Pre-operative Nutritional Risk Assessment Using Malnutrition Universal Screening Tool (MUST) as a Predictor of Postoperative Outcome in Adult Patients Undergoing Abdominopelvic Surgery at a Tertiary Hospital in Iloilo – A Prospective Study

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Abstract

Background. Several studies have shown the serious implications of malnutrition, yet it is still underestimated, understudied and an undertreated problem in hospitalized patients. It remains a challenge for hospitals in the Philippines. Pre-operative malnutrition is a risk factor of perioperative morbidity and mortality. Thus, assessing the pre-operative nutritional status is necessary in planning early nutritional interventions and may predict risk of developing postoperative complications.

Methodology. A prospective cohort study was conducted among adult patients ages 18 to 70 years old admitted for abdominopelvic surgery at St. Paul's Hospital Iloilo from January 2021 to January 2022. Within 24-48 hours of admission, patients' demographic and clinical profiles were identified and the presence of nutritional risk was evaluated using the Malnutrition Universal Screening Tool (MUST). Further statistical analysis was done using cross tabulation, and Pearson's *chi-square* and logistic regression.

Results. The study demonstrated that nutritional risk, age, presence of malignancy, smoking and alcoholic beverage drinking were significantly correlated with post-operative complications.

Conclusion. Nutritional risk screening using MUST pre-operatively can help predict the outcomes of post-operative patients undergoing abdominopelvic operation.

Keywords. Malnutrition Universal Screening Tool, nutritional assessment, pre-operative screening

Introduction

Malnutrition is a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects on tissue/body form (body shape, size, composition), body function and clinical outcome. In the 21st century, protein-energy malnutrition is a major public health problem worldwide especially in the developing countries, affecting approximately 462 million adults.[1-3] It is caused by lack of access to adequate nutrient intake and illnesses that alter appetite, digestion, absorption, or nutrient metabolism.[4] According to the World Health Organization (WHO), the global developmental, economic, social and medical burden of malnutrition to individuals, families, communities and countries are serious and lasting.[3] It is estimated that approximately 31% of all individuals admitted to a hospital for any cause are malnourished, with cancer patients experiencing even higher rates due to the systemic nature of

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malignancy. Several studies show that malnutrition has a multitude of clinical implications adversely affecting mortality, morbidity and length of hospital stay amongst heterogeneous populations.[5-9] Despite the serious implications of malnutrition, it is still underestimated, understudied and an undertreated problem in hospitalized patients. It remains a challenge in the Philippines.[9,10]

Surgery can be considered a form of injury that initiates inflammatory response and immune triggers. This leads to catabolism of glycogen, fat and protein with release of glucose, free fatty acids and amino acids into the circulation for healing, immune response, and to re-establish the disturbed equilibrium.[11,12] Prevalence and severity vary by type and site of surgery.[13]

Pre-operative malnutrition is a risk factor for perioperative morbidity and mortality.[8] Malnourished patients have longer hospital stay, more likely to be confined for more than seven days and have higher risk of complications.[9] Thus, assessing the pre-operative nutritional status is necessary in planning early nutritional interventions and may predict risk of developing postoperative complications.

Significance of the Study. This study hopes to investigate a practical, easy to use and economical nutritional pre-operative screening tool for adult patients scheduled for abdominopelvic surgical procedures. This can help identify patients with nutritional risk or malnutrition and predict possible occurrence of post-operative complications. Clinicians can then be guided to individualize pre-operative nutritional and medical planning of patients to prevent post-operative morbidity or mortality.

General Objective. The aim of the study is to identify the risk of malnutrition of adult Filipino patients admitted for abdominopelvic surgery using the Malnutrition Universal Screening Tool (MUST) and to validate the use of this tool in predicting pre-operatively the occurrence of post-operative complications.

Specific Objectives.

1. To gather the patient's demographic and clinical characteristics in terms of age, sex, BMI, smoking status, alcohol intake, presence or absence of co-morbidity, presence of malignancy, and whether admitted under Surgery or Obstetrics and Gynecology (OB-GYN).
2. To identify the demographic and clinical profiles that have significant correlation with post-operative complications and length of hospital stay.
3. To correlate overall risk of malnutrition using MUST with post-operative complications and length of hospital stay (counted from day of surgery).

Operational Definition of Terms:

1. *Surgical Outcome* can be mortality or non-mortality. Mortality outcome is described as either dead or alive on the other hand, non-mortality outcomes focus on the patient's well-being and possible health deterioration after an intervention (surgery).[14]

Table I. Clavien-Dindo Classification for Grading Surgical Complications

Classification of Surgical Complications	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III Grade IIIa Grade IIIIb	Requiring surgical, endoscopic, or radiological intervention Intervention not under general anesthesia Intervention under general anesthesia
Grade IV Grade IVa Grade IVb	Life-threatening complication (including CNS complications) * requiring IC/ICU management Single organ dysfunction (including dialysis) Multiorgan dysfunction
Grade V	Death of a patient
Suffix "d"	If the patient suffers from a complication at the time of discharge (see examples in Table 2), the suffix "d" (for "disability") is added to the respective grade of complication. This label indicates the need for a follow-up to fully evaluate the complication.

*Brain hemorrhage, ischemic stroke, subarachnoid bleeding, but excluding transient ischemic attacks. CNS, central nervous system; IC, intermediate care; ICU, intensive care unit.

2. *Surgical complication* is any deviation from the normal postoperative course. The most common complications are infections, postoperative bleeding, anastomotic leakages, pulmonary embolism, myocardial infarction/severe arrythmia, wound opening, diarrhea and hepatic encephalopathy.[7] In this study the standardized *Clavien-Dindo* classification was used for grading surgical complication severity. This scale is divided into seven severity grades including subgroups on grades III and IV as illustrated in *Table I*.

3. *Nutritional Risk* refers to abnormal nutritional conditions. Based on ESPEN Guidelines on definition and terminology and clinical nutrition, adults should be considered at risk if they have any of the following:[16]

- Involuntary loss of $\geq$ 10% of usual body weight within 6 months, or involuntary loss of > 5% of usual body weight in 1 month
- Involuntary loss or gain of 10 pounds within 6 months
- Body mass index less than 18.5 kg/m^2 or greater than 25 kg/m^2
- Chronic disease

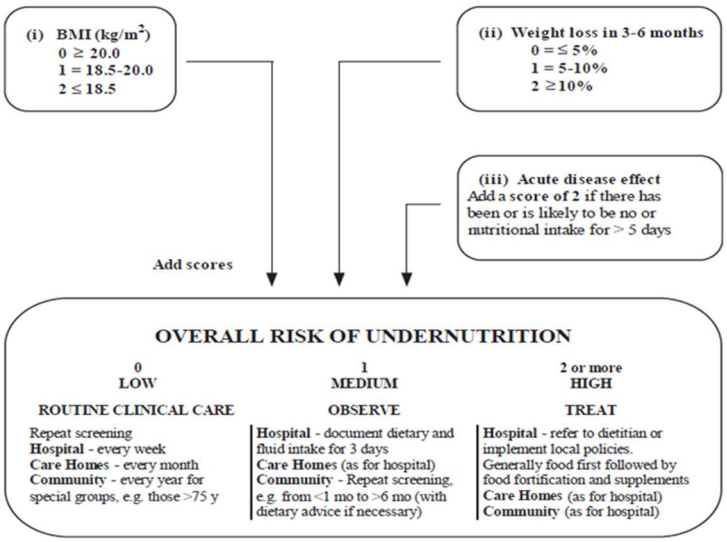


Figure 1. Algorithm Using the Malnutrition Universal Screening Tool

- Increased metabolic requirements
- Altered diets or diet schedules
- Inadequate nutrition intake, including not receiving food or nutrition products for > 7 days

1. Malnutrition is "a state resulting from lack of intake or uptake of nutrition that leads to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease." Malnutrition can result from starvation, disease, or advanced ageing (e.g. >80 years), alone or in combination.[16]
2. Malnutrition risk screening is a rapid process performed to identify subjects at nutritional risk, and should be performed using an appropriate validated tool in all subjects that come in contact with healthcare services. Depending on the care setting, screening should be performed within the first 24-48 h after first contact and thereafter at regular intervals.[16]
3. Abdominopelvic Surgery is defined as an operation done on organs including the stomach, gallbladder, small and large intestines, liver, pancreas, spleen, appendix, uterus, fallopian tubes and ovary.
4. Malnutrition Universal Screening Tool (MUST) is a 5-step validated screening tool designed to identify adults who are underweight and at risk of malnutrition (see *Figure 1*). It was developed by the British Association of Parenteral and Enteral Nutrition (BAPEN), a multi-professional association with the mission of raising awareness of the prevalence and impact of malnutrition to improve nutritional care standard and developing pathways to prevent malnutrition (BAPEN MANUAL). MUST detects protein-energy malnutrition and the risk of developing malnutrition. Parameters used in screening nutrition includes BMI on admission, unplanned weight loss (%) in the past 3-6 months and acute disease effect score. These three components can reflect the 'journey' of the patient from the past (weight loss), to the present (current BMI) and into the future (effect of disease).[18] Each of the three components can independently predict clinical outcome with the importance of individual components varying with the clinical circumstances.[19] Together the three components are better predictors of outcome than the individual components.

Methodology

Study Design. This is a prospective cohort study among adult patients aged 18-70 years old who were admitted from January 1, 2021 to January 31, 2022 for abdominopelvic surgery at St. Paul's Hospital Iloilo.

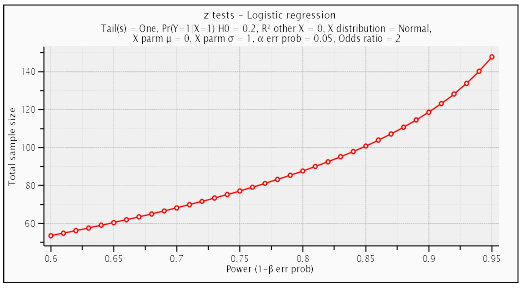
Study Setting. The study was conducted at the Saint Paul's Hospital Iloilo.

Study Period. The study enrolment and follow up of admitted patients started from January 1, 2021 to January 31, 2022.

Study Population. Inclusion Criteria. All patients under pay and service accommodations under the Department of Surgery and OB-GYN who were admitted for elective abdominopelvic surgery, ages 18-70 years old, with stable vital signs and stable comorbidities on admission, who were compliant with the recommended management and medications during the course of admission and who gave their consent were included in the study.

Exclusion Criteria. Patients who were admitted for emergency operations, opted transfer to another institution, discharged against medical advice and whose surgical interventions were deferred were excluded in the study.

Sample Size Computation:



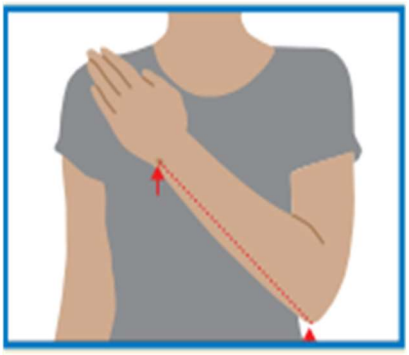


Figure 2. Estimating height from ulna length

The plot above shows the sample size given the varying power of the analysis. *G*Power*™ was used to determine an adequate sample size given an odds ratio of 2 and a power of 80%. The results showed that the sample size is 88. In this study, the total sample size is 118.

By comparison, a study conducted by Sungurtekin, et al., a total of 100 consenting patients were included to assess the influence of nutritional status on complications after major intraabdominal surgery.[36] Henderson et.al. had MUST (Malnutrition Universal Screening Tool) and BNR (Birmingham Nutrition Risk) scores collected from 115 elderly patients and were analyzed if their scores predicted mortality.[37]

Data Collection Tools

1. Nutritional screening was done using the Malnutrition Universal Screening tool.
2. Clavien-Dindo Classification was used for grading surgical complications.

Steps in Screening Using MUST [26]

Step 1: Body mass index (BMI) (kg/m^2). BMI gives a rapid interpretation of chronic protein-energy status based on an individual's height and weight. Take the subject's height and weight to calculate BMI, or use the BMI chart to establish the subject's BMI score.

Measuring height and weight

A. Height

- Use a height stick (stadiometer) where possible. Make sure it is correctly positioned against the wall.
- Ask subject to remove shoes and to stand upright, feet flat, heels against the height stick or wall (if height stick not used).
- Make sure the subject is looking straight ahead and lower the head plate until it gently touches the top of the head.
- Read and document height.

Alternative measurements of height. If height cannot be measured, use recently documented or self-reported height (if reliable and realistic). If height cannot be measured or the subject does not know or is unable to report their height, the following alternative measurements can be used to calculate height.

Length of forearm (ulna)

- Prefer for bed bound subjects, those with severe disabilities and those with kyphosis or scoliosis.
- Ask subject to bend an arm (left side if possible), palm across chest, fingers pointing to opposite shoulder.
- Using a tape measure, measure the length in centimeters (cm) to the nearest 0.5 cm between the point of the elbow (olecranon) and the mid-point of the prominent bone of the wrist (styloid process). • Use the table on page 12 to convert ulna length (cm) to height (m) (*Figure 2*)

Table I. Estimating Height from Ulna Length

Height (m)	Men (<65 years)	1.94	1.93	1.91	1.89	1.87	1.85	1.84	1.82	1.80	1.78	1.76	1.75	1.73	1.71
	Men (≥65 years)	1.87	1.86	1.84	1.82	1.81	1.79	1.78	1.76	1.75	1.73	1.71	1.70	1.68	1.67
	Ulna length (cm)	32.0	31.5	31.0	30.5	30.0	29.5	29.0	28.5	28.0	27.5	27.0	26.5	26.0	25.5
Height (m)	Women (<65 years)	1.84	1.83	1.81	1.80	1.79	1.77	1.76	1.75	1.73	1.72	1.70	1.69	1.68	1.66
	Women (≥65 years)	1.84	1.83	1.81	1.79	1.78	1.76	1.75	1.73	1.71	1.70	1.68	1.66	1.65	1.63
Height (m)	Men (<65 years)	1.69	1.67	1.66	1.64	1.62	1.60	1.58	1.57	1.55	1.53	1.51	1.49	1.48	1.46
	Men (≥65 years)	1.65	1.63	1.62	1.60	1.59	1.57	1.56	1.54	1.52	1.51	1.49	1.48	1.46	1.45
	Ulna length (cm)	25.0	24.5	24.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5	20.0	19.5	19.0	18.5
Height (m)	Women (<65 years)	1.65	1.63	1.62	1.61	1.59	1.58	1.56	1.55	1.54	1.52	1.51	1.50	1.48	1.47
	Women (≥65 years)	1.61	1.60	1.58	1.56	1.55	1.53	1.52	1.50	1.48	1.47	1.45	1.44	1.42	1.40

Knee height

- Measure left leg if possible.
- The subject should sit on a chair, without footwear, with knee at a right angle.
- Hold tape measure between 3rd and 4th fingers with zero reading underneath fingers.
- Place your hand flat across the subject's thigh, about 4 cm (1½ inches) behind the front of the knee.
- Extend the tape measure straight down the side of the leg in line with the bony prominence at the ankle (lateral malleolus) to the base of the heel. Measure to nearest 0.5 cm.
- Note the length and use the table on page 13 to convert knee height (cm) to height (m).

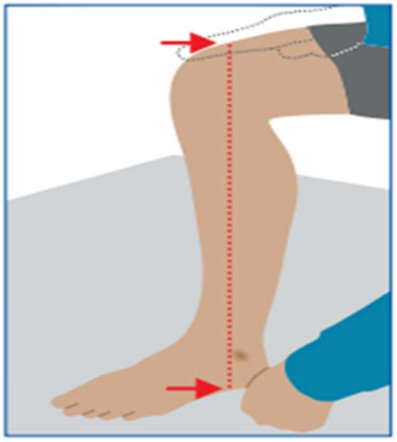


Figure 3. Estimating Height from Knee Height

Table II. Estimating Height from Knee Height

Height (m)	Men (18-59 years)	1.94	1.93	1.92	1.91	1.90	1.89	1.88	1.87	1.865	1.86	1.85	1.84	1.83	1.82	1.81
	Men (60-90 years)	1.94	1.93	1.92	1.91	1.90	1.89	1.88	1.87	1.86	1.85	1.84	1.83	1.82	1.81	1.80
	Knee height (cm)	65.0	64.5	64.0	63.5	63.0	62.5	62.0	61.5	61.0	60.5	60.0	59.5	59.0	58.5	58.0
Height (m)	Women (18-59 years)	1.89	1.88	1.875	1.87	1.86	1.85	1.84	1.83	1.82	1.81	1.80	1.79	1.78	1.77	1.76
	Women (60-90 years)	1.86	1.85	1.84	1.835	1.83	1.82	1.81	1.80	1.79	1.78	1.77	1.76	1.75	1.74	1.73
Height (m)	Men (18-59 years)	1.80	1.79	1.78	1.77	1.76	1.75	1.74	1.73	1.72	1.71	1.705	1.70	1.69	1.68	1.67
	Men (60-90 years)	1.79	1.78	1.77	1.76	1.74	1.73	1.72	1.71	1.70	1.69	1.68	1.67	1.66	1.65	1.64
	Knee height (cm)	57.5	57.0	56.5	56.0	55.5	55.0	54.5	54.0	53.5	53.0	52.5	52.0	51.5	51.0	50.5
Height (m)	Women (18-59 years)	1.75	1.74	1.735	1.73	1.72	1.71	1.70	1.69	1.68	1.67	1.66	1.65	1.64	1.63	1.62
	Women (60-90 years)	1.72	1.71	1.70	1.69	1.68	1.67	1.66	1.65	1.64	1.63	1.625	1.62	1.61	1.60	1.59
Height (m)	Men (18-59 years)	1.66	1.65	1.64	1.63	1.62	1.61	1.60	1.59	1.58	1.57	1.56	1.555	1.55	1.54	1.53
	Men (60-90 years)	1.63	1.62	1.61	1.60	1.59	1.58	1.57	1.56	1.55	1.54	1.53	1.52	1.51	1.49	1.48
	Knee height (cm)	50.0	49.5	49.0	48.5	48.0	47.5	47.0	46.5	46.0	45.5	45.0	44.5	44.0	43.5	43.0
Height (m)	Women (18-59 years)	1.61	1.60	1.59	1.585	1.58	1.57	1.56	1.55	1.54	1.53	1.52	1.51	1.50	1.49	1.48
	Women (60-90 years)	1.58	1.57	1.56	1.55	1.54	1.53	1.52	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44

Demispan

- Ideally the subject should stand as this makes taking the measurement easier.
- Locate and mark the mid-point of the sternal notch (V at the base of the neck).
- Ask the subject to raise the right arm until it is horizontal with the shoulder (give assistance, if necessary, make sure wrist is straight).
- Place a tape measure between the middle and ring finger of the subject's right hand, with zero at the base of the fingers.
- Extend the tape measure along the length of the arm to the mid-point of the sternal notch and note the measurement to the nearest 0.5 cm.

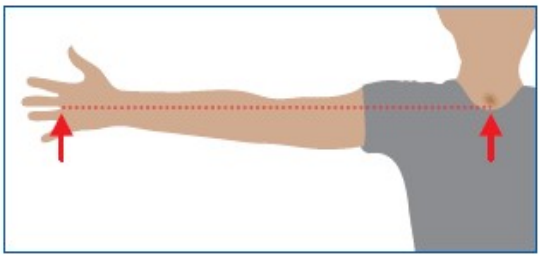


Figure 4. Estimating Height from Demispan

Table III. Estimating Height from Demispan Measurement

Height (m)	Men (16-54 years)	1.97	1.95	1.94	1.93	1.92	1.90	1.89	1.88	1.86	1.85	1.84	1.82	1.81	1.80	1.78	1.77	1.76
	Men (≥55 years)	1.90	1.89	1.87	1.86	1.85	1.84	1.83	1.81	1.80	1.79	1.78	1.77	1.75	1.74	1.73	1.72	1.71
	Demispan (cm)	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83
Height (m)	Women (16-54 years)	1.91	1.89	1.88	1.87	1.85	1.84	1.83	1.82	1.80	1.79	1.78	1.76	1.75	1.74	1.72	1.71	1.70
	Women (≥55 years)	1.86	1.85	1.83	1.82	1.81	1.80	1.79	1.77	1.76	1.75	1.74	1.73	1.71	1.70	1.69	1.68	1.67
Height (m)	Men (16-54 years)	1.75	1.73	1.72	1.71	1.69	1.68	1.67	1.65	1.64	1.63	1.62	1.60	1.59	1.58	1.56	1.55	1.54
	Men (≥55 years)	1.69	1.68	1.67	1.66	1.65	1.64	1.62	1.61	1.60	1.59	1.57	1.56	1.55	1.54	1.53	1.51	1.50
	Demispan (cm)	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66
Height (m)	Women (16-54 years)	1.69	1.67	1.66	1.65	1.63	1.62	1.61	1.59	1.58	1.57	1.56	1.54	1.53	1.52	1.50	1.49	1.48
	Women (≥55 years)	1.65	1.64	1.63	1.62	1.61	1.59	1.58	1.57	1.56	1.55	1.54	1.52	1.51	1.50	1.49	1.47	1.46

B. Weight

If subject cannot be weighed, use a weight recently documented in their notes or use self-reported weight (if reliable and realistic).

Recent weight loss. If weight measurements are not possible, a history of weight loss may be helpful. Use serial measurements, documented in subject's notes or self-reported weight loss (if reliable and realistic). If it is not possible to obtain any of these measurements, subjective criteria should be used to obtain a clinical impression of an individual's overall nutritional risk category.

Subjective Criteria. The following criteria which related to the patient can help form a clinical impression of an individual's overall nutritional risk category. The factors listed below can either contribute to or influence the risk of malnutrition. These criteria should be used collectively not separately as alternatives to Steps 1 and 2 of 'MUST' and are not designed to assign an actual score. Mid upper arm circumference (MUAC) may be used to estimate BMI category (see page 16) to support your overall impression of the subject's nutritional risk. Estimate a malnutrition risk category (low, medium, or high) based on your overall evaluation.

1. BMI

   - Clinical impression - thin, acceptable weight, overweight. Obvious wasting (very thin) and obesity (very overweight) can be noted.

2. Weight loss

   - Clothes and/or jewelry have become loose fitting.
   - History of decreased food intake, reduced appetite or dysphagia (swallowing problems) over 3 – 6 months and underlying disease or psychosocial/ physical disabilities likely to cause weight loss.

3. Acute disease

   - Acutely ill and no nutritional intake or likelihood of no intake for more than 5 days.

Estimating body mass index (BMI) category

In BMI, if neither height nor weight can be measured, range can be estimated using the mid upper arm circumference (MUAC) which may be used to support an overall impression of the subject's risk category using subjective criteria

Measuring mid upper arm circumference (MUAC)

- The subject should be standing or sitting.
- Use left arm if possible and ask subject to remove clothing so arm is bare.
- Locate the top of the shoulder (acromion) and the point of the elbow (olecranon process) (*Figure 5*).
- Measure the distance between the 2 points, identify the midpoint and mark on the arm.
- Ask subject to let arm hang loose and with tape measure, measure circumference of arm at the

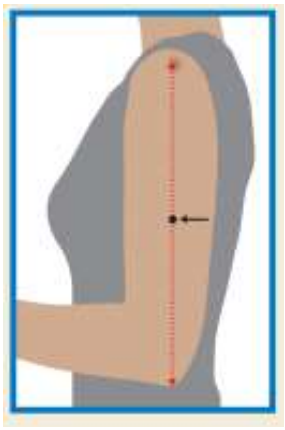


Figure 5. Estimating Weight from Mid upper Arm Circumference

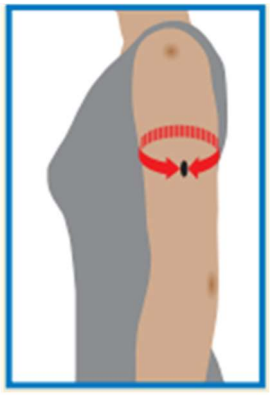


Figure 6. Estimating Weight from Mid-upper Arm Circumference

midpoint. Do not pull the tape measure tight - it should just fit comfortably round the arm (Figure 6)

If MUAC is less than 23.5 cm, BMI is likely < 20 kg/m^2, subject is likely to be underweight. If MUAC is > 32.0 cm, BMI is likely to be more than 30 kg/m^2, subject is likely to be obese.

Step 2: Weight loss

Obtain history of unplanned weight loss over 3–6 months. It is a more acute risk factor for malnutrition than BMI. To establish the subject's weight loss score, ask if there has been any weight loss in the last 3–6 months, and if so, how much (or look in their medical records). Deduct current weight from previous weight to calculate amount of weight loss. Use weight loss tables to establish weight loss score (*Tables 4*). If the subject has not lost weight (or has gained weight) score 0.

Step 3: Acute disease can affect risk of malnutrition

If the subject is currently affected by an acute pathophysiological or psychological condition, and there has been no nutritional intake or likelihood of no intake for > 5 days, they are likely to be at nutritional risk. Such patients include those who are critically ill, those who have swallowing difficulties (e.g. after stroke), or head injuries or are undergoing gastrointestinal surgery. Add 2 to the score if acute disease is present.

Step 4: Overall risk of Malnutrition

Add scores together from Steps 1, 2, and 3 to calculate overall risk of malnutrition after considering all relevant factors obtained from history and measurements needed to calculate BMI obtained.

The Malnutrition Universal Screening Tool (MUST) is reproduced here with the kind permission of BAPEN (British Association for Parenteral and Enteral Nutrition). For further information on MUST see www.bapen.org.uk.

Collection of Data. Prior to data collection, research proposal was presented to the Medical Research Review Committee of the Department of Internal Medicine, Department Chairmen and Training Officers under the Department of Surgery and OB-GYN and to the SPH-Iloilo Hospital Administrator. Necessary steps were also followed as per BAPEN rules to grant copyright permission by following MUST Copyright checklist.

Eligible patients were interviewed within 24-48 hours of admission. Height, weight, or the alternative ways of measuring BMI were taken at the Emergency room. Nutritional risk screening was then done using MUST. Patients' status was followed up after operation and course in the wards, length of stay (starting from the day of surgery) was gathered from the patient's chart.

Statistical Analysis. SPSS version 20 was used to analyze the data. The following Statistical Tools were used:

1. Frequency Count was used to determine the patient's demographic characteristics in terms of age, sex, BMI, smoker or nonsmoker, alcoholic beverage drinker or nonalcoholic beverage drinker, presence, or absence of co morbidity, presence or absence of malignancy, patient case, and type of surgical operation.
2. Cross Tabulation was used to determine the distribution of patients with regards to MUST Risks with Presence of Complications and Surgical Complication Grading.
3. Mean and Standard Deviation was used to describe the Complication Counts, Severity, and Length of Stay.
4. Pearson Chi-Square was used to determine association between patient demographic and clinical profiles including Malnutrition Risk using MUST with Presence of Complications and Surgical Complication Grading.
5. Logistic Regression was used to determine the odds ratio between the Predictor (MUST) with the presence or absence of post-operative complication and its grading of severity, and length of hospital stay. The level of significance is set to 0.05. Indicating that a p-value less than 0.05 would mean significance.

Table IV. Weight loss score

Score	Unplanned weight loss in past 3 – 6 months (% body weight)	Significance
2	>10	Clinically significant
1	5 – 10	More than normal intra-individual variation - early indicator of increased risk of undernutrition
0	<5	Within 'normal' intra- individual variation

Results

The results showed that most of the patients were aged 31-50 years old (48%), predominantly females (75%), had normal BMI (56%) had and zero score in overall Risk of Malnutrition (75%). Forty-eight (41%) of patients had no surgical complication. The most common surgical complication grading was Grade II (38%) (*Table V*).

The average length of hospital stay of patients was 4.46 days. Only one patient expired out of 118 patients (*Table VI*).

Table VII shows the patients clinical profile and its relationship with *Surgical Complication Grading*. Almost all the patients were not smoking (97%) and not drinking alcohol (93%). Most patients had existing comorbidities (68%) and had no malignancy (75%). There was almost equal number of cases of patients admitted under OB-GYN (48%) and Surgery (52%).

The most common comorbidity noted was Hypertension at 40% while 32% had no comorbidities. The top two most common abdominopelvic operations were Total Abdominal Hysterectomy and Bilateral Salphingoopherectomy (TAHBSO) (27%) and Laparoscopic cholecystectomy (22%).

Only Smoking *(p=0.000)*, Alcoholic Beverage Drinking *(p=0.006)* and Presence of Malignancy *(p=0.001)* were found to have a significant relationship with Surgical Complication Grading (*Table VIII*). The proportion of categories of Smoking, Alcoholic Beverage Drinking and Presence of Malignancy with categories of Surgical Complication Grading were significantly different.

Patients who were not smoking (41%), not drinking alcohol (41%) and had no malignancy (49%) had significantly higher proportions with having no surgical complication compared to patients who were smoking (25%), drinking alcohol (38%) and had malignancy (38%). Furthermore, Presence of Comorbidity *(p=0.114)* and patient Case *(p=0.477)* had no significant relationship with Surgical Complication Grading. *See Table 2.a*

Only Presence of Malignancy *(p=0.000)* and Case *(p=0.041)* were found to have significant relationship with length of hospital stay. The average length of hospital stay of patients were significantly different across categories of Presence of Malignancy and Case.

Table V. Surgical Complication Grading

Grading	n	%
None	48	41%
II	45	38%
I	18	15%
IV A	4	3%
III	1	1%
IV B	1	1%
V	1	1%

Table VI. Demographic Profile of Patients and Length of Hospital Stay (LOS)

Profile	Category	Hospital LOS (days, mean)	p Value
Age	20-30 yo	3.94	0.031
	31-50 yo	3.72	
	51-60 yo	5.00	
	61-70 yo	6.17	
Sex	Female	4.36	0.573
	Male	4.79	
BMI	Underweight	6.25	0.375
	Normal	4.26	
	Overweight	4.10	
	Obese	5.21	
Over-all Risk of Malnutrition	0	3.54	0.000
	1	8.43	
	2	7.50	
	3	7.00	
	4	5.83	

Table VII. Clinical Profile and Surgical Complication Grading

Profile	Category	Surgical Complication Grading							Total	p Value
		None	I	II	III	IV A	IV B	V		
Smoking	No	47(41)	17(15)	44(39)	1(1)	4(4)	1(1)		114(97)	0.000
	Yes	1(25)	1(25)	1(25)				1(25)	4(3)	
Alcoholic Beverage Drinking	No	45(41)	16(15)	44(40)	1(1)	3(3)	1(1)		110(93)	0.006
	Yes	3(38)	2(25)	1(13)		1(13)		1(13)	8(7)	
Presence of Comorbidity	No	10(26)	10(26)	16(42)		2(5)			38(32)	0.114
	Yes	38(48)	8(10)	29(36)	1(1)	2(3)	1(1)	1(1)	80(68)	
Presence of Malignancy	No	43(49)	16(18)	26(30)	1(1)	1(1)	1(1)		88(75)	0.001
	Yes	5(17)	2(7)	19(63)		3(10)		1(3)	30(25)	
Case	OB-GYN	25(44)	12(21)	20(35)					57(48)	0.147
	SURGERY	23(38)	6(10)	25(41)	1(2)	4(7)	1(2)	1(2)	61(52)	

Note: Surgical Complication Grading III, IVA, IVB, and V were not included in Chi-square Testing since the total counts do not exceed five

Table VIII. Patient Profile and Relationship to Surgical Complication Grading

Profile	Category	Surgical Complication Grading (Mean)	p Value
Smoking	No	4.47	0.903
	Yes	4.25	
Alcoholic Beverage Drinking	No	4.47	0.941
	Yes	4.38	
Presence of Comorbidity	No	4.37	0.839
	Yes	4.51	
Presence of Malignancy	No	3.65	0.000
	Yes	6.87	
Case	OB-GYN	3.77	0.041
	SURGERY	5.11	

Patients who have presence of malignancy (6.87) have significantly higher average length of stay compared to patients who have none (3.65). Also, cases who were admitted under *Surgery* (5.11) have significantly higher average length of hospital stay compared to patients under *OB-GYN* (3.77).

Discussion

It has been known and recognized that malnutrition is a risk factor for post-operative complications, but its prevalence and severity is often underestimated. There are several nutritional risk screening tools but none is generally accepted as gold standard.[8] The MUST is a tool found to have high predictive validity for the hospital setting and is as good as other validated screening tools.[24] It has also been developed to establish malnutrition risk in all adult patients even in those whose weight and or height could not be measured in contrast to other screening tools that requires it.[25]

Malnutrition is highly prevalent among hospitalized patients in northeast and southeast Asia.[27] In the Philippines, data on prevalence and impact of hospital malnutrition are grossly lacking.[9] Also, initial nutrition risk assessment of surgical patients upon admission is not implemented in most institutions in the country. The practice of nutritional therapy is still at an infancy stage.[29]

To our knowledge this is the first local study that predicts post-operative outcomes of abdominopelvic surgeries using MUST for nutritional risk assessment.

The study showed that malnutrition risk has a significant correlation with post-operative complications. Patients with overall risk of malnutrition scores of zero (51%) significantly have the highest proportion with no surgical complications. Patients with scores of 4 (83%) have the highest proportion of surgical complication grading II compared to those with lower scores. This is also consistent with the results of other studies supporting that patients with pre-operative malnutrition have poorer outcomes and have higher risk of developing complications.[5,23,31,32]

Age has been found to have a correlation with surgical complication grading, with patients < 50 years old having significantly higher proportions with no surgical complications than those > 50 years old. Older age groups have poor dentition, poor appetite, cognitive impairment and multiple comorbidities that make them vulnerable to malnutrition.[28]

Smoking (*p=0.000*), Alcoholic Beverage Drinking (*p=0.006*) and Presence of Malignancy (*p=0.001*) also have a significant relationship with Surgical Complication Grading. Patients who were not smoking (41%), not drinking (41%) and has no malignancy (49%) had significantly higher proportions of having no surgical complications.

Impaired wound and tissue healing, wound infection, and cardiopulmonary complications are often associated with smokers while post-operative infections, cardiopulmonary complications, and bleeding episodes are common in alcoholic beverage drinkers. Both smoking and hazardous alcohol drinking are lifestyle risk factors that can influence the outcome after surgery.[34]

Our results showed that presence of comorbidity had no significant relationship with Surgical Complication Grading. This contrasts with an existing local study on malnutrition in a tertiary hospital which concluded that presence of comorbidities is significantly associated with malnutrition.[9]

The difference in results may be due to limited variety of cases during the period of our research which is still well into the pandemic. The inclusion criteria of our study include patients who are within 18 to 70 years old. In contrast, the other study included a population of inpatients 18 years old and above**.** These factors might have underestimated the relationship between comorbidities and post-operative surgical complications.

Furthermore, our results revealed that older patients, those with presence of malignancy and admitted under the Department of Surgery have longer average length of stay. Studies have shown that patients with nutritional risks have longer hospitalizations.[5,9,23] Scheisser et. al. reports that the highest prevalence of nutritional risk are in patients undergoing hepatobiliary surgery (27%) and upper GI surgery (27%), followed by transplantations (22%), and colorectal surgery (21%). Minor surgery such as hernia repair and cholecystectomies have a prevalence of nutritional risk below 10%. In addition, patients admitted for cancer surgery were found to have higher incidence of nutritional risk (40%) than those with benign diseases (8%).[8]

Our results revealed that higher overall malnutrition risk (scores of 4) does not have longer hospitalization than those with lower scores (1,2,3). The correlation between overall malnutrition risk and length of hospital stay might be underestimated due to the limited variety of cases in our study population with most admissions consisting of

patients who are scheduled for laparoscopic cholecystectomy and TAHBSO. The criteria of elective procedural cases included patients who were mostly stable and cleared cardiology or pulmonary wise for operation prior to admission. Also, length of stay post-operatively could be subjective depending on the attending physician's choice whether to send home patient earlier or later.

Several studies have already highlighted malnutrition as a risk factor for complications, morbidity, mortality, prolonged hospitalization, and increased healthcare cost. A nutritional risk scoring that is easy to use and not time consuming like MUST can increase compliance to the practice of nutritional screening. This validated tool can play an important role in predicting and improving post-operative outcomes.

Conclusion

Most patients who were admitted in our institution for elective abdominopelvic surgery were ages 31-50 years old (48%) , females (75%), had normal BMI (56%) and had zero score in over-all Risk of Malnutrition (75%). Almost all of the patients were not smoking (97%), not drinking alcohol (93%), had existing comorbidities (68%) and had no malignancy (75%). There were almost equal patients admitted under OB-GYN (48%) and Surgery (52%).

The study demonstrates that nutritional risk, age, presence of malignancy, smoking and alcoholic beverage drinking are significantly correlated with post-operative complications.

Thus, nutritional risk screening using MUST pre-operatively can predict the outcomes of post-operative patients undergoing abdominopelvic operation.

Recommendation

We recommend more research should be conducted with a larger population size and a variety in surgical cases and procedures to further display the trend between the relationship of malnutrition risk severity and surgical complication grading and validate the predictive power of MUST.

Conflicts of Interest. All authors declared no potential conflicts of interest.

References

1. Meier R, Stratton R. (2008). Basics concepts in nutrition: Epidemiology of malnutrition. e-SPEN. 2008;3(4). doi: 10.1016/j.eclnm.2008.04.002
2. Desjeux JF. (2006). Recent issues in energy-protein malnutrition in children. Nestle Nutr Workshop Ser Pediatr Program. 2006;58(58):177-188. doi:10.1159/000095062
3. World Health Organization. 2018, February 16. https://www.who.int/news-room/fact-sheets/detail/malnutrition
4. Klein S. Protein-Energy Malnutrition. (2011). Vol 2. Twenty-Four. Elsevier Inc.; 2011. doi:10.1016/B978-1-4377-1604-7.00222-0
5. Schiesser M, Kirchhoff P, Müller MK, Schäfer M, Clavien PA. (2009). The correlation of nutrition risk index, nutrition risk score, and bioimpedance analysis with postoperative complications in patients undergoing gastrointestinal surgery. Surgery.145(5):519-526. doi: 10.1016/j.surg.2009.02.001
6. Velasco C, García E, Rodríguez V, et al. (2010). Comparison of four nutritional screening tools to detect nutritional risk in hospitalized patients: A multicentre study. Eur J Clin Nutr. 2011;65(2):269-274. doi:10.1038/ejcn.2010.243
7. Jie B, Jiang ZM, Nolan MT, Zhu SN, Yu K, Kondrup J.(2012). Impact of preoperative nutritional support on clinical outcome in abdominal surgical patients at nutritional risk. Nutrition. 2012;28(10):1022-1027. doi: 10.1016/j.nut.2012.01.017
8. Schiesser M, Müller S, Kirchhoff P, Breitenstein S, Schäfer M, Clavien PA. (2008). Assessment of a novel screening score for nutritional risk in predicting complications in gastro-intestinal surgery. Clin Nutr. 2008;27(4):565-570. doi: 10.1016/j.clnu.2008.01.010
9. Dominguez RJ. (2013). Burden of Malnutrition in a Tertiary Care Hospital in Baguio City. SAGE Open. 2013;3(3):215824401350493. doi:10.1177/2158244013504936
10. Konturek PC, Herrmann HJ, Schink K, Neurath MF, Zopf Y. (2015). Malnutrition in hospitals: It was, is now, and must not remain a problem! Med Sci Monit. 2015; 21:2969-2975. doi:10.12659/MSM.894238
11. Weissman, C. (1990). The Metabolic Response to Stress. Anesthesiology, 73(2), 308–327. doi:10.1097/00000542-199008000-00020
12. Kyrou I, Tsigos C. (2009). Stress hormones: physiological stress and regulation of metabolism. Curr Opin Pharmacol. 2009;9(6):787-793. doi: 10.1016/j.coph.2009.08.007
13. Alazawi W, Pirmadjid N, Lahiri R, Bhattacharya S. (2016). Inflammatory and immune responses to surgery and their clinical impact. Ann Surg. 2016;264(1):73-80. doi:10.1097/SLA.0000000000001691
14. Jammer I. (2015). Standards for definitions and use of outcome measures for clinical effectives research in perioperative: European Perioperative Clinical Outcome (EPCO) definitions: A statement from the ESA-ESICM joint taskforce on perioperative outcome measures. Eur J Anaesthesiol.2015 Feb;32(2): 88-105.doi: 10.1097/EJA.0000000000000118.
15. Dindo D, Demartines N, Clavien PA. (2004). Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240(2):205-213. doi: 10.1097/01.sla.0000133083.54934.ae
16. Cederholm, T., Barazzoni, R., Austin, P., Ballmer, P., Biolo, G., Bischoff, S. C., Singer, P. (2017). ESPEN guidelines on definitions and terminology of clinical nutrition. Clinical Nutrition, 36(1), 49–64. doi: 10.1016/j.clnu.2016.09.004
17. Stratton, R. J., Hackston, A., Longmore, D., Dixon, R., Price, S., Stroud, M., Elia, M. (2004). Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the "malnutrition universal screening tool" ("MUST") for adults. British Journal of Nutrition, 92(05), 799. doi:10.1079/bjn20041258
18. Elia M Chairman and Editor. (2003). Screening for Malnutrition: A Multidisciplinary Responsibility. Development and Use of the 'Malnutrition Universal Screening Tool' ('MUST') for Adults. Malnutrition Advisory Group (MAG), a Standing Committee of BAPEN. Redditch, Worcs.: BAPEN.
19. Rasmussen HH, Holst M, Kondrup J. (2010). Measuring nutritional risk in hospitals. Clin Epidemiol. 2010;2(1):209-216. doi:10.2147/CLEP.S11265
20. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. (2003). ESPEN guidelines for nutrition screening 2002. Clin Nutr. 2003;22(4):415-421. doi:10.1016/S0261-5614(03)00098-0
21. Green SM, Watson R.(2005). Nutritional screening and assessment tools for use by nurses: Literature review. J Adv Nurs. 2005;50(1):69-83. doi:10.1111/j.1365-2648.2004.03350.x
22. Van Bokhorst-de van der Schueren MAE, Guaitoli PR, Jansma EP, de Vet HCW. (2014). Nutrition screening tools: Does one size fit all? A systematic review of screening tools for the hospital

setting. Clin Nutr. 2014;33(1):39-58. doi:10.1016/j.clnu.2013.04.008
23. Sun Z, Kong XJ, Jing X, Deng RJ, Tian Z Bin. (2002). Nutritional risk screening 2002 as a predictor of postoperative outcomes in patients undergoing abdominal surgery: A systematic review and meta-analysis of prospective cohort studies. PLoS One. 2015;10(7):1-12. doi: 10.1371/journal.pone.0132857
24. Stratton, R. J., Hackston, A., Longmore, D., Dixon, R., Price, S., Stroud, M., Elia, M. (2004). *Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the "malnutrition universal screening tool" ("MUST") for adults. British Journal of Nutrition, 92(05), 799.* doi:10.1079/bjn20041258
25. Stratton RJ, King CL, Stroud MA, Jackson AA, Elia M. (2006). 'Malnutrition Universal Screening Tool' predicts mortality and length of hospital stay in acutely ill elderly. Br J Nutr. 2006;95(2):325-330. doi:10.1079/bjn20051622
26. "MUST" Explanatory Booklet. A Guide to the "Malnutrition Universal Screening tool" (MUST) for adults in BAPEN. Todorovic V. 2003
27. Inciong, J., Chaudhary, A., Hsu, H., Trung,L.,Usman, N.,Ungpinitpung,W. (2020). Hospital malnutrition in northeast and southeast Asia: A systematic literature review. https://doi.org/10.1016/j.clnesp.2020.06.001
28. Kayser-Jones, J., Schell, E., Porter, C., Barbaccia, J. and Shaw, H. (1999) Factors contributiong to dehydration in nursing homes: Inadequate staffing and lack of professional supervision. Journal of the American Geriartric society, 47,1187-1194.
29. Llido, L. (2006). The impact of computerization of the nutrition support process on the nutrition support program in a tertiary care hospital in the Philippines: report for the years 2000-2003. Clin Nutr. 2006 Feb;25(1):91-101. doi: 10.1016/j.clnu.2005.08.006. Epub 2005 Sep 29. PMID: 16198450.
30. del Rosario, D., Inciong, J. Sinamban, R., Llido, L. (2012). The effect of adequate energy and protein intake on morbidity and mortality in surgical patients nutritionally assessed as high or low risk. PhilSPEN Online Journal of Parenteral and Enteral Nutrition-Original Clinical Investigation.
31. Ho, J, Wu, A., Lee, M., Lau, S., Lam, P., Kwok, S., Kwan, R., Tam, C., Lee, S. (2015). Malnutrition risk predicts surgical outcomes in patients undergoing gastrointestinal operations: Results of a prospective study.Clinical Nutrition Volume 34, Issue 4, Pages 679-684,ISSN 0261-5614,https://doi.org/10.1016/j.clnu.2014.07.012.
32. Cerantola Y, Grass F, Cristaudi A, Demartines N, Schäfer M, Hübner M. (2011). Perioperative nutrition in abdominal surgery: recommendations and reality. Gastroenterol Res Pract. 2011; 2011:739347. doi: 10.1155/2011/739347. Epub 2011 May 22. PMID: 21687620; PMCID: PMC3113259.
33. Bradley, K. A., Rubinsky, A. D., Sun, H., Bryson, C. L., Bishop, M. J., Blough, D. K., Henderson, W. G., Maynard, C., Hawn, M. T., Tønnesen, H., Hughes, G., Beste, L. A., Harris, A. H., Hawkins, E. J., Houston, T. K., & Kivlahan, D. R. (2011). Alcohol screening and risk of postoperative complications in male VA patients undergoing major non-cardiac surgery. *Journal of general internal medicine*, *26*(2), 162–169. https://doi.org/10.1007/s11606-010-1475-x
34. World Health Organization. (2020). Smoking Greatly Increases Complications After Surgery.https://www.who.int/news/item/20-01-2020-smoking-greatly-increases-risk-of-complications-after-surgery
35. Tonnesen, H., Lauritzen, J., Nielsen, P., Moller, A. (2009). Smoking and alcohol intervention before surgery: evidence for best practice. British Journal of Anaesthesia. Pages 297-306. https://doi.org/10.1093/bja/aen401
36. Sungurtekin H, Sungurtekin U, Balci C, Zencir M, Erdem E. The influence of nutritional status on complications after major intraabdominal surgery. J Am Coll Nutr. 2004 Jun;23(3):227-32. doi: 10.1080/07315724.2004.10719365. PMID: 15190047.
37. Henderson S, Moore N, Lee E, Witham MD. Do the malnutrition universal screening tool (MUST) and Birmingham nutrition risk (BNR) score predict mortality in older hospitalised patients? BMC Geriatr. 2008 Oct 10;8:26. doi: 10.1186/1471-2318-8-26. PMID: 18847458; PMCID: PMC2572058.