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## Nutritional assessment in surgical oncology

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## Nutritional assessment in surgical oncology: An ESSO-EYSAC global survey



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### ABSTRACT

**Introduction:** The majority of cancer patients report malnutrition, with a significant impact on patient's outcome. This study aimed to compare how nutritional assessment is conducted across different surgical oncology sub-specialties.

**Methods:** Survey modules were designed for breast, hepato-pancreato-biliary (HPB), upper-gastrointestinal (UGI), sarcoma, peritoneal and surface malignancies (PSM) and colorectal cancer (CRC) surgeries to describe 4 domains: participants' setting, evaluation of clinical factors, use of screening tools and clinical practice. Results were compared among sub-specialties and according to human development index (HDI) in the largest cohorts.

**Results:** Out of 457 answers from 377 global participants (62% European), 35.0% were from breast and 28.9% were from CRC surgeons. Although MDTs management is consistently reported (64–88%), the presence of a nutritionist/dietician ranges from 14.1% to 44.2%. Breast surgeons seldom evaluate albumin (25.6%) and weight loss (30.6%), opposite to HPB, PSM and UGI groups (>70%,  $p$  0.044). Overall, responders declared that the use of screening tools is largely neglected, that nutritional status is often assessed by the surgeons and that nutrition is not consistently modified according to risk factors (range among groups respectively: 1.9%–25.6%, 33.1%–51.4%, 33.1%–60.5%). Less than 20% of breast surgeons assess patients before/after surgery, comparing to >60% of PSM surgeons. However, no statistical differences were documented comparing groups for the majority of the items of the 4 domains. Nutritional evaluation is more often conducted by breast surgeons in medium/low HDI countries comparing very high/high HDI ( $p$  0.04).

**Conclusions:** Nutritional assessment is largely neglected. These results identify target-issues for the implementation of clinical practice.

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## Introduction

Nutritional assessment before cancer surgery is a key element to reduce the risk of post-operative adverse events, as well documented in prospective and retrospective series [1]. In particular, in patients with gastrointestinal malignancy undergoing surgery, malnutrition and undernutrition (inadequate oral intake for a period greater than two weeks) were both correlated with a prolonged hospitalization, increased morbidity, post-operative ileus and readmissions, as well as higher mortality rates [1]. Published literature indicates that more than 70% of patients with cancer report malnutrition, higher than the prevalence reported in other hospitalized cohorts [2]. However, the rate reported varies widely among studies and different sub-specialties. A prior study documented a risk of malnutrition in 31–39% of colorectal cancer patients scheduled for an elective procedure [3], while a larger American series reported a prevalence of less than 15% [4]. About one fifth of breast cancer patients are malnourished [5], and similarly, some 28% of pancreatic cancer patients who underwent resection ranked in the malnutrition groups [4]. A past report disclosed that patients with esophageal cancer lost an average 16% of body weight [6] and about 23% are assessed as malnourished [4], equal to that seen in patients scheduled for a gastric cancer resection [7]. On the other hand, up to one third of patients with peritoneal metastasis undergoing cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) were classified as malnourished [8] and the prevalence of protein energy malnutrition was reported as high as 46% in patients with retroperitoneal soft tissue sarcomas scheduled for extended multi-visceral resection [9]. A French observational multicentre cross-sectional study of malnutrition in elderly patients documented that the prevalence of this condition significantly correlates with the age of breast cancer patients: malnutrition was reported in the 32% of patients older than 70 years comparing with 18% of the younger sub-group [10].

However, the multitude of different parameters used to study and evaluate the nutritional status in those studies underline the lack of agreement over a clear definition of malnutrition [11], which may bias the rates observed. On this basis, the European Society for Clinical Nutrition and Metabolism (ESPEN) recommended to assess patients for malnutrition using a validated screening tool, and only those who scored positive or screened at risk should be further evaluated. The assessment should be performed using body mass index (BMI), fat free mass index (FFMI) and unintentional weight loss evaluation. Malnutrition should be defined as a BMI < 18.5, or the combination of unintentional weight loss (> 10% of habitual weight or > 5% over a 3 months period) and BMI < 20 or < 22 kg/m<sup>2</sup> (respectively in patients younger than, or older than 70 years), or FFMI < 15 or < 17 kg/m<sup>2</sup> (respectively in females or males) [12].

Nutritional problems, including malnutrition, undernutrition, cachexia and sarcopenia (or obesity in breast cancers) are all well acknowledged issues, and so interventions addressing these play a crucial role in preventing the complications resulting from these conditions. An international survey conducted in 22 European countries, recently documented that the countries' income significantly influenced the reimbursement for enteral and parenteral nutrition and thus had an impact on nutritional care [13].

On this basis, given the prevalence of malnutrition in cancer patients undergoing surgery and its impact on post-operative outcome, the European Society of Surgical Oncology (ESSO) and its young alumni club (EYSAC) designed a global survey aimed to audit surgeons' practice globally. The primary aim was to describe and compare how nutritional assessment is conducted across six

surgical oncology specialties: breast, hepato-pancreato-biliary (HPB), upper-gastrointestinal (UGI), soft-tissue sarcomas, peritoneal and surface malignancies (PSM) and colorectal cancer (CRC) surgery. The secondary aim was to investigate the practice according to country human development index (HDI) in the most representative cohorts.

## Materials and methods

**Survey design.** The survey's questions were designed with the objective of understanding clinical practice for surgical teams, the basis of nutritional assessment and the use of international validated questionnaires. Briefly, the questions included four domains: participants' demographics and institutional volumes; patients' nutritional evaluation and institutional setting; individual variables assessed regarding patient nutritional status; and clinical applications of nutritional status screening tools.

*Domain 1 – Demographics of participants and institutional volume.* The following items were collected from participants: age (years), years of practice; country; type of institution (university/teaching, community or research hospital); cancer volumes.

*Domain 2- Institutional setting.* Presence of nutritionists/dietitians as part of the multi-disciplinary team (MDT) and use of auditing protocols.

*Domain 3: Individual variables assessed regarding patient nutritional status.* As a first step, the key nutritional screening tools including the Short Nutritional Assessment Questionnaire (SNAQ), Malnutrition Universal Screening Tool (MUST) questionnaire, Nutrition Risk Screening forms (NRS-2002), Mini Nutritional Assessment (MNA), were reviewed to evaluate the items collected before surgical treatment. Accordingly, queries were dedicated to the collection of: BMI, ASA score, serum albumin, triceps skin-fold thickness, unplanned weight loss, decrease in appetite, use of supplementary drinks, current nutritional intake, patients' mobility, stress or acute disease, patient's environment (family/caregivers), current medications, presence of ulcers/pressure sores, performance status according to Karnofsky Performance Status and/or ECOG Grade, use of the SNAQ/MUST/NRS-2002/MNA and quality of life (QoL) questionnaires.

*Domain 4- Clinical application of nutritional evaluation.* The final domain was dedicated to evaluate the impact of nutritional assessment in clinical practice, who is in charge of patients' nutritional evaluation, when nutritional assessment is conducted (before/after surgery, before/after neo-adjuvant or adjuvant treatments) and the use of pre-habilitation or rehabilitation/fast track recovery programs.

The purpose of the final two questions was to gain insight into the most urgent needs in order to increase integration of medical nutrition in daily practice.

**Survey dissemination.** Six Google form modules including the four domains were globally disseminated between April the 30th and August the 31st 2019 using ESSO-EYSAC international networks and social media (Supplement Files 1–6). Actions were also taken by EYSAC steering committee members and the ESSO board to disseminate the project. Modules were dedicated to breast, HPB, UGI, soft-tissue sarcomas, PSM and CRC (Supplement Files 1–6). Surgeons from all-over the world were encouraged to participate by completing modules according to their practice.

**Data analysis.** Results were compared among different sub-specialties. The most represented cohorts were further categorized according to the HDI, a United Nations' composite statistic including life expectancy, education, and income indices)- (<http://hdr.undp.org/en/content/human-development-index-hdi>). Briefly,

the countries were ranked into very high/high HDI and medium/low HDI and nutritional assessment between groups was compared for the four domains.

**Statistics.** Continuous variables were analyzed using mean and standard deviations (SD) and compared using T Tests, whereas categorical variables were analyzed using the Kruskal-Wallis test with a computation of the p-value based on the true distribution of K (to test if k samples come from the same population or populations with identical properties). A p value of <0.05 was considered statistically significant. Statistical analyses were obtained using MedCalc for Windows, version 10.2.0.0, and XLSTAT 2019.3.2.

## Results

The campaign was disseminated using newsletter and social media: ESSO newsletters were sent to 14,228 recipients (email addresses), with an open rate of 18.7% and a click rate of 2.5%. ESSO-EYSAC social media accounts are followed by 1000 users on Facebook, 1550 on LinkedIn and some 2800 on Twitter.

Between April the 30th and August the 31st 2019, 457 answers were received from 377 participants (Fig. 1 and Table 1). Overall, the breast module received 160 responses, CRC 131, UGI 59, PSM 43, HPB 35 and sarcoma 29 answers. Although 62% of participants were from European Institutions all continents Asia, South and North America, Africa and Australia were represented. Table 2 and Supplement Table outline results of the survey.

The participants' experience and mean age were homogeneous among different sub-specialties, with the exception of surgeons treating PSM, who were older compared to CRC, sarcoma and UGI surgeons (mean age  $46.0 \pm 10.6$  vs  $43.5 \pm 10.8$ , vs  $40.5 \pm 7.2$ , and vs  $41.5 \pm 9.0$  years;  $p = 0.014$ ,  $p = 0.019$  and  $p = 0.021$ , respectively). As expected, there was a prevalence –although non-significant– of very high-volume institutions (>101 resections/year) for breast cancer (about 70%), comparing PSM (14%), and UGI surgeries (23.7%), p ns. Although MDTs management is consistently reported (64–88%), the presence of a nutritionist/dietician varied among different sub-specialties ranging from 44.2% in PSM MDTs to 14.2% in breast cancer groups (p ns).

Variables used for patients' nutritional assessment presented a

broad spectrum of variation across specialties. For example, a significant difference was reported regarding BMI, which is consistently investigated by 50.0% of the breast surgeons and 88.4% of the PSM groups. Furthermore, although ASA scores and patients' medications are consistently collected (ranging respectively between 81.9%–100.0% and 95.6%–100.0%, p ns), patients' environment (47.3%–66.1%, p ns), and in particular the presence of ulcers or pressure sores (42.4%–58.6%, p 0.009) are less commonly assessed routinely.

A total of 25.6% of breast surgeons reported that they routinely measure serum albumin levels compared to 86.0% of PSM surgeons (p ns), whereas the evaluation of non-volitional weight loss, is systematically investigated by about one third of breast surgeons compared to more than 75% of HBP, PSM and UGI groups (p 0.044). Of note, UGI and HBP surgeons consistently evaluate a patients' decreased appetite in about 80% of the cases, whereas this feature is investigated by only 32.5% of the breast surgical teams (p ns).

In addition, nearly half of breast surgeons declared to never collect information on the use of supplementary drinks, compared to 2.3% and 5.1% of the PSM and UGI surgeons. Similarly, more than half of the groups assess patients' current intake, whereas this feature is collected by 18.1% of breast surgeons. The reporting of patient's mobility is investigated by 56.9% of breast surgeon and by more than 90% of PSM groups. All these discrepancies, although of interest were not of statistical value.

The patient's performance status is consistently recorded in PSM and UGI sub-specialties (>75%), however, the use of SNAQ, MUST, NRS-2002, Mini Nutritional Assessment and QoL evaluations are largely neglected with few exceptions for PSM surgery (18.6%–32.3%).

Overall, nutritional support is not corrected according to risk factors (including neurological disorders, fractures, cirrhosis, dialysis, diabetes, infection) in about one fourth of breast cancer units comparing with nearly half–60% of other sub-specialties. Nutritional status is personally evaluated by members of the surgical teams in 33.1%–51.4% of cases, and evaluation by dedicated physicians with expertise in medical nutrition is especially rare (16.2%) in CRC units, ranging between 21.9% and 34.9% in other sub-groups. Again, these differences, although of interest, were not of statistical value.

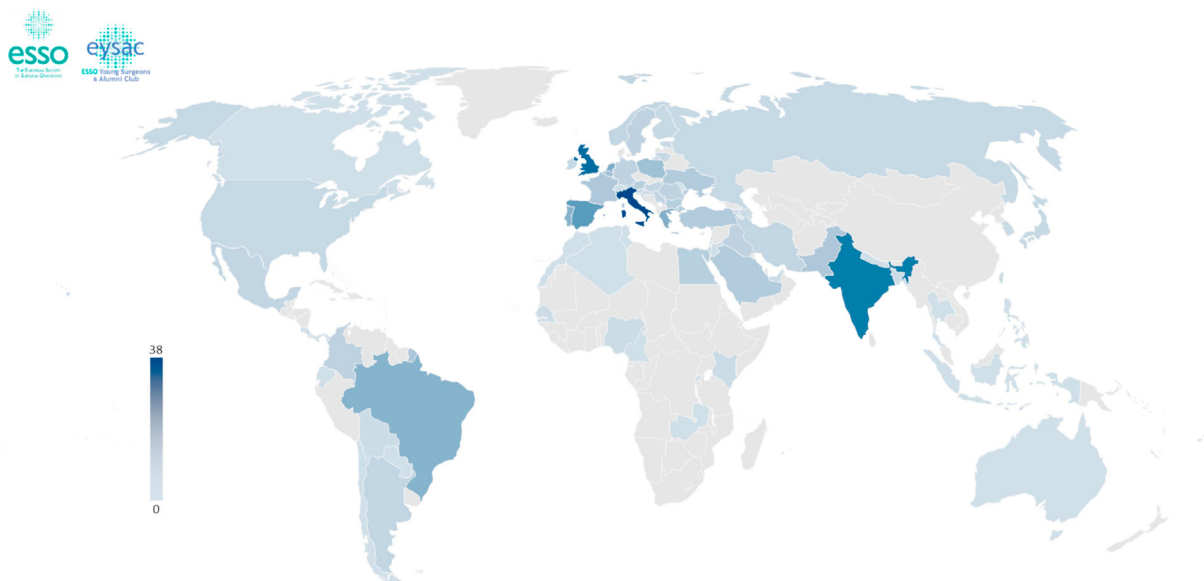


Fig. 1. World map of survey participants (blue scale according to the number of answers).

**Table 1**  
Demographics of participants.

Answers - Modules	n	%
Breast	160	35.0
CRC	131	28.7
HPB	35	7.7
PSM	43	9.4
Sarcoma	29	6.3
UGI	59	12.9
Total	457	100.0
Participants		
Age (years)		
Mean; SD	43.6; 10.2	
Median	41.0	
Range	24–71	
Modules	N	N
	Participants	Answers
Participants responding to 1 Module	322	322
Participants responding to 2 Modules	41	82
Participants responding to 3 Modules	9	27
Participants responding to 4 Modules	1	4
Participants responding to 5 Modules	2	10
Participants responding to 6 Modules	2	12
Total	377	457
Countries	n	
Algeria, Armenia, Australia, Cameroon, Canada, Chile, Costa Rica, Ecuador, Indonesia, Jordan, Moldova, Morocco, Nepal, Panama, Paraguay, Philippines, Rwanda, Switzerland, Thailand, Tunisia, Zambia	1	
Azerbaijan, Bangladesh, Bolivia, Croatia, Kenya, Lebanon, Nigeria, Senegal, South Korea, Taiwan, United Arab Emirates	2	
Estonia, Finland, Ireland, Japan, Lithuania, Russia, Slovenia	3	
Argentina, Hungary, Iran, Mexico, Norway, Serbia, USA	4	
Colombia, Germany, Iraq, Israel, Romania, Sweden	5	
Austria, Bulgaria, Egypt	6	
Saudi Arabia, Turkey, Ukraine	7	
France, Pakistan	8	
Belgium, Poland	10	
Portugal	14	
Greece	15	
Brazil, The Netherlands	16	
Spain	21	
India	27	
United Kingdom	31	
Italy	40	
Total participants	377	
Continent	n	%
Africa	18	4.8
South America	32	8.5
Asia	86	22.8
North America	9	2.4
Europe	230	61.0
Australia	2	0.5
Total	377	100.0

CRC: colorectal cancer surgery; HPB: hepato-pancreato-biliary surgery; PSM: peritoneal and surface malignancies; UGI: upper-gastrointestinal surgery.

Finally, about one fourth of the breast surgery units do not perform nutritional assessment neither peri-operatively, nor before adjuvant treatments.

Participants were also asked what kind of support would help their daily clinical practice with respect of nutritional assessment and care. While CRC surgeons responded that continuous medical education about medical nutrition could potentially improve their practice, the top-ranking option for HBP and UGI groups was the inclusion of a nutrition specialist in MDTs. On the other hand, the integration of medical nutrition in oncology guidelines was the preferred answer for breast, PSM and sarcoma surgeons (Fig. 2A).

Responders could also rank between 1 and 7 the following options: a) Nursing Service; b) Care-line for patients and families; c) Screening and monitoring tools; d) Booklets; e) Dedicated website or social media page; f) Online training and g) Mobile application (ranking 1 as first priority, 7 as the lowest for the implementation of clinical practice).

As documented in Fig. 2B, the vast majority of the responders ranked a nursing service as a top priority, assessed as the first

choice by 46.5% of breast surgeons, 43.6% of CRC, 22.6% of HBP, 50.0% of PSM, 45.4% of sarcoma and by the 40.7% of UGI surgeons. Interestingly, 32.3% of HBP surgeons a screening and monitoring tool as their first choice.

**Results according to HDI.** Data analysis according to HDI was conducted on the two cohorts of participants with the most respondents, namely breast and CRC surgeons. Overall the same trends were reported, with the sole exception of a different distribution of surgeons' experience in CRC groups (surgeons with <5 years of practice: 31.4% in very high/high-HDI countries comparing with 21.7% medium/low HDI,  $p$  0.016); also, and as expected, nutritional evaluation is more often conducted by a member of the surgical team in breast groups from medium/low HDI ( $p$  0.04), Fig. 3.

## Discussion

A great percentage of cancer patients experience malnutrition. Although the prevalence and severity correlates with cancer type

**Table 2**  
Comparison between different organ-based specialties.

Domain 1: Demographics and Institutional Volume													
	Breast		CRC		HPB		PSM		Sarcoma		UGI		p values
Age													
Mean; SD	44.6	10.8	43.3	10.8	41.9	7.2	46.0	10.6	40.5	7.2	41.5	9.0	
Median	42.0		40.0		41.0		47.0		39.0		39.0		<b>T. Test*</b>
Range	27.0	71.0	24.0	67.0	27.0	63.0	25.0	69.0	31.0	57.0	28.0	68.0	
<b>Years of Practice</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	
Currently training	10.0	6.3	13.0	9.9	1.0	2.9	3.0	7.0	2.0	6.9	3.0	5.1	<b>0.006</b>
<5	39.0	24.4	35.0	26.7	9.0	25.7	7.0	16.3	8.0	27.6	16.0	27.1	
6–10	45.0	28.1	21.0	16.0	10.0	28.6	10.0	23.3	10.0	34.5	15.0	25.4	
11–20	27.0	16.9	29.0	22.1	12.0	34.3	10.0	23.3	5.0	17.2	16.0	27.1	
>20	39.0	24.4	33.0	25.2	3.0	8.6	13.0	30.2	4.0	13.8	9.0	15.3	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Domain 2: Patient nutritional evaluation and setting													
Do you discuss patients' management during multidisciplinary team meetings?	Breast		CRC		HPB		PSM		Sarcoma		UGI		
Always	n	%	n	%	n	%	n	%	n	%	n	%	0.646
Sometimes	124.0	77.5	85.0	64.9	26.0	74.3	38.0	88.4	25.0	86.2	47.0	79.7	
Never	32.0	20.0	45.0	34.4	8.0	22.9	5.0	11.6	4.0	13.8	12.0	20.3	
Total	4.0	2.5	1.0	0.8	1.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	
If Yes. Is a nutritionist/dietician part of the team?	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Yes	n	%	n	%	n	%	n	%	n	%	n	%	0.476
No	22.0	14.1	41.0	32.0	10.0	28.6	19.0	44.2	11.0	37.9	22.0	37.3	
Total	134.0	85.9	87.0	68.0	25.0	71.4	24.0	55.8	18.0	62.1	37.0	62.7	
Total	156.0	100.0	128.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Domain 3: Patient nutritional evaluation – clinical factors													
Before surgical treatment. do you collect:	Breast		CRC		HPB		PSM		Sarcoma		UGI		
Unplanned weight loss?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	49.0	30.6	84.0	64.1	28.0	80.0	33.0	76.7	20.0	69.0	45.0	76.3	<b>0.044</b>
Sometimes	71.0	44.4	39.0	29.8	6.0	17.1	7.0	16.3	9.0	31.0	12.0	20.3	
Never	40.0	25.0	8.0	6.1	1.0	2.9	3.0	7.0	0.0	0.0	2.0	3.4	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Decrease in appetite over the last few months?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	52.0	32.5	82.0	62.6	30.0	85.7	31.0	72.1	17.0	58.6	47.0	79.7	0.092
Sometimes	68.0	42.5	41.0	31.3	4.0	11.4	10.0	23.3	12.0	41.4	10.0	16.9	
Never	40.0	25.0	8.0	6.1	1.0	2.9	2.0	4.7	0.0	0.0	2.0	3.4	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Use of supplementary drinks?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	18.0	11.3	42.0	32.1	18.0	51.4	23.0	53.5	8.0	27.6	28.0	47.5	0.072
Sometimes	63.0	39.4	59.0	45.0	12.0	34.3	19.0	44.2	17.0	58.6	28.0	47.5	
Never	79.0	49.4	30.0	22.9	5.0	14.3	1.0	2.3	4.0	13.8	3.0	5.1	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Skin ulcers/pressure sores?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	76.0	47.5	61.0	46.6	15.0	42.9	21.0	48.8	17.0	58.6	25.0	42.4	<b>0.009</b>
Sometimes	62.0	38.8	49.0	37.4	14.0	40.0	18.0	41.9	9.0	31.0	25.0	42.4	
Never	22.0	13.8	21.0	16.0	6.0	17.1	4.0	9.3	3.0	10.3	9.0	15.3	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Performance Status according to Karnofsky and/or ECOG Grade?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	82.0	51.3	77.0	58.8	22.0	62.9	35.0	81.4	18.0	62.1	46.0	78.0	0.053
Sometimes	35.0	21.9	28.0	21.4	11.0	31.4	7.0	16.3	6.0	20.7	8.0	13.6	
Never	43.0	26.9	26.0	19.8	2.0	5.7	1.0	2.3	5.0	17.2	5.0	8.5	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Short Nutritional Assessment Questionnaire (SNAQ)?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	7.0	4.4	15.0	11.5	4.0	11.4	11.0	25.6	2.0	6.9	5.0	8.5	0.430
Sometimes	21.0	13.1	29.0	22.1	15.0	42.9	5.0	11.6	8.0	27.6	16.0	27.1	
Never	132.0	82.5	87.0	66.4	16.0	45.7	27.0	62.8	19.0	65.5	38.0	64.4	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Malnutrition Universal Screening Tool (MUST) questionnaire?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	9.0	5.6	9.0	6.9	3.0	8.6	10.0	23.3	5.0	17.2	12.0	20.3	0.723
Sometimes	19.0	11.9	16.0	12.2	9.0	25.7	7.0	16.3	6.0	20.7	5.0	8.5	
Never	132.0	82.5	106.0	80.9	23.0	65.7	26.0	60.5	18.0	62.1	42.0	71.2	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Nutrition Risk Screening forms (NRS-2002)?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	3.0	1.9	13.0	9.9	2.0	5.7	8.0	18.6	4.0	13.8	6.0	10.2	0.730
Sometimes	15.0	9.4	16.0	12.2	11.0	31.4	6.0	14.0	5.0	17.2	7.0	11.9	
Never	142.0	88.8	102.0	77.9	22.0	62.9	29.0	67.4	20.0	69.0	46.0	78.0	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Mini Nutritional Assessment questionnaire?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	5.0	3.1	11.0	8.4	3.0	8.6	14.0	32.6	3.0	10.3	8.0	13.6	0.696
Sometimes	18.0	11.3	26.0	19.8	13.0	37.1	9.0	20.9	8.0	27.6	15.0	25.4	
Never	137.0	85.6	94.0	71.8	19.0	54.3	20.0	46.5	18.0	62.1	36.0	61.0	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Domain 4: Clinical application of nutritional evaluation													
Before surgical treatment	Breast		CRC		HPB		PSM		Sarcoma		UGI		



Table 2 (continued)

Domain 1: Demographics and Institutional Volume													
	Breast		CRC		HPB		PSM		Sarcoma		UGI	p values	
do you modify nutrition/nutritional support according to risk factors?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	53.0	33.1	66.0	50.4	17.0	48.6	26.0	60.5	15.0	51.7	30.0	50.8	0.143
Sometimes	69.0	43.1	55.0	42.0	17.0	48.6	17.0	39.5	13.0	44.8	24.0	40.7	
Never	38.0	23.8	10.0	7.6	1.0	2.9	0.0	0.0	1.0	3.4	5.0	8.5	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Who is in charge of patients' nutritional evaluation?	n	%	n	%	n	%	n	%	n	%	n	%	
A Nutritionist/physician with expertise in nutritional assessment	35.0	21.9	21.0	16.0	8.0	22.9	15.0	34.9	8.0	27.6	15.0	25.4	0.059
Nurse	13.0	8.1	2.0	1.5	2.0	5.7	1.0	2.3	2.0	6.9	4.0	6.8	
The surgical team	53.0	33.1	58.0	44.3	18.0	51.4	17.0	39.5	10.0	34.5	28.0	47.5	
None of the above	23.0	14.4	6.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.4	
All of the above	36.0	22.5	44.0	33.6	7.0	20.0	10.0	23.3	9.0	31.0	10.0	16.9	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Do patients undergo nutritional evaluation													
Before adjuvant/neo-adjuvant treatments?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	47.0	29.4	51.0	38.9	14.0	40.0	17.0	39.5	8.0	27.6	21.0	35.6	0.177
Sometimes	88.0	55.0	67.0	51.1	19.0	54.3	25.0	58.1	17.0	58.6	32.0	54.2	
Never	25.0	15.6	13.0	9.9	2.0	5.7	1.0	2.3	4.0	13.8	6.0	10.2	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Before surgical treatment?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	30.0	18.8	57.0	43.5	17.0	48.6	30.0	69.8	12.0	41.4	32.0	54.2	0.181
Sometimes	90.0	56.3	64.0	48.9	16.0	45.7	13.0	30.2	17.0	58.6	26.0	44.1	
Never	40.0	25.0	10.0	7.6	2.0	5.7	0.0	0.0	0.0	0.0	1.0	1.7	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
After surgical treatment?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	27.0	16.9	44.0	33.6	16.0	45.7	27.0	62.8	9.0	31.0	31.0	52.5	0.153
Sometimes	88.0	55.0	79.0	60.3	18.0	51.4	16.0	37.2	19.0	65.5	24.0	40.7	
Never	45.0	28.1	8.0	6.1	1.0	2.9	0.0	0.0	1.0	3.4	4.0	6.8	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	
Do patients undergo prehabilitation before surgical treatment?	n	%	n	%	n	%	n	%	n	%	n	%	
Always	18.0	11.3	23.0	17.6	4.0	11.4	15.0	34.9	5.0	17.2	14.0	23.7	0.138
Sometimes	73.0	45.6	77.0	58.8	23.0	65.7	27.0	62.8	20.0	69.0	34.0	57.6	
Never	69.0	43.1	31.0	23.7	8.0	22.9	1.0	2.3	4.0	13.8	11.0	18.6	
Total	160.0	100.0	131.0	100.0	35.0	100.0	43.0	100.0	29.0	100.0	59.0	100.0	

CRC: colorectal cancer surgery; HPB: hepato-pancreato-biliary surgery; PSM: peritoneal and surface malignancies; UGI: upper-gastrointestinal surgery.

Breast vs CRC p 0.294; Breast vs HPB p 0.156; Breast vs PSM p 0.446; Breast vs sarcoma p 0.058; Breast vs UGI p 0.047.

CRC vs HPB p 0.477; CRC vs PSM p 0.0149; CRC vs sarcoma p 0.213; CRC vs UGI p 0.266.

HPB vs PSM p 0.053; HPB vs sarcoma p 0.489; HPB vs UGI p 0.814.

PSM vs sarcoma p 0.019; PSM vs UGI p 0.021.

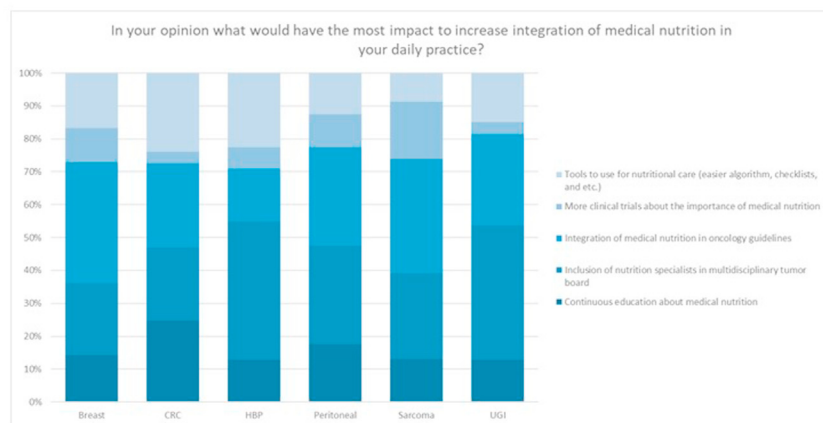
Sarcoma vs UGI p 0.664.

\*T. Test.

and stage, the clinical impact of this condition across different sub-specialties has been widely documented [1,3,4]. ESSO joined the effort of ERAS® Society (ERAS coalition) to promote awareness

among surgical oncologists about malnutrition, to encourage nutritional assessment and improve practice for the best treatment options [1]. In this survey, the vast majority of responders were

A. Features to impact nutritional assessment in daily practice



B. Nursing Service

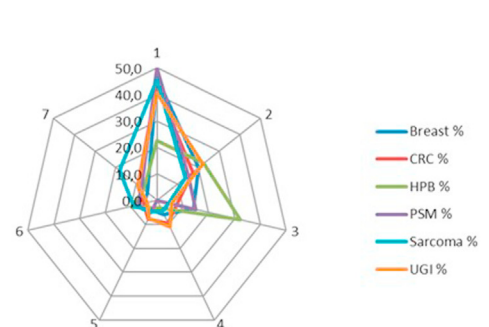


Fig. 2. Surgeons' preferences to support nutritional care: A. Features for the implementation of nutritional assessment in daily practice (bars showing percentages of answers according to sub-specialties in breast, hepato-pancreato-biliary –HPB-, upper-gastrointestinal –UGI-, soft-tissue sarcomas, peritoneal and surface malignancies –PSM- and colorectal cancer –CRC- surgery); B. Nursing service ranking among different sub-specialties: radar map showing percentages of answer according to sub-specialties in breast, hepato-pancreato-biliary –HPB-, upper-gastrointestinal –UGI-, soft-tissue sarcomas, peritoneal and surface malignancies –PSM- and colorectal cancer –CRC- surgery.

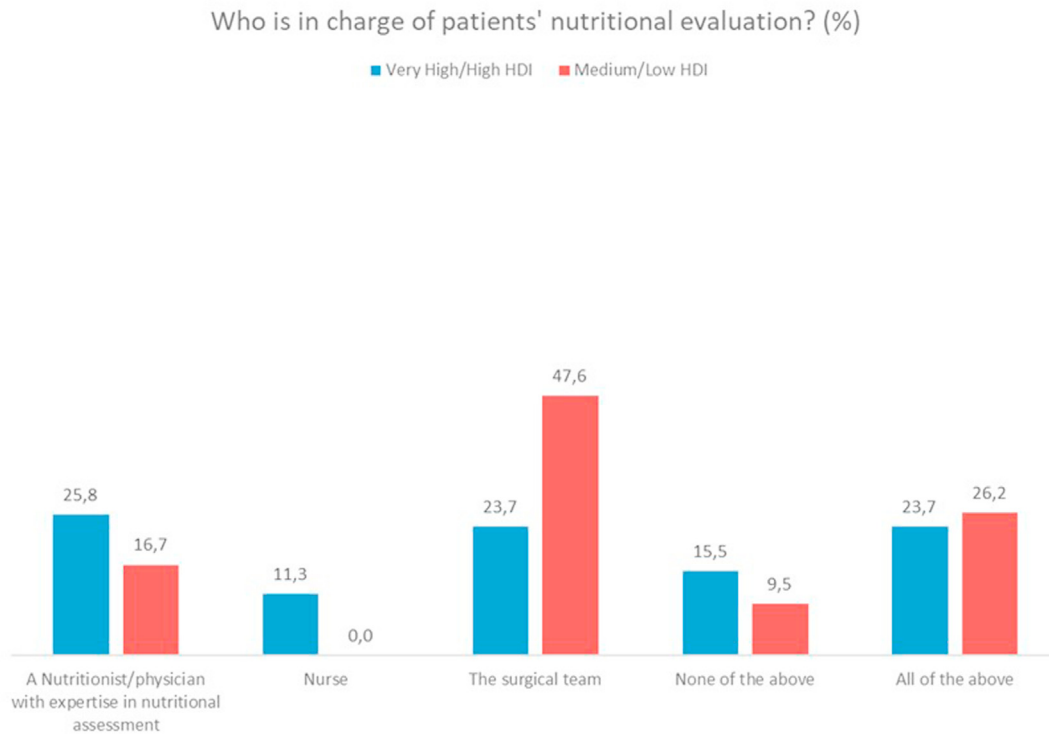


Fig. 3. Nutritional assessment in breast surgery: comparison of medium/low HDI vs high/very high HDI countries. Bars showing percentages of answers.

breast and CRC surgeons although all sub-specialties were represented. The inter-specialty comparison documented that breast surgery units in particular often lack a structured nutritional assessment.

Undoubtedly, gastrointestinal surgeons are more aware of nutritional issues in their patients since malnutrition is more prevalent owing to the nature of the malignancy in this cohort. Nevertheless, malnutrition has been reported to also affect head and neck, ovarian/uterine, lung and prostate cancer patients as well as those with leukemia/lymphoma and breast cancer. It has been documented in regional and metastatic cancers and in patients treated with previous chemotherapy and radiotherapy [5], as a feature associated with disease progression [5]. In this setting, the implementation of systematic screening, referral and treatment is a key element to prevent complications related to this disorder.

Similar to the present findings, a recent American study showed that only 38% of the CRC and GI surgical oncology fellowship programs utilize a formal preoperative nutritional screening process. Surgeons are responsible for the nutritional assessment in 85% of the cases, and although most surgery was being performed in an outpatient setting, the nutritional status evaluation was conducted postoperatively in the surgical ward, half of the time [14].

The positive trend reported for surgeons dedicated to PSM, is consistent with a previous study conducted among the attendees of the International Regional Cancer Therapies Symposium in 2017. Although only 35.19% reported the availability of screening tools, 86.5% of participants stated that their CRS/HIPEC patients have access to a dietician referral [15]. This is of striking importance, since the vast majority of patients undergoing HIPEC and CRC are treated with multiple abdominal organ resections and chemotherapy drugs; malnutrition in these patients is reported with a prevalence of 33% and correlated with hospitalization and post-operative infections [8]. The higher prevalence of malnutrition in these patients could be correlated in a higher awareness on these themes and on the patients' nutritional assessment in surgeons

treating this condition.

Given the burden of this condition, ESPEN published several recommendations, including definitions and validated diagnostic criteria [11,12,16] and guidelines to implement in surgical practice [17,18], including the use of a nutritional risk screening (NSR) based on BMI, weight loss, diminished food intake and severity of the disease [19]. Indeed, a number of screening tools are currently available for hospitalized patients, including the Malnutrition Universal Screening Tool, Nutritional Risk Screening 2002, Mini Nutritional Assessment®, Short Nutritional Assessment Questionnaire®, Malnutrition Screening Tool, and the Subjective Global Assessment [20], and although evaluated by several authors, few of them were reported with modest agreement rates. In particular, Mini Nutritional Assessment could identify more “at-risk” patients while the Subjective Global Assessment, Malnutrition Screening Tool and the Nutritional Risk Screening 2002 could better assess existing malnutrition [21]. Also, the Global Leadership Initiative on Malnutrition (GLIM) recently suggested a 2-step approach: first screening to identify “at risk” status by the use of any validated screening tool, and second, the assessment for diagnosis and grading the severity of malnutrition [22]. The use of these tools, however, in the surgical oncology community is largely neglected as documented by the present survey. In this setting, it should be noted that few of the features included in the present survey (including triceps skin fold thickness evaluation), may have been replaced by more recent techniques.

Finally, ESPEN recently emphasized steps to update nutritional care for people with cancer, including the “*use multimodal nutritional interventions with individualized plans, including care focused on increasing nutritional intake*”. Responders from the present study regarded that education and the involvement of a nutrition specialist in multidisciplinary tumor board would significantly have an impact on their practice; indeed, establishing a nursing service was ranked as a first choice priority.

As a final point, the analysis conducted according to HDI,



documented that before neo-adjuvant treatments or a surgical procedure, surgeons from medium/low HDI countries were more likely to modify the nutritional intake according to each patients risk factors, than surgeons from high/very high HDI countries. A possible interpretation of this finding is that in countries where malnutrition is a prevalent issue, surgeons are more responsive to the condition and related treatment.

Malnutrition is a severe disease and its prevalence present a wide variation across the globe. The latest data provided by WHO, disclosed that mean BMI increased over time, but low-income and lower-middle income countries had lower mean BMI comparing the upper middle and higher income countries (Supplement File 7) Fig. S1 [23].

A possible limitation of the present study is the relative non-homogeneous composition of the participants, with the greater percentage of responders being breast and CRC surgeons from European Institutions. However, this issue mirrors the surgeons affiliated to ESSO and participants from all sub-specialties from all around the world were able to join.

The most important findings that this study revealed is that several features of the standard nutritional assessment are largely neglected in different surgical oncology sub-specialties, but in particular in the breast sub-group. Moreover, nutritional assessment relies on the surgical teams and dedicated specialists are currently missing across different MDTs. A positive trend was reported for PSM surgery, but this result should be validated on a larger sample. The results herein reported with this survey identified issues to implement clinical practice and could provide the basis of interventions design to implement patients' management. In the future, the development of educational tools and the introduction of dedicate physicians in the multidisciplinary teams would be highly advocated and recommended in all surgical oncology specialties in order to implement clinical practice. A newly platform in this field is the recently launched life Long Learning (LLL) Programme in Clinical Nutrition and Metabolism, provided by ESPEN and developed with the support of European Union. This educational platform aims to provide a post-graduate qualification in Clinical Nutrition; the learning modules have been accredited by Union Européenne des Médecins Spécialistes (UEMS), and hopefully will positively contribute to implement clinical daily practice.

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## Ethical approval for research

Not applicable.

## CRedit authorship contribution statement

**Laura Lorenzon:** Conceptualization, Data curation, Funding acquisition, Formal analysis, Writing - original draft, Writing - review & editing, Study concepts, Study design, Data acquisition, Quality control of data and algorithms, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review. **Andreas Brandl:** Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review. **Delia Cortes Guiral:** Data

curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Frederik Hoogwater:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Dara Lundon:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Luigi Marano:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Giacomo Montagna:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Karol Polom:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Florian Primavesi:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Yvonne Schrage:** Data curation, Formal analysis, Writing - review & editing, Funding acquisition, Study design, Data acquisition, Quality control of data and algorithms, Data analysis and interpretation, Manuscript review. **Santiago Gonzalez-Moreno:** Conceptualization, Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Study concepts, Data analysis and interpretation, Manuscript preparation, Manuscript editing, Manuscript review. **Tibor Kovacs:** Conceptualization, Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Study concepts, Data analysis and interpretation, Manuscript preparation, Manuscript editing, Manuscript review. **Domenico D'Ugo:** Conceptualization, Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Study concepts, Data analysis and interpretation, Manuscript preparation, Manuscript editing, Manuscript review. **Sergio Sandrucci:** Conceptualization, Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Study concepts, Quality control of data and algorithms, Data analysis and interpretation, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review, GB, Conceptualization, Study concepts.

## Declaration of competing interest

None of the authors has any potential financial conflict of interest related to this manuscript.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejso.2020.08.028>.

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<sup>1</sup> Supplement File 7 is a Supplementary Figure

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