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Research Article

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Comparison of NRS-2002 And MST Nutritional Screening and Correlation with Cluster Symptoms in Lung Cancer Patients: A Pilot Observational Study

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Abstract

Purpose: *Approximately a 70% of lung cancer (LC) patients experience malnutrition. Therefore, a rapid and functional nutritional assessment is needed. Several nutritional screening instruments are available for clinical use. This study aimed to compare the Nutritional Risk Screening - 2002 (NRS-2002) and the Malnutrition Screening Tool (MST) to assess malnutrition in LC patients.*

Methods*: MST, NRS-2002, cluster symptoms (CS) assessment and Handgrip Test were performed in LC patients at baseline (T0), at day 30th (T1) and at day 90th (T2). The Edmonton Symptom Assessment System (ESAS) was used to assess CS.*

Results: *The nutritional counselling intervention was offered to 198 LC patients. At T0, NRS-2002 and MST identified 141 and 127 patients at moderate/high risk of malnutrition, respectively. A concordance was observed between the two screening tests throughout the observation period with a correlation coefficient 0.7 ($p<0.001$). LC patients with weight loss ≥ 5% at T0, age > 67 years and severe inappetence were more likely to report an NRS-2002 ≥3 while weight loss ≥5%, inappetence, malaise and depression were significantly associated with an MST ≥ 3.*

Conclusion: *These results suggest that both NRS-2002 and MST are useful tools to detect malnutrition in LC patients. Furthermore, some CS appear to be related to nutritional status with an important impact on quality of life (QoL)*

Keywords: *lung cancer, malnutrition, MST, NRS-2002, cluster symptoms, quality of life.*

Introduction

Lung cancer (LC) is the 2nd most common cancer worldwide with an annual mortality rate of about 1.8 million [1,2]. Malnutrition is commonly detected in LC patients, with an incidence rate ranging between 35% and 70% [3,4,5], varying according to the specific screening tools and/or disease timing. It is known that weight stabilization in LC patients correlates with a significant improvement in median survival [6]. The European Society of Parenteral Nutrition (ESPEN), according to the metabolism guidelines for nutrition and cancer, recommended that all cancer patients, including those with lung cancer, should undergo nutritional screening at diagnosis and at regular intervals thereafter. Each screening tool has several individual characteristics. In particular, the nutritional risk screening-2002 test (NRS-2002) is a screening method recommended for hospitalized patients and it is currently used extensively worldwide. The Malnutritional Screening Tool (MST) has been well-validated in both in- and outpatient populations, it is faster and easier and it can be used also by volunteers or caring staff [7].

Currently, no specific screening tests have been identified for a specific cancer type, and there is no data available on the superiority of one assessment instrument over another. It is likely, LC patients should undergo special nutritional surveillance due to the early occurrence of typical cluster symptoms as inappetence, breathlessness, fatigue, cough, pain, insomnia, sleep disturbances, anxiety and depression [8], which often impact their nutritional status and quality of life (QoL) [9].

Our study evaluates whether NRS-2002 and MST are equally effective in identifying LC patients at medium/high risk of malnutrition in order to use a faster and simpler test, (such as MST) in real life by non-medical or nursing staff.

Materials and Methods

Study design

Our study is a single-centre pilot perspective observational. This study was approved by the Ethics Committee of the San Luigi Gonzaga University Hospital and was conducted in accordance with the Declaration of Helsinki.

Endpoints
The primary endpoint was to evaluate the correlation coefficient between NRS-2002 and MST in LC patients. The secondary endpoint was to identify any correlation between nutritional status and CS.

Inclusion criteria
Age over 18 years; signature of informed consent for the study; LC patients with an indication for active oncologic therapy; LC patients undergoing active oncology treatment.

Exclusion criteria
Patients unable to sign consent to the study, LC patients with palliative care indication.

Tools and interventions
Nutritional assessments were carried out through the instruments: NRS-2002 and MST, simultaneously performed at baseline (T0) and subsequently 30 (T1) and 90 (T2) days after for an overall observation period of 3 months. In addition, muscle strength data through the Handgrip Test (HGS) were collected and the Body Mass Index (BMI) was calculated for each patient. The HGS was performed by using the dominant hand for 3 consecutive repetitions, with a break between attempts of at least 50 seconds, and the score was the average of the three measurements. The cut-off values used for the different screening tests to define malnutrition risk were: 0-1 low risk, 2 moderate risk, ≥3 high risk for NRS-2002 and 0 low risk, 1-2 moderate risk and ≥3 high risk for MST. The HGS cut-off values to indicate moderate/high-risk sarcopenia were < 27 for men and < 16 for women. Patients with BMI < 18 were considered at risk of malnutrition.

CS were assessed by using the Edmonton Symptom Assessment System (ESAS) multidimensional questionnaire. The ESAS is a 10-item multidimensional assessment tool designed to evaluate QoL by obtaining patient-reported symptom ratings. It uses a score from 0 to 10 to measure the patients' distress associated with physiological and psychological symptoms through an 11-point numerical rating scale [10]. The ESAS has been translated and validated in multiple languages, including Italian [11], both in the palliative and active treatment settings [12]. The intensity of the symptoms reported was defined as: "mild" if score ≤3, "moderate" between 4-6 and "severe" if score ≥7. An uncontrolled symptom was defined with a score ≥ 4. ESAS assessment was performed at each time point (T0, T1, T3).

Statistical analysis
Descriptive statistics were provided as frequencies and percentages for categorical variables, whereas averages and standard deviation were used for continuous variables. Sex was considered a confounding factor, so the analyses are also presented divided into females/males. Other comparisons were done by weight loss </≥5%, pre/in therapy and low/high handgrip score.

Differences between groups were investigated by the Chi-square test for categorical variables, while the Wilcoxon test was used for continuous variables. Correlations between weight loss and psychological variables were investigated by using Pearson's test, and the results were presented as a correlation coefficient and p-value.

The factors which affect the different scores were studied with Odds Ratio (OR) models and reported with their Confidence intervals at 95% (95%CI).

The relationship between the treatment cycle and CS or weight was evaluated by using the ANOVA test.
The Log Rank Test was used to evaluate differences between groups.
Finally, General Linear Model was used to evaluate the relationships between NST-2002, MST and time, sex, and HGS. An error type-I alpha of 0.05 was considered. All the analyses were performed by SAS® Statistics Software v. 9.4.

Results

Patients' characteristics
From February 2019 to December 2020, the nutritional counselling intervention was offered to 198 LC outpatients (81 women and 117 males). The average age was 67.48 years (range 35-83). Most patients (n=181, 91%) had advanced/metastatic stage disease according to the 8th version of the TNM staging system. Only 24 (12%) patients were evaluated before cancer treatment while 174 (88%) were already undergoing active treatment. Pre-treatment patients had a greater NRS (mean 3 vs 2.3, p=0.02) and MST (2 vs 1.33, p=0.01) than in-treatment patients. After 3 months, 66.7% (n=16) of pre-treatment patients and 37.3% of other patients had a weight loss greater than 5% (p=0.0073). Considering the overall time points, no differences in terms of weight loss were detected between pre- and in-treatment patients (4.20 vs 1.55, p= 0.0594).
Only 83 (42%) patients were evaluated at T2 due to disease progression with loss of active cancer treatment indication.
Patients' characteristics are summarized in Table 1.

Characteristics	Population [n (%)]
Sex	
▪ Males	117 (59%)
▪ Females	81 (41%)
Age (range 35-83)	
▪ ≤ 67 years	86 (43%)
▪ > 67 years	112 (57%)
Performance status	
▪ 0	93 (47%)
▪ 1	95 (48%)
▪ 2	10 (5%)
Stage	
▪ Stage I-II	17 (8%)
▪ Stage III	38 (20%)

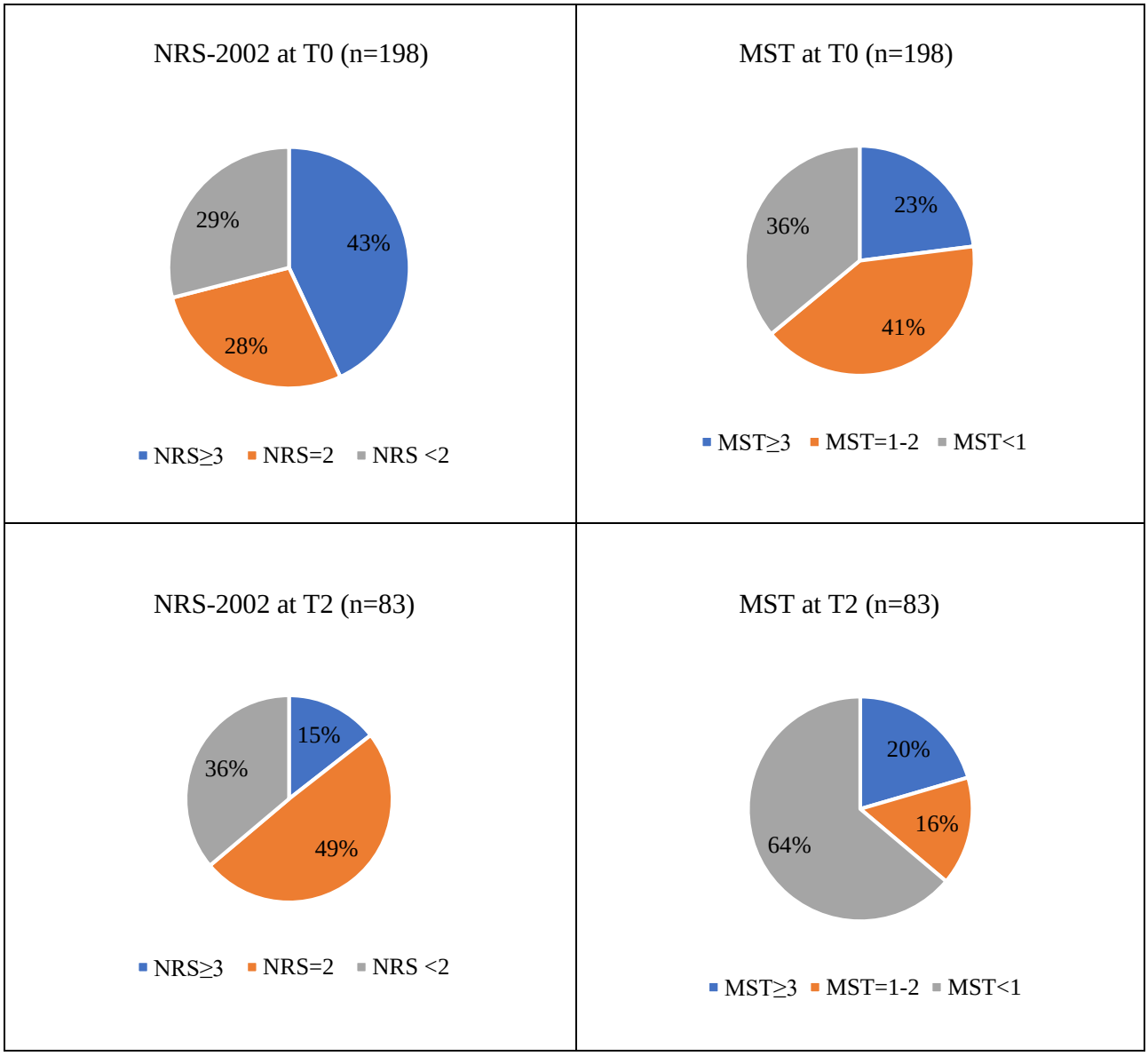
▪ Stage IV	143 (72%)
Timing of medical intake	
▪ Oncology pre-treatment	24 (12%)
▪ Ongoing cancer treatment	174 (88%)
Type of cancer therapy	
▪ Chemotherapy	43 (22%)
▪ Immunotherapy	37 (19%)
▪ Chemotherapy+immunotherapy	33 (16%)
▪ Target therapy	79 (40%)
▪ Other	6 (3%)
Treatment line	
▪ 1st line	115 (58%)
▪ 2nd line	35 (18%)
▪ ≥ 3rd line	47 (24%)

Table 1: Patients' characteristics (n=198).

Nutritional status

At baseline (T0), NRS-2002 screening identified 141 (71%) patients at moderate/high risk of malnutrition, with 85 of them (43%) reporting an NRS-2002 value of ≥ 3 and 56 (28%) an NRS-2022 value of 2. The MST identified 127 (64%) patients at moderate-high risk of malnutrition, with 81 of them (41%) with MST 1-2 and 46 (23%) with MST of 3 (Figure 1).

Figure 1: Screening tests divided by risk classes.



Legend: *graphs show the evaluation of screening tests divided by risk classes. NRS-2002 identifies patients at high risk of malnutrition (NRS≥ 3) in a percentage higher than MST (MST≥3). This result is caused by age and disease severity, not evaluated in the MST.*

At T0, 145 patients (73%) reported a weight loss in the previous three months (mean 3.3 kg with range -31 - 25) and 41 of them (15%) had a weight loss > 5%. In detail, the 78% of patients (n=66/85pts) with NRS-2002 ≥ 3 at T0 had a larger (≥5%) weight loss, while only the 29% (n=43/113pts) of patients with NRS-2002 <3 had ≥5% of weight loss (p<0.001).

NRS-2002 and MST were significantly correlated with patients' age (p <0.001). Patients ≥67 years old had higher values (equal to 2-3) at T0 than those with <67 years (equal to 1).

In addition, both NRS-2002 and MST values were associated with patients' sex (2.2 for females, 2.6 for males, p=0.038) and HGS. In particular, males had a higher NRS-2002 at T0 than females (p=0.038).

For both males and females, no significant changes in HGS class were observed when using cut-offs of 27 for males (p=0.1611) and 16 for females (p=0.7967). Regardless of timing, a slightly significant correlation (r=0.34) was observed between HGS and body weight (p < 0.001).

Concordance between NRS-2002 and MST screening

A total agreement with a Cohen's kappa of 0.52 (0.47-0.58, 95%CI) is observed between NRS-2002 and MST considering all assessments from T0 to T3. The concordance is therefore discrete, according to Cohen's scale. In particular, NRS-2002 is often higher than MST. However, the correlation coefficient between NRS-2002 and MST is 0.7 (p<0.001) both for males and females (see Table 2), so the two scores are correlated.

Relation between nutritional status and QoL

At T0, the most disabling symptoms (score ≥7) were fatigue in 77 patients (40%) and anxiety in 39 (22%). A correlation emerged between the pain and fatigue, depression, inappetence, malaise, and dyspnea (p<0.001). NRS-2020 and MST are related to inappetence in both sexes. In particular, when considering the symptoms of inappetence and nausea, a high correlation was observed between fatigue (r>0.4) and nausea in females and inappetence in males. See Table 2 for details.

Moreover, to understand which factors most affect an NRS-2002 ≥3 or MST≥3, an OR model was performed. Patients with weight loss ≥5% at T0 (OR=8.7, 4.1-18.5 95%CI) and the elderly (>67 y.o., OR=4.4, 2.1-9.5 95%CI) are more likely to have NRS-2002 ≥3. The sex is irrelevant (OR=0.6, 0.3-1.2 95%CI). As concerns the items of QoL only inappetence (OR=3.3, 2.1-5.0 95%CI) was a risk factor for a higher NRS score.

Considering MST, instead, weight loss ≥5% at T0 (OR=22.4, 1.2-404.1 95%CI), depression (OR=2.9, 1.1-7.5 95%CI), inappetence (OR=3.1, 1.1-9.1 95%CI), and malaise (OR=10.6, 1.7-65.1 95%CI) are a risk factor for a higher score. The CS were analyzed in the two groups (weight loss<5% and ≥5%). Patients with a weight loss ≥5% had a worse intensity of depression (p=0.0165) and inappetence (p=0.0046) at T2 compared to patients with a lower weight loss.

r coefficient and p value		Weight	Weight loss since T0	Weight loss (%) in the compared T0	Weight loss (%) in the previous 3 months	BMI	handgrip	NRS-2002	MST	Pain	Fatigue	Nausea	Depression	Anxiety	Sleepiness	Inappetence	Malaise	Dyspnea
		Males																
Weight	**Females**		0.09287 0.2769	0.05034 0.5562	-0.21711 0.0005	**0.91627** **<.0001**	0.28351 <.0001	**-0.45353** **<.0001**	-0.25571 <.0001	-0.14878 0.0277	-0.07652 0.2827	0.03138 0.6465	-0.02187 0.7521	-0.01521 0.8253	-0.01167 0.8659	-0.18232 0.007	-0.03559 0.6055	0.00094 0.989
Weight loss since T0		0.12389 0.1322		**0.98446** **<.0001**	**0.46398** **<.0001**	0.11948 0.1612	-0.08369 0.34	0.19413 0.022	0.25806 0.0022	0.12797 0.171	-0.032 0.7582	0.07003 0.4611	0.15661 0.1023	0.14686 0.124	0.20662 0.0296	0.16564 0.0782	0.19618 0.0391	0.07338 0.4399
Weight loss (%) in the compared T0		0.08412 0.3077	**0.95213** **<.0001**		**0.46004** **<.0001**	0.07899 0.3553	-0.08694 0.3216	0.21966 0.0094	0.26597 0.0016	0.10679 0.2539	-0.00527 0.9596	0.08298 0.3823	0.16305 0.0888	0.11954 0.2114	0.20898 0.0277	0.17335 0.0651	0.19082 0.0448	0.08118 0.3927
Weight loss (%) in the previous 3 months		-0.28067 <.0001	0.35663 <.0001	0.36014 <.0001		-0.22455 0.0003	-0.11085 0.0853	**0.58064** **<.0001**	**0.72179** **<.0001**	0.16155 0.0167	0.12344 0.0824	0.12628 0.0639	0.29908 <.0001	0.13888 0.0429	0.19342 0.0047	**0.40539** **<.0001**	0.33094 <.0001	0.09093 0.1841
BMI		**0.94694** **<.0001**	0.13145 0.11	0.08138 0.3238	-0.27165 <.0001		0.20009 0.0018	**-0.46324** **<.0001**	-0.26471 <.0001	-0.12016 0.076	-0.1167 0.1007	0.09472 0.1654	-0.06002 0.3857	-0.04099 0.5518	0.0059 0.9319	-0.24962 0.0002	-0.08167 0.2353	-0.00001 0.9999
Handgrip		0.05513 0.4137	0.12038 0.1492	0.18661 0.0246	-0.11205 0.0966	-0.05573 0.4087		-0.21038 0.001	-0.12212 0.0584	-0.12738 0.0629	-0.08625 0.2293	-0.01899 0.7839	-0.10105 0.1484	-0.24224 0.0004	-0.25115 0.0003	-0.03289 0.6339	-0.06022 0.3887	-0.13253 0.0558
NRS-2002		-0.36444 <.0001	0.07704 0.3503	0.10564 0.1998	0.5528 <.0001	-0.36656 <.0001	-0.28407 <.0001		**0.69797** **<.0001**	0.17976 0.0078	0.27565 <.0001	0.12115 0.0763	0.23804 0.0005	0.06083 0.3781	0.2175 0.0015	**0.45668** **<.0001**	0.25855 0.0001	0.19629 0.0039
MST		-0.32805 <.0001	0.14696 0.0737	0.18204 0.0263	**0.5739** **<.0001**	-0.34749 <.0001	-0.16274 0.0152	**0.70851** **<.0001**		0.2173 0.0012	0.25951 0.0002	0.13776 0.0436	0.27284 <.0001	0.13607 0.0478	0.27774 <.0001	**0.45576** **<.0001**	0.30047 <.0001	0.17715 0.0094
Pain		0.14139 0.0442	-0.00743 0.9347	-0.03603 0.6912	0.03882 0.5833	0.12025 0.0875	-0.16603 0.0197	0.21125 0.0025	0.16149 0.0214		0.31829 <.0001	0.12551 0.0662	0.24203 0.0004	0.28307 <.0001	0.23345 0.0006	0.29229 <.0001	0.37703 <.0001	0.31409 <.0001
Fatigue		0.0701 0.3404	0.12104 0.2121	0.03764 0.699	0.09576 0.1935	0.04873 0.5078	-0.26145 0.0004	0.22364 0.0021	0.13576 0.0639	**0.53592** **<.0001**		0.28028 <.0001	**0.42533** **<.0001**	0.34679 <.0001	**0.49239** **<.0001**	**0.41398** **<.0001**	**0.45645** **<.0001**	0.36918 <.0001
Nausea		0.0142 0.8394	0.14554 0.1026	0.14899 0.0946	0.20472 0.0032	0.03578 0.6096	-0.13321 0.0588	0.19944 0.0041	0.21013 0.0024	0.27615 <.0001	**0.44616** **<.0001**		0.20141 0.0034	0.14458 0.0363	0.3613 <.0001	0.29486 <.0001	0.32003 <.0001	0.2815 <.0001
Depression		0.06773 0.3346	-0.02857 0.7508	-0.10238 0.254	0.14637 0.0367	0.07038 0.316	-0.1229 0.0822	0.19643 0.0048	0.16419 0.0187	**0.42027** **<.0001**	**0.42588** **<.0001**	**0.4147** **<.0001**		**0.58896** **<.0001**	0.35894 <.0001	**0.45026** **<.0001**	**0.54117** **<.0001**	0.26695 <.0001
Anxiety		0.09391 0.1805	-0.05411 0.5457	-0.1418 0.1118	0.06308 0.3701	0.07781 0.2675	-0.07912 0.2642	0.19312 0.0055	0.14925 0.0327	0.24335 0.0005	0.412 <.0001	0.24286 0.0005	**0.54484** **<.0001**		0.30957 <.0001	0.21344 0.0017	0.3454 <.0001	0.24934 0.0002

Sleepiness	0.14632 0.0363	0.05344 0.5507	0.06016 0.5017	0.01247 0.8595	0.13364 0.0561	-0.15922 0.024	0.19763 0.0045	0.15606 0.0255	0.28554 <.0001	**0.40955** **<.0001**	0.23337 0.0008	0.26845 0.0001	0.11834 0.091		**0.40926** **<.0001**	**0.45751** **<.0001**	0.38285 <.0001
Inappetence	-0.22732 0.001	0.11816 0.1823	0.09586 0.2798	0.25685 0.0002	-0.24251 0.0004	-0.1452 0.0387	**0.54851** **<.0001**	**0.46252** **<.0001**	0.30199 <.0001	0.36327 <.0001	0.36335 <.0001	0.27727 <.0001	0.25039 0.0003	0.37297 <.0001		**0.48813** **<.0001**	0.2709 <.0001
Malaise	0.09555 0.1729	0.04608 0.6069	-0.03561 0.691	0.13123 0.0614	0.08738 0.2128	-0.21736 0.0019	0.2951 <.0001	0.269 <.0001	**0.58348** **<.0001**	**0.5489** **<.0001**	**0.44119** **<.0001**	**0.56085** **<.0001**	**0.50534** **<.0001**	0.36162 <.0001	**0.42729** **<.0001**		0.2384 0.0005
Dyspnea	0.0448 0.5225	-0.12932 0.1473	-0.20201 0.0228	0.10754 0.1248	0.07416 0.2894	-0.23131 0.001	0.26447 0.0001	0.14131 0.0428	0.32486 <.0001	0.39053 <.0001	0.30697 <.0001	**0.45068** **<.0001**	0.37938 <.0001	0.21125 0.0024	0.21822 0.0017	**0.4519** **<.0001**	

Table 2: Correlation between different items[a]

Clinical and nutritional follow-up

During observation, significant improvements of NRS-2002 (p<0.001), MST (p<0.001), anxiety (p=0.0021), malaise (p=0.0377) and dyspnea (0.0288) items were observed. In addition, depression (p=0.0027) and inappetence (p=0.055) items improved in the >5% weight loss group.

A significant improvement in the malaise symptom was observed in patients with an NRS-2002≥3 evaluated before the start of oncology treatment compared to those with ongoing cancer treatment (p=0,0497). No significant upgrading was evidenced with MST in the same group of patients.

At T2 (n=83) the percentage of patients with a weight loss of > 5% decreased to 5% versus 15% at T0.

Among the patients in the weight loss ≥ 5% group at T0, 42 (51.2%) patients maintained an NRS-2002<3 and 39 (47.5%) improved their NRS-2002 from >3 to <3 and only 1 patient had a worsening of nutritional status, at T2 assessment. In the group of patients with a weight loss ≤ 5% at T0, 102 (90.3%) maintained their nutritional status with NRS -2002 <3 and the remaining 11 (9.7%) improved their NRS-2002 from >3 to NRS-2002 < 3 (p<0.0001) at T2 assessment.

Similar results were shown in the group of patients with MST. Seventy-five (91.5%) patients remained stable (MST≤3) and 7 (8.5%) changed from an MST>3 to <3 between T0 and T2 in the with weight loss ≥5% group, while all the patients maintained their MST to ≤3 (p=0.0016) at T2, in the group with ≤5% weight loss at T0.

Discussion

Our study is the first comparing nutritional screening tests in patients with LC and the sample population has a homogeneous neoplasm type and stage (91% of patients have an advanced or metastatic stage).

Our study showed a significant correlation between NRS-2002 and MST to detect malnutrition in LC outpatients, with a coefficient of 0.7 (p<0.001). It is worth noting that in 44% of patients, there was a discrepancy between the results of the two tests. This may be due to the inclusion of factors such as age and disease severity in the NRS-2002, which can lead to a higher score compared to the MST. Previous research by Rabito et al. found similar accuracy between the MST and NRS-2002 in 752 hospitalized patients, although only 19% of these patients had cancer [14]. To date, there are no studies comparing different nutritional screening tests specifically in LC patients.

A moderate or high-risk incidence of malnutrition was found in 71% and 64% of our population (for NRS-2002 and MST, respectively) in agreement with previous data by Abbass *et al*, from a prospective database of 643 LC patients awaiting radiotherapy treatment [15]. These data confirm the importance of the malnutrition issue in LC patients.

Our data reveal that males had a higher value of NRS-2002 and MST at T0 than females (p=0.038). This finding suggests that nutritional assessments in LC patients should consider gender, as males may be at higher risk for malnutrition. Previous research by Yin et al. found that sex was an independent risk factor for malnutrition in a multicentre observational cohort study of 1219 patients with LC. Other studies, such as a cross-sectional study by Alkan et al. of 104 patients with gastrointestinal cancer, have also reported a higher incidence of malnutrition in male patients [16].

In addition, NRS-2002 and MST depend on age. Patients aged ≥60 years had higher values at T0 than those aged <60 years. These findings agree with the literature data that report an incidence of malnutrition in about 66% of older cancer adults [17]. We observed a correlation between nutritional status and HGS strength since both NRS and MST depend on HGS. In addition, a slightly significant correlation (r=0.34) was observed between HGS and body weight (p < 0.001) regardless of observational timepoint, in agreement with the findings of a retrospective cohort study of 8651 cancer patients [18].

The importance of HGS is increasingly relevant in the oncological setting. Recently, HGS was recommended as a primary criterion for defining cancer cachexia [19] and sarcopenia, as acting as a surrogate endpoint of muscle mass measurements [20]. Therefore, HGS could be used as a rapid method to notice changes in nutritional status and worsening of performance status. In this regard, Wang D et al highlighted the predictive role of a low HGS on daily activities deterioration in a meta-analysis evaluating studies with an adult population with a mean or median age of more than 65 years [21]. QoL is universally accepted, along with survival, as the central outcome of cancer care. The QoL items include psychological well-being, functional status, disease- and treatment-related symptoms health perception. Many of these items included in the CS of patients with lung cancer. In a systematic review, Wheelwright S et al showed a negative correlation between weight loss and health-related quality of life in 23 out of 27 examined studies [22]. Polański J *et al*. confirmed this link in a descriptive cross-sectional study of 310 LC patients [23]. In our study the severity of malnutrition correlated with a worse intensity of CS. At T0, NRS and MST significantly correlated with "inappetence. Moreover, at T2, they correlated as well also with nausea, malaise and dyspnea. Patients with a ≥5% weight loss had worse depression (p=0.0165) and severe inappetence (P=0.0046) than patients with lower weight loss. Symptoms of depression are frequently seen in older adults with cancer, but they are scantily recognized. Recently, Yildirim D confirmed the correlation between malnutrition and depression in a descriptive, cross-sectional study of 245 advanced cancer patients through the NRS-2002-Nutritional Risk Score and the Beck Depression Inventory [24]. The relationship between malnutrition and depression is complex and requires further investigation, particularly in light of a recent meta-analysis of 51 cohort studies which found that malnutrition has prognostic significance [25]. Wang et al described a strong association between depression and higher cancer-specific mortality and poorer cancer survival in several neoplasms including LC. Lately, Li W et al. highlighted how depressive disorder in patients with non-oncogenic LC negatively affects the curative effect of first-line chemo-immunotherapy [26].

The limitations of our study are related to the disparity between pre/in-therapy patients, the high dropout rate and the lack of a control group. As concerns the first point, most of the patients were already undergoing oncological treatment before being sent to nutritional counselling, and patients who started the counselling in a pre-therapy setting were in worse conditions. This happened because there is not a habitude, or the possibility, to start both counselling and oncological therapies. This work could help oncologists understand the importance of this, improve clinical practice and to involve the nursing staff more closely in these evaluations through faster and more manageable tools. As concerns the sample size, the minimum sample size to

see a significant correlation between NRS and MST, with a power of 80%, is 43 subjects. The used sample size is therefore sufficient. Finally, the lack of a control group is due to ethical reasons.

Conclusion

Nutritional screening in LC patients can be safely performed with both MST and NRS-2002 based on the discrete correlation coefficient. In addition, special attention should be given to the assessment of CS, particularly for general malaise and depressive status closely related to the nutritional status of these patients.

Statements and Declarations

Conflict of Interest

Financial interests:

PB received honoraria as speaker bureau/advisory board by Roche, Bristol-Myers Squibb, Astra Zeneca, Janssen, Takeda, Merck Sharp and Dohme, Beigene, outside the submitted work. He declares expenses by Amgen and Daiichi Sankyo and he received institutional research funding from Roche and Pfizer.

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The other authors have no relevant financial or non-financial interests to disclose.

Ethics approval

This study was approved by the Ethics Committee of the San Luigi Gonzaga University Hospital and was conducted in accordance with the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from all individual participants included in the study. All data included and analyzed in this study is anonymized.

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Availability of the data

Data available within the article or its supplementary materials: the authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

Author Contributions

All authors contributed to the study conception, design and processing. Material preparation, data collection and analysis were performed by SC, IC and IS. The first draft of the manuscript was written by SC and IC and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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