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1 **Characteristics and outcome of patients referred to a specialized outpatient clinic for the**
2 **management of malnutrition: a retrospective audit**

3

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23 **Highlights**

- 24 • A low body fat mass index (odds ratio = 0.72 [0.54-0.96]) was the only factor
25 significantly associated with severe malnutrition.
- 26 • During the follow-up (median=70 days), 11% of patients were admitted at hospital after
27 the first nutritional consultation, 19% had infections and 23.1% died.
- 28 • There was a moderate consistency between the decided medical nutrition therapy and
29 the ESPEN guidelines of nutritional care.

30 **Abstract**

31 Background & aims: Insufficient screening and management of malnutrition leads to increase
32 morbidity and mortality. Aims: to evaluate the characteristics and clinical outcomes of
33 malnourished patients referred to a specialized outpatient clinic for the management of
34 malnutrition (primary); to compare the latter according to malnutrition severity; to determine
35 the factors associated with severe malnutrition and mortality; to compare the consistency of the
36 decided medical nutrition therapy with the European Society for Clinical Nutrition and
37 Metabolism (ESPEN) guidelines (secondary).

38 Methods: This retrospective, observational study included malnourished adults referred for the
39 first time to the specialized nutrition consultation of a teaching University Hospital during 50
40 months. Malnutrition was diagnosed according to the Global Leadership Initiative on
41 Malnutrition criteria, including body composition assessment by bioimpedance analysis.
42 Statistics: Chi² or Fisher, Student or Wilcoxon rank-sum tests; multivariable logistic regression
43 to assess the factors associated with severe malnutrition and mortality.

44 Results: 108 malnourished adults were included: 74% had severe malnutrition. The main
45 secondary diagnosis was digestive cancer (48.2%). During the follow-up (median=70 days)
46 after the first nutritional consultation, 11% of patients were admitted at hospital, 19% had
47 infections and 23.1% died, without any difference according to malnutrition severity. Severely
48 malnourished patients had lower body mass index, a smaller fat mass index (FMI) (4.6 ± 1.8 vs
49 6.0 ± 2.5 kg/m²; $p=0.01$), and a higher level of total body water (64.7 ± 7.1 vs 60.6 ± 5.4 %; $p=0.02$),
50 compared to moderately malnourished individuals. A low FMI (odds ratio=0.72 [0.54-0.96])
51 was the only factor significantly associated with severe malnutrition. We did not find any factor
52 associated with mortality. There was a moderate consistency (47.1%) between the decided
53 medical nutrition therapy and the ESPEN guidelines of nutritional care. Conclusions: Adults
54 referred for the first time to a specialized nutritional consultation present mostly with severe

55 malnutrition and are at risk for significant complications, leading to a high mortality rate. In
56 this population, a low FMI is associated with severe malnutrition. An earlier diagnosis and care
57 of malnutrition and an earlier referral to clinical nutrition units would improve outcomes.

58

59 Keywords: malnutrition; body composition; outpatients; outcomes; nutrition support.

60 **Introduction**

61 Malnutrition, related to insufficient intake or assimilation of nutrients regarding needs, leads to
62 altered body composition and function. Its screening and adequate care is essential as
63 malnutrition is associated with adverse clinical outcomes such as increase morbidity, mortality
64 and length of hospital stay [1]. In patients at hospital or with specific diseases, insufficient food
65 intake, plasma albumin <35 g/l and phase angle $<5^\circ$, measured by bio-impedance analysis
66 (BIA), were associated with severe malnutrition or mortality [2–6].

67 The risk of malnutrition has been poorly evaluated in outpatients: in Australia, one study
68 showed that 17% of ambulatory cancer patients were malnourished [7], while another in the
69 USA found that 11% of the older people followed in medical outpatient clinics were
70 malnourished and an appropriate intervention was only performed in 14% of cases [8]. The
71 recent consensus of the Global Leadership Initiative on Malnutrition (GLIM), revised the
72 diagnostic criteria for malnutrition in order to unify terminology and improve clinical
73 management [9]. Combining body mass index (BMI) with weight loss calculations is essential,
74 especially nowadays due to increasing prevalence of obesity [10], resulting in situations of
75 malnutrition with normal/high BMI. To accurately detect decreased muscle mass, validated
76 methods of body composition measurement, such as dual energy X-ray absorptiometry (DXA)
77 or BIA, easier in clinical practice, and their related thresholds, should be used [9].

78 Since 2000, the European Society for Clinical Nutrition and Metabolism (ESPEN) has
79 published a great number of disease specific guidelines for medical nutrition therapy [11]. All
80 disease specific guidelines recommend oral nutrition as the first route of feeding in
81 malnourished patients with an intact gastrointestinal tract. Enteral tube feeding is recommended
82 when the nutritional requirements cannot be met via oral route or in patients not reaching 75%
83 of their energy and protein targets within 5 to 7 days. Parenteral nutrition is proposed only if
84 enteral nutrition is insufficient or badly tolerated. Older people with reasonable prognosis shall

85 be offered enteral nutrition, if oral intake is expected to be below 50% of energy requirements
86 for more than one week or impossible for more than three days [12].

87 While many studies have focused on the management of hospital malnutrition, to our
88 knowledge, the phenotypes and outcomes of malnourished patients followed on an outpatient
89 basis has been poorly studied, despite the incitation of health policies to increase outclinic
90 follow-ups. Therefore, the primary aim of this study was to evaluate the characteristics and
91 clinical outcomes of malnourished patients referred to a specialized outpatient clinic for the
92 management of malnutrition. The secondary aims were: to compare these characteristics and
93 clinical outcomes according to malnutrition severity, to determine the factors associated with
94 severe malnutrition and mortality; and to compare the consistency of the decided nutritional
95 care with the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines.

96

97 **Methods**

98 *Study design and patients*

99 This was a retrospective observational study including all consecutive adult patients referred
100 for the first time to the specialized nutrition consultation of one single physician (RT) at Rennes
101 University Hospital (CHU Rennes), Rennes, France, between September 29, 2016 and
102 December 31, 2020, diagnosed with malnutrition. Individuals were referred in case of positive
103 screening of malnutrition by using the French guidelines [1], in case of insufficient daily food
104 intake on the 10-point analogue scale, e.g. the Simple Evaluation of Food Intake (SEFI®)
105 (www.sefi-nutrition.com, Knoë - Groupe Get, Le Kremlin-Bicêtre, France)[13], or in case of
106 clinical suspicion of malnutrition after examination by a physician in a hospital unit. Patients
107 with anorexia nervosa, obesity (with or without obesity surgery) and patients with intestinal
108 failure needing home parenteral nutrition were excluded.

109 *Data collection*

110 The data were collected prospectively during the medical consultation, except for hospital
111 admission within the month following the consultation, infections and death that were collected
112 retrospectively. The follow-up time was calculated starting from the patient's first consultation
113 to the patient's last consultation or death.

114 The Clinical Nutrition consultations were conducted by one single physician (RT) and their
115 course was standardized. The mean duration was 30 minutes. Were collected: demographic data
116 as age, gender, addictions (alcohol use, smoking, others), living conditions (at home, nursing
117 home, alone or not), comorbidities, current and previous treatments, digestive symptoms
118 (diarrhea, nausea, vomiting), as well as weight loss within the last one and six months or
119 compared to the usual weight. Main diagnosis apart from malnutrition was collected.

120 Malabsorption/maldigestion refers to diseases or clinical situations with impaired nutrient
121 absorption or digestion (of one or more nutrients) at any point across the gastrointestinal tract.

122 Weight and height were measured, and BMI calculated. Clinical examination also included the
123 seek for ascites, edema, and amyotrophy. Body composition was assessed by BIA (Bodystat
124 1500 MDD, Bodystat ltd, Man Island, UK). BIA was performed by a specialized nurse before
125 the physician consultation after a 10 min bed rest. The following parameters were reported: fat
126 mass (kg, %), free-fat mass (kg, %), dry free-fat mass (kg, %) and total body water (l, %). The
127 fat mass index (FMI) was calculated as: fat mass (kg)/ height (m²), and the fat-free mass (FFM)
128 index (FFMI) as: FFM (kg)/ height (m²). Reduced FFM was defined by a FFMI <17 for male
129 or <15 for female. Food intake was assessed using the 10-point visual analogue scale of SEFI®.

130 The SEFI® allowed a visual assessment of the food intake, with an immediate result, not
131 requiring food collection, and is very well correlated with real daily energy intakes [2]. The
132 reliability of SEFI® for diagnosing malnutrition or the risk of malnutrition has been
133 demonstrated in patients in general practice, inpatients or outpatients and in nursing homes [14–

134 16]. Insufficient food intake correlated with malnutrition or the risk of malnutrition was defined
135 by SEFI® <7 [2,14,15].

136 Malnutrition and its severity were retrospectively diagnosed according the GLIM criteria [9].

137 Malnutrition was defined by the combination of at least one phenotypic criterion among BMI
138 <20kg/m² (or <22 if age ≥70 years), weight loss >5% within the past 6 months or >10% beyond
139 6 months, or reduced muscle mass (FFMI on the first BIA), with at least one etiological criterion
140 among reduced food intake defined by SEFI® score <7 (considered as equivalent to the GLIM
141 ≤50% of energy requirements) or reduced food assimilation (malabsorption or previous history
142 of gastro-intestinal surgery), or chronic disease-related inflammation (cancer or chronic organ
143 failure), or acute disease/injury.

144 Malnutrition was considered as severe if: weight loss >10% within the past six months or >20%
145 beyond six months, and/or BMI <18.5kg/m² if age <70 years or BMI <20kg/m² if age ≥70 years.
146 Otherwise, malnutrition was considered as moderate.

147 Main diagnosis, besides malnutrition, was categorized as: chronic organ failure, digestive
148 cancer with or without surgery, non-digestive cancer, non-oncological digestive surgery,
149 psychogenic anorexia (reduction of food intake with no intention to lose weight), intestinal
150 malabsorption, digestive disease without malabsorption, pancreatic disease, neuromuscular
151 disease, or auto-immune disease.

152 The medical nutrition therapy accepted by the patient, namely the prescription made at the end
153 of the consultation, was recorded. This was not always the first line proposal of the clinician.

154 The different options were: food fortification, oral nutritional supplements (ONS), enteral or
155 parenteral nutrition, depending on functionality of the digestive tube and patients' acceptance.

156 These therapeutics could have been prescribed alone or in association.

157

158 *Study endpoints*

159 The primary endpoint was the nutritional characteristics of patients referred for the first time to
160 an outpatient clinic for the management of malnutrition. This was a composite end point
161 regrouping: malnutrition severity, main diagnosis, comorbidities, physical signs of
162 malnutrition, body composition parameters, complications (infections, hospital admission
163 within 1 months) and mortality.

164 The secondary endpoints were the nutritional prescription after this first consultation, and the
165 consistency of this medical nutrition therapy with the ESPEN guidelines for nutritional care.
166 ESPEN has published since 2000 a great number of disease specific guidelines for nutritional
167 care [17]. To sum up, all disease specific guidelines recommend oral nutrition as the first route
168 of feeding for nutritional therapy of malnourished patients who are able to ingest food [18].
169 Enteral tube feeding should be implemented in medical inpatients who could not reach 75% of
170 their energy and protein targets or when the nutritional requirements cannot be met via oral
171 route during the recommended 5 to 7 days (according to the majority of the guidelines, although
172 this period can be extended to 8 weeks in chronic infectious diseases). In patients with an intact
173 gastrointestinal tract, parenteral nutrition should be seen as a last resource when patients cannot
174 be fed sufficiently orally or enterally. The older people with reasonable prognosis shall be
175 offered enteral nutrition, if oral intake is expected to be impossible for more than three days, or
176 expected to be below half of energy requirements for more than one week, despite interventions
177 [12].

178 Taking into account the recommendations cited above, the medical nutrition therapy provided
179 was considered consistent with the ESPEN guideline if: food fortification or ONSs were
180 prescribed in moderately malnourished patients with spontaneous oral intakes $\geq 2/3$ of
181 requirements or SEFI® ≥ 7 ; enteral nutrition was prescribed in moderately malnourished
182 patients with insufficient food intake ($< 2/3$ of energy needs or SEFI® < 7) and in severely

183 malnourished patients, except patients with non-functioning digestive for whom parenteral
184 nutrition was indicated. As the follow up of the medical nutrition therapy was not collected, the
185 data about a potential second-line nutritional therapy were not available.

186

187 *Statistical analysis*

188 Categorical variables were reported as n- (%) and compared using Chi2 or Fisher tests.
189 Quantitative variables were reported as mean \pm standard deviation or median and interquartile
190 intervals; and compared using Student tests or Wilcoxon rank-sum tests. Logistic regressions
191 were used to assess variables associated with i) malnutrition and ii) mortality. Odds ratios (OR)
192 with a 95% confidence interval [IC95%] were reported. All tests will be carried out with a 5%
193 significance level ($p < 0.05$). Statistical analysis was performed with SAS statistical software
194 V9.4 (SAS Institute, Cary, NC, USA).

195

196 *Ethical statement*

197 This non-interventional retrospective study was conducted in accordance with the Declaration
198 of Helsinki. This study has been approved by the Ethical committee of Rennes University
199 Hospital (approval number 24.06).

200

201 **Results**

202 *Patients' inclusion*

203 During the 50 months of the study period, 646 outpatient's patients have been referred for the
204 first time to the specialized nutrition consultation at the Nutrition Department at CHU Rennes.
205 538 patients were excluded (**Figure 1**), and then 108 malnourished patients were finally
206 included and analyzed.

207

208 *Characteristics of malnourished individuals*

209 The baseline characteristics of the 108 included patients are shown in **Table 1**. Thirty-eight
210 patients (35,2%) were over 65 years old. Most of the malnourished patients were severely
211 malnourished (n=80 (74.1%)). The main diagnosis, besides malnutrition, was digestive cancer
212 treated by surgery (n=33 (30.6%)). The main comorbidity was a cardiovascular disease (n=31
213 patients (28.7%)). The other comorbidities were present as follows: respiratory disease in 17
214 patients (15.7%), gastrointestinal and liver disease in 10 patients (9.3%), psychiatric disease in
215 10 patients (9.3%), history of cancer disease in 10 patients (9.3%), uro-renal disease in 7
216 patients (6.5%) and autoimmune disease in 5 (4.6%). More than half of the patients (n=55
217 (59%)) were currently treated for an active cancer, and 51 patients (47.2%) were in a clinical
218 situation of malabsorption or maldigestion.

219 Weight of malnourished patients was available in the consultation report in 92.8% of cases; if
220 not, a declarative weight was reported, allowing calculation of BMI from the patient's height
221 (**Table 2**). The BIA was performed in 73% of patients. As expected, BMI was lower in patients
222 with severe than moderate malnutrition. Severely malnourished patients had also a smaller FMI
223 and a higher total body water at their first BIA, compared to patients with moderate
224 malnutrition. Patients with severe malnutrition tended to have a lower FFMI and greater
225 proportion of amyotrophy.

226 The evaluation of food intake by SEFI® was available for 86 patients (77.5%) (**Table 2**). There
227 was no statistically significant correlation between SEFI <7 and weight loss within the last
228 month or 6 months or compared to the usual weight (**Table 3**). There was a tendency of a lower
229 BMI and FFMI in patients with SEFI <7 compared to SEFI ≥7.

230

231 *Complications and mortality during the follow up*

232 The mean follow-up for all patients was 70 days and 247.5 days (range, 6-917) if excluding
233 patients having only the first consultation. The proportion of patients admitted to hospital was
234 11.3%, higher in patients with severe (14.1%) than moderate (3.6%) malnutrition but the
235 difference was not statistically significant ($p=0.18$) (**Table 4**). The proportion of patients with
236 infections was 28.6% in patients with moderate malnutrition and 16.3% in those with severe
237 malnutrition; infections were treated by antibiotics in 14.3% and 11.4% of cases, respectively.
238 The most frequent type of infection was pneumonia (6.5%). The proportion of patients who
239 died during the follow up was 23.1% (**Table 4**).

240

241 *Univariable analyses of factors associated with severe malnutrition and mortality*

242 The logistic regression analysis showed that only a low FMI (FMI for one-point increase:
243 $OR=0.72$; 95% confidence interval [0.54-0.96]) was significantly associated with severe
244 malnutrition (**Table 5**). Insufficient food intake defined by SEFI® ≥ 7 ($OR=0.89$; 95%
245 confidence interval [0.33-2.37], phase angle $\geq 5^\circ$ ($OR=0.64$ [0.15-2.79]) or albuminemia $\geq 35g/l$
246 ($OR=0.17$; 95% confidence interval [0.02-1.25]) were not associated with mortality (**Table 6**).

247

248 *Medical nutrition therapy*

249 Food fortification was used in 25% of cases, ONS in 59.3%, enteral nutrition in 42.6% and
250 parenteral nutrition in 10.8%. of cases. At least one of these modalities were prescribed in 76
251 out of 80 patients (95%) with severe malnutrition and in 27 out of 28 patients (96.5%) with
252 moderate malnutrition. There was a moderate consistency (47.1%) between the medical
253 nutrition therapy decided at the end of this first consultation and the ESPEN guidelines, with a
254 tendency of a lower adequacy in patients with severe malnutrition (45.3%) compared to patients
255 with moderate malnutrition (52.4%) ($p=0.57$). Only three patients, two with moderate

256 malnutrition and one with severe malnutrition, had a non-functioning digestive tract and
257 received parenteral nutrition.

258

259 **Discussion**

260 Seventy-four % of the adult patients referred for the first time to the specialized nutrition
261 consultation of a university teaching hospital for the management of malnutrition were severely
262 malnourished. After a median follow up of 70 days, these patients were frequently complicated
263 with infections (19%) and mortality (23%). A low FMI was the only factor significantly
264 associated with severe malnutrition. We did not find any factor associated with mortality. A
265 medical nutrition therapy was prescribed in 96.5% and 95% of patients with moderate and
266 severe malnutrition, respectively. There was a moderate consistency (47.1%) between the
267 medical nutrition therapy decided at the end of the consultation and the ESPEN guidelines of
268 nutritional care.

269 At present, body composition parameters are considered as a more appropriate as simple
270 anthropometric measurement, such as BMI in order to assess nutritional status [19]. The non-
271 invasive, safe and inexpensive characteristics of BIA make this method applicable in
272 outpatients' populations. It is a valid alternative for body composition evaluation and has been
273 validated against existing reference methods as DXA. BIA is a more practical, nonradioactive
274 and well-tolerated method that can be completed in a short operating time. When used in
275 outpatients' nutritional clinics it allows early individualized nutritional intervention, improving
276 clinical outcomes and long-term health [19].

277 Patients with severe malnutrition had smaller FMI and higher total body water than patients
278 with moderate malnutrition. There were no significant differences in FFMI and proportion of
279 patients with amyotrophy, suggesting that, in a population of malnourished patients, the
280 identification of reduced muscle mass is not discriminant enough to evaluate the severity of

281 malnutrition. Future studies should evaluate whether FMI and total body water could be useful
282 body composition parameters to determine the severity of malnutrition and should try to
283 identify thresholds. The fact that a high total body water could make uninterpretable the levels
284 of fat-free mass [20] with regard to muscle mass could explain the fact that FFMI was poorly
285 related to malnutrition severity in our study. Albumin plasma levels were not significantly
286 different between patients with severe and moderate malnutrition, that is concordant with the
287 fact that albumin plasma levels fail to distinguish the degree of malnutrition on their own [21].
288 This reinforces the relevance of the recent suppression of this measurement as a phenotypic
289 diagnostic criterion for malnutrition [9]. The SEFI® was also not different between patients
290 with severe and moderate malnutrition. Whereas a low level of food intake seems a good
291 indicator of malnutrition [2,14–16], the SEFI® <7 threshold is not an indicator of malnutrition
292 severity in our study. Future studies could try to identify a SEFI® cut-off associated to
293 malnutrition severity. Another semi-quantitative method for assessing food intake is the
294 assessment of the consumed food portions as proposed in the NutritionDay® survey [22]. Using
295 this method, a correlation between reduced food intake and low BMI has already been reported
296 [22]. Although this could be also done using the SEFI®, consumed food portions were not
297 assessed in this study because this more likely suits to the hospital setting, where the health-
298 care staff can directly observe the food consumed when clearing the meal tray [23].

299 Nutrition support, i.e. fortification, ONS, enteral or parenteral nutrition, was prescribed in
300 92.8% of the malnourished patients of this series. This is much higher than common practice in
301 French hospital wards, where only 57.6% of malnourished patients received nutrition support
302 [24]. This higher number could be easily understood by the fact that the patients were managed
303 by a physician specialized in clinical nutrition. In our study, malnourished patients received
304 food fortification in 25% of cases, ONS in 59.3%, enteral nutrition in 42.6% and parenteral
305 nutrition, in 10.8% of cases. The consistency between the medical nutrition strategy decided at

306 the end of the consultation and the ESPEN guidelines of nutritional care is moderate (47.1%).
307 This figure may have been underestimated, as we did not collect the information of the medical
308 nutrition therapy received within the weeks following the consultation. The patients' rejection
309 to receive the therapy was also an important reason why the ESPEN guidelines were not
310 followed. This was especially the case when proposing to set up enteral or parenteral nutrition
311 that the patient could consider as invasive and/or uncomfortable. Thus, the decision of initiating
312 enteral or parenteral nutrition would have been postponed to the next consultation due to
313 patient's initial reluctance to accept the indicated nutrition support. Physician prescribed in this
314 case fortification and ONS. Another obstacle to the implementation of enteral and parenteral
315 nutrition is the difficulty of quickly implementing and properly managing these modalities at
316 home, particularly among older or dependent people. Nevertheless, this finding indicates the
317 difficulty to initiate the appropriate medical nutrition therapy in the setting on a 30-minute
318 outpatient consultation in the real life.

319 It is well known that adequate nutritional care allows reduction of hospital stay, risk of
320 infections as well as post-surgical complications, and improves quality of life [25,26].
321 Moreover, adequate nutritional care in community has a great medico-economic benefit. It
322 allows a reduction of hospital admissions and length of stay, as well as care costs. Only
323 prescription of ONS by a general practitioner saves around 200 euros per patient per year [27].
324 Therefore, efforts have to be made in order to improve malnutrition diagnosis and nutritional
325 care in outpatients, and its timing that should be as early as possible, by improving physicians'
326 knowledge regarding the guidelines and the acceptance of the proposed therapies by the patient.
327 In our population of malnourished patients, infections were reported in 19.4% of cases, with
328 pneumonia as the most frequent type (6.5%). These figures are consistent with a cohort study
329 performed in hospitalized malnourished patients, in which 5.9% of patients reported pneumonia
330 [28]. A very high mortality rate of malnourished patients (23.1%) was found in our study, two-

331 fold higher than in hospitalized patients, according to a previous study (12.4%) [28]. This can
332 be explained by the high proportion of patients with severe malnutrition and digestive cancers,
333 that could act as intricate confounding factors.

334 Phase angle measurement, derived from BIA, is a prognostic marker in various diseases and
335 one of the most sensitive markers of malnutrition [4,5]. In this study, there was no association
336 between a phase angle $<5^\circ$ and mortality, but this lack of difference could be due to the small
337 number of patients in whom phase angle was reported, and the high proportion of patients with
338 severe malnutrition itself related to poor prognosis. Hypoalbuminemia is also a well-known
339 poor prognostic factor, and has been associated with higher mortality rates in outpatients with
340 heart failure or colorectal cancer [6,29]. We did not find this relation in our study, potentially
341 due to a lack of power because of missing data.

342 *Strengths and weaknesses*

343 To our knowledge, this is the first study that has evaluated the characteristics and outcomes of
344 malnourished patients' referend for the first time to an outpatient clinic for the management of
345 malnutrition in France. It brings new data concerning socio-demographic characteristics,
346 comorbidities, main diagnosis and malnutrition diagnosis parameters. Another strength of this
347 study is the use of the GLIM criteria to diagnose malnutrition, including food intake evaluation
348 and, when available, body composition assessment by BIA. As this is a retrospective study,
349 there are some missing data, such as for the assessment of body composition by BIA, which
350 could have led to lack of statistical differences for some parameters. The evaluation of
351 comorbidities was not made by using the Charlson Comorbidity Index that could have reduced
352 arbitrariness in extracting background diseases. The information about the long-term outcomes
353 was not collected. It would have been interesting to include a longitudinal follow-up of the
354 patients and achieve medico-economic analyses, in order to determine if the medical nutrition

355 therapy decided in the consultation is effective and associated with reduction of the costs
356 generated by the malnutrition in the long term.

357

358 **Conclusion**

359 Malnourished adults referred for the first time to a specialized nutritional consultation present
360 mostly with severe malnutrition and are at risk for significant complications, leading to a high
361 mortality rate. A higher body fat mass is associated with a lower risk for severe malnutrition.
362 Further studies should evaluate whether a specific threshold of body fat mass index should be
363 used to improve the diagnosis of severe malnutrition. More effort should be made to develop
364 multidisciplinary teams dedicated to outpatient nutritional care to better apply the ESPEN
365 recommendations of nutritional care. Future studies should evaluate whether a better screening
366 of malnutrition, an earlier referral to clinical nutrition units and a more adequate medical
367 nutrition therapy should improve outcomes.

368

369

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373 patients included in this study.

374

375 Statement of Authorship

376 All three authors were involved in the making of the study. Patricia Vaduva collected the data
377 and wrote the manuscript. Maxime Esvan performed the statistical analysis. Ronan Thibault
378 designed the study, collected the data, supervised the study and drafted the manuscript. Ronan
379 Thibault is the guarantor of this work and, as such, had full access to all the data and takes
380 responsibility for the integrity of the data.

381

382 Conflict of Interest Statement

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390

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393

394

395 **References**

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494 **Table 1- Patient demographics and clinical characteristics according to malnutrition**
 495 **severity (n=108).** Qualitative parameters are expressed as number (%) [missing data].
 496 Quantitative parameters are expressed as mean \pm standard deviation [missing data] tests.
 497

Variables	Total (n=108)	Patients with moderate malnutrition (n=28)	Patients with severe malnutrition (n=80)
Female	49 (45.4%)	12 (42.9%)	37 (46.3%)
Age	58.6 \pm 14.6	58.8 \pm 12.7	58.5 \pm 15.3
Smoking	93 [15]	26 [2]	67 [13]
active	27 (29.0%)	8 (30.8%)	19 (28.4%)
weaned	4 (4.3%)	1 (3.8%)	3 (4.5%)
Alcohol use	93 [15]	26 [2]	67 [13]
active	18 (19.4%)	6 (23.1%)	12 (17.9%)
weaned	4 (4.3%)	2 (7.7%)	2 (3.0%)
Other toxics	93 [15]	26 [2]	67 [13]
active	2 (2.2%)	0 (0.0%)	2 (3.0%)
weaned	1 (1.1%)	0 (0.0%)	1 (1.5%)
Diagnosis category			
psychogenic anorexia	3 (2.8%)	0 (0.0%)	3 (3.8%)
digestive cancer without surgery	19 (17.6%)	4 (14.3%)	15 (18.8%)
digestive cancer with surgery	33 (30.6%)	7 (25.0%)	26 (32.5%)
non-digestive cancer	2 (1.9%)	0 (0.0%)	2 (2.5%)
non-oncologic digestive surgery	3 (2.8%)	0 (0.0%)	3 (3.8%)
organ failure	6 (5.6%)	1 (3.6%)	5 (6.3%)
intestinal failure	3 (2.8%)	2 (7.1%)	1 (1.3%)
malabsorption	13 (12.0%)	7 (25.0%)	6 (7.5%)
digestive disease without malabsorption	8 (7.4%)	1 (3.6%)	7 (8.8%)
pancreatic disease	3 (2.8%)	0 (0.0%)	3 (3.8%)
neuro-muscular disease	7 (6.5%)	2 (7.1%)	5 (6.3%)
other	8 (7.4%)	4 (14.3%)	4 (5.0%)
Malabsorption/maldigestion	51 (47.2%)	14 (50.0%)	37 (46.3%)
Chemotherapy	39 (38%)	8 (28.6%)	33 (41.3%)
Digestive surgery	49 [2] (46.2%)	12 (42.9%)	37 [2] (47.4%)
Living alone	19 (19.0%)	2 (7.7%)	17 (23.0%)
Living in nursing-home	2 (1.9%)	0 (0.0%)	2 (2.6%)

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500

501 **Table 2- Patient nutritional evaluation and therapy according to the severity of**
 502 **malnutrition (n=108).** Qualitative parameters are expressed as number (%) [missing data], and
 503 compared with Chi2 or Fisher tests. Quantitative parameters are expressed as mean \pm standard
 504 deviation [missing data], and compared with Student or Mann-Whitney Wilcoxon tests. BIA,
 505 bioimpedance analysis; BMI, body mass index; FFM, fat-free mass; FFMI, fat-free mass index;
 506 FMI, fat mass index; ONS, oral nutritional supplements; SEFI®, Simple Evaluation of Food
 507 Intake®.
 508

Variables	Malnourished patients (n=108)	Patients with moderate malnutrition (n=28)	Patients with severe malnutrition (n=80)	P value
Weight measurement - n (%)	100 (92.6%)	26 (92.9%)	74 (92.5%)	1.00
Weight (kg)	55.3 \pm 11.5	59.3 \pm 12.3	54.0 \pm 11.0	0.04
Height (cm)	1.67 \pm 0.10	1.65 \pm 0.08	1.68 \pm 0.11	0.11
BMI (kg/cm ²)	19.7 \pm 3.5	21.8 \pm 3.6	19.0 \pm 3.2	<0.01
Usual weight	69.1 \pm 18.5	64.0 \pm 13.1	70.8 \pm 19.7	0.12
Weight loss in the last 6 months (%)	12.2 \pm 6.8	6.9 \pm 3.5	13.9 \pm 6.8	0.01
Weight loss compared to fit weight (%)	18.9 \pm 9.7	8.0 \pm 3.6	21.6 \pm 7.6	<0.01
Edema - n (%)	7 (6.5%)	3 (10.7%)	4 (5.1%)	0.37
Ascites - n (%)	6 (5.7%)	2 (7.1%)	4 (5.1%)	0.65
Diarrhea - n (%)	36 (34.0%)	11 (39.3%)	25 (32.1%)	0.49
SEFI®	5.7 \pm 2.9 [23]	4.7 \pm 3.1 [7]	6.0 \pm 2.8 [16]	0.08
Body composition				
Fat mass (kg)	13.8 \pm 5.0 [29]	16.1 \pm 6.0 [7]	13.0 \pm 4.4 [22]	0.01
Fat mass (%)	25.2 \pm 8.6 [29]	27.0 \pm 7.6 [7]	24.5 \pm 8.9 [22]	0.26
Free-fat mass (kg)	42.5 \pm 11.1 [26]	44.2 \pm 10.6 [7]	41.9 \pm 11.2 [19]	0.43
Free-fat mass (%)	75.1 \pm 9.2 [26]	73.2 \pm 7.6 [7]	75.8 \pm 9.6 [19]	0.27
Dry free-fat mass (kg)	7.6 \pm 3.9 [37]	7.9 \pm 4.2 [8]	7.5 \pm 3.8 [29]	0.72
Dry free-fat mass (%)	12.9 \pm 5.4 [37]	12.6 \pm 5.6 [8]	13.1 \pm 5.3 [29]	0.76
Total body water (%)	63.6 \pm 6.9 [27]	60.6 \pm 5.4 [7]	64.7 \pm 7.1 [20]	0.02
Total body water (L)	35.7 \pm 7.5 [27]	36.3 \pm 7.4 [7]	35.4 \pm 7.6 [20]	0.63
FMI	5.0 \pm 2.1 [29]	6.0 \pm 2.5 [7]	4.6 \pm 1.8 [22]	0.01
FFMI	15.1 \pm 2.9 [26]	16.0 \pm 2.7 [7]	14.8 \pm 2.8 [19]	0.08
Reduced FFM - n (%)	57 (69.5%) [26]	20 (71.4%)	37 (68.5%) [26]	1.00
Amyotrophy - n (%)	47 (94.0%) [58]	7 (77.8%) [19]	40 (97.6%) [29]	0.08
Albuminemia (g/l)	39.3 \pm 5.9 [81]	38.0 \pm 6.0 [22]	39.7 \pm 5.9 [59]	0.55
Nutritional therapy				
Fortification (excluding ONS)	27 (25.0%)	8 (28.6%)	19 (23.8%)	0.61
ONS	64 (59.3%)	13 (46.4%)	51 (63.8%)	0.11
Enteral nutrition	45 (41.7%)	10 (35.7%)	35 (43.8%)	0.46
Parenteral nutrition	9 (8.3%)	3 (10.7%)	6 (7.5%)	0.69

509

510 **Table 3- Comparison of the malnutrition phenotypic criteria according to food intake**
 511 **assessed by the Simple Evaluation of Food Intake® (SEFI®).** An insufficient food intake
 512 was defined by SEFI® < 7. Data are expressed as mean ± standard deviation (number of
 513 individuals analyzed) and compared using the Student's test. BMI, body mass index; FFMI, fat-
 514 free mass index.
 515

Variables	Malnourished patients	SEFI® < 7	SEFI® ≥ 7	P value
Weight loss within the last month - %	9.1 ± 7.8 (75)	8.5 ± 5.9 (44)	10.2 ± 11.4 (31)	0.74
Weight loss within the last 6 months - %	12.3 ± 7.1 (57)	11.4 ± 6.2 (32)	14.2 ± 8.5 (25)	0.32
Weight loss compared to fit weight - %	19.6 ± 11.1 (19)	19.3 ± 12.5 (10)	20.3 ± 8.7 (9)	0.72
BMI – kg/m²	19.4 ± 3.5 (3)	18.8 ± 3.1 (2)	20.3 ± 3.9 (1)	0.07
FFMI – kg/m²	15.1 ± 2.9 (24)	14.5 ± 2.7 (18)	15.8 ± 3.1 (6)	0.09

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517

518 **Table 4- Complications and mortality according to the malnutrition severity, occurring**
 519 **during the post nutritional consultation follow up (n=108).** Data are expressed as number
 520 [missing data] (%), and compared with Chi2 or Fisher tests. * during the month following
 521 consultation.
 522

Variables	Patients with malnutrition (n=108)	Patients with moderate malnutrition (n=28)	Patients with severe malnutrition (n=80)	P value
Follow up (in days)	70 (38)	16 (12)	54 (26)	0.94
Death	25 (23.1%)	5 (17.9%)	20 (25.0%)	0.44
Hospital admission*	12 (11.3%)	1 (3.6%)	11 (14.1%)	0.18
Infection (all sites)	21 (19.4%)	8 (28.6%)	13 (16.3%)	0.16
Bacteriemia	4 (3.8%)	1 (3.6%)	3 (3.8%)	1.00
Central catheter infection	2 (1.9%)	1 (3.6%)	1 (1.3%)	0.46
Pneumonia	7 (6.5%)	4 (14.3%)	3 (3.8%)	0.07
Abdominal infection	4 (3.7%)	1 (3.6%)	3 (3.8%)	1.00
Urogenital infection	6 (5.6%)	0 (0.0%)	6 (7.5%)	0.34
Other infection	3 (2.8%)	2 (7.1%)	1 (1.3%)	0.16
Antibiotics use	13 (12.1%)	4 (14.3%)	9 (11.4%)	0.74

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526 **Table 5- Univariate analysis of the factors associated with severe malnutrition (n=108).**
 527 Data shown in columns 2 and 3 are expressed as n. BMI, body mass index; FMI, fat mass index;
 528 SEFI®, Simple Evaluation of Food Intake®.

Variables	Total population (n=108)	Patients with severe malnutrition (n=80)	Odds ratio [95% confidence interval]	P value
Living alone*	19	17	3.58 [0.77; 16.70]	0.10
Living in nursing home†	2	2	1.82 [0.04; 77.14]	0.75
Cardiovascular disease	31	21	0.64 [0.26; 1.61]	0.34
Respiratory disease	17	11	0.58 [0.19; 1.76]	0.34
Auto-immune disease	5	4	1.42 [0.15; 13.28]	0.76
Gastrointestinal and liver disease	10	8	1.44 [0.29; 7.25]	0.66
Psychiatric disease	10	7	0.80 [0.19; 3.33]	0.76
History of cancer	10	8	1.44 [0.29; 7.25]	0.66
Uro-renal disease	7	6	2.19 [0.25; 19.03]	0.48
Smoking	93	67		0.97
Active	27	19	0.88 [0.33; 2.38]	
Weaned	4	3	0.90 [0.10; 8.18]	
Alcohol use	74	56		0.96
Active	2	2	1.73 [0.04; 74.01]	
Weaned	1	1	1.05 [0.01; 101.92]	
Other toxics	93	67		0.97
Active	27	19	0.88 [0.33; 2.38]	
Weaned	4	3	0.90 [0.10; 8.18]	
Chemotherapy	41	33	1.76 [0.69; 4.46]	0.24
Digestive surgery‡	49	37	1.20 [0.50; 2.87]	0.68
FMI (for a 1-point increase)§	79	58	0.72 [0.54; 0.96]	0.03
Albuminemia ≥ 35 g/l¶	21	18	5.29 [0.73; 38.36]	0.10
SEFI® ≥ 7	35	28	1.56 [0.55; 4.37]	0.40

529 *Living alone was assessed in 100 patients. † Living in nursing home was assessed in 104
 530 patients. ‡ Digestive surgery was assessed in 106 patients. § FMI was assessed in 79 patients.
 531 ¶ Albuminemia was assessed in 27 patients. || SEFI® was assessed in 85 patients.

532

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536

537 **Table 6- Univariate analysis of the factors associated with mortality (logistic regression)**
 538 **(n=108).** SEFI®: Simple Evaluation of Food Intake®.
 539

Variables	Patients (n)	Deaths (n)	Odds ratio [95% confidence interval]	P value
SEFI® ≥ 7 *	35	9	0.89 [0.33; 2.37]	0.82
Phase angle $\geq 5^\circ$ †	27	3	0.64 [0.15-2.79]	0.55
Albuminemia ≥ 35 g/l‡	21	3	0.17 [0.02-1.25]	0.08

540 *SEFI® was assessed in 85 patients. †Phase angle was assessed in 56 patients. ‡Albuminemia

541 was assessed in 27 patients.

542

543

544 **Figure legend**

545

546 **Figure 1-** Study flow-chart. GLIM, Global Leadership Initiative on Malnutrition; HPN, home
547 parenteral nutrition.

548

Figure 1