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## Nutrition screening in the adult stroke population using the Canadian Nutrition Screening Tool in comparison with the Subjective Global Assessment

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Foods and Nutrition

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## Abstract

Although the Canadian Best Practice Recommendations for Stroke Care recommend all acute stroke patients be screened for malnutrition within 48 hours of admission to hospital using a valid screening tool, none have been validated for use in adult acute stroke patients. The Canadian Nutrition Screening Tool (CNST) tool has been validated within medicine and surgery patients. The purpose of this study is to estimate the level of agreement between the CNST and the Subjective Global Assessment (SGA), a nutrition assessment tool, in a cohort of 58 acute adult stroke patients at the Southwestern Ontario Regional Stroke Centre in London. In this prospective study, the patient's nurse conducted CNST within 48 hours of admission and research RD conducted the SGA. CNST had a weak agreement with SGA ( $K=0.23$ ). Sensitivity was 24% and specificity was 97%. CNST may not be the best nutrition screening tool for acute stroke patients. Future work and nutritional implications are discussed.

## Keywords

Malnutrition screening tool, malnutrition screening, adult acute stroke, Subjective Global Assessment (SGA), Canadian Nutrition Screening Tool (CNST), Canadian Best Practice Recommendations for Stroke Care, nutrition assessment, registered dietitian (RD), adult malnutrition, Canadian Malnutrition Task Force (CMTF)

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## List of Abbreviations

PEM	Protein Energy Malnutrition
CMTF	Canadian Malnutrition Task Force
CNST	Canadian Nutrition Screening Tool
Academy	Academy of Nutrition and Dietetics
ASPEN	American Society of Parenteral and Enteral Nutrition
NFPA	Nutrition Focused Physical Assessment
RD	Registered Dietitian
EAL	Academy of Nutrition and Dietetics Evidence Analysis Library
ESPEN	European Society of Parenteral and Enteral Nutrition
SGA	Subjective Global Assessment
JaNuS	Just a Nutrition Screening
STAMP	Screening Tool for the Assessment of Malnutrition in Pediatrics
3-MinNS	3-Minute Nutrition Screening
SCREEN II	Seniors in the Community: Risk Evaluation for Eating and Nutrition version II
MST	Malnutrition Screening Tool

MUST	Malnutrition Universal Screening Tool
LOS	Length of hospital stay
AVM	Arteriovenous malformation
TIA	Trans ischemic attack
PG-SGA	Patient-Generated Subjective Global Assessment
MNA	Mini Nutrition Assessment
NRS 2002	Nutrition Risk Screening 2002
CI	Confidence Interval
DGEM	German Society for Clinical Nutrition
CT	Computed tomography
POA	Power of attorney
SDM	Substitute decision maker
SLP	Speech-language pathologist
RSC-Lon	Regional Stroke Centre- London, Ontario

## Introduction

Malnutrition associated with stroke has a significant negative impact on rehabilitation and survival.<sup>1-3</sup> The term “malnutrition” typically refers to long term protein and energy depletion, but can be difficult to pinpoint.<sup>4</sup> Loss of body tissues resulting in wasting is common in several conditions which can be caused by a combination of reduced food intake, excessive requirements, altered metabolism, sepsis, trauma, ageing and inactivity.<sup>5</sup> These have been referred to loosely as ‘malnutrition’ but not all will respond simply by providing sufficient nutrients to meet the patient’s estimated needs. Protein energy malnutrition (PEM) mainly occurs due to elevated energy expenditure and decreased energy intakes in which nutrition support can be highly effective.<sup>5</sup> The reported prevalence of malnutrition following stroke varies greatly, ranging from 6.1% to 62%.<sup>4</sup> The varied screening and assessment methods, timing of assessments, and varied untrained users likely account for the different estimates of the prevalence of malnutrition following stroke.<sup>4</sup>

Although many nutritional screening and assessment tools are used, none have been evaluated to establish their validity and reliability within this specific patient population. In a recent review of 22 trials examining the prevalence of malnutrition following stroke, 18 used different assessment methods.<sup>6</sup> To further complicate this process, screening and assessment tools evaluate different combinations of nutrition-related markers such as weight, bloodwork related to nutrition, dietary intake history, and use different criteria to interpret this data.<sup>4,6</sup> Furthermore, these differences may hinder the registered dietitian’s (RD) ability to determine a patient’s true nutritional status, as well as monitor and evaluate their response to nutritional intervention over time.<sup>7</sup>

Per the 2015 Canadian Stroke Best Practice Recommendations the nutritional and hydration status of stroke patients should be screened within the first 48 hours of admission using a valid screening tool.<sup>8</sup> A recent survey of 95 RDs practicing at acute care hospitals across Canada exploring the use of valid screening and assessment following stroke revealed that only 11% of RDs reported using previously validated screening tools and 40% indicated that the tools were modified in some way.<sup>9</sup> This could lead to patients at high risk for malnutrition being left unidentified and untreated which may impact their hospital length of stay, poor long- term rehabilitation and their prognosis or mortality.

Mandatory standardized screening protocols in hospitals are a top priority for the Canadian Malnutrition Task Force (CMTF). The CMTF has developed the Canadian Nutrition Screening Tool (CNST) found in Appendix A which has been validated in the hospital setting, composed of two questions: ‘Have you lost weight in the past 6 months without trying to lose this weight?’ and ‘Have you been eating less than usual for more than one week?’ Two “yes” answers indicate nutrition risk and a referral to the RD should be immediate.<sup>10</sup> Although the CNST has been validated in the medicine and surgical departments, this has not been validated specifically for acute stroke patients.

# 1 Background

## 1.1 Definition of Malnutrition

Malnutrition in acute-care settings has been well researched in the developed world. It is recognized that malnutrition is associated with negative clinical outcomes including increased risk of pressure ulcers and impaired wound healing, immunity suppression, muscle wasting, functional loss, increased risk of falls, longer length of hospital admissions, higher re-admission rates, and increased mortality.<sup>11,12</sup>

To adequately assess incidence of malnutrition in a specific population group the definition of malnutrition is required and currently no standardised definition of malnutrition world-wide exists. In simple terms, malnutrition refers to any nutrition imbalance.<sup>13</sup> Loss of body tissues resulting in wasting is common in several conditions which can be caused by a combination of reduced food intake, excessive requirements, altered metabolism, sepsis, trauma, ageing and inactivity.<sup>5</sup> These have been referred to loosely as 'malnutrition' but not all will respond simply by providing sufficient nutrients to meet the patient's estimated needs. Cachexia is a clinical feature of illnesses such as cancer, heart failure, arthritis and chronic pulmonary disease. The mechanism of muscle loss in cachexia is related to a direct action of cytokines and indirect effects of the hypothalamus on metabolism rather than simply protein-energy starvation.<sup>5</sup> Cachexia

should not be identified as malnutrition as it cannot be successfully treated with nutrition alone.<sup>5</sup> Sarcopenia is a condition characterized by loss of skeletal muscle mass and function.<sup>14</sup> Although a condition primarily seen in the elderly, sarcopenia can be seen in conditions that are not exclusive to the older population such as cachexia, malnutrition, and in younger patients with inflammatory conditions such as Crohn's disease.<sup>15</sup> The mechanisms of sarcopenia are not clearly defined. Risk factors for sarcopenia include age, gender and level of physical activity, and resistance exercise is particularly effective for slowing the age-related loss of skeletal muscle. Furthermore, sarcopenia is associated with major co-morbidity such as obesity, osteoporosis and type 2 diabetes and insulin resistance.<sup>14</sup> The loss in muscle mass may be associated with increased body fat so that despite normal weight there is marked weakness, this is a condition called sarcopenic obesity.<sup>14</sup> With aging, lean body mass decreases, while fat mass increases particularly in the intra-abdominal area, even in relatively weight-stable individuals. Obesity and sarcopenia may strengthen each other and act synergistically causing physical impairment, metabolic disorders and mortality.<sup>14</sup> It has been proposed that excess energy intake, physical inactivity, low-grade inflammation, insulin resistance and changes in hormonal homeostasis may result in the development of sarcopenic obesity.<sup>14</sup>

According to Jeejeebhoy, the term malnutrition should only be applied only to conditions which dramatically respond to feeding.<sup>5</sup> PEM mainly occurs due to elevated

energy expenditure and decreased energy intakes in which nutrition support can be highly effective.<sup>5</sup>

### 1.1.1 Characteristics Recommended for the Diagnosis of Adult Malnutrition

In response to a growing need to standardize the approach to the diagnosis of malnutrition in adults, the Academy of Nutrition and Dietetics (Academy) and American Society of Parenteral and Enteral Nutrition (ASPEN) appointed a workgroup in 2009 to identify and standardize characteristics that reflect nutrition status vs. the inflammatory response that is associated with various diseases and /or conditions.<sup>13</sup> These characteristics should support a nutrition diagnosis, characterize severity, change as nutrition status changes, be evidenced based when possible or consensus- derived, and may change over time as evidence of validity accrues.<sup>13</sup>

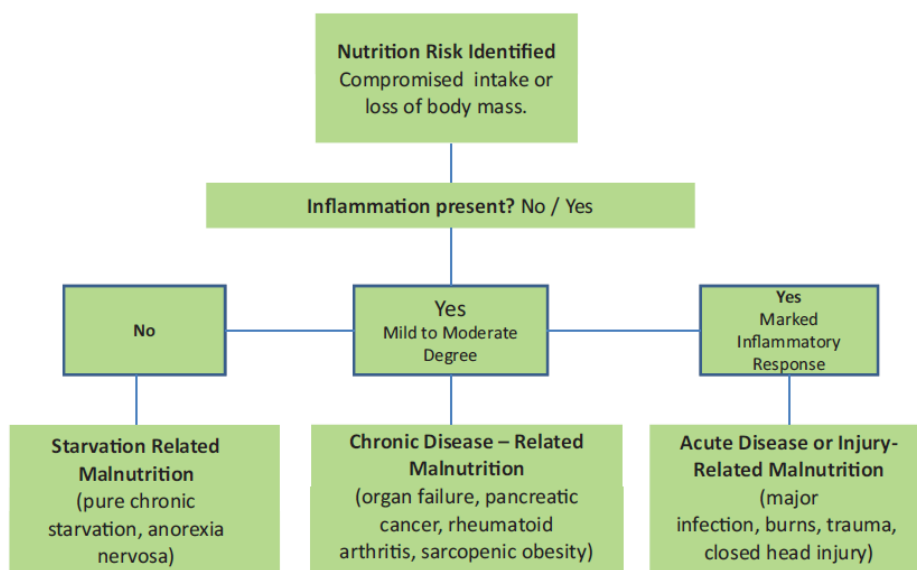
The identification of 2 or more of the following 6 characteristics is recommended for diagnosis of malnutrition: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation that may mask weight loss, diminished functionality as measured by hand-grip strength.<sup>13</sup> These characteristics should be routinely assessed on admission to hospitals and at frequent intervals during a patient's hospitalization or in rehabilitation.<sup>13</sup>



An integral characteristic mentioned above is the assessment of loss of muscle and fat mass. A Nutrition-Focused Physical Assessment (NFPA) is an efficient way to evaluate a patient's muscle and fat loss, edema and micronutrient deficiencies.<sup>16</sup> The NFPA entails a head to toe assessment of the patient's fat and muscle stores using visualization and palpation methods.<sup>16</sup> Muscle wasting is loss of bulk and tone that can be detected around the patient's temple region, clavicle bone, deltoid and trapezius muscles, and scapular bone in the upper body.<sup>16</sup> In the lower body, loss of muscle tone in the quadriceps region is also an important indicator of clinical muscle wasting.<sup>16</sup> To evaluate subcutaneous fat loss, examination areas include orbital region of the eyes, upper arm region or triceps and thoracic and lumbar region (ribs and lower back).<sup>16</sup> Traditionally, the role of the RD has not always included a physical examination. The NFPA serves to more accurately confirm suspicion of malnutrition and the degree of severity.<sup>16</sup> A head to toe approach is useful, and use of visualization as well as palpation helps to better define muscle and fat stores. Performing a full NFPA and routine nutrition re-assessments throughout the patient's hospitalization is important to note any changes in nutrition status.<sup>16</sup>

Historically, many clinicians including RDs, used laboratory values such as acute phase proteins (i.e. serum albumin and prealbumin) as primary diagnostic indicators of adult malnutrition.<sup>17-21</sup> The Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) analyzed reduction and change in serum albumin and prealbumin with

weight loss in prolonged protein energy restriction, anorexia nervosa, non-malabsorptive gastric partitioning bariatric surgery, calorie-restrictive diets, starvation, low-calorie diets, and nitrogen balance.<sup>13</sup> The results indicated that these acute-phase proteins do not consistently or predictably change with weight loss, calorie restriction, or nitrogen balance but appear to better reflect severity of inflammation rather than poor nutrition status and do not respond to feeding interventions in the setting of inflammatory response.<sup>13</sup> Thus, the Academy and ASPEN do not recommend or propose any specific inflammatory marker for diagnostic purposes of malnutrition, and state these indicators of an inflammatory response should be interpreted with caution as their relevance to malnutrition is limited.<sup>13</sup> Figure 1 shows work done by ASPEN and the European Society for Clinical Nutrition and Metabolism (ESPEN) in 2009 to develop an etiology-based approach to the diagnosis of malnutrition.<sup>13</sup>



**Figure 1. Etiology-based Malnutrition Definitions**

### 1.1.2 Malnutrition and Assessment Methods

As shown in **Table 1**, ASPEN recommends incorporating these characteristics of malnutrition into a full assessment for clinical care: <sup>13</sup>

1. History and clinical diagnosis (if inflammation present could lead to higher risk for malnutrition).
2. Physical exam/clinical signs (to identify weight loss, fluid retention, loss of muscle or fat, or clinical signs of inflammation such as fever, etc).
3. Anthropometric data- weight upon admission, recent weight loss, height.

4. Laboratory data- indicators of inflammatory response which have been traditionally used as indicators for malnutrition (ie. prealbumin) should be interpreted with caution.
5. Food/Nutrient Intake- assessment of meal intakes patterns/changes prior to admission and comparison of current intakes can be used as evidence of inadequate intakes.
6. Functional assessment- hand grip strength is recommended to document a decline in physical function.

**Table 1. ASPEN Recommendations for Full Nutritional Assessment for Clinical Care**

A multidisciplinary approach in detecting and managing malnutrition in hospitals is important. The prompt recognition and proper referrals to RDs requires education of the nursing and physician staff. There needs to be a reliable channel of communication among pharmacy, nursing, medical and nutrition disciplines.<sup>22</sup> According to Jensen et al. there is no single “gold standard” by which nutrition status can be defined or measured.<sup>22</sup> No one single measure is optimal for assessing nutritional status for all patients in all situations, and the overall validity of each measure as a nutrition marker varies widely depending on the population or clinical situation.<sup>22</sup>

The Subjective Global Assessment (SGA) is a nutritional assessment tool widely used in hospital practice. In 1982 Baker et al. validated a survey capable of identifying the risk for worse clinical outcomes associated with worse nutritional status in surgical

patients.<sup>23</sup> Detsky et al. standardized this survey and called it Subjective Global Assessment (SGA).<sup>24</sup> SGA is comprised of history of weight loss, dietary intake change, gastrointestinal symptoms, functional capacity, metabolic demand related to the underlying disease and a full NFWA to detect muscle wasting, loss of subcutaneous fat and edema. SGA's results are broken down into SGA A= well nourished, SGA B = moderately malnourished, and SGA C= severely malnourished. A copy of SGA can be found in Appendix B. SGA is widely used as it is non-invasive, inexpensive, demanding about 10 minutes for its completion, able to be done at patients' bedside by any trained health-care professional, and can identify patients at higher nutritional risk.<sup>25</sup> SGA is not without limits; its accuracy depends on the proper training and experience of the assessor and their ability to interpret changes in nutritional status which may limit its use in hospitals where there is no trained health care professional available.<sup>25</sup> In 2015, a systematic review of the literature examined the performance of SGA as a method for the assessment of the nutritional status of hospitalized adults.<sup>25</sup> Of 21 studies selected, 6 included surgical patients, 7 included clinical patients (geriatric and medicine), and 8 included both. Most studies demonstrated SGA performance similar or better than the usual assessment methods for nutritional status (anthropometry and laboratory data). Of note was the finding that different nutritional screening tools were as capable as, if not more so as the SGA, in detecting important alterations in nutrition status which related to the occurrence of worse clinical outcomes. In one study, the nutrition screening tool NRS

2002 was tested against SGA in surgery patients and both demonstrated to be accurate in predicting postoperative complications, but NRS 2002 had higher sensitivity and specificity values than SGA (69% and 80% versus 50% and 77%) and higher positive predictive value (38% versus 35%).<sup>26</sup> Their conclusion remained that there continues to be an absence of one single tool that can be considered as gold standard for diagnosis of malnutrition.<sup>25</sup>

In 2015, Jeejeebhoy et al. compared the ability of different nutrition indicators to predict outcomes of length of hospital stay and readmission to refine the detection of malnutrition in acute care.<sup>27</sup> The nutrition indicators measured were: SGA (A, B, C), body weight, midarm and calf circumference, serum albumin, handgrip strength, and patient self-assessment of food intake. After controlling for age, sex, and diagnosis, only SGA C (severely malnourished), and hand grip strength were independent predictors of length of stay. However, the authors concluded that because HGS has a wide range of normal values, SGA is the single best predictor and should be advocated as the primary measure for diagnosis of malnutrition.<sup>27</sup>

## 1.2 Nutrition Screening

Nutrition screening differs from assessment in that it is the process for identifying patients, clients or groups of people who have a risk of being malnourished and can benefit from an in-depth nutrition assessment and intervention by an RD.<sup>28</sup> In real-life

hospital situations, it is not realistic to conduct a full nutrition assessment on each patient who is admitted due to staffing levels and time constraints. To be useful, nutrition screening must be quick, easy to use, valid and reliable for the specific population in question. Nutrition screening should occur within an appropriate time frame for the setting in order to produce referrals to the RD, and in fact the Academy recommends screening be performed within 24 hours of hospital admission<sup>28</sup>.

The literature reports nursing staff are the most common health care practitioners to use a nutrition screening tool.<sup>29-31</sup> In 2008 members of the Clinical Nutrition Management Dietetic Practice Group were surveyed. Out of 522 completed surveys 84% reported nursing staff had primary responsibility for nutrition screening; 10% used nutrition services staff and 4% used computerized screening.<sup>29</sup> Furthermore, a nursing survey conducted by the Nutrition Care in Canadian Hospitals study found that 91% of the nurses responded that they would be willing to integrate a two-or three-item screening tool in the nursing admission assessment.<sup>32</sup>

### 1.2.1 Validity of Nutrition Screening Tools

Validity indicates whether a tool measures what it intends to measure. A validity study must be conducted within the population for which is it intended, the subjects must be representative of the population, and the selection must be done by randomization or convenience sampling.<sup>33</sup> Selection must be independent from nutrition status. Inclusion

and exclusion criteria, time of administration, and type of training provided for administrators should be in accordance with the tool's intended usage. All validity assessments should be done independently from the gold standard.<sup>33</sup> Jones uses three labels for validity: content, construct and criterion validity.<sup>33</sup> Because content validity relates to a tool's development, it will not be discussed further in this paper.

#### 1.2.1.1 Construct vs Criterion Validity in Nutrition Screening Tools

Construct and criterion validity relate to a tool that has already been developed. Construct validity is the expected relationship between the tool in question to variables that are not measured within the tool.<sup>33</sup> Examples include anthropometric measurements, biochemical markers and body mass index. Validity is a matter of degree and not an all-or-nothing measurement and there may be construct validity established only in relation to certain variables but not all.<sup>33</sup> Criterion validity is established by showing the level of agreement between the screening tool in question compared to the gold standard.<sup>33</sup> The gold standard could include a pre-existing nutritional tool, the clinical judgement of RDs, or standardized procedure.<sup>33</sup> When using expert clinical judgement one must consider that they may differ in their interpretation of the data, and therefore, using a standardized tool or procedure can decrease these disagreements.<sup>33</sup>



### 1.2.1.2 Sensitivity and Specificity

The tool's performance is summarized by its sensitivity and specificity as illustrated in **Table 2**. Sensitivity is the percentage of malnourished patients identified by the tool as at risk and specificity is the number of adequately nourished patients identified as not at risk.<sup>33</sup> Estimates for both sensitivity and specificity can be obtained from previous research or a pilot study. The decision to base sample size on sensitivity or specificity may come from knowing which of the two is the most important measure in this specific study, or on the practical issue of recruitment.<sup>33</sup> Analyzing data from a larger-than-needed sample size can lead to statistical significance when in fact there is no clinical significance.<sup>33</sup>

Tool assessment	Gold standard		Total
	Malnourished	Nourished	
At risk	$a$	$b$	$a + b$
Not at risk	$c$	$d$	$c + d$
Total	$N_1 = a + c$	$N_2 = b + d$	$N$

**Table 2. Summary Measures from Cross-tabulation of the Tool's Assessment with a Gold Standard**

Aside from sensitivity and specificity another method of measuring validity is to use a measurement of agreement such as Kappa statistic, or  $K$ , which is a measure of agreement over and above that which would be expected due to chance.<sup>34</sup> For  $K$ , a value of 0 means agreement is no better than chance and 1.0 means agreement is perfect.<sup>34</sup> The higher the values for sensitivity and specificity (or  $K$ ), the more valid the tool is for that particular gold standard.<sup>33</sup> **Table 3** shows interpretation of  $K$  statistic based on Altman.<sup>35</sup>

Value of $K$	Strength of agreement
< 0.20	Poor
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Good
0.81 - 1.00	Very good

**Table 3. Interpretation of  $K$  statistic**

### 1.2.2 Reliability

Inconsistencies arise despite training the users to use a nutrition screening tool, and therefore, there should always be a measure of the reliability of the tool. Intra-rater reliability measures agreement between assessments conducted by the same rater on two different occasions.<sup>34</sup> Reliability can change from one setting to another, therefore it is

important that a reliability study be carried out when using a new tool to determine how well the tool does at that specific site.<sup>34</sup> The *K* statistic can also be used in this test to measure the index of agreement between two raters.<sup>34</sup> Estimates of the expected value of reliability should be obtainable from the developers of the existing tool or from a pilot study.<sup>34</sup>

According to Jones, a well conducted validity and reliability assessment study protocol must include the following components: definition of the target population; inclusion and exclusion criteria; sampling method; sample size and calculation; number and type of users; methods to select and train users; time of tool's administration; definition and justification of the gold standard; time period during which all evaluations are made; assurance that all assessments are independent and blinded to the gold standard, or additional investigations; person(s) responsible for the organization of the study; distribution, and collection of screening forms; and proposed analysis.<sup>33</sup>

In Canada, the CMFT was originally established to: 1) investigate the prevalence of nutritional risk and malnutrition in Canadian hospitals, 2) describe the state of nutrition care in Canadian hospitals and 3) uncover the increased negative outcomes on health and the health care system, associated with malnutrition, especially when it is not resolved.<sup>36</sup> Among their findings, the Nutrition Care in Canadian Hospitals study estimated that 45% of surgical and medical patients were malnourished (using SGA) and nutrition practices

such as diagnosis, treatment and monitoring of malnourished patients were not standardized across hospitals.<sup>37</sup> Mandatory standardized screening protocols in hospitals are a top priority by the CMTF, and they aimed to develop, validate and assess the reliability of a nutritional screening tool called the Canadian Nutrition Screening Tool (CNST) which fulfills most of the validity and reliability study assessment protocol components listed above. In its validation study, the CNST's reliability was excellent ( $K=0.88$ ), sensitivity was good (71.5%) and specificity was good (83.2%). It had a good predictive length of stay and 30-day readmission and mortality.<sup>10</sup> The CNST is composed of two questions: 'Have you lost weight in the past 6 months without trying to lose this weight?' and 'Have you been eating less than usual for more than one week?' Two "yes" answers indicate nutrition risk and a referral to the RD should be immediate.<sup>10</sup> If there is only one "yes" answer it indicates no nutrition risk. The authors compared CNST against SGA in this validation study.<sup>10</sup> A strength of this validation study was the large number of untrained raters to examine reliability as this mirrors 'real-life' hospital settings in which most of the staff conducting nutrition screening tools are untrained nursing staff.<sup>10</sup> Another strength was that body mass index (BMI), a measure of body fat based on weight and height, was not needed in order to achieve great sensitivity and specificity.<sup>10</sup> This is particularly useful in 'real-life' hospital settings as the accurate measure of patients' weights is often missed or not performed. In the CNST validation study only 45% of all the patients' weights were available upon admission, therefore 55% of them had to be

measured by the raters.<sup>10</sup> Some limitations included that this study sample was not representative of the cognitively impaired patient population and therefore the validity of the CNST in a cognitively impaired population was not assessed.<sup>10</sup>

### 1.2.3 Nutritional Screening Tools Available

A simple google search can produce dozens of nutrition risk screening tools, but not all have been properly assessed for their validity and reliability in the intended population group. **Table 4** is a review of validation studies (looking at criterion validity comparing to a gold standard) on multiple nutrition screening tools and how they compare to the CNST in their fulfillment to the recommended study assessment protocol components. All nutrition screening tools reported a definition of the target population except for JaNuS (Just a Nutrition Screening).<sup>38</sup> Similarly, all the screening tools reported inclusion and exclusion criteria except for JaNuS.<sup>38</sup> Most of the articles described their sample population; however, they did not provide a sample method except for the STAMP (Screening Tool for the Assessment of Malnutrition in Pediatrics) article which described how the researchers approached the participants.<sup>39</sup> Sample size calculations were found in only two articles: the CNST and 3-MinNS on Nurses (3-Minute Nutrition Screening) articles.<sup>10,30</sup> The MST (Malnutrition Screening Tool) reported a convenience sample of 408.<sup>40</sup> The lack of sample size is particularly problematic especially when looking at the 3-MinNS on Nurses which had a total of 818 participants but no sample

size calculation.<sup>28</sup> The 3-MinNS on Nurses article found statistical significance; however, since their sample size was quite large and they did not calculate a sample size based on sensitivity or specificity, their results may have shown statistical significance only because of the large sample size. The numbers and types of users varied from article to article, most did include a mixture of nurses and RDs. The CNST's users were nurses who were purposefully not trained on how to complete the CNST as the authors wanted to mirror real-life scenarios where nutrition screening is usually completed by nurses who have not had previous nutrition screening training.<sup>10</sup> All except JaNuS and MST reported assessments that were blinded to the gold standard, and in fact, MST only had one rater perform both nutrition screening tool and gold standard.<sup>38,40</sup> Most tools were administered within 24-48 hours of admission, except for SCREEN II (Seniors in the Community: Risk Evaluation for Eating and Nutrition version II) which was administered to participants in the community and the time frame for this tool was not mentioned.<sup>41</sup> SGA was used as gold standard in four articles (CNST, MST, 3-MinNS, and 3-MinNS on Nurses), and three articles reported using RD nutrition risk assessment or RD nutritional evaluation (STAMP, SCREEN II, JaNuS).<sup>10,38,39,41,42,40</sup> None provided a clear justification for their chosen gold standard. All tools except for JaNuS provided a time frame during which all evaluations were made and these ranged from 3-month periods (3-MinNS on Nurses) to approximately 2-year period (CNST). The CNST, STAMP, and SCREEN II articles mentioned site coordinators, researchers, RDs or senior clinical advisers as

persons responsible for the organization of the study.<sup>10,39,41</sup> The 3-MinNS, 3-MinNS on Nurses, and JaNuS tool did not mention any person(s) responsible for organization of study.<sup>30,38,42</sup> None of the articles mentioned the distribution and collection of screening forms, and all articles described proposed analysis of the data. Only two articles mentioned intra-rater reliability (CNST, and STAMP).<sup>10,39</sup>

A recent prospective observational study used the MUST (Malnutrition Universal Screening Tool) to screen adult acute stroke patients from two hyperacute stroke units in south London, United Kingdom, between June 2011 and May 2012. The study aimed to determine the ability of the MUST to predict poor outcomes such as mortality, cumulative length of hospital stay (LOS), and hospitalization costs. After adjusting for age, severity of stroke, and a range of stroke risk factors, a high risk for malnutrition was associated with a significant increase in mortality ( $P < .001$ ).<sup>43</sup> Also, patients were followed up at 6 months' post stroke, and malnutrition was an independent predictor of mortality, LOS ( $P < .001$ ), and increased hospitalization costs ( $P = 0.049$ ); however, this study is not a validation study as the authors did not use numerical variables predicted to be related to malnutrition such as midarm muscle circumference, triceps skinfold thickness, BMI, or hand grip strength.<sup>33</sup> One limitation of this study is the use of a tool that relies on the calculation of BMI which needs a measure of accurate weight. One researcher measured all of the participants' ( $n=543$ ) weights and heights and filled out the

rest of the MUST form, which is not indicative of a real-life hospital setting in which most nutrition screening is performed by nursing staff.<sup>29</sup> A further limitation is that the authors did not report how answers were obtained from cognitively-impaired stroke patients.

In summary, as a health care practitioner one must be aware of the limitations in the methodologies of a validation study and the impact this can have on results. Design flaws in validation studies are common, as evidenced in the literature. The CNST stood out from other nutrition screening tools in its ability to fulfil most of the proposed nutrition assessment protocols proposed by Jones.<sup>33</sup>



**Table 4. Review of Nutritional Screening Tools and Validation Protocols**

<b>Nutrition Screening Tool</b>	<b>Definition of the target population</b>	<b>Provided inclusion and exclusion criteria</b>	<b>Sampling method</b>	<b>Sample size and calculation</b>	<b>Number and type of users</b>	<b>Methods to select and train users</b>
<b>CNST</b>	Adults in surgery/ medicine	Yes	No mention	Yes	160 untrained nurses	Did not train nurses on purpose **
<b>MST</b>	Adults in acute care	Yes	No mention	Convenience Sample- 408	1 user	No mention
<b>3-MinNS</b>	Pts mixed ethnicities	Yes	No mention	818 – No sample size calculation	2 users, both RDs	RDs, no training provided
<b>3-MinNS on Nurses</b>	Pts mixed ethnicities	Yes	No sampling method	Yes	3 nurses, RD to perform SGA	Description of training provided
<b>STAMP</b>	Pediatric pts with SCI	Yes	All children admitted to NSIC between Jan 2010 and Dec 2010 were invited	Total 51 pts in study, no sample size calculation	Nurses, RD- No numbers	Pediatric nurses for screen, RD for re screen and full assessment- no training mentioned
<b>SCREEN II</b>	Octogenarians in Bay of Plenty, New Zealand. Community living residents	Yes	No method mentioned	Total 45 residents ages 85-86 – no sample size calculation	Nurses or RDs	No method of selection noted. Noted that nurses were trained- no description
<b>JaNuS</b>	No specific population given	No specific inclusion/exclusion criteria	No method mentioned	Total 73 pts, no sample size calculation	No mention	No method noted

<b>Nutrition Screening Tool</b>	<b>Time of tool's administration</b>	<b>Definition and justification of the gold standard</b>	<b>Time during which all evaluations are made</b>	<b>Assurance that assessments are blinded to gold standard</b>	<b>Persons responsible for organization of study</b>	<b>Distribution and collection of screening forms</b>	<b>Proposed Analysis</b>
<b>CNST</b>	48 h/ 72h on weekend	SGA; no justification	July 2010-September 2013	Yes	Site coordinators RD + researcher	No mention	Yes
<b>MST</b>	2d	SGA; no justification	3 months	No- same rater	No mention	No mention	Yes
<b>3-MinNS</b>	24 h	SGA; no justification	10-month period	Yes	No mention	No mention	Yes
<b>3-MinNS on Nurses</b>	24 h; then 24h from first screen	SGA; no justification	3-month period	Yes	No mention	No mention	Yes
<b>STAMP</b>	Screen in 24 h, RD assess in 24h from screen	Full RD assessment	Jan 2010-Dec 2010	Yes	Researcher, senior clinical adviser	No mention	Yes
<b>SCREEN II</b>	Participants completed screening/ questionnaire at one session	RD nutrition risk assessment-description and justification given	Jan 2011-August 2011	Yes	Research RD	No mention	Yes
<b>JaNuS</b>	No mention	Nutritional evaluation	No mention	No mention	No mention	No mention	Yes

Abbreviations: CNST, Canadian Malnutrition Screening Tool; MST, Malnutrition Screening Tool; Ex, Exclusion criteria; In, Inclusion criteria; Pts, patients; RD, registered dietitian; SGA, Subjective Global Assessment; 3-MinNS, 3-Minute Nutrition Screening; CI, confidence interval; STAMP, Screening Tool for the Assessment of Malnutrition in Paediatrics; SCI, Spinal Cord Injury; SCREEN II, Seniors in the Community: Risk Evaluation for Eating and Nutrition, version II; JaNuS, Just a Nutrition Screening.

## 1.3 Overview of Stroke

### 1.3.1 Definition of Stroke

Stroke is a syndrome caused by disruption in blood flow to a part of the brain; it occurs when a vessel either ruptures or becomes blocked.<sup>44</sup> This disruption in blood flow deprives neurons and other brain cells from glucose and oxygen which can lead to brain cell death. In general terms, there are two types of stroke: ischemic (85% of all strokes) and hemorrhagic (15% of all strokes).<sup>44</sup> Unfortunately, stroke results in permanent brain damage and the effects depend on the area affected and severity.<sup>44</sup> Most commonly, stroke is associated with weakness of one side of the body, difficulty with speech and understanding speech, or loss of vision, but can also lead to cognitive difficulty, and loss of sensation and balance.<sup>44</sup>

### 1.3.2 Types of Stroke

An ischemic stroke is caused by interruption in blood flow due to sudden blockage by a blood clot or plaque fragment that is formed somewhere in the body (such as the heart) and travels to the brain; this is called embolic stroke.<sup>45</sup> An ischemic stroke can also be caused by a thrombus or blood clot that is formed in an artery supplying blood to the brain; this is considered a thrombotic stroke.<sup>45</sup> This type of stroke is usually seen in people with high cholesterol levels and atherosclerosis. A thrombotic stroke is further classified as either a large vessel thrombosis (occurs in the brain's largest arteries)

or small vessel thrombosis in which blood flow is blocked to very small arterial vessels. Little is known about the causes of small vessel thrombosis but it is closely linked to hypertension.<sup>45</sup>

Hemorrhagic stroke is less common and is usually caused by a burst or leak of a blood vessel in the brain.<sup>46</sup> The blood spilt creates pressure and swelling which can damage tissue and cells. There are two types of hemorrhagic stroke: intracerebral and subarachnoid. Intracerebral hemorrhages occur when a blood vessel inside the brain bursts and leaks into the surrounding brain tissue; high blood pressure and aging blood vessels are the most common causes for intracerebral bleeds.<sup>46</sup> Sometimes an arteriovenous malformation (AVM), which is a congenital malformation, can cause an intracerebral hemorrhage. Subarachnoid hemorrhages occur when there is bleeding between the brain and the tissue covering the brain called the subarachnoid space. This type of hemorrhage occurs most commonly in a burst aneurysm, or an AVM, bleeding disorders, head injury, or blood thinners.<sup>46</sup>

A trans ischemic attack (TIA) is the least severe form of a stroke, which typically lasts about 30 minutes, and it is often a warning sign for a future ischemic stroke.<sup>44</sup>

### 1.3.3 Impact of Stroke in Canada

According to the Ontario Stroke Network, stroke is the third leading cause of death and leading cause of adult disability in Canada; every year there are over 50,000

new strokes in Canada; nearly 14,000 Canadians die of stroke each year; more women die of stroke than men; more women die of stroke than breast cancer, and stroke costs more than \$3.6 billion a year in physician services, hospital costs, lost wages and decreased productivity.<sup>47</sup>

### 1.3.4 Risk Factors of Stroke

There are several risk factors that can lead to stroke which are not modifiable such as age, sex, ethnic origin, family history and prior TIA.<sup>48</sup> Risk factors associated with modifiable lifestyle, health and nutritional behaviours include obesity, diabetes, hypercholesterolemia, hypertension, and alcohol intake which all have direct links to nutrition.<sup>49</sup> Central obesity, where waist circumference is 40 inches or more for men and waist circumference is 35 inches or more for women, is a risk factor for stroke.<sup>48</sup> Diabetes increases a patient's risk for stroke by 2 to 4 times.<sup>48</sup> In some studies, increased alcohol intake above recommended amounts is an independent risk factor for stroke.<sup>48</sup> Hypertension accounts for 35-50% of stroke risk<sup>48</sup> and smokers have double the risk of stroke than non-smokers.<sup>48</sup> On the other hand, eating a heart-healthy diet rich in vegetables, fruits, mono and poly-unsaturated fats reduces the risk of stroke and heart disease by a substantial 80%.<sup>47</sup>

## 1.4 Malnutrition in Stroke

### 1.4.1 Prevalence of Malnutrition in Stroke

The prevalence of malnutrition in the stroke population ranges from 6.1-62%.<sup>6</sup> Although many nutritional screening and assessment tools are used, none have been evaluated to establish their validity and reliability within the stroke patient population. In a recent review of 22 trials examining the prevalence of malnutrition following stroke, 18 used different assessment methods.<sup>6</sup> Only five trials used previously validated assessment methods; however, none of these tools have been validated for use among patients receiving acute stroke care.<sup>50-54</sup> To further complicate this process, screening and assessment tools evaluate different combinations of nutrition-related markers such as weight, biochemical parameters related to nutrition, dietary intake history, and use different criteria to interpret this data.<sup>4,6</sup> Furthermore, these differences may hinder the RD's ability to determine a patient's true nutritional status, as well as monitor and evaluate their response to nutritional intervention over time.<sup>55</sup>

SGA has been used in one study to assess prevalence of stroke. Davis et al. found 16% of patients malnourished within 24 hours of symptoms.<sup>50</sup> Two other studies have used Patient Generated SGA (PG-SGA) which uses SGA and incorporates input from the patient and a score, as well as the global assessment.<sup>51,53,56</sup> Of the studies using PG-SGA, Lim & Choue found 49.3% moderately malnourished and 24.7% severely malnourished

in which assessments occurred on average 60 days post stroke,<sup>53</sup> and Martineau et al. found 19.2% of patients malnourished within 2 days of symptom onset.<sup>51</sup>

Many risk factors associated with stroke are linked with nutritional factors such as: diabetes, hypertension, obesity, and hyperlipidemia and therefore, patients may already be malnourished before a stroke occurs.<sup>49</sup>

#### 1.4.2 Effects of Malnutrition in Stroke

Complications resulting from malnutrition in patients with stroke have been well studied. Aside from the aforementioned complications of malnutrition affecting acutely ill hospital patients (e.g., increased rate of pressure ulcers, decreased rate of wound healing, muscle wasting, immunity suppression, loss of function, higher mortality)<sup>11,12</sup>, PEM in a rat model has been shown to alter the expression of plasticity-associated genes that are associated with recovery mechanisms after global ischemia.<sup>57</sup> Initial results from the FOOD Trial Collaboration showed nutritional status in early adult acute stroke is independently associated with long-term outcomes.<sup>2</sup> After adjusting for age, pre-stroke functional state and stroke severity, undernourished patients were more likely to develop pneumonia, other infections, and gastrointestinal bleeding during hospital admission.<sup>2</sup> Davalos et al. assessed malnutrition in 104 acute stroke patients via triceps skinfold thickness, midarm muscle circumference, serum albumin, and calorimetry at admission and one week after.<sup>58</sup> Malnourished patients showed higher stress reaction and increased frequency of infections and pressure ulcers in comparison with the well-nourished group.



Malnutrition after one week and elevated free urinary cortisol increased the risk of poor outcome independently of age and malnutrition upon admission.<sup>58</sup>

There are limitations to assessing the development of malnutrition by examining skinfold thickness and midarm muscle circumference, as factors secondary to stroke may also affect the sensitivity of the measures. Most patients have significantly decreased mobility following a stroke, and skeletal muscle loss may occur over prolonged periods of time because of atrophy, secondary to immobility.<sup>59,60</sup> Gradual weight loss with losses of lean muscle and subcutaneous fat stores are usually seen in prolonged periods of PEM. Stroke patients identified as malnourished that measured malnutrition at a later point in the hospitalization may have undergone non-nutritional changes in body composition mainly from being immobilized.<sup>6</sup>

### 1.4.3 Factors Leading to Malnutrition in Stroke

#### 1.4.3.1 Dysphagia

Dysphagia is common following stroke and its relationship to malnutrition was explored by Foley et al. A systematic review of eight studies concluded the odds of being malnourished were increased given the presence of dysphagia following stroke.<sup>61</sup> Decreased intake or delayed enteral feeding may have contributed to declines in nutritional status. While stroke size and location are the greatest determinants of swallow function, the presence of dysphagia is itself an indicator of greater stroke severity.<sup>61</sup>

### 1.4.3.2 Stroke Type and Severity

Very little research has been conducted around stroke type and severity and its relationship to malnutrition in stroke patients. Yoo et al. observed an association of increased ischemic stroke severity associated with baseline malnutrition, and Choi-Kwon et al. reported a much higher prevalence of malnutrition among intracerebral hemorrhagic versus ischemic stroke (62% vs. 25%); however, the authors noted the differences were likely due to pre-existing malnutrition between groups.<sup>62,63</sup>

### 1.4.3.3 Hypermetabolism Post-stroke

Foley et al. reviewed the evidence and concluded stroke patients are mildly hypermetabolic but are not at risk of developing malnutrition due to effects of hypermetabolism. There is an elevation in metabolic rate that ranges from 107% to 126% above predicted levels. There is conflicting evidence that metabolic rate is elevated more in hemorrhagic stroke compared to ischemic stroke.<sup>6</sup>

### 1.4.3.4 Catabolism Following Stroke

Although studies do exist reporting elevations of acute phase reactants following stroke, their contribution to the development of malnutrition is unclear. Prolonged elevations of these reactants (C-reactive protein, glucagon, cortisol, Interleukin-1B, Interleukin-6, serum amyloid A) may lead to the depletion of lean body mass and fat, which may contribute to the development of malnutrition.<sup>6</sup>

#### 1.4.3.5 Gastrointestinal Function Alteration in Stroke

Stroke patients could theoretically have altered gastric motility since it is modulated via the central nervous system; however, no scientific evidence for this exists. Constipation has been frequently cited as a complaint following stroke, but this is thought to be because of multiple factors secondary to stroke including decreased mobility, decreased fluid intake and increased medication use.<sup>64,65</sup> Stroke per se is not known to cause constipation. There is an absence of literature to confirm or refute whether there are significant gastrointestinal impairments following stroke.<sup>6</sup>

#### 1.4.3.6 Nutrient Intake Following Stroke

Several factors could lead to decreased oral intake following stroke including: visual neglect, upper extremity paralysis, dysphasia, apraxia (an inability to use objects correctly), and depression.<sup>49</sup> Furthermore, cognitive deficits which occur in 20-80% of patients with stroke can also affect appetite and therefore total oral intake.<sup>66</sup> According to Foley et al., stroke patients eat between 74 and 86% of their energy and protein requirements during the first several weeks following stroke.<sup>6</sup> Stroke patients are often in and out of diagnostic imaging tests during their hospital stay, and many of these tests are scheduled during meal times, which can affect their total oral intake. As well, many acute stroke patients may experience fatigue from intensive physical therapy sessions they must undergo and this could impact their ability to self-feed.

#### 1.4.4 Barriers to Assessing Malnutrition in Stroke

As previously noted, a major barrier to assessing adult malnutrition in hospitalized patients is the lack of a standardized definition of malnutrition and a gold standard. The literature is not conclusive that SGA is the gold standard for nutrition assessment in all populations. A recent survey of 95 RDs practicing at acute care hospitals across Canada exploring the use of valid screening and assessment following stroke revealed that only 10 respondents reported using previously validated screening tools and 32 responded they used a validated assessment tool.<sup>9</sup> Of those using validated screening and assessment tools, 40% and 64% indicated they used modified versions of the original screening and assessment tools, which could have effectively changed the original validity and reliability of the tool.<sup>9</sup> According to the Canadian Stroke Best Practice Recommendations, patients should be screened for premorbid malnutrition within 48 hours of admission using a valid screening tool.<sup>8</sup> Several agencies and stroke-specific clinical guidelines suggest using commonly known nutrition screening tools for the acute stroke population; however, none of the recommended screening tools have been validated in this population group. The German Society for Clinical Nutrition (DGEM) recommends the NRS 2002, and report other screening and assessment tools may also be used and applicable to this population (MUST, MNA, SGA).<sup>67</sup> The Royal College of Physicians' National Clinical Guideline for Stroke recommends the MUST,<sup>68</sup>

and the Canadian Stroke Best Practice Recommendations suggest three tools: CNST, MUST, and MNA.<sup>8</sup>

Health care practitioners may be aware of the various world-wide stroke guidelines which recommend screening stroke patients for malnutrition, but are misled by the recommendations of various nutrition screening tools which have not been assessed for either their validity or reliability in the stroke population. It is imperative to conduct reliability and validity assessments of a nutrition screening tool in the population it is intended to be used. The evidence presented above suggests clinicians and/or health care leaders may not be aware of these standards. Furthermore, the timing of the screening must be completed as close to the hour of admission as possible to document baseline data and monitor changes throughout the patients' hospital stay, as several studies have shown that malnutrition rates increase the longer the hospitalization.<sup>54,58,62,69-71</sup>

## 1.5 Summary

Malnutrition is a term that has yet to be fully defined. Substantial work has been done to identify and standardize characteristics that reflect nutrition status vs. the inflammatory response that is associated with various diseases and /or conditions. A gold standard for identification and assessment of malnutrition has yet to be developed and this is compounded by the tremendous task of creating or modifying one tool that can assess nutritional status for all patients in all situations. Nutrition screening differs from

assessment in that it is the process for identifying patients, clients or groups of people who have a risk of being malnourished and can benefit from an in-depth nutrition assessment and intervention by an RD. Nutrition screening in acute care setting is crucial as it aims to detect and prevent further malnutrition. Although several stroke clinical practice guidelines recommend nutrition screening upon admission to hospital and even recommend several nutrition screening tools, none have been validated for the use in acute stroke population. The current practice of screening for nutrition status in acute stroke patients is inconsistent and not standardized. Literature reports varied estimates of prevalence of malnutrition from 6.1-62%. The wide range of malnutrition in acute stroke patients speaks to the lack of standardization assessment and screening practices.

## 2 Rationale and Objectives

The prevalence of malnutrition among acute stroke patients has been reported as high as 62% depending on timing and methods used for nutrition screening and assessments.<sup>4</sup> Furthermore, the Canadian Stroke Best Practice Recommendations recommend all acute stroke patients be screened for premorbid malnutrition within 48 hours of admission to hospital using a valid screening tool.<sup>8</sup> Although many nutritional screening and assessment tools are currently used across Canadian hospitals providing acute stroke care, none have been evaluated to establish their validity and reliability within this specific patient population.<sup>9</sup>

The CMTF has developed and validated the Canadian Nutrition Screening Tool (CNST) to screen for malnutrition within medicine and surgery patients.<sup>10</sup> The CNST is a simple, two-question survey, and is expected to be implemented in hospitals across Canada; however, it has not been validated in the stroke patient population. The Subjective Global Assessment (SGA) has been validated for the identification of malnutrition and is routinely used in clinical practice for nutrition assessment of many patient populations, including acute stroke.<sup>24</sup>

Therefore, the objectives of this study are to:

1. Assess the prevalence of malnutrition among stroke patients admitted to London Health Sciences Centre, University Hospital within 48 hours of admission using SGA.
2. Estimate the level of agreement between the Canadian Nutrition Screening Tool and the Subjective Global Assessment, using Kappa statistic and calculations for sensitivity and specificity.



## 3 Methods

### 3.1 Current Local Nutrition Screening Practices in Acute Stroke

London Health Sciences Centre, University Hospital is the Regional Stroke Centre of London, Ontario, (RSC-Lon) and the surrounding area. A Regional Stroke Centre is a facility that has specialized stroke care services, written stroke protocols and clinicians with stroke expertise.<sup>1,2</sup> Despite RSC-Lon being an advanced stroke care centre in the region, standardized nutrition screening within the acute stroke unit as recommended by the Canadian Stroke Best Practice Recommendations is currently lacking.<sup>8</sup>

### 3.2 Study Subjects

In this prospective study, the target population were adult acute patients admitted under the stroke protocol at RCS-Lon with either a confirmed or suspected ischemic or hemorrhagic stroke. Inclusion criteria included adult patients, older than or equal to 18 years of age. Exclusion criteria included patients who had the SGA completed within 48 hours of admission but did not have the CNST completed within that timeframe. Patients with a confirmed Transient Ischemic Attack (TIA), and patients who could not provide consent, and their power of attorney (POA) or substitute decision maker (SDM) did not live with the patient or had any close involvement with the patient, such that they could

not answer the questions adequately, were also excluded from the study. Ethics approval was obtained from Western University's Health Science Research Ethics Board (reference 107709). A copy of the approval certificate can be found in Appendix C.

### 3.3 Data Collection

Nurses were chosen to complete the CNST to duplicate how the CNST was previously validated, and to imitate how nutrition screening would be performed in a real-life setting. Prior to commencing the study, communication emails were sent out to all the unit nurses with a description of the study, the study objectives, and a picture of the CNST questions to be asked. This was to increase awareness of the study and its objectives. A non-mandatory information session was held to provide further information and communication with the unit nurses. Only two nursing staff attended this session. No further training was provided to the nurses.

The research RD received training on how to perform the SGA, and how to interpret its results prior to commencing data collection.

Subjects were identified using the hospital's database, with permission obtained from unit managers. The unit clerk placed a sticker with the CNST questions on an admission form that was already routinely used by nurses for patients' admissions. This nursing admission form already included basic questions pertaining to nutrition, and therefore the CNST did not imply any change in the patients' routine care plan. The patient's nurse

conducted the CNST within 48 hours of admission using information obtained from the patient or a proxy in the event of cognitive and/or language impairments. The research RD was blinded to the CNST results. Within 48 hours of admission, the research RD approached the patient, provided the letter of information and consent and obtained verbal or written consent. In the event of cognitive impairment/language barrier/aphasia, etc., the RD obtained consent through a POA or SDM. Once consent was obtained, the RD conducted the SGA and classified patients as either A (well nourished), B (moderately malnourished), or C (severely malnourished). B and C of the SGA were combined into one “malnourished” category. The research RD then collected the completed results from the CNST and SGA and recorded these results on a master patient list. The following information was collected and recorded: subjects’ age, sex, type of stroke, whether they required an automatic referral to a RD (due to enteral feeds), and whether the subject triggered an RD referral based on CNST or SGA results. Patients identified at risk for malnutrition by CNST or malnourished by SGA received an immediate referral to the unit RD if one had not already been initiated; calorie counts and oral nutritional supplementation were initiated ensuring compliance with prescribed oral food and fluid textures as per Speech Language Pathologist (SLP) recommendations. Some of these patients were identified as not at risk for malnutrition according to CNST and well-nourished according to SGA but still had an automatic referral to the RD due to enteral feeding.

### 3.4 Statistical Analysis and Sample Size

Sensitivity and specificity, as well as positive and negative predictive value were analyzed using IBM SPSS Statistics version 21. Percentages were used to summarize acute stroke patients at risk for malnutrition (yes/no) and patients identified as malnourished and well nourished by SGA. Percentages were also used to summarize the age distribution of the study subjects. Age was also reported as a continuous variable using the mean and standard deviation. To investigate the level of agreement between the SGA and the CNST, the Kappa statistic was used. According to Altman<sup>4</sup>, the Kappa statistic can be interpreted as per **Table 3**.

The CNST has been identified to have 71.5% sensitivity and 83.2% specificity.<sup>5</sup> As shown previously, the prevalence of malnutrition in the stroke population is reported at 6.1-62%.<sup>6</sup> Several studies report that 16% of stroke patients are malnourished upon first week of admission<sup>7-9</sup>, therefore an estimated prevalence of 16% was used. The confidence interval (CI) was set at 95%.

The following calculations were used from Jones et al.<sup>10</sup> to calculate the required sample size necessary to obtain adequate sensitivity and specificity.

Sensitivity: 71.5, specificity: 83.2, maximum error of estimate: 5, prevalence: 16.

$$\begin{aligned} \text{Sensitivity} &= 1.96^2 \cdot 71.5 \cdot (100 - 71.5) / 5^2 = 313.13 \\ &= 100 \cdot (314) / 16 = \underline{\underline{1963}} \end{aligned}$$

$$\begin{aligned} \text{Specificity} &= 1.96^2 \cdot 83.2 \cdot (100 - 83.2) / 5^2 = 214.78 \\ &= 100 \cdot (215) / (100 - 16) = \underline{\underline{256}} \end{aligned}$$

According to 2014/15 data, the annual age- and sex- adjusted inpatient admission rate for stroke/TIA within the South West Local Health Integration Network, which includes RSC-Lon, was between 1300-1700 admissions.<sup>11</sup> An objective of this study was to observe agreement between CNST and SGA to detect malnourished patients, and therefore sensitivity is the more important measure because sensitivity reports study subjects that have the condition or disease (in this case malnourished); however, 1963 patients was an unrealistic number of participants to recruit given the timeframe for data collection (9 months) and the actual annual rate of admissions for the region. A more attainable number based on practical recruitment was established at 135 patients (10-15 study subjects per month of data collection), and this was based on expert opinion of health care professionals who have worked in this field in acute stroke care.

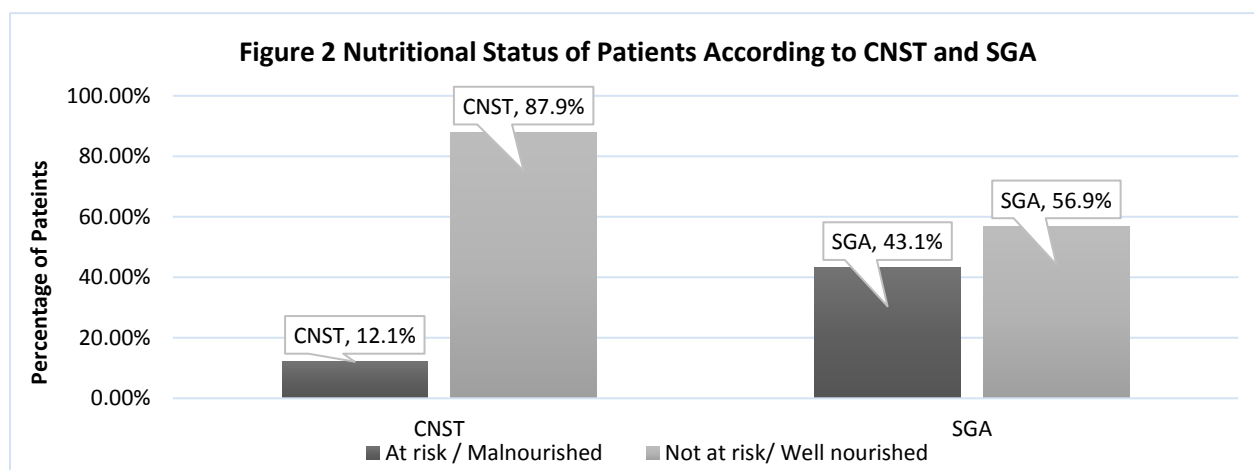
## 4 Results

Fifty-eight patients (27 women, 31 men) were enrolled in this study. The mean age in years was  $73.8 \pm 13.5$ ; 14 patients (24.1%) were between the age of 41-64 years, 12 (20.7%) between 65-74 years, and 32 (55.2%) were 75+ years old. There were 48 patients with ischemic stroke (82.3%) and 10 with hemorrhagic stroke (17.2%). **Table 5** summarizes the characteristics of the study subjects.

**Table 5. Characteristics of Study Subjects**

Characteristics	N
Age	$73.8 \pm 13.5$
Sex	
Female	27 (46.6%)
Male	31 (53.4%)
Age Range	
41-64	14 (24.1%)
65-74	12 (20.7%)
75+	32 (55.2%)

**Figure 2** summarizes the nutritional status of patients according to the CNST and SGA. CNST indicated 7 patients (12.1%) were at risk for malnutrition; however, SGA found 25 patients (43.1%) to be malnourished. The CNST showed a fair level of agreement with SGA ( $K=0.23$ ).



**Figure 2. Nutritional Status of Patients According to CNST and SGA**

Within the malnourished group, 19 out of 25 (76%) were 75 years and older with  $p = 0.006$ , whereas 6 out of 25 malnourished patients were younger than 75 (24%).

CNST had a sensitivity of 24% (95% CI 2.6 – 45.4%) and a specificity of 97% (95% CI 89.5 – 104.4%). The positive predictive value was 85.7% and the negative predictive value was 62.7%. This is summarized in **Table 6**. Certain patients had an automatic RD referral as they were receiving enteral feeding despite CNST or SGA results. There was a total of 12 patients who received an automatic referral. Of those 12 patients, 5 were identified as malnourished by SGA (B or C), and only 1 was identified as at risk for malnutrition by CNST. Alternatively, the SGA identified 20 patients as malnourished who did not have an automatic referral to the RD, whereas CNST identified 6 patients. There were 8 patients whose CNST screens had only one “yes” answer which identified them as not at risk by default. Of those 8 patients, SGA identified 7 as malnourished (B or C). This is summarized in **Table 7**.

**Table 6. Comparison of CNST in Screening of Malnutrition against SGA**

	Malnourished (SGA)	Well nourished (SGA)	Total
At risk (CNST)	6	1	7
Not at risk (CNST)	19	32	51
Total	25	33	58
Sensitivity= $100 \times 6/25 = 24\%$ 95% CI (2.6 – 45.4%)		Specificity= $100 \times 32/33 = 97\%$ 95% CI (89.5 – 104.4%)	
Positive Predictive Value = $100 \times 6/7 = 85.7\%$ 95% CI (52.6 – 118.8%)		Negative Predictive Value= $100 \times 32/51 = 62.7\%$ 95% CI (45.8 – 79.7%)	



**Table 7. Patients Receiving Automatic Referral to RD and Patients Requiring Referral to RD Based on CNST and SGA (n=58).**

<b>Description</b>	<b>Number</b>	<b>Percentage</b>
Patients with automatic referral to RD due to enteral feeding	12	20.6%
Patients with automatic referral identified as at risk by CNST	1	1.7%
Patients with automatic referral identified as malnourished by SGA	5	8.6%
Patients identified as at risk by CNST who did not have an automatic referral	6	10.3%
Patients identified as malnourished by SGA who did not have an automatic referral	20	34.4%
CNST screens only one “yes”	8	13.7%
Patients with one “yes” a/p CNST who were malnourished per SGA	7	12%

## 5 Discussion

### 5.1 Discussion of Main Findings

The aim of this study was to determine prevalence of malnutrition among adults admitted under the stroke protocol to the Regional Stroke Centre in London, Ontario within 48 hours of admission using SGA and level of agreement between CNST and SGA in acute stroke patients.

### 5.2 Prevalence of Malnutrition using SGA in Acute Stroke

In this study, the prevalence of malnutrition according to SGA was 43.1% (95% CI 26.8 – 59.4). This study included a rater who had previously been trained on SGA prior to data collection. This is important to ensure accuracy as it has been recognized SGA requires the user be trained on how to perform SGA as well as how to interpret results.<sup>25</sup> To our knowledge, there is only one other study that used SGA to assess prevalence of malnutrition in stroke patients.<sup>50</sup> Davis et al. found 16% of patients (n=185) malnourished within 24 hours of symptom onset, and criteria used to detect malnutrition was SGA A= well nourished, B +C= malnourished. Similarities to the current study include the use of SGA in compressed categories (A= well nourished, B+C=

malnourished) and assessment within 48 hours of admission.<sup>50</sup> A reason for the difference in prevalence of malnutrition found by Davis et al. compared to the current study is that they did not specify whether the SGA users received formal training on how to conduct SGA as opposed to the current study which did include a user who had been trained on how to conduct SGA. If the rater was not properly trained, this could have influenced their interpretation of patients' nutrition status. Two studies were identified that used PG-SGA (a modified version of SGA) as the method of nutrition assessment.<sup>51,53</sup> Lim & Choue used PG-SGA and found prevalence of malnutrition as high as 74% among patients with cerebral infarcts; however, their study subjects were assessed for malnutrition within 60 days of being admitted for stroke, and not within 48 hours.<sup>53</sup> Having a longer period within which to assess for malnutrition likely contributed to more patients identified as malnourished who may have developed malnutrition during their admission. The second study using PG-SGA conducted by Martineau et al. found 19.3% of patients (n=73) were malnourished within 48 hours of admission using the same scoring as SGA (A= well-nourished and B+C= malnourished).<sup>51</sup> Similarities to the current study included the rater was trained on conducting the nutrition assessment using PG-SGA, and the study subjects were assessed within 48 hours of admission.<sup>51</sup> Differences in prevalence of malnutrition can be explained by the fact the PG-SGA is a variation of the SGA which includes a patient-derived assessment portion and score and may lead to different results and interpretation of the overall SGA score. Although the

present study demonstrates a higher prevalence of malnutrition using SGA than other studies,<sup>50,51</sup> the present study included a rater who had been trained to use SGA as well as assessment within 48 hours of admission, ensuring accurate and timely assessment. This study's prevalence of malnutrition at 43% also falls within the reported range in literature of 6.1-62%.

Within age groups, prevalence of malnutrition was found to be the highest in patients who were 75 years and older with 19 out of the 25 malnourished patients being over the age of 75 years (76%). There was a significant relationship between malnutrition and age of 75 years and older ( $p = 0.006$ ). This is important information for clinicians wanting to incorporate effective nutrition screening methods as the risk for malnutrition in acute stroke is significantly higher when a patient is 75 years and older.

### 5.3 CNST vs. SGA in Acute Stroke

The current study utilized Kappa as a chance-corrected method to assess level of agreement between CNST and SGA. According to Altman, CNST showed a "fair" level of agreement with SGA ( $K=0.23$ ).<sup>35</sup> A  $K$  value of 0.61 and higher is considered good level of agreement, therefore, the current study indicates CNST may not be the best screening tool to use within this population.<sup>35</sup> To our knowledge, this is the first study that has used Kappa to observe level of agreement between CNST and SGA. The CNST

validation study assessed inter-rater reliability by using Kappa ( $K=0.88$ ), but not level of agreement between CNST and SGA.<sup>10</sup>

Sensitivity of CNST was low at 24%, which means CNST missed about 75% of the patients who were malnourished as per SGA, and specificity was very good at 97% which indicates CNST was very good at detecting those that were well-nourished. CNST showed good sensitivity, 72.6% and good specificity 85.1% when validated in surgery and medicine patients meaning the tool performed better in those patient populations.<sup>10</sup> In order to obtain precise sensitivity, with a 95% confidence interval, a sample size of at least 1963 patients was needed; however, this number was unrealistic given the average annual rate of admission to the region is 1300-1700 admissions per year.<sup>72</sup> Due to the small sample size ( $n=58$ ) this study had a sensitivity of 24% (95% CI 2.6 –45.4%) or 24% within +/- 21.4% and specificity of 97% (95% CI 89.5 – 104.4%) or 97% within +/- 7.5%.

Because there is no generally accepted clinical definition of malnutrition and no gold standard for determining nutrition status a study of diagnostic accuracy of a nutritional tool is particularly problematic. According to Jones, another method of calculating sample size based on  $K$  would be valid in this scenario, in which an estimate of  $K$  and prevalence of malnutrition within a population group is needed.<sup>33,34</sup> In this case, given prevalence of malnutrition of 16% was used, and  $K=0.88$  for CNST, according to

Jones a sample size of 116-209 would be sufficient.<sup>34</sup> Normally, this method relates to a reliability study between two raters; however, as per Jones, with the absence of gold standard and definition of malnutrition this method can be applied to a validity study.<sup>33</sup>

## 5.4 Positive and Negative Predictive Value of CNST

CNST had a positive predictive value of 85.6% which means CNST had a probability of correctly identifying malnourished patients 85.6% of the time (95% CI 52.6 – 118.8%). The negative predictive value was 62.7% which means CNST had the probability of correctly identifying patients who were well nourished 62.7% of the time (95% CI 45.8 – 79.7%). This implies CNST had a higher probability of correctly identifying malnourished patients rather than well-nourished patients. Since this study's focus is identifying patients who are at risk for malnutrition, it is favourable that CNST have a greater positive predictive value rather than negative predictive value. Predictive value is defined as the likelihood that a test correctly predicts presence or absence of malnutrition.<sup>73</sup> It takes the sum of the true positives and true negatives divided by total tests. Because it incorporates information on both the test and the study population it is considered a good measure of overall clinical usefulness.<sup>73</sup> Predictive value of any test depends mostly on prevalence of malnutrition: when prevalence is low, even very sensitive and specific tests have low positive predictive value.<sup>73</sup> Alternatively, when prevalence is high tests with rather low sensitivity and specificity have relatively high

positive predictive values.<sup>73</sup> According to Gibson, in general, the highest predictive value is achieved when specificity is high, irrespective of sensitivity because a good predictive value of any test depends on the number of false-positive and false-negative considered tolerable accounting for the prevalence of malnutrition .<sup>73</sup> In this study, prevalence was assessed as 43.1% which is neither low nor high, and its specificity was high at 97% meaning based on predictive value, CNST was useful in testing nutritional status within acute stroke patients. In its validation study, CNST had a positive predictive value of 81.2% with an estimated prevalence of malnutrition of 50% which means it was also useful in testing nutritional status within medicine and surgery patients.<sup>10</sup>

## 5.5 Prevalence of Risk of Malnutrition According to CNST

While SGA assessed 25 patients (43%) as malnourished the CNST identified only 7 patients (12%) at risk for malnutrition, suggesting the CNST missed many of the malnourished patients. To trigger an “at risk” score, there had to be two “yes” answers, and not just one. There were 8 patients who had only one “yes” answer within the CNST and therefore automatically identified them as not at risk, however of those 8 patients SGA identified 7 as malnourished which implies that the CNST missed those patients who were malnourished according to SGA. The CNST could be further modified to

trigger risk when only one “yes” answer is obtained. Based on the information from this study, modifying the CNST in this method, would increase agreement, or  $K$ , as well as sensitivity of CNST compared to SGA. Further testing is required to assess effects of modification of CNST in this manner on sensitivity, specificity, and positive and negative predictive value, as well as to assess if  $K$  value would be altered, or high enough to be considered good agreement to change clinical practice.

## 5.6 Limitations of Nutrition- Focused Physical Assessment in Acute Stroke Patients

In Canada, 75% of patients who have had a stroke are over the age of 65.<sup>74</sup> As previously mentioned, sarcopenia, is typically a condition seen in the elderly population.<sup>5</sup> Most of the study subjects (55.2%) were 75 years and older which supports the literature that stroke mostly occurs in older adults. SGA has measures of functionality at baseline and a measure of metabolic demand related to underlying conditions and the rater may be able to assess whether loss of muscle tone or fat loss may be due to decreased mobility, or chronic effects of inflammation and chronic disease. If, however, the elderly patient has been maintaining a constant low intake of food and fluid, and there is no evidence to suggest systemic inflammation, it is difficult to differentiate between sarcopenia and pure PEM in this patient population. In this case, purely providing sufficient nutritional



support will not be sufficient to reverse the adverse effects of a patient identified as malnourished experiencing sarcopenia and PEM, but a combined approach including diet and exercise will be required in rehabilitation making it difficult to implement in this specific population as many stroke patients suffer from decreased mobility after stroke.<sup>59</sup> In real life, these conditions often overlap and each patient must be assessed individually based on the information available to the assessor. Additionally, specific to the stroke population, the assessor often relies on information obtained from a POA, SDM or proxy who may or may not know the patient very well.

## 5.7 Patients who “Fall Through the Cracks”

There were several patients who obtained an automatic referral to the RD as they were receiving enteral feeds (n=12). The patients who obtained an RD referral due to CNST or SGA (or both) would not have normally received an RD referral automatically. The SGA performed due to the study, and not as part of routine care, identified 34.4% (n=20) patients as malnourished who did not have an automatic referral to the RD and would have not received nutrition intervention. Comparatively, the CNST identified 6 patients. Overall the SGA was 3.3 times more effective in recognizing patient who would have “fallen through the cracks”. It is clear SGA is a more thorough assessment than CNST; however, it is not realistic to expect all patients will have a full nutrition assessment upon admission as the current health care system does not support the staffing

levels. Despite this CNST did pick up 6 patients which otherwise may not have gotten any RD referral. Although nutrition screening will likely impact RD referrals and increase the numbers, benefits of nutrition intervention will outweigh the cost of hiring more RDs to meet the demand with higher referrals. These benefits will include less infections, lower length of hospital stay, lower rates of pressure ulcers, increased ability to regain functionality and decreased re-admission rates.<sup>11,12</sup>

## 5.8 Strengths of the Current Study

One strength of this study is that the research RD receive training to conduct and interpret SGA from a CMFT representative before data collection began, and the same rater conducted all of SGA assessments which increased consistency of results of SGA. Ensuring the rater is trained on SGA is important to ensure accurate results. Another strength is that the current study aimed to mirror the CNST validation study in that there was no formal training to nursing personnel to assess validity among untrained users. A third strength is that the research RD was blinded to the CNST results while conducting SGA and therefore rater bias was eliminated. If the research RD knew the results of the CNST before commencing SGA, this might affect or influence what score the research RD gave the patient. Lastly, we can add on to the body of knowledge of prevalence of malnutrition within mostly ischemic stroke patients.

## 5.9 Limitations of the Current Study

Due to the lack of formal training of nurses on how to perform CNST, and any audits performed by managers to ensure compliance, we cannot ensure data was collected accurately. Also, at the time of the study, the stroke protocol at RSC-Lon included mostly patients with ischemic strokes whereas patients with hemorrhagic strokes were categorized as “neurosurgery patients”. This implies selection bias and is not representative of the larger stroke population.

Small sample size of n=58 led to wider confidence intervals of 24% sensitivity +/- 21.4% and therefore the margin of error is quite wide, and not as accurate. Our small sample size was due to missed stroke patients not screened within 48 hours and incomplete CNST results. Another limitation to this study is that numbers of missed stroke patients not screened within 48 hours and incomplete CNST results were not kept, this could have provided more insight as to adherence practices of nurses to conduct the study which might have been useful to provide to the acute stroke care managers, and for future studies involving nutrition screening in this specific stroke unit.

## 5.10 Significance to Dietetics

This study highlights the importance of assessing the effectiveness of a diagnostic tool before implementing it in a specific patient population.

The CNST has been validated in medicine and surgery patients in acute care hospitals in Canada; however, this has not been done within acute stroke patients or patients having cognitive impairment. This is the first study conducted in a Regional Stroke Centre in Ontario, Canada looking at level of agreement between a nutrition screening tool compared to a nutrition assessment.

## 5.11 Future Directions

As this is the first study examining malnutrition screening using CNST in adult stroke population, further studies are needed to explore possible reasons for the low agreement between SGA and CNST. Stroke specific factors that can lead to malnutrition include decreased oral intakes related to depression, apraxia, ataxia, fatigue, and dysphagia. Future studies should include a nutrition screening tool which is sensitive to the specific needs of the acute stroke population. In this case, the CNST could be modified to trigger risk when only one “yes” answer and then observe if this modification improves scores for sensitivity, specificity as well as  $K$  when compared to SGA. Furthermore, given that risk of stroke increases with age, and age older than 75 years has a significant correlation to malnutrition, it is imperative for nutrition screening efforts to focus on this specific population group.

A tool which is quick, simple and easy to use with little or no formal training is needed. Unfortunately, screening tools which need a measure of weight or BMI are not recommended presently as these values are hardly available in real-life practice. Sample size calculation for this study was based on previous studies pointing to a prevalence of malnutrition of 16%.<sup>50,58,69</sup> Given that this study identified a prevalence of 43% using SGA, future studies looking at calculating sample size for sensitivity and specificity can include this number, which is higher than 16% and will result in a much smaller and realistic sample size needed for this patient population. Also, possible future studies could include a sample size calculation based on previous  $K$  value of the CNST, 0.88, and our current estimate of prevalence, 43% leading to a much smaller and manageable sample size (73-77)<sup>34</sup> to establish reliability and/or validity given the average stroke admissions for this geographical region.

## 6 Conclusion

Nutrition screening is needed in our health care systems to detect malnutrition risk, prevent further deterioration of nutritional status, and ensure timely RD involvement. Patients identified as high risk based on nutrition screening should then receive a comprehensive nutrition assessment and appropriate treatment. This study

highlights the importance of certifying that a nutrition screening tool is validated within the intended population. The CNST, although validated for medicine and surgery patients, had a weak agreement with SGA in the acute stroke population. Conversely, CNST had an adequate positive predictive value (85.6%) meaning this tool was effective in detecting true at-risk patients in this population. Further studies are warranted to investigate possible reasons for low level of agreement between CNST and SGA.

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## Appendices

### 1.1 Appendix A. Canadian Nutrition Screening Tool (CNST)

## CANADIAN NUTRITION SCREENING TOOL (CNST)

Name:	Age:	Weight:	Room:

### Identify patients who are at risk for malnutrition

Ask the patient the following questions*	Date:		Date:	
	Admission		Rescreening	
	Yes	No	Yes	No
Have you lost weight in the past 6 months <b>WITHOUT TRYING</b> to lose this weight? <small>If the patient reports a weight loss but gained it back, consider it as NO weight loss.</small>				
Have you been eating less than usual <b>FOR MORE THAN A WEEK?</b>				
<b>Two “YES” answers indicate nutrition risk<sup>†</sup></b>				

\* If the patient is unable to answer the questions, a knowledgeable informant can be used to obtain the information. If the patient is uncertain regarding weight loss, ask if clothing is now fitting more loosely.

### Patients at nutrition risk need an assessment to confirm malnutrition

Nutrition screening using a valid tool can generate a significant volume of requests for nutrition evaluation. Subjective Global Assessment (SGA) is a simple and efficient first-line assessment of nutritional status that can be used following a positive screening and to help prioritize cases.

If a patient is malnourished (SGA B or C), an in-depth nutrition assessment, along with treatment, is required by a registered dietitian.

**The Canadian Nutrition Screening Tool was rigorously validated and tested for reliability in Canadian hospitals. Non-expert raters completed the tool and it was compared to the SGA conducted by a dietitian or trained nutrition researcher.**

<sup>†</sup> If a patient is not at risk, rescreen within a week. Only consider weight change in the past week.

## 1.2 Appendix B. Subjective Global Assessment (SGA)

# Subjective Global Assessment Form

### MEDICAL HISTORY

Patient name: \_\_\_\_\_ Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

### DIETARY INTAKE

- No change; adequate
- Inadequate; duration of inadequate intake \_\_\_\_\_  
 Suboptimal solid diet     Full fluids or only oral nutrition supplements     Minimal intake, clear fluids or starvation
- Dietary Intake in past 2 weeks\***  
 Adequate \_\_\_\_\_     Improved but not adequate \_\_\_\_\_     No improvement or inadequate \_\_\_\_\_

### WEIGHT

Usual weight \_\_\_\_\_ Current weight \_\_\_\_\_

- Non fluid weight change past 6 months**    Weight loss (kg) \_\_\_\_\_  
 <5% loss or weight stability     5-10% loss without stabilization or increase     >10% loss and ongoing  
 If above not known, has there been a subjective loss of weight during the past six months?  
 None or mild     Moderate     Severe
- Weight change past 2 weeks\***    Amount (if known) \_\_\_\_\_  
 Increased     No change     Decreased

### SYMPTOMS (Experiencing symptoms affecting oral intake)

- Pain on eating     Anorexia     Vomiting     Nausea     Dysphagia     Diarrhea  
 Dental problems     Feels full quickly     Constipation
- None     Intermittent/mild/few     Constant/severe/multiple
- Symptoms in the past 2 weeks\***  
 Resolution of symptoms     Improving     No change or worsened

### FUNCTIONAL CAPACITY (Fatigue and progressive loss of function)

- No dysfunction
- Reduced capacity; duration of change \_\_\_\_\_  
 Difficulty with ambulation/normal activities     Bed/chair-ridden
- Functional Capacity in the past 2 weeks\***  
 Improved     No change     Decrease

### METABOLIC REQUIREMENT

High metabolic requirement     No     Yes

### PHYSICAL EXAMINATION

Loss of body fat     No     Mild/Moderate     Severe  
 Loss of muscle mass     No     Mild/Moderate     Severe  
 Presence of edema/ascites     No     Mild/Moderate     Severe

### CACHEXIA

No     Yes

### SGA RATING

**A** Well-nourished Normal     **B** Mildly/moderately malnourished Some progressive nutritional loss     **C** Severely malnourished Evidence of wasting and progressive symptoms

\*See page 2 SGA Rating for more description.

## Appendix B (cont'd)

### Subjective Global Assessment Guidance For Body Composition

#### SUBCUTANEOUS FAT

Physical examination	Normal	Mild/Moderate	Severe
Under the eyes	Slightly bulging area	Somewhat hollow look, Slightly dark circles,	Hollowed look, depression, dark circles
Triceps	Large space between fingers	Some depth to fat tissue, but not ample. Loose fitting skin.	Very little space between fingers, or fingers touch
Ribs, lower back, sides of trunk	Chest is full; ribs do not show. Slight to no protrusion of the iliac crest	Ribs obvious, but indentations are not marked. Iliac Crest somewhat prominent	Indentation between ribs very obvious. Iliac crest very prominent

#### MUSCLE WASTING

Physical examination	Normal	Mild/Moderate	Severe
Temple	Well-defined muscle	Slight depression	Hollowing, depression
Clavicle	Not visible in males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone
Shoulder	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
Scapula/ribs	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
Quadriceps	Well defined	Depression/atrophy medially	Prominent knee, Severe depression medially
Interosseous muscle between thumb and forefinger (back of hand)**	Muscle protrudes; could be flat in females	Slightly depressed	Flat or depressed area

#### FLUID RETENTION

Physical examination	Normal	Mild/Moderate	Severe
Edema	None	Pitting edema of extremities / pitting to knees, possible sacral edema if bedridden	Pitting beyond knees, sacral edema if bedridden, may also have generalized edema
Ascites	Absent	Present (may only be present on imaging)	

Prior to giving the final rating, the evaluator must determine whether changes in body composition and body weight are due to decreased food intake or to cachexia/dysuse. If there is evidence of reduced muscle and fat and no improvement with optimal nutrient intake, this is consistent with cachexia. If cachexia is present, SGA rating may be SGA A despite body composition changes of weight loss, muscle wasting and subcutaneous fat loss.

**A - Well-nourished** no decrease in food intake; < 5% weight loss; no/minimal symptoms affecting food intake; no deficit in function; no deficit in fat or muscle mass **OR** \*an individual with criteria for SGA B or C but with recent adequate food intake; non-fluid weight gain; significant recent improvement in symptoms allowing adequate oral intake; significant recent improvement in function; and chronic deficit in fat and muscle mass but with recent clinical improvement.

**B - Mildly/moderately malnourished** definite decrease in food intake; 5% - 10% weight loss without stabilization or gain; mild/some symptoms affecting food intake; moderate functional deficit or recent deterioration; mild/moderate loss of fat and/or muscle mass **OR** \*an individual meeting criteria for SGA C but with improvement (but not adequate) of oral intake, recent stabilization of weight, decrease in symptoms affecting oral intake, and stabilization of functional status.

**C - Severely malnourished** severe deficit in food intake; > 10% weight loss which is ongoing; significant symptoms affecting food intake; severe functional deficit **OR** \*recent significant deterioration obvious signs of fat and/or muscle loss.

\*\*In the elderly prominent tendons and hollowing is the result of aging and may not reflect malnutrition.



Canadian  
Malnutrition  
Task Force\*

le Groupe de  
travail canadien  
sur la malnutrition\*

Advancing Nutrition Care in Canada / Améliorer les soins nutritionnels au Canada

## 1.3 Appendix C. Research Ethics Approval Certificate



Research Ethics

### Western University Health Science Research Ethics Board HSREB Delegated Initial Approval Notice

Principal Investigator: Dr. Colleen O'Connor  
Department & Institution: Brescia, Brescia University College

Review Type: Delegated  
HSREB File Number: 107709  
Study Title: Nutrition screening in the adult acute stroke population using the Canadian Nutrition Screening Tool in comparison with the Subjective Global Assessment.

HSREB Initial Approval Date: May 05, 2016  
HSREB Expiry Date: May 05, 2017

#### Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Letter of Information & Consent		2016/04/12
Other	Telephone transcript to use when calling a power of attorney or substitute decision maker should they not be available to speak in person (Received 20Apr16)	
Western University Protocol	Western Protocol - Clean copy with revisions	2016/04/12
Other	The Canadian Nutrition Screening Tool (Received 01Feb16)	
Other	References	2016/01/27
Other	The Subjective Global Assessment tool (Received 01Feb16)	

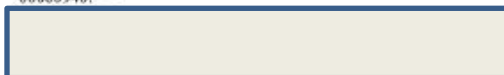
The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.



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## Curriculum Vitae

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**Post-secondary Education and Degrees:** Western University  
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2007-2010 BSc Food and Nutrition

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Zanatta T., Ward S., Seabrook J., Foley N., O'Connor C. Nutrition screening in the adult stroke population using the Canadian Nutrition Screening Tool in comparison with the Subjective Global Assessment. Poster presented at the 2017 Clinical Nutrition Week, American Society of Enteral and Parenteral Nutrition (ASPEN) Conference, Orlando, FL, February 17-21, 2017

Zanatta T., Ward S., Seabrook J., Foley N., O'Connor C. Nutrition screening in the adult stroke population using the Canadian Nutrition Screening Tool in comparison with the Subjective Global Assessment. Poster presented at the 2017 Dietitians of Canada Conference, St John's, NL, June 7-11, 2017