which may explain the moderate concurrence observed between the tools of nutritional screening adopted by the cited article.

Indeed, another article had compared the PG-SGA and the MNA for the nutritional assessment of individuals diagnosed with cancer, of whom 48% were older adults. The investigators found that MNA showed high sensitivity (97%) but low specificity (54%). The authors concluded that MNA is sensitive enough to diagnose patients with malnutrition but was only moderately specific in identifying the degree of malnutrition, as compared with PG-SGA. They acknowledge the usefulness of the MNA for screening these patients and further emphasize its simplicity and ease applicability by unskilled care providers[18].

The ideal nutritional screening tool should present high sensitivity, which means the detection of positive results for patients who are actually malnourished. At the same time, the tool should present high specificity, delivering negative results for patients who are not malnourished[22]. It was found sensitivity of 72.2% and specificity of 75.9% for the MNA when compared with the PG-SGA. The results suggest that MNA is a more specific than sensitive tool, although having greater capacity to identify well-nourished than malnourished patients. Despite being quick, inexpensive, and easily executed, one of the disadvantages of the MNA is the lack of coverage of gastrointestinal symptoms, a fact that could potentially explain its lower sensitivity in the diagnosis of malnourishment in this sample. This hypothesis is being brought up because of the impact of cancer on gastrointestinal manifestations associated with chemotherapy, the symptoms of which are investigated by the PG-SGA but not the MNA.

In clinical practice, for the patient's best interest, it is necessary that the nutritional screening tool presents high sensitivity for early diagnosis of nutritional risk. Previously, it has been suggested that PG-SGA, compared with the subjective global assessment (SGA), may be highly sensitive in detecting small nutritional changes when performed consecutively, due to its short period for discovering investigative changes in dietary intake and the coverage of gastrointestinal symptoms that have persisted for more than two weeks, which are highly prevalent in cancer patients[23].

Kroc et al. (2020), in a prospective cohort study investigating 963 hospitalized elderly people, recommend SGA to detect malnutrition or risk of malnutrition in the clinical routine of the geriatric ward as a result of some of their findings[24]. Along those lines, another study investigating a population of 57 patients whose average age was 79.1 years reported that MNA showed a specificity of 97%, whilst its sensitivity was only 58%, and the ROC area was 0.854, as compared to the standard classification 'International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification' (ICD-10-AM) [25]. Their results showed that MNA may be suitable for nutrition assessment for the study population, ensuring that all malnourished patients are identified.

The univariate regression analysis showed that anorexia, constipation, diarrhoea, dry mouth, dysgeusia, dysphagia, early satiety, fat reserve deficit, muscle reserve deficit, nausea, pain, vomiting, and cancer present in the gastrointestinal tract were independent predictors of malnutrition in the study population. Among the PG-SGA predictors of nutritional deficiency, muscle reserve deficit, early satiety, and anorexia remained in the final multivariate regression model, showing an increased likelihood of malnutrition in patients with those symptoms. Anorexia is often observed in patients with cancer, which significantly contributes to severe weight loss[26]. Older adults have a proportionally higher secretion of anorexigenic hormones, such as cholecystokinin and peptide YY, followed by lowered levels of orexigenic hormones, such as ghrelin. This imbalance is further exacerbated in cancer, intensifying the manifestations commonly observed[26–30].

The sample, having been obtained by convenience, is a limitation of the study; however, it is a fair reflection of the population investigated in the city of Salvador in Brazil, and neighbouring cities, because the Aristides Maltez Hospital is a charitable referral centre for tertiary medicine. As there is no gold-standard screening method, it was deemed necessary to choose a reference, in this case the PG-SGA, because there is a consensus among practitioners that it is more suitable for individuals with cancer. The lack of data related to tumour staging limited the characterization of the sample and identification of possible factors associated with nutritional status; however, it does not influence the results of the nutritional assessment tools used in this study.

Studies comparing both nutritional diagnosis tools (PG-SGA and MNA) in the elderly oncology population in a large sample size are still limited in the literature. The only study found in the scientific database with this goal was carried out with a total of 47 individuals,[21] which demonstrates the importance of this work.

5. Conclusion

Despite its many advantages and its simplicity of access, the MNA did not provide results identical to the PG-SGA. Caution is recommended when employing the MNA in this population to ensure that borderline-malnourished patients, as well as patients in the early stages of malnourishment, are identified, as the MNA appears to be more specific than sensitive. It is reasonable to suggest that the MNA may not present greater sensitivity in the diagnosis of malnourishment in the sample because of the absence of detailed questions covering gastrointestinal symptoms. A new instrument derived from the MNA with the incorporation of gastrointestinal symptom coverage would be useful in the early diagnosis of malnutrition.

Declaration of conflict of interest

There is no conflict of interest to declare.

Abbreviations

PG-SGA: Patient-Generated Subjective Global Assessment; MNA: Mini Nutritional Assessment for the older adults; ROC: Receiver Operating Characteristic Curve. *Area statistically greater than 0.5. AUC: Area under the Curve; P: prevalence; S: sensibility; S#: specificity; PPV: positive predictive value; NPV: negative predictive value.

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