Clinical Nutrition 38 (2019) 1927–1935

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

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

Estelle Guerdoux-Ninot [a, b, *], Nicolas Flori [b], Chloé Janiszewski [b], Arnaud Vaillé [b], Hélène de Forges [c], Bruno Raynard [d], Vickie E. Baracos [e], Simon Thezenas [f], Pierre Senesse [a, b]

[a] Department of Supportive Care, Cancer Institute of Montpellier (ICM), Montpellier, University of Montpellier, France
[b] Department of Clinical Nutrition and Gastroenterology, Cancer Institute of Montpellier (ICM), University of Montpellier, France
[c] Clinical Research Department, Cancer Institute of Montpellier (ICM), University of Montpellier, France
[d] Department of Supportive Care, Gustave Roussy Cancer Campus, Villejuif, France
[e] Department of Oncology, University of Alberta, Canada
[f] Department of Biostatistics, Cancer Institute of Montpellier (ICM), University of Montpellier, France

ARTICLE INFO

Article history:
Received 30 November 2017
Accepted 19 June 2018

Keywords:
Ingesta
Nutrition
Cancer
Medical oncology
Weight loss
Visual analogue scale

SUMMARY

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

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

Results: The feasibility of the *ingesta*-VVAS was 97.7%. The scores were significantly correlated with energy intake ($\rho = .67$, $p < .05$), whatever the specific situation (*i.e.* malnutrition or not). With a cut-off of ≤ 7, the *ingesta*-VVAS exhibited a good power discrimination (AUC = .804) to detect patients who ingested less or more than 25 kcal kg^{-1} day^{-1}, with a sensitivity of 80.8%, a positive predictive value of 83.6%, a specificity of 67.5%, and a negative predictive value of 63.3%. 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); $p < .001$]. Sensitivity to detect patients with a significant weight loss was 71%, and a positive predictive value of 75.9%.

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

1. 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

* Corresponding author. Institut régional du Cancer de Montpellier (ICM), SIRIC, Pôle Soins de Support, Unité de Psycho-Oncologie, Parc Euromédecine, 208 avenue des Apothicaires, 34298 Montpellier, France.
E-mail address: estelle.guerdoux-ninot@icm.unicancer.fr (E. Guerdoux-Ninot).

https://doi.org/10.1016/j.clnu.2018.06.974
0261-5614/

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 3–7 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.

2. Methods

2.1. 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 48 h, 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).

2.2. 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.

2.3. 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-h recall (*i.e.,* the day before the hospitalization), conducted in an in-depth interview manner during 20 min. 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 tables[1] (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-h 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

[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)*".

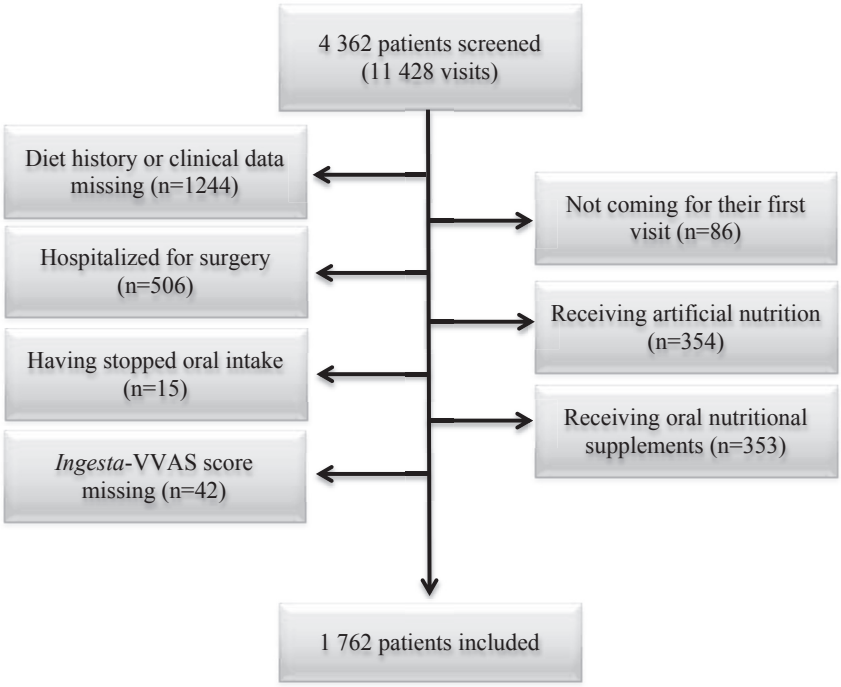

Fig. 1. Patients enrolled in the study according to the inclusion and non-inclusion criteria.

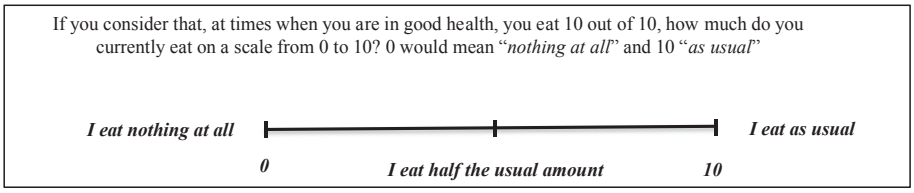

Fig. 2. The *ingesta*-Visual Analogue Scale.

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 ≥5% compared with the patient's previous weight [6]. Undernourished patients were defined on Nutritional Risk Index (NRI) in accordance with the Buzby's 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}.

2.4. 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).

3. Results

3.1. Demographic and clinical characteristics, and nutritional status

Our study included 1762 patients, of mean age 61.7 years (±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%),

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 (±14.77)
% Weight loss[b**]	6.2 (±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%)
Ingesta-VVAS score[c]	6 [1; 10]
Daily energy intake (KCal/Kg)[b]	20.5 (±9.2)
Energy intake < 25 kcal kg^{-1} day^{-1}[a]	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] × 100.

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 weigh, and 60.2% of patients (n = 1051) had lost ≥5% compared with their previous weight [6]. The *ingesta*-VVAS score was ≤7 in 64.9% patients (n = 1144), while 35.1% had a score >7 (n = 618). More characteristics are presented in Table 1.

3.2. 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).

3.3. 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-R^2 of respectively 0.51 as followed: mean energy intake (kcal kg^{-1} day^{-1}) = 2.3**ingesta*-VVAS score + 5.9.

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 ≥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).

3.4. 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 0.804 (Fig. 4).

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

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.

In multivariate analysis (Table 4), the main independent criteria to predict nutritional risk (defined as food intake < 25 kcal kg^{-1} 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 kcal kg^{-1} 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); $p < .001$].

3.5. Accuracy of the ingesta-VVAS for assessing significant weight loss

Furthermore, about two-thirds (60.2%) of patients (n = 1051) exhibited a weight loss ≥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.

4. 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-h dietary recall for *ingesta* in a large and a representative

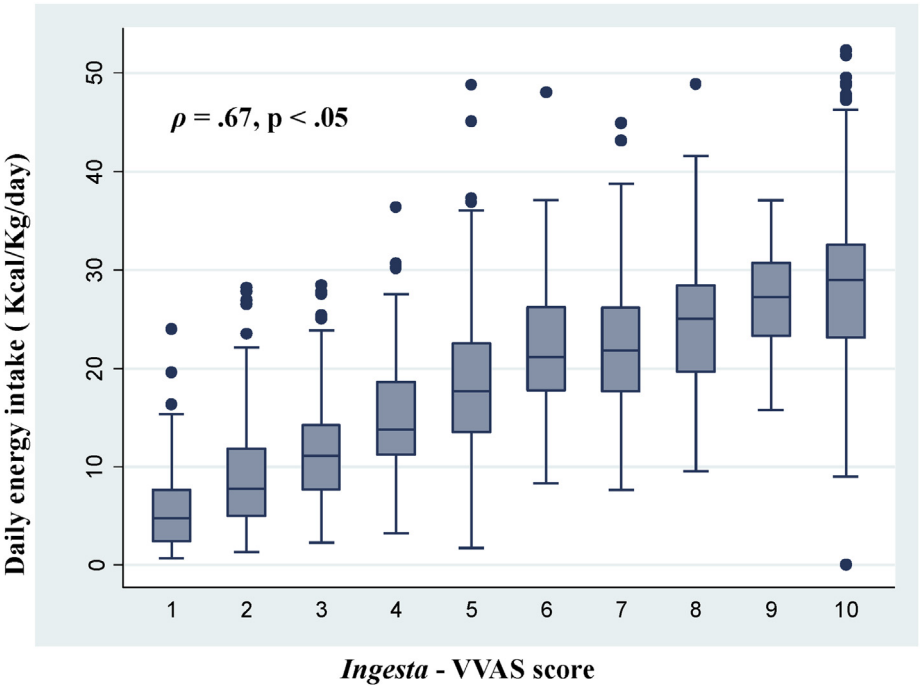

Fig. 3. Statistical correlation between *ingesta*-Verbal/Visual Analogue Scale (*ingesta*-VVAS) and daily energy intake, calculated from a 24-h dietary inquiry and expressed as kcal kg^{-1} day^{-1}. ρ = Spearman correlation coefficient.

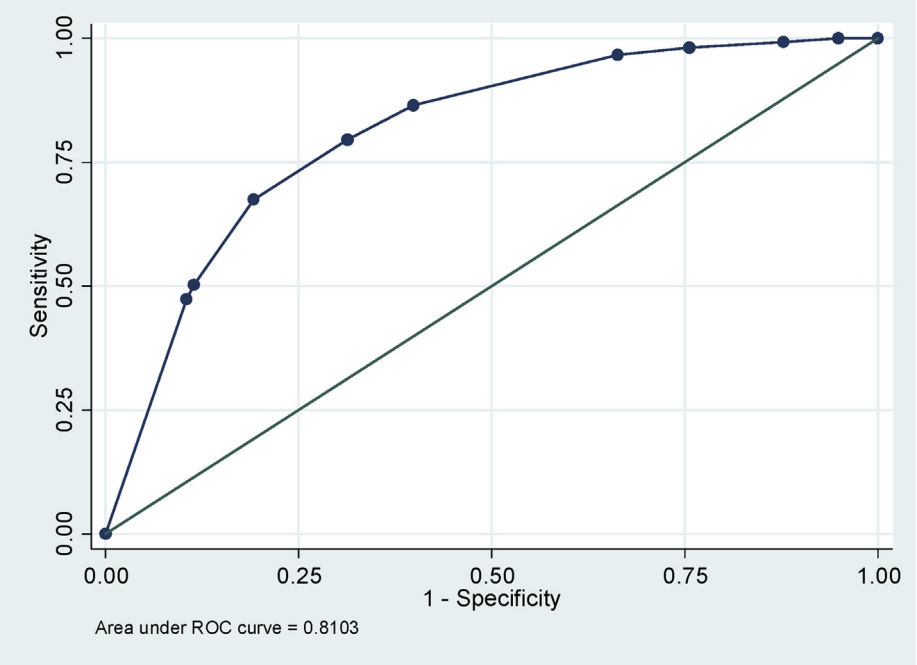

Fig. 4. Receiver Operating Characteristic curve.

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.,* ≥ 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

Table 2
Relationships between nutritional risk (defined as food intake <25 kcal kg^{-1} day^{-1}) and clinical data.

Clinical data	Patients (%) with a nutritional risk (*ingesta* < 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
Ingesta-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*.

Table 3
Assessment of nutritional risk (defined as food intake < 25 kcal kg^{-1} day^{-1}) using the Verbal/Visual Analogue Scale of food *ingesta* (*ingesta*-VVAS).

	Nutritional risk (*ingesta* < 25 kcal kg^{-1} day^{-1})	Low nutritional risk (*ingesta* ≥ 25 kcal kg^{-1} day^{-1})	Total (n)
Ingesta-VVAS ≤ 7	956 (TP) 80.8%	188 (FP) 32.5%	**1144**
Ingesta-VVAS > 7	227 (FN) 19.2%	391 (TN) 67.5%	**618**
Total (n)	**1183**	**579**	**1762**

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

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., Refs. [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 validity.[2] 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 h of dietitian time (587.3 h to do the 24 h recall in 1762 patients *vs.* 29.4 h to use the VVAS), thus saving 15 272.46 € (587.33*27.37[3]). Many institutions do not have staff to do the 24 h 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

[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.

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

Table 4
Predictive factors independently associated with nutritional risk (defined as food intake < 25 kcal kg^{-1} 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
Ingesta-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*.

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

	Undernutrition (WL ≥ 5%)	"Normal" nutrition (no WL or WL < 5%)	Total (n)
Ingesta-VVAS ≤ 7	868 (TP) 71%	276 (FP) 51,2%	**1144**
Ingesta-VVAS > 7	355 (FN) 29%	263 (TN) 48,8%	**618**
Total (n)	**1223**	**539**	**1762**

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

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 25–30 [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 30–40% of cancer patients were malnourished. In line with recent guidelines [6,8], the cut-off of ≥5% compared with the patient's previous weight (and not 10%) was taking into account, that explained 60.2% of patients were found to be undernourished in this study. All these patients already warrant some nutritional intervention. A score of 7 (or less) at the *ingesta*-VVAS has allowed detecting 71% of these undernourished patients. Those results suggest using the *ingesta*-VVAS tool in the remaining group of patients to potentially plan some earlier nutritional intervention.

Several limitations could be pointed out in our study. First, Thibault et al. [22] followed the Burke et al. [42] dietary historical method based on a 3-day food intake, whereas our inquiry was based only on one day. However, a simple 24-h recall, or structured 24-h recall, or a 7-day estimated record or open-ended food diary give similar values [43]. Epidemiologic studies showed that any single method cannot assess dietary exposure perfectly [20]. In practice, given our sample size and the practical burden of a 3–7 day dietary record, we can guess that it would have been unfeasible to use in research or in clinical practice. Another weakness may be that the interviewer – who was aware of the results of the 24-h dietary recall – was the same clinician who performed the *ingesta*-VVAS. This "not-blinded design" may not be a major bias because the patients directly and blindly responded to the inquiries, the dietary recall and the *ingesta* assessment, with a low dietician's influence, in a randomized order. Then, validity and accuracy the cut-off were assessed using patient recall of information about diet and weight. This chose was based on the findings that self-reporting of weight and 24-h dietary recall may be valid and reliable measurements to identify malnutrition in patients [20,44]. Of course, those self-reports depend on the patients' memory and the skills of a well-trained dietician to minimize recall bias. The notion of a simple continuous scale to assess the subjective perception of 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 et 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.

Statement of authorship

EGN participated in performed some statistical analyses, drafted the manuscript and provided intellectual content. CJ and AV carried out the collection of data. ST performed the statistical analyses. VB, HF and BR participated in the design of the study and revised the manuscript critically for important intellectual content. PS and NF conceived the study, carried out the collection of data and drafted the manuscript.

Funding

This study was supported by the SIRIC Montpellier Cancer (Grant INCa_Inserm_DGOS_12553), which was not involved in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. All authors critically reviewed the manuscript and approved the version for submission.

Conflict of interest

The authors declare that they have no financial or non-financial competing interests.

Acknowledgments

The authors are grateful to the dietetic staff for their assistance with patient recruitment toward the end of the study and their support in completing the study: Stéphanie Arnac, Berénice Clavié, Laure Francioni, and Anne Fallières. They also thank Drs. Vanessa Guillaumon and Jean-Pierre Bleuse, and Pr. Marc Ychou for their support.

References

[1] Coa KI, Epstein JB, Ettinger D, Jatoi A, McManus K, Platek ME, et al. The impact of cancer treatment on the diets and food preferences of patients receiving outpatient treatment. Nutr Cancer 2015;67:339–53. https://doi.org/10.1080/01635581.2015.990577.

[2] Bozzetti F, on behalf of the SCRINIO Working Group. Screening the nutritional status in oncology: a preliminary report on 1,000 outpatients. Support Care Cancer 2009;17:279–84. https://doi.org/10.1007/s00520-008-0476-3.

[3] Guerdoux-Ninot E, Kilgour RD, Janiszewski C, Jarlier M, Meuric J, Poirée B, et al. Meal context and food preferences in cancer patients: results from a French self-report survey. SpringerPlus 2016;5. https://doi.org/10.1186/s40064-016-2538-1.

[4] Hébuterne X, Lemarié E, Michallet M, de Montreuil CB, Schneider SM, Goldwasser F. Prevalence of malnutrition and current use of nutrition support in patients with cancer. J Parenter Enteral Nutr 2014;38:196–204. https://doi.org/10.1177/0148607113502674.

[5] Mariani L, Lo Vullo S, Bozzetti F, SCRINIO Working Group. Weight loss in cancer patients: a plea for a better awareness of the issue. Support Care Cancer Off J Multinatl Assoc Support Care Cancer 2012;20:301–9. https://doi.org/10.1007/s00520-010-1075-7.

[6] Fearon K, Strasser F, Anker SD, Bosaeus I, Bruera E, Fainsinger RL, et al. Definition and classification of cancer cachexia: an international consensus. Lancet Oncol 2011;12:489–95. https://doi.org/10.1016/S1470-2045(10)70218-7.

[7] Fearon KC, Voss AC, Hustead DS. Cancer Cachexia Study Group, Definition of cancer cachexia: effect of weight loss, reduced food intake, and systemic inflammation on functional status and prognosis. Am J Clin Nutr 2006;83:1345–50.

[8] Martin L, Senesse P, Gioulbasanis I, Antoun S, Bozzetti F, Deans C, et al. Diagnostic criteria for the classification of cancer-associated weight loss. J Clin Oncol 2015;33:90–9. https://doi.org/10.1200/JCO.2014.56.1894.

[9] August DA, Huhmann MB, American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Board of Directors. A.S.P.E.N. clinical guidelines: nutrition support therapy during adult anticancer treatment and in hematopoietic cell transplantation. J Parenter Enteral Nutr 2009;33:472–500. https://doi.org/10.1177/0148607109341804.

[10] French Speaking Society of Clinical Nutrition and Metabolism (SFNEP). Clinical nutrition guidelines of the French Speaking Society of Clinical Nutrition and Metabolism (SFNEP): summary of recommendations for adults undergoing non-surgical anticancer treatment. Dig Liver Dis 2014;46:667–74. https://doi.org/10.1016/j.dld.2014.01.160.

[11] Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clin Nutr 2017;36(1):11–48.

[12] Lee JLC, Leong LP, Lim SL. Nutrition intervention approaches to reduce malnutrition in oncology patients: a systematic review. Support Care Cancer 2015;24:469–80. https://doi.org/10.1007/s00520-015-2958-4.

[13] Mueller C, Compher C, Ellen DM, the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Board of Directors. A.S.P.E.N. Clinical guidelines: nutrition screening, assessment, and intervention in adults. J Parenter Enteral Nutr 2011;35:16–24. https://doi.org/10.1177/0148607110389335.

[14] Buzby GP, Williford WO, Peterson OL, Crosby LO, Page CP, Reinhardt GF, et al. A randomized clinical trial of total parenteral nutrition in malnourished surgical patients: the rationale and impact of previous clinical trials and pilot study on protocol design. Am J Clin Nutr 1988;47:357–65.

[15] Leitch EF, Chakrabarti M, Crozier JEM, McKee RF, Anderson JH, Horgan PG, et al. Comparison of the prognostic value of selected markers of the systemic inflammatory response in patients with colorectal cancer. Br J Cancer 2007;97:1266–70. https://doi.org/10.1038/sj.bjc.6604027.

[16] Forrest LM, McMillan DC, McArdle CS, Angerson WJ, Dunlop DJ. Evaluation of cumulative prognostic scores based on the systemic inflammatory response in patients with inoperable non-small-cell lung cancer. Br J Cancer 2003;89:1028–30. https://doi.org/10.1038/sj.bjc.6601242.

[17] Jensen GL, Hsiao PY, Wheeler D. Adult nutrition assessment tutorial. J Parenter Enteral Nutr 2012;36:267–74. https://doi.org/10.1177/0148607112440284.

[18] Dewys WD, Begg C, Lavin PT, Band PR, Bennett JM, Bertino JR, et al. Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. Am J Med 1980;69:491–7.

[19] Kumanyika SK, Mauger D, Mitchell DC, Phillips B, Smiciklas-Wright H, Palmer JR. Relative validity of food frequency questionnaire nutrient estimates in the Black Women's Health Study. Ann Epidemiol 2003;13:111–8.

[20] Shim J-S, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health 2014. https://doi.org/10.4178/epih/e2014009. e2014009.

[21] Ottery FD. Definition of standardized nutritional assessment and interventional pathways in oncology. Nutrition 1996;12:S15–9.

[22] Thibault R, Goujon N, Le Gallic E, Clairand R, Sébille V, Vibert J, et al. Use of 10-point analogue scales to estimate dietary intake: a prospective study in patients nutritionally at-risk. Clin Nutr 2009;28:134–40. https://doi.org/10.1016/j.clnu.2009.01.003.

[23] Senesse P, Isambert A, Janiszewski C, Fiore S, Flori N, Poujol S, et al. Management of cancer cachexia and guidelines implementation in a comprehensive cancer center: a physician-led cancer nutrition program adapted to the practices of a country. J Pain Symptom Manag 2017;54. https://doi.org/10.1016/j.jpainsymman.2017.01.010. 387–393.e3.

[24] Senesse P, Vasson M-P. Nutrition chez le patient adulte atteint de cancer : quand et comment évaluer l'état nutritionnel d'un malade atteint de cancer ? Comment faire le diagnostic de dénutrition et le diagnostic de dénutrition sévère chez un malade atteint de cancer ? Quelles sont les situations les plus à risque de dénutrition ? Nutr Clin Metab 2012;26:165–88. https://doi.org/10.1016/j.nupar.2012.10.004.

[25] Pressoir M, Desné S, Berchery D, Rossignol G, Poiree B, Meslier M, et al. Prevalence, risk factors and clinical implications of malnutrition in French Comprehensive Cancer Centres. Br J Cancer 2010;102:966–71. https://doi.org/10.1038/sj.bjc.6605578.

[26] Senesse P, Hébuterne X. Nutrition chez le patient adulte atteint de cancer : besoins nutritionnels, énergétiques et protéiques, au cours de la prise en charge du cancer chez l'adulte. Nutr Clin Metab 2012;26:189–96. https://doi.org/10.1016/j.nupar.2012.10.005.

[27] Ovesen L, Allingstrup L, Hannibal J, Mortensen EL, Hansen OP. Effect of dietary counseling on food intake, body weight, response rate, survival, and quality of life in cancer patients undergoing chemotherapy: a prospective, randomized study. J Clin Oncol 1993;11:2043–9.

[28] Hutton JL, Martin L, Field CJ, Wismer WV, Bruera ED, Watanabe SM, et al. Dietary patterns in patients with advanced cancer: implications for anorexia-cachexia therapy. Am J Clin Nutr 2006;84:1163–70.

[29] Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. Radiology 1982;143:29–36. https://doi.org/10.1148/radiology.143.1.7063747.

[30] Blundell J, de Graaf C, Hulshof T, Jebb S, Livingstone B, Lluch A, et al. Appetite control: methodological aspects of the evaluation of foods. Obes Rev 2010;11:251–70. https://doi.org/10.1111/j.1467-789X.2010.00714.x.

[31] Blauwhoff-Buskermolen S, Ruijgrok C, Ostelo RW, de Vet HCW, Verheul HMW, de van der Schueren MAE, et al. The assessment of anorexia in patients with cancer: cut-off values for the FAACT–A/CS and the VAS for appetite. Support Care Cancer 2016;24:661–6. https://doi.org/10.1007/s00520-015-2826-2.

[32] Sunde B, Ericson J, Kumagai K, Lundell L, Tsai JA, Lindblad M, et al. Relief of dysphagia during neoadjuvant treatment for cancer of the esophagus or

gastroesophageal junction. Dis Esophagus 2015. https://doi.org/10.1111/dote.12352.
[33] Rahemtulla Z, Baldwin C, Spiro A, McGough C, Norman AR, Frost G, et al. The palatability of milk-based and non-milk-based nutritional supplements in gastrointestinal cancer and the effect of chemotherapy. Clin Nutr 2005;24:1029–37. https://doi.org/10.1016/j.clnu.2005.08.003.
[34] Wilkie D, Lovejoy N, Dodd M, Tesler M. Cancer pain intensity measurement: concurrent validity of three tools–finger dynamometer, pain intensity number scale, visual analogue scale. Hosp J 1990;6:1–13.
[35] Hemati K, Zaman B, Hassani V, Imani F, Dariaie P. Efficacy of fentanyl transdermal patch in the treatment of chronic soft tissue cancer pain. Anesthesiol Pain Med 2015;5, e22900. https://doi.org/10.5812/aapm.22900.
[36] Eguchi K, Honda M, Kataoka T, Mukouyama T, Tsuneto S, Sakamoto J, et al. Efficacy of corticosteroids for cancer-related fatigue: a pilot randomized placebo-controlled trial of advanced cancer patients. Palliat Support Care 2014:1–8. https://doi.org/10.1017/S1478951514001254.
[37] Bruera E, Kuehn N, Miller MJ, Selmser P, Macmillan K. The Edmonton Symptom Assessment System (ESAS): a simple method for the assessment of palliative care patients. J Palliat Care 1991;7:6–9.
[38] Aitken RC. Measurement of feelings using visual analogue scales. Proc R Soc Med 1969;62:989–93.
[39] Chaytor N, Schmitter-Edgecombe M. The ecological validity of neuropsychological tests: a review of the literature on everyday cognitive skills. Neuropsychol Rev 2003;13:181–97.
[40] Ginty AT. Psychometric properties. In: Gellman MD, Turner JR, editors. Encyclopedia of behavioral medicine. New York: Springer; 2013. p. 1563–4. https://doi.org/10.1007/978-1-4419-1005-9d_480.
[41] Chambrier C, Sztark F. Société Francophone de nutrition clinique et métabolisme (SFNEP), French clinical guidelines on perioperative nutrition. Update of the 1994 consensus conference on perioperative artificial nutrition for elective surgery in adults. J Vis Surg 2012;149:e325–36. https://doi.org/10.1016/j.jviscsurg.2012.06.006.
[42] Burke BS. The dietary history as a tool in research. J Am Diet Assoc 1947:1041–6.
[43] Bingham SA, Gill C, Welch A, Day K, Cassidy A, Khaw KT, et al. Comparison of dietary assessment methods in nutritional epidemiology: weighed records v. 24 h recalls, food-frequency questionnaires and estimated-diet records. Br J Nutr 1994;72:619. https://doi.org/10.1079/BJN19940064.
[44] Haverkort EB, de Haan RJ, Binnekade JM, van Bokhorst–de van der Schueren MAE. Self-reporting of height and weight: valid and reliable identification of malnutrition in preoperative patients. Am J Surg 2012;203:700–7. https://doi.org/10.1016/j.amjsurg.2011.06.053.