Original Article

Development of a screening tool to detect nutrition risk in patients with inflammatory bowel disease

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Background and Objectives: Malnutrition is a known complication of Inflammatory Bowel Disease (IBD). We assessed a known screening tool, as well as developed and validated a novel screening tool, to detect nutrition risk in outpatients with IBD. **Methods and Study Design:** The Saskatchewan IBD–Nutrition Risk (SaskIBD-NR Tool) was developed and administered alongside the Malnutrition Universal Screening Tool (MUST). Nutrition risk was confirmed by the IBD dietitian (RD) and gastroenterologist (GI). Agreement between screening tools and RD/GI assessment was computed using Cohen's kappa. **Results:** Of the 110 patients screened, 75 (68.2%) patients had Crohn's Disease and 35 (31.8%) ulcerative colitis. Mean BMI was 26.4 kg/m^2 (SD=5.8). RD/GI assessment identified 23 patients (20.9%) at nutrition risk. The SaskIBD-NR tool classified 21 (19.1%) at some nutrition risk, while MUST classified 17 (15.5%). The SaskIBD-NR tool had significant agreement with the RD/GI assessment (k 0.83, p<0.001), while MUST showed a lack of agreement (k 0.15, p=0.12). The SaskIBD-NR had better sensitivity (82.6% vs 26.1%), specificity (97.7% vs 87.4%), positive predictive value (90.5% vs 35.3%), and negative predictive value (95.5% vs 81.7%) than the MUST. **Conclusion:** The SaskIBD-NR, which assesses GI symptoms, food restriction, and weight loss, adequately detects nutrition risk in IBD patients. Broader validation is required.

Key Words: nutrition screening tool, nutrition risk, inflammatory bowel disease, Crohn's disease, ulcerative colitis

INTRODUCTION

Malnutrition and weight loss are well recognized complications of inflammatory bowel disease (IBD).[1] One of the most under recognized mechanisms of malnutrition is reduced food intake and specific avoidance of foods among IBD patients. Up to 90% of Crohn's disease (CD) patients and 71% of ulcerative colitis (UC) patients in remission use elimination diets to control symptoms.[2] Protein-energy malnutrition is common in active, severe IBD; however micronutrient deficiencies (vitamins, minerals and trace elements) are seen even in patients with mild disease or in clinical remission. Micronutrient deficiencies can lead to co-morbidities including anemia, osteoporosis, thrombophilia, colorectal cancer, and poor wound healing.[3] Weight loss may not be the best measure of nutrition risk in IBD, as emerging literature suggests that IBD patients in remission have similar body mass indices (BMI) as healthy controls.[4,5] As well, there is a growing prevalence of obesity in the IBD population.[6-10]

A number of nutrition screening tools are available that have been validated in a variety of populations including medical, oncologic, and surgical patients.[11-13] However, routine nutrition screening is not commonly performed in the IBD outpatient setting, resulting in under detection and undertreatment of both malnutrition and nutrient deficiencies.[1,14] The Subjective Global Assessment (SGA) is widely considered the gold standard to diagnose patients who are moderately or severely malnourished.[15] However, patients who are at risk of malnutrition should be identified early when interventions can be applied, rather than once they are already malnourished. SGA does not assess whether patients are avoiding food items or food groups. A screening tool to detect IBD patients at risk of malnutrition and nutrient deficiencies, rather than those who are already malnourished, is therefore needed. Existing nutrition screening tools may be of limited use in the IBD outpatient population, as BMI and weight loss are often key

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measures used in these tools. A recent systematic review indicates that BMI does not accurately predict body composition in IBD[16] and the growing prevalence of obesity in the IBD population,[6-10] means that patients with normal or elevated BMIs may not be appropriately identified as at risk of malnutrition with traditional screening tools.

The malnutrition universal screening tool (MUST)[12] has been validated in varied populations, including medical, surgical, and general gastroenterology patients.[17] The tool focuses on BMI, weight loss, and the acute disease effect. Although the MUST has not been validated specifically in the IBD patient population, it has been reported to be quick and easy to use which is desirable in demanding IBD outpatient settings.[17,18] A recent publication showed that patient-administered MUST was comparable to healthcare practitioner-administered MUST, in the outpatient IBD clinic setting.[18] However, potential limitations of MUST are the emphasis it places on BMI, and that it does not take into consideration recent nutrient intake and food avoidance, which are risk factors for micronutrient deficiencies.

A screening tool to detect nutrition risk that is quick and easy to administer and that identifies key nutrition risk factors in the IBD outpatient population does not currently exist in clinical practice. Given that elimination diets, food exclusion and micronutrient deficiencies are common in IBD patients, and that BMI may not be an accurate predictor of nutrition risk in this population, the aim of this study was to develop a reliable and valid nutrition screening tool that would identify patients with IBD at risk for malnutrition and potential nutrient deficiencies in the outpatient setting.

MATERIALS AND METHODS

Development of a nutrition screening tool for patients with IBD

The Saskatchewan Inflammatory Bowel Disease – Nutrition Risk Tool (SaskIBD-NR Tool) is a locally developed screening tool that was initially developed by three dietetic interns. Key criteria for development of the nutrition screening tool were that it 1) be simple, quick and easily completed by all team members; 2) use data that was routinely available; 3) be non-invasive and economical; 4) could be incorporated into routine assessment; and 5) be valid and reliable. The dietetic interns met with the multidisciplinary IBD team (Registered Dietitian, two Gastroenterologists, Nurse Practitioner, Nurse Clinician, and IBD Research Coordinator) to determine nutrition risk factors that should be incorporated into a nutrition screening tool.

The questions in the SaskIBD-NR Tool were developed from the literature,[1,3-7] available tools,[19] and clinician experience. The SaskIBD-NR Tool considers symptoms (nausea, vomiting, and diarrhea), nutrient intake (food intake and food avoidance), and unintentional weight loss, all of which are all well-defined risk factors for malnutrition in the IBD outpatient population. Questions pertaining to symptoms gauge IBD disease activity (active or remission). Questions pertaining to nutrient intake screen for potential micronutrient deficiency. Questions relating to weight loss screen for potential protein-energy malnutrition. Once a final version of the questionnaire was defined, content validity of the tool was evaluated by the Saskatchewan multidisciplinary IBD team which acted as a committee of experts. Subsequently, the SaskIBD-NR Tool was piloted by dietetic interns with five IBD patients to determine if the questions were clear and easy to understand.

Sample

The study was conducted in the outpatient department at Royal University Hospital in Saskatoon, Saskatchewan, Canada in the Multidisciplinary Inflammatory Bowel Disease Clinic over a three-month period. A convenience sample of 110 outpatients with IBD participated in the study. All participants in the study were ≥18 years, and had an established diagnosis of IBD based on standard clinical, radiologic, endoscopic and histologic criteria. Pregnant women with IBD were excluded.

Prior to entering the treatment room, weight (kilograms) and height (meters) were completed by support staff, and BMI was calculated (kilograms divided by meters squared). Patients were asked the questions on the SaskIBD-NR Tool (Table 1) and the MUST (Table 2) by the gastroenterologist, dietitian, or nurse practitioner as part of the patient's regularly scheduled appointment. Responses to each of the nutrition screening questions in the SaskIBD-NR Tool and MUST were given a score (low, medium or high-risk categories). For the purposes of analysis, patients falling into the 'at risk'/'medium risk' and 'malnourished'/'high risk' groups (≥1 for MUST and ≥3 for the SaskIBD-NR Tool) were combined into one 'pooled-risk' group for each method of screening. This method of combining risk groups has been previously used in similar studies.[17,19-21] The prevalence of nutrition risk using both screening tools was compared.

Reliability of the SaskIBD-NR and the MUST screening tools

The Registered Dietitian and Gastroenterologist (RD/GI) assessment was chosen as the "gold standard" for determining the actual risk of malnutrition. A major challenge

Table 1. SaskIBD-NR Tool

Nutrition screening item	Score
1. Have you experienced nausea, vomiting, diarrhea or poor appetite for greater than two weeks?	"no symptoms"=0, "1-2 symptoms"=1, "≥3 symptoms"=2
2. Have you lost weight in the last month without trying?	"no"=0, "unsure"=1, "yes"=see below
IF YES, how much weight have you lost?	"<5 lbs"=0, "5-10 lbs"=1, "10-15 lbs"=2, ">15 lbs"=3
3. Have you been eating poorly because of a decreased appetite?	"no"=0, "yes"=2
4. Have you been restricting any foods or food groups?	"no"=0, "yes"=2

Total score: 0-2=low risk, 3-4=medium risk, ≥5=high risk.

Table 2. MUST

Nutrition screening item	Score
Step 1: BMI score BMI=kg/m^2	">20"= 0, "18.5-20"= 1, "<18.5"= 2
Step 2: Weight loss score Unplanned weight loss in past 3-6 months (% Score)	"<5"= 0, "5-10"= 1, ">10"= 2
Step 3: Acute disease effect score Patient is acutely ill and there has been or is likely to be no nutritional intake for >5 days	"no"= 0, "yes"=2

Total score: 0=low risk, 1=medium risk, ≥2=high risk

Table 3. Criteria used to determine nutrition risk: RD/GI assessment

- Diagnosis (Crohn's disease or ulcerative colitis)
- Body mass index (BMI)
- Unintentional weight loss
- Presence or absence of symptoms (stools, vomiting, nausea, pain)
- Location of disease, disease severity, concurrent conditions
- Surgical history
- Medications
- Laboratory parameters (albumin, vitamin D, iron status, vitamin B12)
- Simple Colitis Activity Index (SCAI)[†], Harvey Bradshaw score (HBS)[†]
- Intake (appetite, food restriction)

[†]When available.

to validating nutrition risk screening tools is the absence of single "gold standard" for identifying patients at risk of malnutrition.[22] The SGA is widely considered the gold standard in many studies pertaining to malnutrition. However, the SGA identifies patients who are already moderately or severely malnourished, rather than those who are at risk of becoming malnourished. SGA examines overall nutrition intake versus specific food avoidance which is common in the IBD population.[2,23,24] As well, a study assessing different indicators of malnutrition in IBD patients found that although 74% of patients were well nourished according to the SGA, these patients had decreases in body cell mass and handgrip strength compared to controls.[5] We therefore instead used a comprehensive assessment by the RD/GI as the "gold standard" for determining the patients who are at risk of malnutrition.

For each patient, the RD and GI completed a retrospective chart review using the criteria outlined in Table 3 to determine nutrition risk. No formal scores were assigned for each criterion. Rather, all the factors were taken into account by the RD and GI to determine if patients were either 'not at risk' or 'at risk' of malnutrition. The RD/GI assessment was completed within one week of the nutrition screening. The RD and GI were not aware of the scores of the SaskIBD-NR or the MUST until the chart review (RD/GI assessment) was completed. Upon completion of the chart review the patient's scores on the SaskIBD-NR Tool and the MUST were compared to the RD/GI assessment. To assess concurrent validity, the SaskIBD-NR Tool and the MUST score were compared.

Cohen's kappa statistic was computed to measure agreement between the SaskIBD-NR tool and RD/GI assessment, as well as between MUST and RD/GI assessment. Receiver operating characteristic (ROC) curves were also drawn using the actual scores of the MUST and SaskIBD-NR screening tools. Using the pooled-risk groups, sensitivity, specificity, positive predicted value (PPV), negative predictive value (NPV), and ROC area were computed, with their respective 95% confidence intervals (95% CI), for the SaskIBD-NR and MUST screening tools. Inter-rater reliability was not evaluated given that each evaluation was completed by a gastroenterologist, dietitian, or nurse practitioner. Statistical analyses were performed using IBM SPSS Statistics version 23 (SPSS Inc. Chicago, IL) and the *diagti* command in STATA version 13 (Stata Corporation, College Station, TX).

The University of Saskatchewan Research Ethics provided an exemption for ethics board review prior to initiation of the study. Patients provided informed consent for the use of their data in the evaluation of these screening tools. If patients were deemed at nutrition risk, by any method, they were referred to the RD for further assessment.

RESULTS

The SaskIBD-NR Tool

The SaskIBD-NR Tool evaluates four components: gastrointestinal symptoms, weight loss, anorexia, and food restrictions (Table 1). This nutrition screening tool was specifically developed for patients with IBD. The committee of experts verified the content validity of the final version of the SaskIBD-NR Tool and approved it. In the pilot, patients with IBD confirmed that the questions of the screening tool were clear and understandable.

Sample group

Demographics and clinical characteristics of IBD patients are summarized in Table 4. Mean age was 39 years (SD=15), 63 (57.3%) participants were female, 75 (68.2%) patients had CD, and 35 (31.8%) UC. Mean BMI

Was 26.4 kg/m^2 (SD=5.8).

Reliability of the SaskIBD-NR and the MUST screening tools

All participants were screened with the SaskIBD-NR Tool, MUST and had a RD/GI nutrition risk assessment. Differences were observed in the prevalence of IBD patients at nutritional risk using these 3 methods of assessment (Figure 1). The RD/GI assessment identified 20.9% (95% CI 13.7-29.7%, n=23) of the patients at nutritional risk. The SaskIBD-NR Tool classified 19.1% (95% CI 12.2-27.7%, n=21) of the patients at some nutritional risk: 9 (8.2%, 95% CI 3.8-15%) at high risk and 12 (10.9%, 95%CI 5.8-18.3%) at medium risk. In contrast, the MUST considered that only 15.5% (95%CI 9.3-23.6%, n=17) of the patients were at some nutritional risk: 5 (4.5%, 95%CI 1.5-10.3%) at high risk and 12 (10.9%, 95%CI 5.8-18.3%) at medium risk.

The results of the nutritional screening tools were compared with the results of the RD/GI assessment (Table 5). A high and significant agreement was identified between the SaskIBD-NR Tool and RD/GI assessment (kappa 0.83, p<0.001), with good levels of agreement among both patients with CD (kappa 0.82, p<0.001) and UC (kappa 0.84, p<0.001). Conversely, a lack of agreement was observed between the MUST and RD/GI assessment (kappa 0.15, p=0.12). This disagreement was similar among patients with CD (kappa 0.14, p=0.27) and UC (kappa 0.16, p=0.31). There was no significant agreement between the SaskIBD-NR Tool and MUST (kappa: 0.18, p=0.06). A larger ROC area was observed for the SaskIBD-NR tool (97.7%, 95% CI 95.5-98.3%) in comparison to the ROC area of the MUST (56.4%, 95% CI 46.7-66%) (Figure 2a).Using the pooled-risk group, the ROC area of the SaskIBD-NR Tool was 90.2% (95%CI 82.1-98.2%) versus 56.7% (95% CI 46.9-66.5%) for the MUST (Figure 2b).

Table 4. Demographics and clinical characteristics (n=110)

	Mean±SD, range/n (%)
Age, years	39±15, 17-79
Gender	
Female	63 (57.3)
Body mass index (kg/m^2)	26.4±5.8, 17.7-43.2
Diagnosis[†]	
CD	75 (68.2)
Upper gastrointestinal	2 (2.7)
Ileal	21 (28)
Colonic	21 (28)
Ileocolonic	32 (42.7)
Perianal	11 (14.7)
UC	35 (31.8)
Proctitis	7 (20)
Left-sided colitis	16 (45.7)
Extensive colitis	12 (34.3)
HBI score[‡]	4.2±6.7, 0-35
SCCAI score[§]	1.3±2.2, 0-9
Medication type for IBD (%)	
None	16 (14.5)
5-aminosalicylic acid	32 (29.1)
Corticosteroids	5 (4.5)
Immunomodulator monotherapy	17 (15.5)
Anti-TNF monotherapy	14 (12.7)
Other biologics	3 (2.7)
Immunomodulator + biologic	13 (11.8)
Other combined schemes	10 (9.1)

[†]Percentages total more than 100% because some patients have been counted in more than one category.
[‡]Harvey-Bradshaw Index (HBI), n=67.
[§]Simple Clinical Colitis Activity Index (SCCAI), n=33.

Sensitivity and specificity of the SaskIBD-NR Tool was tested at different cut-off values to determine variations of this screening tool. This evaluation identified that the chosen cut-off in this study (i.e., classifying IBD patients with a score of ≥3 as at risk of malnutrition and those with a score of <2 at low risk of malnutrition) had

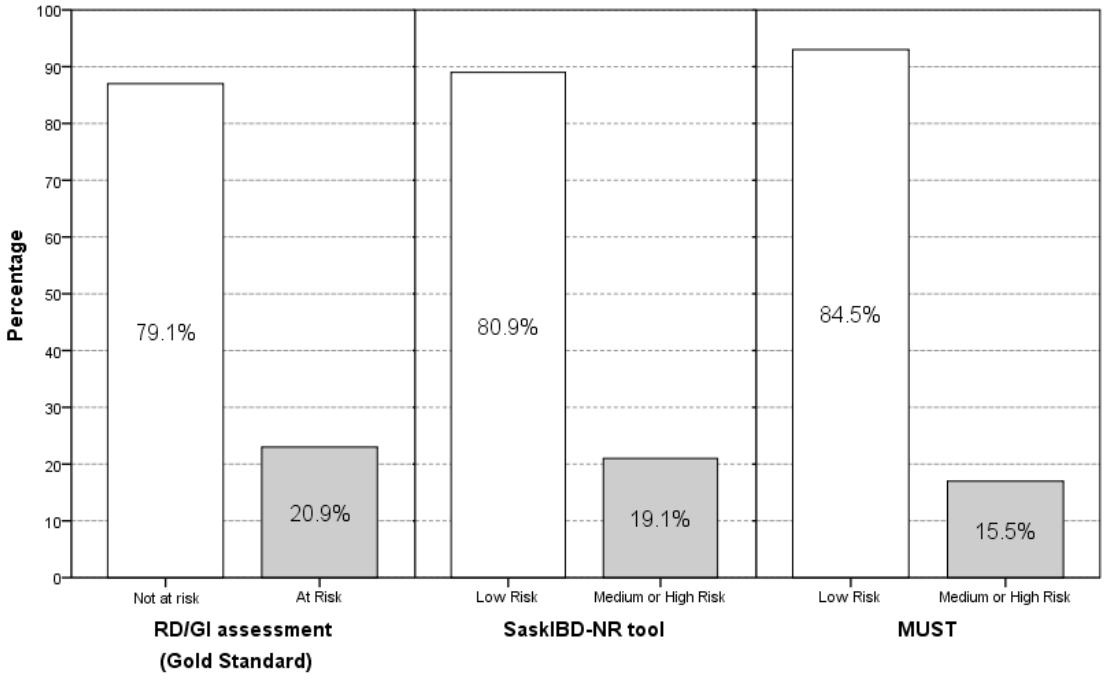

Figure 1. Prevalence of IBD patients at nutritional risk according to the RD/GI nutrition risk assessment, SaskIBD-NR Tool, and MUST.

Table 5. Reliability of the nutrition risk screening tools

Screening tool		RD/GI assessment			K	SE % (95% CI)	SP % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	ROC area % (95% CI)
		Not at risk	At risk	Total						
SaskIBD-NR	Low risk	85	4	89	0.83*	82.6 (61.2-95)	97.7 (91.9-99.7)	90.5 (69.6-98.8)	95.5 (88.9-98.8)	90.2 (82.1-98.2)
	At risk	2	19	21						
MUST	Low risk	76	17	93	0.15	26.1 (10.2-48.4)	87.4 (78.5-93.5)	35.3 (14.2-61.7)	81.7 (72.4-89)	56.7 (46.9-66.5)
	At risk	11	6	17						

K: kappa statistic; SE: sensitivity; SP: specificity; PPV: positive predicted value; NNV: negative predicted value; ROC: receiver operating characteristic.
*p-value <0.001

an adequate balance of sensitivity and specificity and the best ROC area.

DISCUSSION

We developed a valid and reliable screening tool to detect nutrition risk in outpatients with IBD, as one was previously not available. Poor nutritional status has many consequences for patients including worsening disease progression and having a negative impact on patients' quality of life.[25] A screening tool developed specifically for the IBD outpatient population could help identify patients who are at nutrition risk and who would benefit from a more detailed nutrition assessment and counselling from a dietitian.

Despite the number of nutrition risk screening tools available, most tools use BMI (<20) as an indicator of nutrition risk. Ample evidence has shown that IBD patients in remission have similar BMI as healthy controls[4,5] and that there is a growing prevalence of obesity in the IBD population,[6-10] which makes BMI a poor indicator of nutrition risk. Our sample was reflective of the growing prevalence of obesity in the IBD population as the mean BMI was 26.4 kg/m^2 (SD=5.8).

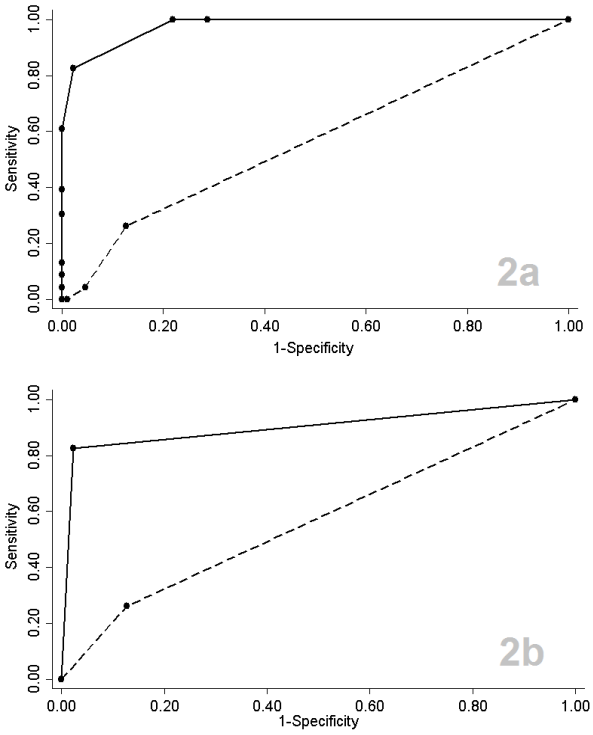

Figure 2. ROC curves of the MUST (dashed lines) and SaskIBD-NR (solid lines) screening tools for actual scores (2a) and pooled-risk group (2b).

When compared with the GI/RD assessment, the SaskIBD-NR Tool showed very good sensitivity and excellent specificity in identifying patients at nutrition risk. The high sensitivity of the tool illustrates that the SaskIBD-NR Tool was accurately able to detect nutrition risk in our sample, indicating the validity of the tool. As observed in the ROC area, the selected cut-off demonstrated an excellent ability of the SaskIBD-NR Tool to identify patients with IBD at nutritional risk.

The SaskIBD-NR Tool showed significant agreement with the RD/GI assessment with 91% agreement identifying patients at nutrition risk. The high level of agreement between the two demonstrates that the SaskIBD-NR Tool is equivalent to the RD/GI assessment. The SaskIBD-NR Tool misidentified six patients with two false positive and four false negative results. The two false positive patients both had CD and had ongoing gastrointestinal symptoms that were attributed to irritable bowel syndrome, as objective investigations did not demonstrate any active inflammation. These patients were not classified as 'at risk of malnutrition' by the RD/GI. The four false negative patients all had active inflammatory disease based on objective investigations, but all greatly minimized their symptoms. These patients would therefore not have been identified as being at risk of malnutrition with any screening tool using patient reported symptoms. It was only with a more in-depth review of the patient history by the RD/GI that these patients were identified as being at risk of malnutrition.

The lack of agreement between the RD/GI assessment and the MUST is likely related to our sample having a mean BMI was 26.4 kg/m^2, therefore the MUST underestimated the number of patients at nutrition risk due to the increased prevalence of overweight (BMI >24.9) patients in our population.

Reduced food intake and specific avoidance of foods among IBD patients is another mechanism leading to malnutrition.[3] This is not taken into account with the MUST. The SaskIBD-NR Tool identified that 37.3% of the patients had been restricting foods or food groups. This is important to identify as restriction of foods can lead to micronutrient deficiencies,[3] which may not be routinely assessed for in clinical practice.

Although the time to complete the SaskIBD-NR Tool was not recorded for every patient, our experience sug-

gests that it can be completed as part of a standard clinic visit in less than 2-3 minutes. Conversely, the RD/GI assessment, which entailed a review of clinical symptoms, physical exam findings, disease history, and laboratory markers, was significantly more time consuming to perform. The time required for this complete assessment, as well as limitations in resources such as access to a RD for review of all IBD patients, makes this approach impractical in many gastroenterology practices. The SaskIBD-NR Tool, in comparison, is quick and easy to administer in the busy outpatient setting.

Limitations to this study may be attributed to the RD/GI assessment being performed based on review of the patient's complete medical record. The retrospective nature of this assessment may have led to recall bias. Future applications of the SaskIBD-NR Tool include assessment in other clinical settings, such as community-based gastroenterology clinics, and in other centers in Canada and internationally, to confirm the screening tool's validity and reliability.

In conclusion, SaskIBD-NR Tool is a valid and accurate screening tool that can be helpful in identifying IBD outpatients at nutrition risk who would benefit from referral to a dietitian for a more in-depth nutrition assessment and counselling. The use of traditional tools, such as the SGA, limits our identification to patients who are already malnourished. Our focus needs to change. We instead should be using screening tools to identify patients who are at risk of malnutrition early when appropriate interventions can be implemented. The SaskIBD-NR tool is quick and easy to administer, and if implemented systematically in the outpatient setting, could have a significant beneficial impact in the care of IBD patients.

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AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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