Assessing dietary intake in accordance with guidelines: Useful correlations with an ingesta-Verbal/Visual Analogue Scale in medical oncology patients

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1 **Full Length Article**

2 **Assessing dietary intake in accordance with guidelines: useful correlations**
3 **with an *ingesta*-Verbal/Visual Analogue Scale in medical oncology patients**

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37

38 Abstract

39 **Background & aims.** Energy intake and food *ingesta* are central in nutritional screening
40 and assessment. Cancer patients are at nutritional risk of losing weight, and clinicians need
41 quick and easy tools to identify patients for nutritional support. This study aimed to evaluate
42 the feasibility and the accuracy of a Visual/Verbal Analogue Scale of food *ingesta* (*ingesta*-
43 VVAS) to assess energy food intake and nutritional risk in medical oncology patients.

44 **Methods.** Dieticians administered prospectively the *ingesta*-VVAS in 1762 medical
45 oncology patients. The external validity of the *ingesta*-VVAS was determined against daily
46 energy intake based on a 24-hour dietary recall. Patients had to estimate how they currently
47 ate on a scale from 0 “*nothing at all*” to 10 “*as usual*”. Area Under the Receiver-Operating
48 Characteristics (ROC) curve served as determine the optimal cut-off and provide the
49 discriminative power of the tool to detect patients who ingested less or more than 25 kcal.kg⁻¹.
50 day⁻¹.

51 **Results.** The feasibility of the *ingesta*-VVAS was 97.7%. The scores were significantly
52 correlated with energy intake ($\rho=.67$, $p<.05$), whatever the specific situation (*i.e.*
53 malnutrition or not). With a cut-off of ≤ 7 , the *ingesta*-VVAS exhibited a good power
54 discrimination (AUC =.804) to detect patients who ingested less or more than 25 kcal.kg⁻¹.
55 day⁻¹, with a sensitivity of 80.8%, a positive predictive value of 83.6%, a specificity of
56 67.5%, and a negative predictive value of 63.3%. Patients with a score ≤ 7 on the *ingesta*-
57 VVAS score were at 12-fold higher probability of nutritional risk [OR 12.3; 95%CI (8.7-
58 17.4); $p<.001$]. Sensitivity to detect patients with a significant weight loss was 71%, and a
59 positive predictive value of 75.9%.

60 **Conclusions.** This easy-to-use *ingesta*-VVAS is well-correlated with energy intake and may
61 be useful in clinical practice. An *ingesta*-VVAS score is ≤ 7 could be used to detect patients
62 with nutritional risk of weight loss in medical oncology.

- 63 **Keywords:** Ingesta; Nutrition; Cancer; Medical Oncology; Weight Loss; Visual Analogue
- 64 Scale

Introduction

Decreased dietary intake, involuntary weight loss (WL) and nutritional symptoms are frequent in oncology, affecting up to 85% of cancer patients [1–5]. Weight loss contributes to poor prognosis, is closely related to anorexia, decreased calorie intake, skeletal muscle wasting, and inflammation [6–8]. Recent guidelines recommend systematic nutritional screening or assessment as well as a systematic follow-up of nutritional risk for all patients undergoing anticancer treatment [9–11]. Furthermore, there is increasing evidence showing that nutritional interventions significantly contribute to the prevention and reduction of WL in oncology patients [11–13]. Therefore, assessing energy intake is a key piece of clinical information to identify patients who would be candidates for nutritional support in oncology.

Historically, clinicians have used different methodologies to assess the cancer patient's nutritional status. For a long time, undernourished patients were defined using the Nutritional Risk Index (NRI) in accordance with the Buzby's criteria [14]. Inflammatory markers including albumin and C reactive protein (CRP) were also used in accordance with the modified Glasgow Prognostic Score [15, 16]. However, these markers and criteria were inconsistently used. Levels of Body Mass Index (BMI) were often used to define underweight, but again, the thresholds of clinical importance of these measures were inconsistent [17]. The cut-off of 5% of WL in medical oncology compared with the pre-treatment weight (in particular a loss of lean tissue mass) is now accepted [6, 10, 18].

In order to gather information about ingesta and energy intake, specific inquiries based on a diet history over several days is a commonly-used approach [19]. However, this self-administered form for recording food intake has several disadvantages. It requires the implementation of dietary records during 3 to 7 days, is time consuming, effortful and costly

[20]. One of the most reliable screening tools endorsed by cancer nutrition guidelines is the Patient-Generated Subjective Global Assessment [21] (© FD Ottery, 2001). The second item of this questionnaire focuses on food intake, providing an *ingesta* score based on how the patient self-rates his/her intake during the past month (choice between “unchanged”, “more than usual” and “less than usual”). However, clinicians needed more precise quantitative information on energy intake to provide nutritional support defined by guidelines [9–11]. In this context, Thibault *et al.* [22] demonstrated that *ingesta*-analogue scales could be useful to estimate dietary intake in 114 patients, included cancer patients. If cancer patients could reliably and accurately self-screen their energy intake by using this simple valid tool, they would reduce the amount of health care professionals’ work while becoming active in their own disease. Therefore we aimed to proceed through a development process, including the feasibility and the accuracy, of a Visual/Verbal Analogue Scale of food *ingesta* (*ingesta*-VVAS) to assess energy food intake and nutritional risk of WL in medical oncology patients.

Methods

Participants

This study is a part of a large prospective population-based dataset conducted in the Cancer Institute of Montpellier (ICM) which is referral centre in France [23]. Since January 2009, 11 428 visits (n=4362 patients) were screened in our cancer institute to assess their nutritional status. Patients were eligible for inclusion in this cross-sectional study if they 1/ provided from January 2009 to December 2011 the diet history, the *ingesta*-VVAS score, and the clinical characteristics (*i.e.*, Eastern Cooperative Oncology Group performance status, height, NRI, modified Glasgow Prognostic Score, current body weight, usual body

weight), 2/ came for their first stay in our institute, 3/ were hospitalized for more than 48h, and 4/ scheduled for a chemotherapy treatment. Patients were excluded if they 1/ were hospitalized for surgery, 2/ had stopped oral intake because of a physician's prescription, 3/ received artificial nutrition (enteral or parenteral nutrition) or 4/ received oral nutritional supplements. Forty-two patients who met inclusion criteria did not complete the *ingesta-VVAS*. Data analysis was conducted on 1762 patients (Flowchart in Fig.1). The study was carried out in accordance with the Declaration of Helsinki, and data were subject of an official declaration to the CNIL, the French Data Protection Authority (methodological reference MR-001).

Fig. 1. Patients enrolled in the study according to the inclusion and non-inclusion criteria.

Material: The *ingesta*-Verbal/Visual Analogue Scale (*ingesta*-VVAS)

A Visual Analogue Scale with verbal anchors was used for dietary intake [22]. Inquiries for the ten-point *ingesta*-Verbal Analogue Scale were performed in French with the following question “If you consider that, at times when you are in good health, you eat 10 out of 10, how much do you currently eat on a scale from 0 to 10?”. 0 would mean eating “*nothing at all*” and 10 eating “*as usual*”. For the patients who did not understand this oral question, the dietician helped them in illustrating: “How do you currently eat at this moment: a quarter of the usual amount, half the usual amount or three-quarters of the usual amount?”. For the *ingesta*-Visual Analogue Scale, the patients had to tick a 100-mm line traced on a paper to answer the inquiry “How much do you currently eat on a scale from 0 “*nothing*” (far left side of the line) to 10 “*as usual*” (far right side of the line)”. The left extremity of the line was anchored by “*I eat nothing at all*” (0 cm), the middle by “*I eat half the usual amount*” (5 cm), and the right extremity by “*I eat as usual*” (10 cm). The *ingesta*-Visual Analogue Scale score was obtained by measuring the distance in centimeters from the far left side of the scale (anchored “*I eat nothing at all*”) to the point ticked by the patient (Fig. 2) and by choosing the closest whole number.

Fig. 2. The *ingesta*-Visual Analogue Scale.

Procedure

Five dieticians completed the standardized forms edited by the Departments of Clinical

Nutrition and Gastroenterology of the Cancer Institute of Montpellier to assess the patients' nutritional status [23]. They first administrated the *ingesta*-VVAS in its verbal form. If the patient did not understand the verbal form, then the patient was asked to perform the visual form. Dieticians also collected: age, sex, type of cancer, current weight and weight loss within the last month and the last 6 months, subjective weight loss (with the inquiry "Have you experienced involuntary weight loss during the last 6 months?"), height, BMI, Eastern Cooperative Oncology Group (ECOG) Performance Status score, albumin, C reactive protein levels and daily energy intake.

The dietary record was based on a 24-hour recall (*i.e.*, the day before the hospitalization), conducted in an in-depth interview manner during 20 minutes. Detailed data about food preparation methods, ingredients used in mixed dishes, and the brand name of commercial products were explored. The amounts of each food consumed were estimated in reference to a common size container, standard measuring cups and spoons. The experienced dietician calculated energy intake based on the French food composition tables¹ (in kcal.kg⁻¹.day⁻¹). To avoid any methodological bias, the performance of the *ingesta*-VVAS was randomized either before or after the dietary 24-hour recall.

Percent WL was based on weight reported in the previous 6 months; if missing, the next longest time frame for reported percent WL was substituted where available (*i.e.*, usual body weight, previous 3 or 2 months, or previous month). Based on international and French definitions before treatment [24], the BMI were separated into three classes: low (≤ 20), intermediate (21-30) and high BMI (> 30). WL was considered in accordance with the historical cut-off of $\geq 5\%$ compared with the patient's previous weight [6]. Undernourished patients were defined on Nutritional Risk Index (NRI) in accordance with the Buzby's

¹ The food composition tables are edited by the French « *Centre d'Information sur la Qualité des Aliments* (CIQUAL, Maisons-Alfort, France) », which belongs to the « *Agence Française de Sécurité Sanitaire des Aliments* (AFSSA) ».

criteria [14]. Inflammatory markers were also used to compute the modified Glasgow Prognostic Score [15, 16].

In line with the Thibault *et al.*' study [22], different criteria were used as reference methods to determine the external validity of the *ingesta*-VVAS but the daily energy intake served as the primary criterion. Convergent data in the literature highlight that ingesting less than of 25 kcal.kg⁻¹.day⁻¹ is not enough to maintain a stable weight, whatever the type or grade of cancer and treatment [10, 11, 16, 25–28]. In order to determinate the accuracy of the *ingesta*-VVAS for assessing the energy intake, patients were thus split in two sub-groups depending on whether they ingested less or more than 25 kcal.kg⁻¹.day⁻¹.

Statistical considerations

Categorical variables were reported by means of frequencies and percentages. Means, medians and range values were computed for continuous variables. The association between the demographic and clinical characteristics features including the *ingesta*-VVAS, the univariate statistical analyses were performed using the Pearson's Chi-square or the Fisher's exact test, if applicable, and using the Kruskal-Wallis or Student T test. Logistic regressions were used to determine whether the criteria were independent factors and to calculate the regression equation. The Receiver Operating Characteristic curve was used to determine the optimal cut-off of the *ingesta*-VVAS, defined with an dietary intake < 25 kcal.kg⁻¹.day⁻¹. The area under the ROC curve served as establish the discriminative power of the tool [29]. Sensitivity, specificity, positive, and negative predictive values were weight up. All reported *p*-values are two-sided and were considered significant at the 5% level. Statistical analysis was performed using the STATA v.11.0 software (Stata Corporation, College Station, TX, USA).

Results

Demographic and clinical characteristics, and nutritional status

Our study included 1762 patients, of mean age 61.7 years ($\pm$ 12.9 years), ranging from 15 to 96 years (Table 1). Primary cancers were localized in the gastro-intestinal tract (26.5%), breast (17.8%), urological tract (14.7%), lung (9.6%) or head and neck (9.1%), gynecological (8.6%) and others (13.7%). Patients were metastatic in 73.1% of cases. Forty percent of the patients (n=704) had lost 10% or more of their usual weight, and 60.2% of patients (n=1051) had lost $\geq$ 5% compared with their previous weight [6]. The *ingesta-VVAS* score was $\leq$ 7 in 64.9% patients (n=1144), while 35.1% had a score $>$ 7 (n=618). More characteristics are presented in Table 1.

Table 1

Clinical and nutritional characteristics of the patients

Characteristics	N = 1762
Age < 70 years old ^a	1246 (70.7%)
Female ^a	925 (52.5%)
Metastatic disease ^a	1288 (73.1%)
ECOG* Performance Status ^a	
0-1	864 (49.0%)
2	552 (31.3%)
3-4	346 (19.6%)
Current weight (Kg) ^b	66.6 ($\pm$ 14.77)
% Weight Loss ^{b **}	6.2 ($\pm$ 7.42)
Weight loss compared with usually ^a	

< 5%	694 (39.4 %)
[5-10%[	347 (19.7%)
[10%; 15%[	357 (20.3%)
[15%; 20%[	181 (10.3%)
≥ 20%	166 (9.4%)
Subjective feeling of weight loss ^a	1163 (66.6%)
Body Mass Index (BMI) ^a	
≤ 20	369 (21.0%)
21-30	1252 (71.2%)
>30	138 (7.8%)
Nutritional Risk Index (NRI) ^a	
<83.5 (Major risk)	189 (13.2%)
[83.5; 97.5] (Moderate-to-Low risk)	658 (46.1%)
>97.5 (No risk)	581 (40.7%)
Modified Glasgow Prognostic Score (m-GPS) ^a	
0 (Good prognostic)	391 (33.8%)
1 (Moderate prognostic)	380 (32.8%)
2 (Poor prognostic)	387 (33.4%)
Ingesta-VVAS score ^a	
1	60 (3.4%)
2	88 (5.0%)
3	152 (8.6%)
4	117 (6.6%)
5	372 (21.1%)
6	141 (8.0%)

7	214 (12.1%)
8	192 (10.9%)
9	28 (1.6%)
10	398 (22.6%)
<i>Ingesta</i> -VVAS score ^c	6 [1 ; 10]
Daily energy intake (KCal/Kg) ^b	20.5 (± 9.2)
Energy intake < 25 kcal.kg ⁻¹ .day ^{-1a}	1183 (67.1%)

Values are expressed as: ^a n (%), ^b mean (± SD), ^c median [area]; * The Eastern Cooperative Oncology Group (ECOG) performance status refers to functional ability scores (ranged from 0 to 5) to quantify cancer patients general well-being and activities of daily life; ** Percent weight loss was based on weight reported in previous 6 months; if missing, the next longest time frame for reported percent weight loss was substituted where available (*i.e.*, usual body weight, previous 3 or 2 months, or previous 1 month). Percent weight loss was calculated as follows: [(current weight in Kg - previous weight in Kg)/previous weight in kg] x 100.

Feasibility of the Visual/Verbal Analogue Scales of food *ingesta*

The feasibility of the verbal form of the *ingesta*-VVAS was 95% (n=1674). The use of the visual form was necessary in second intention for 5% of patients (n=88) who did not understand the oral question. Only 42 patients who met the inclusion criteria were unable to complete the verbal or visual *ingesta*-VVAS. Thus, the feasibility for the *ingesta*-VVAS was 97.7% (n=1762).

Accuracy of the *ingesta*-VVAS for assessing dietary intake

Correlation coefficients between the *ingesta*-VVAS scores and the mean daily energy intake were positive and significant ($\rho=.67$, $p<.05$) (Fig. 3). The linear regressions may offer moderately-to large predictive values with adjusted-R² of respectively .51 as followed: mean energy intake (kcal.kg⁻¹.day⁻¹) = 2.3 * *ingesta*-VVAS score + 5.9.

Fig. 3. Statistical correlation between *ingesta* -Verbal/Visual Analogue Scale (*ingesta* – VVAS) and daily energy intake, calculated from a 24-hour dietary inquiry and expressed as kcal.kg⁻¹.day⁻¹. ρ = Spearman correlation coefficient.

We also conducted correlations between mean daily energy and the *ingesta*-VVAS scores, in different patients subgroups (*i.e.*, depending on their WL, their BMI and their NRI). All the coefficients between groups remained relevant, significantly moderate or high ($p < .001$): $\rho = .67$ in patients who had lost $\geq 5\%$ compared with their previous weight, $\rho = .68$ in undernourished patients (defined by a NRI below 97.5), $\rho = .70$ in overweight patients (defined by a BMI > 30), $\rho = .71$ in underweight patients (defined by a BMI below or equal to 20), and $\rho = .74$ in patients with a major nutritional risk (NRI < 83.5).

Accuracy of the *ingesta*-VVAS for assessing nutritional risk

Two thirds (67.1%) of patients ($n = 1183$) ingested less than 25 kcal.kg⁻¹.day⁻¹. Taking into account these data, the optimal cut-off of the *ingesta*-VVAS determinate with the ROC curve was ≤ 7 , with a 95% confidence interval (Fig. 4). The area under the ROC Curve was

248 .804 (Fig. 4).

249

250 **Fig.4.** Receiver Operating Characteristic curve.

251 The results of univariate analysis presented in Table 2 indicate that age, gender, presence of
252 metastases, ECOG Performance Status, subjective feeling of weight loss, WL, BMI, m-GPS,
253 NRI, and *ingesta*-VVAS scores are associated ($p<.001$) with a nutritional risk (*i.e.*, patients
254 ingesting less than $25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$).

255

256 **Table 2**

257 Relationships between nutritional risk (defined as food intake $<25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$) and
258 clinical data

Clinical data	Patients (%) with a nutritional risk (<i>ingesta</i> < 25 kcal.kg ⁻¹ .day ⁻¹)	Odds Ratio	[95% Confidence Intervalle]	P-Value
Age (in years old)				

<70	64.5	1		
≥ 70	73.5	2.77	2.28 - 3.36	<0.001
Gender				
Male	64.2	1		
Female	69.8	2.32	2.01 - 2.66	<0.001
Metastatic disease				
No	56.3	1		
Yes	71.1	2.46	2.18 - 2.78	<0.001
ECOG Performance Status				
0-1	53.8	1		
2	75.5	3.09	2.54 - 3.75	<0.001
3-4	87.0	6.69	4.89 - 9.15	<0.001
Subjective feeling of Weight Loss				
No	53.9	1		
Yes	73.4	2.76	2.43 - 3.15	<0.001
Weight Loss				
<5%	63.8	1		
≥5%	68.6	2.18	1.94 - 2.47	<0.001
BMI				
≤ 20	50.1	0.44	0.35-0.56	<0.001
21-30	69.7	1		
>30	90.6	4.19	2.03-2.59	<0.001
NRI				
<83.5	74.1	1.63	1.12-2.35	0.009
[83.5; 97.5]	70.8	1.38	1.09-1.76	0.008
>97.5	63.7			
m-GPS				
0 (Good prognostic)	56.8	1		
1 (Moderate prognostic)	70.8	2.42	1.94 - 3.02	<0.001
2 (Poor prognostic)	81.4	4.37	3.39 - 5.65	<0.001
<i>Ingesta</i> -VVAS score				
≤ 7	83.6	8.75	6.98-10.98	<0.001
> 7	36.7	1		

ECOG: Eastern Cooperative Oncology Group; BMI: Body Mass Index; NRI: Nutritional Risk Index; m-GPS: Modified Glasgow Prognostic Score; *Ingesta*-VVAS: Visual/Verbal Analogue Scale of food *ingesta*

The cut-off of ≤ 7 on the *ingesta*-VVAS detected 83.6% of the patients who had a nutritional risk (n=956). The main data are reported in Table 3. The sensitivity and the positive predictive value were 80.8% and 83.6%, respectively, while the specificity and the negative predictive value were 67.5% and 63.3%, respectively.

Table 3

Assessment of nutritional risk (defined as food intake $< 25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$) using the Verbal/Visual Analogue Scale of food *ingesta* (*ingesta*-VVAS).

	Nutritional risk (<i>ingesta</i> $< 25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$)	Low nutritional risk (<i>ingesta</i> $\geq 25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$)	Total (n)
<i>Ingesta</i> -VVAS ≤ 7	956 (TP) 80.8%	188 (FP) 32.5%	1 144
<i>Ingesta</i> -VVAS > 7	227 (FN) 19.2%	391 (TN) 67.5%	618
Total (n)	1 183	579	1762

TP: true-positives; FP: false-positives; FN: false-negatives; TN: true-negatives

In multivariate analysis (Table 4), the main independent criteria to predict nutritional risk (defined as food intake $< 25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$) were: age, ECOG Performance Status, m-GPS, BMI and *ingesta*-VVAS scores. Patients with a score ≤ 7 on the *ingesta*-VVAS score were at 12-fold higher probability of nutritional risk [OR 12.3; 95%CI (8.7-17.4); $p<.001$]. Obesity (BMI >30) was associated with an increased risk of ingesting less than $25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$ [OR 5.7; 95%CI (2.7-11.8); $p<.001$]. Bad prognostic (m-GPS = 2) was significantly associated with a nutritional risk [OR 1.67; 95%CI (1.1-2.5); $p<.001$].

Table 4

Predictive factors independently associated with nutritional risk (defined as food intake $< 25 \text{ kcal.kg}^{-1}.\text{day}^{-1}$)

Risk factors	Odds Ratio	[95% Confidence Intervalle]	P-Value
Age (in years old)			
<70	1		
≥ 70	1.58	1.10 - 2.27	0.014
ECOG Performance Status			
0-1	1		
2	1.12	0.549	0.77 - 1.64
3-4	1.68	0.015	1.10 - 2.55
BMI			
≤ 20	0.25	0.17 - 0.37	<0.001
21-30	1		
>30	5.70	2.75 - 11.83	<0.001
m-GPS			
0 (Good prognostic)	1		
1 (Moderate prognostic)	1.12	0.77 - 1.64	0.549
2 (Poor prognostic)	1.68	1.10 - 2.55	0.015
<i>Ingesta</i> -VVAS score			
≤ 7	1		
> 7	12.32	8.73 - 17.39	<0.001

ECOG: Eastern Cooperative Oncology Group; BMI: Body Mass Index; NRI: Nutritional Risk Index; m-GPS:

Modified Glasgow Prognostic Score; *Ingesta*-VVAS: Visual/Verbal Analogue Scale of food *ingesta*

Accuracy of the *ingesta*-VVAS for assessing significant weight loss

Furthermore, about two-thirds (60.2%) of patients (n=1051) exhibited a weight loss $\geq 5\%$ compared with their usual weight. The cut-off of ≤ 7 on the *ingesta*-VVAS detected 71% (n=868) of these patients. More details are presented in Table 5. The sensitivity and the positive predictive value were 71% and 75.9%, respectively, while the specificity and the negative predictive value were 48.8% and 42.6%, respectively.

Table 5

Assessment of undernutrition (defined as weight loss $\geq 5\%$ compared with the usual weight) using the Verbal/Visual Analogue Scale of food *ingesta* (*ingesta*-VVAS).

	Undernutrition (WL $\geq 5\%$)	“Normal” nutrition (No WL or WL $< 5\%$)	Total (n)
<i>Ingesta</i> -VVAS ≤ 7	868 (TP) 71%	276 (FP) 51,2%	1 144
<i>Ingesta</i> -VVAS > 7	355 (FN) 29%	263 (TN) 48,8%	618
Total (n)	1 223	539	1762

Notes: WL: Weight Loss; TP: true-positives; FP: false-positives; FN: false-negatives; TN: true-negatives

Discussion

In line with the Patient-Generated Subjective Global Assessment [21] and the 10-points analog scales [22], this *ingesta*-VVAS was developed as a clinically practical tool to assess food intake and nutritional risk of WL. Feasibility and accuracy were determined with a 24-hour dietary recall for *ingesta* in a large and a representative prospective sample of 1762 medical oncology patients. Main results showed an excellent feasibility of the *ingesta*-VVAS. Positive and significant correlation coefficients were found between the *ingesta*-VVAS score and the mean daily energy intake. These correlations were not modified according to specific situations of malnutrition (*i.e.*, in different patients subgroups including WL, BMI and NRI criteria). With a cut-off of ≤ 7 , the *ingesta*-VVAS exhibited a good power discrimination to detect patients who showed a nutritional risk (*i.e.*, who ingested less 25 kcal.kg⁻¹.day⁻¹), and also patients who had a significant weight loss (*i.e.*, $\geq 5\%$ compared with their usual weight).

A recent review of appetite and food intake methodology [30] concluded that visual

analogue scales are currently the most established tools to assess subjective appetite. However, "appetite" or "anorexia" (like mentioned in the last version of the Common Terminology Criteria for Adverse Events) have no consistent meaning for patients and are in any case not the same thing as food intake. Thibault *et al.* [22] had already shown that a 10-point VVAS was feasible and valid to quickly assess dietary intakes in hospitalized patients. This is why French guidelines for cancer management recommended the use of food intake *ingesta*-VVAS for nutritional screening [10, 23, 26]. Both the verbal and visual versions of the *ingesta*-VVAS are feasible. Although a dedicated tool (EPA® or SEFI® in its English version), based on Thibault's study [22], has been approved by the French Society for Clinical Nutrition and Metabolism, a written analog scale was preferred here. We aimed to test the feasibility and the accuracy of a very simple tool (*i.e.* a verbal form of *ingesta*-VVAS and a 'paper' visual analogue scale) that can be available as much as possible for the worldwide clinicians. Furthermore, the feasibility and usefulness of visual analogue scales in cancer patients have already been documented for the assessment of appetite [31, 32], palatability [33], pain [e.g., 34, 35] and fatigue [36] as well as other symptoms [37]. As Aitken [38] suggested, "people seem to like using this sort of scale and readily understand its requirements. It takes only seconds to obtain a score and imposes no inconvenience" to the patient. Thus, *ingesta*-VVAS is an interesting tool with a good ecological validity². It enables the patients' subjective nutritional sensations to be measured and quantified [39]. Cost effectiveness using the *ingesta*-VVAS as a first-line screening patients at risk is also very interesting compared with a 24 h recall. In the present study, using a stratified approach could have saved 558 hours of dietitian time (587.3 hours to do the 24h recall in 1762

² An ecologically valid measure has characteristics similar to a naturally occurring behavior and can predict everyday function [39], with two requirements: (1) verisimilitude: the demands of a test and the testing conditions resemble demands in the everyday world of the patient; and (2) veridicality: the performance on a test predicts some aspects of the patient's functioning on a day-to-day basis.

patients vs. 29.4 hours to use the VVAS), thus saving 15 272.46 € (587.33*27.37³). Many institutions do not have staff to do the 24h recall whereas clinicians can use the *ingesta*-VVAS worldwide as a first-line screening.

Recent data in literature highlight that an intake <25 kcal.kg⁻¹.day⁻¹ is not enough to maintain a stable weight, whatever the type or grade of cancer and type of treatment [11]. In our study, more than two thirds of the patients ingested less than 25 kcal.kg⁻¹.day⁻¹. The ROC curves detected an optimum cut-off of < 8 divided this population exactly in three and one-quarter in accordance with the tool validated by the French society. The *ingesta*-VVAS for assessing energy intake is very sensitive and exhibits a high positive predictive value: in medical oncology patients, the probability of not eating enough when the *ingesta*-VVAS score is 8 is 83.6%, (which can be considered as a good quality [40]). In multi-adjusted model, *ingesta*-VVAS score, age, ECOG Performance Status, m-GPS and BMI remained significantly and independently associated with nutritional risk (defined as food intake < 25 kcal.kg⁻¹.day⁻¹). Nutritional risk is 12-fold higher in patients exhibiting a score ≤ 7 on the *ingesta*-VVAS than patients with a score ≥ 8. Obesity (BMI >30) was associated with an increased risk of ingesting less than 25 kcal.kg⁻¹.day⁻¹. It underlines that having a BMI >30 is not a guarantee of maintaining a stable weight. Obesity is not a protection against under nutrition. However, these results should be taken with caution. Indeed, the energy intake is calculated on the standardized weight for a theoretical BMI of 25 to 30 [41].

Concerning the assessment of WL, which was not the first goal, the positive predictive value was good with 75.9%. As the sensitive value was 71%, one can guess that repeated measures of *ingesta*-VVAS may probably permit to provide a better sensitivity on time. These results are also in line with the physiopathology of WL in medical oncology (*i.e.*, first anorexia then WL). Using a cut-off of 10% of WL, two European surveys found that 30-

³ The hourly cost for a dietitian in France is 27.37 €.

361 40% of cancer patients were malnourished. In line with recent guidelines [6, 8], the cut-off
362 of $\geq 5\%$ compared with the patient's previous weight (and not 10%) was taking into
363 account, that explained 60.2% of patients were found to be undernourished in this study. All
364 these patients already warrant some nutritional intervention. A score of 7 (or less) at the
365 *ingesta*-VVAS has allowed detecting 71% of these undernourished patients. Those results
366 suggest using the *ingesta*-VVAS tool in the remaining group of patients to potentially plan
367 some earlier nutritional intervention.

368 Several limitations could be pointed out in our study. First, Thibault *et al.* [22] followed the
369 Burke *and al.* [42] dietary historical method based on a 3-day food intake, whereas our
370 inquiry was based only on one day. However, a simple 24-hour recall, or structured 24-hour
371 recall, or a 7-day estimated record or open-ended food diary give similar values [43].

372 Epidemiologic studies showed that any single method cannot assess dietary exposure
373 perfectly [20]. In practice, given our sample size and the practical burden of a 3-7 day
374 dietary record, we can guess that it would have been unfeasible to use in research or in
375 clinical practice. Another weakness may be that the interviewer - who was aware of the
376 results of the 24-hour dietary recall - was the same clinician who performed the *ingesta*-
377 VVAS. This "not-blinded design" may not be a major bias because the patients directly and
378 blindly responded to the inquiries, the dietary recall and the *ingesta* assessment, with a low
379 dietician's influence, in a randomized order. Then, validity and accuracy the cut-off were
380 assessed using patient recall of information about diet and weight. This chose was based on
381 the findings that self-reporting of weight and 24-hour dietary recall may be valid and
382 reliable measurements to identify malnutrition in patients [20, 44]. Of course, those self-
383 reports depend on the patients' memory and the skills of a well-trained dietician to minimize
384 recall bias. The notion of a simple continuous scale to assess the subjective perception of
385 food intake as a potential screen for clinically significant malnourishment is worth pursuing,

but additional work seems to be needed in terms of content and concurrent validation, reliability testing, responsiveness to change, and the value of a cutoff score that would suggest clinical action. Also, it would be interesting to study the *ingesta*-VVAS values as a function of the WL grades and BMI level as defined recently by Martin and *al.*[8]. Finally, even if the tool may offer very good psychometric proprieties, it is intended for screening and not as a substitute for assessment by a nutritional professional.

In conclusion, food intake screening is central in nutritional assessment. Clinicians have to detect *ingesta* deficits, which is the major way to predict risk of WL in cancer patients. This study confirms a valid and clinically practical tool, the *ingesta*-VVAS, for a quick estimation of dietary intake in medical oncologic patients, easy to use by verbal form on worldwide. According to its properties, it may be very helpful to identify patients who would be candidates for nutritional support in prevention and supportive care.

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