

1 An evaluation of the feasibility and validity of a patient-administered Malnutrition Universal
2 Screening Tool ('MUST') compared to Health Care Professional screening in an Inflammatory
3 Bowel Disease (IBD) outpatient clinic

4

5 Keywords

6 Malnutrition Universal Screening Tool, nutritional screening,
7 Inflammatory bowel disease, outpatients

8

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Abstract

Background: Malnutrition is common in Inflammatory Bowel Disease (IBD) and is associated with poor health outcomes. Despite this, screening for malnutrition in the outpatient-setting is not routine and research in the area is limited. This study aimed to evaluate whether agreement between malnutrition screening completed by patients and Healthcare Professionals (HCP's) could be achieved by comparing patient self-administered 'MUST' ('MUST'-P) to HCP administered 'MUST' ('MUST'-HCP) in a single tertiary IBD outpatient clinic.

Methods: We conducted a feasibility and validity study on adult outpatients with IBD. We collected anthropometric, nutritional and clinical data from patients. All patients completed 'MUST'-P using a self-administered questionnaire, followed by 'MUST'-HCP. 'MUST'-P was timed and feedback on ease-of-use was obtained. Malnutrition risk was classified as low (score=0), medium (score=1), and high (score \geq 2) and agreement tested using kappa statistics (κ).

Results: Eighty patients were recruited (Crohn's Disease:n=49, Ulcerative Colitis:n=29, Unclassified:n=2), with mean age 39.9 \pm SD:15.1yrs, 51.2% were males. Seventy one (92%) of patients found 'MUST'-P either easy or very easy. The mean time to complete 'MUST'-P was 3.1 \pm 1.8min (range 1-10min). Sixty-eight (85%) of patients were at low risk of malnutrition when screened by the HCP. There was moderate agreement (κ =0.486, p<0.001) between 'MUST'-P and 'MUST'-HCP with 100% agreement in scoring for medium- and high-risk categories.

Conclusions: Our study suggests that self-screening using 'MUST' could be effectively used in an IBD outpatient clinic to identify those at medium and high risk of malnutrition. The patient friendly version of 'MUST'; 'MUST'-P was considered quick and easy to use by patients. Implementation of self-screening with 'MUST' could improve the nutritional management of IBD patients.

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72

73 **Introduction (maximum 2 pages)**

74

75 Malnutrition can be defined as “a state of nutrition in which deficiency, excess or imbalance
76 of energy, protein, and other nutrients causes measurable adverse effects on tissue and body
77 form (body shape, size, composition), function and clinical outcome” (1,2). It is a serious and
78 common condition associated with significant morbidity and mortality, affecting adults and
79 children with all types of diseases in all health care settings. Prevention, identification and
80 treatment of malnutrition at an early stage could reduce potential health risks, dependency on
81 others, hospital admissions and costs (3,4). The economic impact of malnutrition risk due to
82 increased use of health and social care resources, hospitalisation and length of hospital stay as
83 identified using tools including ‘MUST’ is well documented (5-6). A study conducted in
84 Portugal on 637 inpatients found that high risk of malnutrition in 21-29% patients, identified
85 using malnutrition screening tools, was an independent predictor of increased hospitalisation
86 costs (7). NICE recommend that all outpatients should be screened for malnutrition at their first
87 appointment and screening should be repeated when there is clinical concern (8).

88

89 Crohn’s disease (CD) and Ulcerative Colitis (UC) are the main types of Inflammatory Bowel
90 Diseases (IBD), with a rarer type (Unclassified IBD-U) accounting for approximately 10% of
91 all cases (9). In a northern English population the prevalence of IBD has been estimated at
92 approximately 387 per 100, 000 population (243 per 100,000 with UC and 144 per 100,000 with
93 CD) in 1995, with the prevalence of CD increasing faster than UC (10). IBD is associated with
94 substantial morbidity, one aspect includes nutritional status where malnutrition and weight loss
95 are common (11-12). Up to 75% of adults with active IBD are malnourished (13-15) and up to
96 33% of adults in remission have been found to be malnourished (16). IBD patients often alter
97 their eating habits to alleviate their symptoms, potentially leading to malnutrition and weight
98 loss (17). In addition to protein-energy malnutrition, deficiencies in trace elements and vitamins
99 such as magnesium, iron and vitamin B12 are common (18-19). Prolonged symptoms as well as
100 the disease management either by drug treatment or surgery may further impact on the
101 nutritional status of patients.

102

103 Food and nutrition is viewed as a high priority for IBD patients (20) yet dietetic service
104 provision remains poor with approximately 60% of inpatients receiving no dietetic contact (21).
105 Malnutrition can be under-recognised in IBD patients as routine screening is not common

106 practice, resulting in under-detection and thus under-treatment of malnutrition (^{22,23}). Factors
107 contributing to this include: lack of recognition of the detrimental effects of malnutrition in
108 IBD, difficulties implementing nutritional plans, lack of staffing in busy outpatient clinics and
109 lack of guidance on the management of those identified at risk of malnutrition (²¹). A systematic
110 review looking at barriers and facilitators of adoption of nutritional screening by nurses
111 concluded that it was unlikely, unless it was considered an integral part of the nursing
112 assessment and was appropriate resourced (²⁴). The use of patient self-administered
113 malnutrition screening tools has been shown to be beneficial in the hospital outpatient setting
114 (²⁵).

115

116 The UK IBD Audit (²¹) advises that all IBD inpatients are screened for malnutrition and
117 recommend ‘MUST’ as an appropriate tool. In addition, while nutritional screening guidelines
118 exist for a variety of health care settings (²⁶) no specific screening tool has been developed for
119 IBD outpatients. Patient administered self-screening has recently been investigated in different
120 studies and has demonstrated benefits in various disease states (^{1,22,25,27}).

121

122 The ‘MUST’ tool is considered an appropriate malnutrition screening tool as it has face-,
123 content-, concurrent- and predictive- validity with a range of other screening tools. It is also
124 internally consistent and reliable and has very good to excellent reproducibility when used with
125 different assessors in a variety of settings. Guerra et al (⁷) found agreement between ‘MUST’
126 and the ESPEN (European Society of Parenteral and Enteral Nutrition) recommended Nutrition
127 Risk Screening tool (²⁶) as a predictor for increased hospitalisation costs. The ‘MUST’ tool has
128 been found to be easy, quick to use and acceptable to patients, research-participants and
129 healthcare workers (²⁸⁻²⁹). Previous research examining self-screening in outpatients is either
130 not IBD specific (^{1, 27, 28}) or has not been conducted in the UK population (²²).

131

132 This study aims to assess feasibility (completion time and ease of use) and validity of ‘MUST’-
133 P compared to risk classification obtained by ‘MUST’-HCP in IBD outpatients. This research
134 has the potential to improve patient care by contributing to the malnutrition risk identification,
135 which impacts not only on the disease related complications but also on healthcare costs (³⁰).
136 Nutritional support to treat malnutrition may improve symptoms and allow deficiencies in
137 calories as well as macro and micro-nutrients to be rectified (¹⁸).

138

139

140 **Materials and Methods**

141 *Study design and population*

142 This is a feasibility and validity study ⁽³¹⁾. Eighty three patients in the adult IBD outpatient
143 clinic at UCLH were approached from the waiting area using convenience sampling over an 8-
144 week period between May 2015 and July 2015. The inclusion criteria were patients with a
145 confirmed IBD diagnosis and ≥ 18 years of age. Exclusion criteria were unwillingness or
146 inability to provide informed consent and inability to communicate in the English language.
147 Patients accompanied by a relative able to translate or act as an interpreter were recruited.
148 Every effort was made to recruit all eligible patients to minimise selection bias. However three
149 patients declined the invitation to participate, making the sample size eighty patients.

150

151 Ethical approval was sought from London Metropolitan University Ethics Committee and by
152 the University College London Hospital research and development committee. Full ethical
153 approval was not required as the study was deemed part of service evaluation. Written informed
154 consent was obtained from all study participants and patients were assured of confidentiality
155 and anonymity.

156

157 **Data Collection**

158 The tools utilised for the data collection were the patient administered screening tool ('MUST'-
159 P) followed by the 'MUST' tool completed by the researcher ('MUST'-HCP) to screen the
160 participants for malnutrition. Using routinely collected data from electronic databases and
161 paper medical records information was collected on the characteristics of the patient group,
162 including: demographics (date of birth, gender); anthropometry (height, weight and weight
163 changes) and IBD type and date of diagnosis obtained from medical records. Well-being was
164 taken from validated tools to measure disease activity in IBD: the Harvey Bradshaw Index ⁽³²⁾
165 for CD and the Simple Clinical Colitis Activity Index ⁽³³⁾ for UC which measures wellbeing
166 on a 5-point likert scale from "very well" (0) to "terrible" (4). Referral to a Dietitian since
167 diagnosis was also obtained. Area deprivation was based on national specific data of multiple
168 deprivation rank from 2015, a composite score including income; employment; education,
169 training and skills; health deprivation and disability; crime, barriers to housing and services;
170 and living environment deprivation, with 1 missing value as one patient's postcode could not
171 be assigned a deprivation score ⁽³⁴⁾. The research team consisted of two qualified dietitians.

172

173

174 **Malnutrition Tools**

175 *'MUST'-P*

176 Patients were provided with a simple instruction sheet, BMI chart and weight loss tables. The
177 HCP recorded the length of time the patient took to complete the tool. The patients were asked
178 initially to complete the 'MUST'-P independently. The 'MUST'-P was the 'MUST' tool
179 developed by Cawood et al (27) who adapted 'MUST' for patient use in a hospital outpatient
180 setting. The BMI and weight loss charts were used from the British Association for Parenteral
181 and Enteral Nutrition (BAPEN) tool kit (35). Following completion of the 'MUST'-P the
182 patient was asked to rate the ease-of-use of the 'MUST'-P tool on a Likert scale (very difficult
183 to very easy) and time for completion in minutes was estimated by the patient.

184

185 *Health care professional 'MUST' ('MUST'-HCP)*

186 The screening was completed by a trained HCP researcher using the BAPEN resources (35).
187 Weighing scales and a stadiometer were both available in the clinic. Patients' height and
188 weight was measured by a trained HCP and documented in the medical notes. The patients
189 were informed of their weight and height.

190

191 **Statistical analysis**

192 Frequencies and percentages (%) were used to describe categorical variables. Mean, standard
193 deviation (SD) and range (minimum and maximum) were used to describe continuous
194 variables. Area deprivation was categorised as 'least' and 'most' by using the median of the
195 national index of multiple deprivation rank. Risk scores from both administrations of 'MUST'
196 were classified as low (score=0), medium (score=1), and high (score \geq 2) risk, from which
197 sensitivity and specificity was calculated. Agreement between the two tools was assessed using
198 kappa statistics. The kappa coefficient (κ) was interpreted using the grading system of Landis
199 and Koch (<0=no agreement; 0-0.20=slight; 0.21-0.40=fair; 0.41-0.60=moderate; 0.61-
200 0.80=substantial; 0.81-1=almost perfect agreement) (36). In sensitivity analyses, we examined
201 whether patient characteristics; age (young vs. old); gender (men vs. women); and IBD
202 duration (short vs. long) would influence agreement between 'MUST'-P and 'MUST'-HCP.

203

204 Differences in demographic variables by IBD status (CD vs. UC) were presented by mean (SD)
205 for normal continuous data and n (%) for categorical data, and tested using T-test and Chi-
206 squared tests, respectively. P-values were two-tailed and set at a significance level of 0.05.
207 Statistical Analysis was conducted using STATA version 14 [StataCorp, College Station, TX].

208 **Results**

209 *Study population*

210 Table 1 shows the demographic and clinical characteristics of the 80 IBD patients who
211 participated in the study. Overall, the study sample consisted of 51.2% males and the mean age
212 of participants was 39.9 ± 15.1 years old (range 19-84). The majority of the participants $n=49$
213 (61.3%) had CD. No demographic or clinical characteristics were significantly different by
214 IBD status except area deprivation where those with CD were least likely to live in a deprived
215 area compared to UC patients ($p=0.01$). However, there was a non-significant trend towards a
216 lower BMI in the CD versus UC group. In total one UC patient had active disease and 3 CD
217 patients had active disease (2 mild and 1 moderate).

218

219 **Agreement between ‘MUST’-P and ‘MUST’-HCP screening**

220 Of the eighty IBD patients included in the study, three patients (3.8%) refused to complete the
221 ‘MUST’-P for the following reasons; one due to eye sight difficulties, one considered that it
222 should be done by a HCP, and one did not state a reason. Thus, the total sample size included
223 for agreement analysis of ‘MUST’-P and ‘MUST’-HCP is $n=77$.

224

225 There was 100% sensitivity for patients who were at medium or high risk using the ‘MUST’-
226 P tool compared to the ‘MUST’-HCP tool. However, specificity was somewhat lower in that
227 2 were scored as medium risk and 15 patients scored as high risk using ‘MUST-P’, whereas
228 they were scored as low risk using ‘MUST’-HCP. Overall, this meant that there was moderate
229 agreement between the ‘MUST’-P and ‘MUST’-HCP scores as determined by the kappa
230 statistic ($\kappa= 0.486$, $p<0.001$). We found no evidence that agreement between ‘MUST’-P and
231 ‘MUST’-HCP was affected by stratification by age, gender, or IBD duration.

232

233 **Ease of use and time to complete ‘MUST’-P**

234 Overall, 51.9% ($n=40$) of patients’ reported the completion of ‘MUST’-P as easy; 40.2%
235 ($n=31$) rating it as very easy; 6.5% ($n=5$) as difficult and 1.3% ($n=1$) as very difficult. The
236 average time for the completion of the questionnaire was 3.1 ± 1.8 min (range 1-10 min).

237

238

239 **Prevalence of malnutrition assessed by ‘MUST’-P**

240 A comparison of the malnutrition risks as identified by the patients themselves and the
241 researcher is shown in Table 2. There was 100% agreement between ‘MUST-P and ‘MUST’-
242 HCP for all patients with medium and high malnutrition risk. However, this reduced to 74.3%

243 agreement with the 'MUST'-HCP score in the low risk category. This was due to 17
244 discrepancies with low risk categories, mostly associated with difficulty reading the BMI chart
245 22.7% (n=15) and 3% (n=2) were related to the weight loss score.

246

247 The proportion of participants with medium and high risk scores of malnutrition was
248 explored using the 'MUST'-HCP. The results show similar proportions of the sample in the
249 medium and high risk malnutrition categories: 8.8% (n= 7 patients) at medium risk- and
250 6.3% (n= 5 patients) at high risk- of malnutrition when screened by the researcher. Of the
251 patients in the study at high risk of malnutrition 2 out of 5 had not been referred to a dietitian
252 since diagnosis and 1 out of 5 had seen a dietitian but did not arrange a follow-up. In total 50
253 patients (62.5%) had seen a Dietitian since diagnosis. The majority of patients (91.3%) had a
254 BMI score 0 in the initial part of the 'MUST'. 71 patients (88.8%) had minimal weight loss
255 ($\leq 5\%$) in the past 6 months and all the patients (100%) were not acutely ill while completing
256 the study.

257

258 **Outcomes of the three steps of 'MUST' used by the researcher to identify malnutrition**

259 The 'MUST'-HCP identified that of 80 patients screened, 85% (n=68) 8.8% (n=7) and 6.3%
260 (n=5) were at low risk, medium risk, and high risk of malnutrition, respectively. 91.3% (n=73)
261 of patients had a low risk BMI, 3.8% (n=3) medium risk and 5% (n=4) high risk. 85% (n=68)
262 of patients had no weight loss. Of the 15% with weight loss, 88.8% (n=71) had $< 5\%$, 8.8%
263 (n=7) 5-10% and 2.5% (n=2) $> 10\%$ weight loss. None of the patients were deemed acutely
264 unwell. One patient at medium risk and one patient at high risk using 'MUST'-HCP had
265 moderately active disease.

266

267 **Discussion**

268 Overall, the results showed that 'MUST'-P can be used to capture medium and high
269 malnutrition risk in the IBD outpatient setting. If accurately implemented this could be
270 included in patients' nutritional assessments. This bridges a gap in knowledge, as there is
271 limited research to date exploring use of self-screening in IBD outpatients, particularly from
272 UK based studies.

273

274 **Accuracy of tool and ease of use of 'MUST'-P**

275 Patient self-screening has been found to be an easy and well accepted tool, generating precise
276 measurements compared with those made by a HCP ⁽²⁵⁾. Our study found a moderate
277 agreement between 'MUST'-P and 'MUST'-HCP (κ coefficient= 0.486, $p < 0.001$), such that

278 100% of IBD patients with medium and high risk of malnutrition were identified by the patient
279 and the HCP; providing confidence in using a patient administered tool.

280

281 However, 17 ‘MUST’-P related discrepancies were identified, mainly relating to difficulty
282 reading the BMI chart. In addition, there was no influence of age, gender and IBD duration
283 on agreement between ‘MUST’-P and ‘MUST’-HCP. Other studies have found the
284 discrepancies between HCP and patient self-screening were mostly associated with the weight
285 loss and BMI score ^(22,27). The use of mobile technology for calculating ‘MUST’ scores could
286 help facilitate the implementation of ‘MUST’-P by improving its accuracy and ease of use for
287 patients, thus improving compliance. McGurk et al ⁽²⁵⁾ investigated ‘MUST’ self-screening
288 using digital technology to calculate BMI in a gastroenterology outpatient clinic. All patients
289 were able to self-screen and there was perfect agreement in test-retest reliability between the
290 patient and dietitian suggesting that use of digital screening may produce more accurate results.

291

292 Based on previous published studies, with the exception of reports from McCurk et al ⁽²⁵⁾, the
293 majority of IBD patients reported the completion of ‘MUST’-P as either easy or very easy.
294 This study is consistent with previous findings by Sandhu et al ⁽²²⁾ where 96% of IBD patients
295 rated self ‘MUST’ screening as either easy or very easy to understand and complete.

296

297 This study used a patient friendly version of ‘MUST’ adapted from Cawood et al ⁽²⁷⁾. In our
298 study the average time for completion was 3.1 ± 1.8 min (range 1-10 min) and 100% completed
299 the tool in 5 minutes or less. Cawood et al ⁽²⁷⁾ found 75% of 205 outpatients were able to screen
300 themselves in less than 5 minutes and rated the self-screening as easy or very easy. In a
301 Canadian study ⁽²²⁾ of 154 IBD adult outpatients, all patients were able to self-screen and 96%
302 reported the tool as either easy or very easy to use. Cawood et al ⁽²⁷⁾ observed that the overall
303 prevalence of malnutrition (medium and high risk) was similar between self-screening (19.6%)
304 and HCP screening (18.6%) which correlated well with our study findings.

305

306

307 **Prevalence of Malnutrition**

308 Our study suggests that the prevalence of malnutrition in the IBD outpatient-setting at UCLH
309 is low compared to other published studies ⁽¹³⁻¹⁶⁾. This is possibly enhanced by close
310 monitoring by an IBD multidisciplinary team. However, due to the small size in our study
311 these results should be viewed with caution. When screened by the HCP the majority of patients
312 (85%) were at low risk of malnutrition, with 8.8% and 6.3% of the sample at medium and high

313 risk, respectively. Seventy one patients reported less than 5% of weight loss in the last 6 months
314 and had a low-risk BMI.

315 Few studies to date have specifically looked at prevalence of malnutrition in IBD outpatients.
316 Vadan et al., ⁽¹⁵⁾ found that 59.3% of 30 patients attending a Gastroenterology Clinic in
317 Bucharest were malnourished, whereas, in a UK based study ⁽²⁹⁾ there was a high prevalence
318 of malnutrition identified in general gastroenterology outpatients using different tools
319 including 'MUST'. Interestingly, in this study the mean BMI score indicated the UC patients
320 were overweight (mean BMI: 27.6kg/m²) and CD patients were at the upper end of the healthy
321 weight range (mean BMI: 25.3kg/m²). Obesity as well as increased fat mass has been
322 associated with elevated inflammatory markers and a more severe disease course in CD
323 patients ⁽³⁷⁻³⁸⁾. Although 'MUST' is able to detect higher proportions of malnutrition risk
324 compared to BMI alone, basic anthropometry is insufficient to differentiate fat mass and lean
325 body mass. In a prospective controlled study among IBD patients, despite 74% of IBD patients
326 having a normal BMI, handgrip strength and lean body mass was impaired in both CD and UC
327 patients ⁽³⁹⁾. More than half of IBD patients were found to have muscle mass depletion despite a
328 normal BMI ⁽⁴⁰⁾ as IBD not only causes weight change it also alters body composition.
329 Assessment of body composition in addition to simple anthropometry would better indicate
330 nutritional status in IBD patients.

331 Specific micronutrient deficits, loss of body cell mass and muscle strength often persist even
332 in disease remission and would not be detected by standard malnutrition screening alone ⁽³⁹⁾.
333 In the IBD cohort it may not be possible to fully evaluate malnutrition risk based solely on
334 malnutrition screening, due to the complex nature of the disease.

335 The Bioelectrical Impedance Analysis (BIA) is a measure of body composition that can be
336 used to differentiate between fat and fat free mass and is also a predictor for nutritional status
337 ⁽⁴⁰⁾. BIA is used in clinical settings as it is considered to be non-invasive, no technical skill is
338 required and it is comfortable for patients compared to other methods. However, BIA is expensive
339 and time consuming and due to time and staffing constraints in a busy outpatient setting a more
340 economic and practical measurement of body composition is required.

341 Tricep Skinfold thickness (TSF) is the most frequently used method for assessment of body
342 composition as it is cheap and feasible. Body fat can be predicted by the sum of skinfold thickness
343 from different parts, as the total body fat correlates with subcutaneous fat ⁽⁴¹⁾. TSF has been found
344 to correlate well with BIA in a study which evaluated the body fat estimated by BIA and TSF on

345 348 undergraduate students and concluded that the anthropometric method can surrogate fat mass
346 % and assess body fat when BIA is unavailable ⁽⁴²⁾. The addition of TSF may be useful to
347 support ‘MUST’ in identifying malnutrition risk in the IBD patient cohort. However, the
348 acceptability of this additional measure in the IBD patient group would require further testing
349 in clinical practice.

350 **Implications**

351 Implementing ‘MUST’-P could potentially reduce the workload demands on HCP’s to screen
352 patients for identification of malnutrition risk of patients in the outpatient setting. Furthermore,
353 the use of self-screening has the capacity to promote patient involvement in their own care.
354 However, due to the complex nature of IBD there are concerns that using a generic malnutrition
355 screening tool may not capture all patients at malnutrition risk. It may be that screening in the
356 community is a more appropriate setting for ‘MUST’ where rates of under-recognised and
357 under-treated malnutrition are known to be high ⁽³⁵⁾. Patients could be advised to use the web-
358 based malnutrition self-screening tool based on ‘MUST developed and available on the
359 BAPEN website ⁽³⁵⁾ which is designed to help adults to identify their own risk of malnutrition
360 in the community.

361

362 **Recommendations for further research**

363 In order to be able to generalise these findings to the wider IBD population, larger studies are
364 required in different UK hospital outpatient settings.

365

366 The use of HCP led focus groups could be used to explore perceptions of ‘MUST’-P and help
367 to identify the potential barriers and facilitators of its use develop the tool further and improve
368 its accuracy and validity. To enable successful implementation of ‘MUST’-P in the outpatient
369 setting, appropriate and practical malnutrition care pathways would need to be developed so
370 that those identified as malnourished are appropriately managed and treated. However, dietetic
371 resourcing available for those patients identified at high risk may be a limiting factor.

372

373 **Limitations**

374 Test-retest reliability was performed both by Cawood et al ⁽²⁷⁾ and McCurk et al ⁽²⁵⁾ in order
375 to compare the accuracy of two different self-screening scores. Similar to the work of Sandhu
376 et al ⁽²²⁾, this study did not perform test-retest reliability as there would be a short duration of
377 time between baseline ‘MUST’-P and repeat screening and it is highly likely the patients would
378 recall their baseline score, potentially introducing reporting bias. Only 3 patients approached

379 refused to complete 'MUST'-P indicating a high response rate. The sample size of 80 compares
380 favourably to other studies in IBD cohorts (²⁰). A limitation of the validity of the study was
381 that due to the low numbers of patients with active disease, it was not possible to assess whether
382 there was a significant relationship between disease activity and 'MUST' score. The results of
383 our study correlate well with a previous larger study in a similar patient cohort (²²). However,
384 the results of our study cannot be generalised to the wider population due to the small sample
385 size which was restricted to a single UK based large tertiary hospital.

386

387 **Conclusions**

388 This study confirms previous findings that suggest 'MUST'-P is a quick and easy method of
389 nutritional screening for use in a busy outpatient setting. Moderate agreement was found
390 between 'MUST'-HCP and 'MUST'-P with the strongest agreement for medium and high risk
391 patients. Although the overall malnutrition rates were found to be low, not all patients
392 recognised as at high risk of malnutrition by 'MUST'-HCP were referred to the Dietitian.
393 Furthermore, due to the complexity of nutritional issues specific to IBD patients the use of a
394 generic tool may risk missing patients deemed as low risk that may still require nutritional
395 intervention. The authors recommend that to ensure all nutritionally at risk patients are
396 identified, this tool is combined with measurement of body composition and consideration of
397 micronutrient serum levels. Frequent and regular nutritional screening in all health care settings
398 will allow the malnutrition risk to be identified early and be prevented or treated appropriately.

399

400

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408

409 **‘Transparency Declaration’.**

410 *"The lead author affirms that this manuscript is an honest, accurate, and transparent account*
411 *of the study being reported, that no important aspects of the study have been omitted and that*
412 *any discrepancies from the study as planned have been explained. The reporting of this work*
413 *is compliant with STROBE guidelines."*

414

415 **Conflict of Interest Statement and Funding sources:**

416 None declared.

417

418

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580 **Figure and Table Legends**

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582 **Table 1:** Demographic and Clinical Characteristics of the study participants (total n=80).

583 **Table 2:** Comparison of malnutrition risks as identified by the MUST-P and the MUST-HCP
584 (total n=77)

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Table 1: Demographic and Clinical Characteristics of the study participants (total n=80).

Characteristic	UC % (n) 36.2 (29)	CD* % (n) 61.3 (49)	Comparison of UC and CD P value	IBD-U 2.5 (2)	Total IBD cohort (n=80)
Age: mean (SD) years	43.1 (16.2)	37.8 (14.6)	0.14	45 (5.7)	39.9 (15.1)
Gender (n,%)					
Female	14 (48.3)	23 (46.9)	0.91	2 (100.0)	39 (48.8)
Male	15 (51.7)	26 (53.1)		0 (0.0)	41 (51.2)
Time since diagnosis (n,%)			0.90		
≤ 10 years	17 (58.6)	28 (57.1)		2 (100.0)	47 (58.8)
>10 years	12 (41.4)	21 (42.9)		0 (0.0)	33 (41.2)
Well-being (n,%)**	0=11(37.9) 1=17(58.6)	0=20 (40.8) 1=22 (44.9)	0.80	0=1 (50.0) 1=0 (0.0)	0=32 (40.0)
0 (very well)	2=1(3.5)	2=4 (8.2)		2=0 (0.0)	1=39
1 (slightly below average)	3=0 (0.0) 4=0 (0.0)	3=2 (4.1) 4=1 (2.0)		3=1 (50.0)	(48.8)
2 (poor)					2=5 (6.2)
3 (very poor)					3=3 (3.8)
4 (terrible)					4=1 (1.2)
Height (m) mean (SD)	1.71 (0.09)	1.71 (0.08)	0.75	1.54 (0.11)	1.71 (0.09)
Weight (kg) mean (SD)	81.7 (20.9)	74.2 (19.5)	0.12	50.1 (9.3)	76.3 (20.4)
BMI (kg/m²) mean (SD)	27.6 (6.0)	25.3 (5.8)	0.10	20.9 (1.0)	26 (5.89)
Area (n,%) Deprivation***					
Most deprived	23 (79.3)	24 (50.0)	0.01	1 (50.0)	48 (60.8)
Least deprived	6 (20.7)	24 (50.0)		1 (50.0)	31(39.2)

588 Data are presented as mean (SD), n(%), using unpaired t-test and Chi-square test to test for
589 differences by IBD group. P-values represent differences between subgroups UC and CD only.

590 *including Crohn's Colitis

591 ** Well-being variable was categorised as very well (score 0) versus all other scores (1-4)
592 when compared by IBD group using the Chi square test

593 ***Area deprivation variable includes n=1 missing value

594 Abbreviations: BMI, body mass index; IBD, Inflammatory Bowel Disease

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597 **Table 2:** Comparison of malnutrition risks as identified by the MUST-P and the MUST-HCP
 598 (total n=77)

		Malnutrition Risk by MUST-P						Total
		Low		Medium		High		
		N	%	N	%	N	%	N
Malnutriti on Risk by MUST- HCP	Low	49	74.2%	2	3.0%	15	22.7%	66
	Medium	0	0.0%	6	100.0%	0	0.0%	6
	High	0	0.0%	0	0.0%	5	100.0%	5
Total	49	63.6%	8	10.4%	20	26.0%	77	

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