Original Research Article

To evaluate the nutritional status of patients with diabetes mellitus type 2 in out-patient department of a multi-specialty hospital in Mumbai using malnutrition universal screening tool assessment score

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ABSTRACT

Objective: To screen for the nutritional status of patients with Diabetes Mellitus in out-patient department of a Multi Speciality Hospital during treatment using validated Malnutrition Universal Screening Tool. Nutritional status is an important element for quality of life and wellness among patients with Diabetes Mellitus Type 2. This study aimed to assess the nutritional status of adult diabetic outpatients using MUST-Malnutrition Universal Screening Tool and evaluate relative factors in these patients.

Patients and Method: A total of 168 adult patients with Diabetes Mellitus Type 2 seen at the out-patient department of a Multi Speciality hospital in a suburb of Mumbai were included in this study. A cross-sectional study was carried out from February 2019 to June 2019 in the out-patient department. Patients were evaluated for their nutritional status using Malnutrition Universal Screening Tool (MUST). Socio-demographic, current pharmaceutical treatment information, BMI, MUST score was recorded. As a part of ongoing research, 3-day dietary recall and physical activity information were collected. Multivariate regression was used to ascertain the aspects associated with nutritional status.

Results: The aggregate age of the study subjects was 56 years. A total of 12 participants had MUST score of 2 or more points by MUST screening and 5 patients had a score of 1 and rest had a MUST score of 0 but 72.62% were overweight or obese.

Conclusion: Early screening of nutritional status using simple screening tools like MUST might help to identify and thereby improve the nutritional status of patients with Diabetes Mellitus type 2 in out-patient department of any healthcare setting.

1. Introduction

Malnutrition is a perturbing issue globally. Malnutrition has been defined by the World Health Organization as a "cellular imbalance between supplies of nutrients and energy and the body's demand for them to ensure growth, maintenance and specific functions and thereby the spectrum oscillates towards both- undernourished or at risk to obesity"[1]. Unrecognized as it may be, malnutrition may be a problem in adult patients with diabetes mellitus. Nutritional imbalance especially in diabetes mellitus patients may be influenced by factors such as use of poly pharmacy for therapeutic treatment, insufficient access to food, not sufficient intake, non-nutritive food choices and even associated comorbidities that may restrict adequate nutrient absorption or variability in appetite due to underlying illness. At times patients on insulin regimen may not adhere to insulin administration and meal delivery compromising efficacy of glycemic management. Hence, malnutrition may be defined as a multi factorial syndrome that implies to the complex role between deficiency in the dietary intake, increased requirements associated with disease-related metabolic alterations and/or decreased availability of nutrients due to processes such as poor absorption and/or

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immoderate nutrient losses[2]. Nutritional risk goes on to be unrecognized and thereby probably under-treated in clinical practice. Routine screening of all patients is not always done in all hospital out-patient department, and nutritional support thereby may be missed for these undernourished or obese patients. Hence, identification of malnutrition and its associate factors becomes the first critical step of management of these patients.

2. Diabetes Mellitus- An Overview

A metabolic disease Diabetes Mellitus (DM) can involve inappropriately raised or altered blood glucose levels[3]. Consisting of several types, Diabetes Mellitus can be categorized as type 1, type 2, maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes, and also secondary causes due to endocrinopathies or steroid use to name a few[4]. With approximate occurrence in adult Indian population of around 72.96 million cases of diabetes the prevalence in urban areas is high ranging between 10.9% and 14.2% and prevalence in rural India may be estimated around 3.0-7.8% among population aged 20 years and above with a much larger prevalence among individuals aged over 50 years (INDIAB Study)[5]. The chief subtypes of Diabetes Mellitus (DM) are Type 1 Diabetes Mellitus (T1DM) and Type 2 Diabetes Mellitus (T2DM) that starkly result from defective insulin secretion (T1DM) and/or action (T2DM)[6]. T1DM mostly presents in children or adolescents, while T2DM is thought to affect middle-aged and older adults who may have prolonged or undiagnosed hyperglycaemia that may be influenced by poor lifestyle and dietary choices[4,6]. T1DM and T2DM have drastically different pathogenesis and hence each different type of DM has various aetiologies, clinical presentations and treatment modalities[7]. A patient with DM has possibility for hyperglycaemia. or hypoglycaemia. and that too prolonged or mis managed may by itself impair pancreatic beta-cell function contributing to impaired insulin secretion[8]. Chronic hyperglycaemia may further cause nonenzymatic glycation of proteins and lipids. The extent of this glycation is measurable via the glycation haemoglobin (HbA1c) test[9]. Glycation may eventually result to damage in small blood vessels in the retina, kidney and peripheral nerves leading to the classic diabetic complications of diabetic retinopathy, nephropathy and neuropathy[9]. Physiologic and pathophysiologic stressors like inflammation, infection and injury may ignite a chain of metabolic reactions resulting in a negative nitrogen balance and eventually a decrease in lean body mass[10], especially if patients do not have a proper nutritional status and hence one needs to be mindful to screen and address underlying malnutrition in these patients irrespective of the acute condition as the nutritional status of patients coming to the hospital either in out-patient or in-patient department should not be a missed opportunity to identify and address malnutrition. Acute and chronic diseases in most organ systems have conspicuous effects on food intake and metabolism with increased catabolism, which then may lead to nutrition-related conditions linked with increased morbidity and eventually death. The genesis of malnutrition may vary and can be due to increased requirements secondary to disease or poor nutritional intake[11]. The prevalence and severity of an ebbed nutritional status also differs with individual treatment regimens and it is well documented that several pharmacotherapies available to manage diabetes mellitus type 2 may result in mild to moderate side effects such as increased appetite or nausea, anorexia, lethargy, esophagitis, dysphagia or at times even voracious appetite[12] e.g. with hyperglycaemia (above 7 mmol/l or 126 mg/dl) and/or hypoglycemia (blood glucose levels range below 4 mmol/l or 70 mg/dl) as companions of diabetes mellitus[13], patients may crave to eat even after meals say in case of hypoglycemic episode and all this eventually leads to increased caloric intakes and long term rigorous blood glucose control, can thus cause weight gain. Insulin being a natural hormonal appetite stimulant, the use of insulin regimen especially in insulin dependent diabetes mellitus patients may initially lead to appetite stimulation and consequently weight gain[14]. Weight gain may be an unwanted result of treatment for patients with type 1 or type 2 diabetes[15]. And this unfortunate weight gain is adversely associated with poor cardiovascular outcomes and other co-morbidities and may further expedite insulin resistance in both type 1 and type 2 diabetes mellitus patients[15].

On the contrary, diet is a major determinant of preventive health as well as slowing down of comorbidities like cardio-vascular disease, renal diseases and cognitive disease and, though these phenomena are well known in patients with DM, for patients walking into the hospital whether in out-patient department or in-patient admissions, the focus may be on the acute condition of hospitalization and not DM unless brought in ketoacidosis. Focus is to control the blood glucose levels and the acute disease.

And even in the out-patient department the primary aim is to manage blood glucose control and at times obesity but as these patients may have been suffering from DM since probable years and as shown in the diagnostic tree below, diabetes mellitus being an inflammatory disease, that itself could be a major cause of malnutrition and hence the identification and screening of malnutrition should be made as a primary algorithm even in out-patient setting.

So as to say that even if the diagnostic tree states that disease related malnutrition is of importance, may be at times Diabetes Mellitus patients be over looked as routine cases as DM is very common amongst Indian Population. And may be considered with neglect and commonality.

These are common occurrences and may compromise both nutritional status and functional ability of the patient, which will in turn negatively impact quality of life.
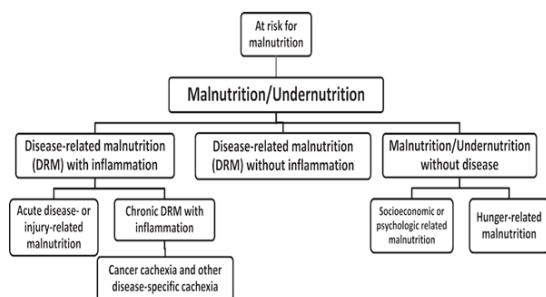
Fig. 1: Graphical Representation of diagnosis tree of malnutrition [16]

2.1. Nutritional status screening and assessment

There isn't a typical gold standard for recognizing nutritional risk or malnutrition. In usual cases, nutritional risk is investigated via screening tools, typically practiced by nutritionists, doctors, or other healthcare professionals like nursing staff, preceding a full nutritional assessment. Nutrition screening of diabetic patients can help identify those at risk for malnutrition. Multiple screening tools have been used to identify those at risk and screening parameters can include, but are not limited to, weight changes, dietary habits, activities of daily living and side effects related to diabetic treatment.

Different techniques may be used for screening for malnutrition, including specialist dietetic assessment, measurements such as mid-arm circumference, hand-grip dynamometry, and other specific screening tools as per the hospital protocols [17]. Tools such as the Mini Nutritional Assessment-short form (MNA-sf), the Geriatric Nutrition Risk Index (GNRI), the Nutritional Risk Screening 2002 (NRS-2002), the Malnutrition Universal Screening Tool (MUST), the Nutritional Risk Index (NRI), the Short Nutritional Assessment Questionnaire (SNAQ), Nutrition Risk in the Critically Ill (NUTRIC) [18] and more recently the malnutrition screening and assessment using Glim Criteria scores [16] are said to be practical and inexpensive to apply and can aid to predict clinical outcomes. Nutritional assessment tools namely the Global Assessment Subjective (SGA) and the Mini Nutritional Assessment (MNA), also evaluate biochemical parameters, clinical and dietetic factors [19]. While MNA, MNA-sf, GNRI, MUST, and NRI were developed mainly to assess nutritional risk or malnutrition in adults and older adults. The guidelines of the European Society for Clinical Nutrition and Metabolism (ESPEN) state that nutritional screening should be able to prognosticate the clinical course of the disease dependent on nutritional status and to assess if a patient could benefit from nutritional treatment [16]. Screening tools are designed to ascertain protein and energy malnutrition and/or to predict if malnutrition is likely to develop or deteriorate under present and/or future set of conditions influencing a patient [20]. In

hospitals, further aspects of a disease like biochemical parameters, co-morbidities, etc. have to be taken into consideration in combination with nutritional measurements so as to determine whether nutritional support is likely to be beneficial. Primary advantage of nutritional screening tools over nutritional assessment tools is that the prior requires less rigorous training to conduct them [21]. Depending on the type of healthcare setting, patient population to be screened and the available man power as well as other resources the screening tool may be chosen. For Malnutrition Universal Screening Tool (MUST) details are collected on the pointers like patient's change in weight, body mass index or weight history, the appropriacy of food intake and, at times with further details collected, the severity of disease [22]. MUST is a five-step malnutrition screening tool, devised and validated by BAPEN (British Association for Parenteral and Enteral Nutrition) to recognize adults and elderly who are malnourished or at probable risk of malnutrition or obesity. [23] It also includes suggested guidelines for management of identified cases which may aid to develop a care plan.

The purpose of the MUST tool system is to identify adults who are at risk for malnutrition or who are malnourished based on the interconnection between compromised nutritional status, body composition and physical function [23]. It has been endorsed that close overseeing of patients at risk for malnutrition should be a standard practice. If inadequate staffing is a hurdle, a referral system for high-risk patients suggested be put in action.

Malnutrition scores were calculated using the MUST screening tool. Patients were categorized according to their risk of malnutrition with a score of 0, 1 and 2 indicating low risk, medium risk and high risk of malnutrition respectively [24]. The Malnutrition Universal Screening Tool (MUST) may be suggested for risk screening and bestows 3 scores for risk classification: 0=low risk, 1=intermediate risk, 2=high risk. Body mass index (BMI) was also used as an indicator of nutritional status [24]. The MUST tool assesses three core areas namely: body mass index (BMI), unplanned weight loss in the past 3-6 months and acute illness or likelihood of no nutritional intake for 5 or more days [23]. The scores assigned to each of these domains are amalgamated to produce the MUST score. The MUST score may then be used to categorize patients as low, medium or high risk. Details of MUST scoring thus obtained was recorded on a pre-set proforma.

The purpose of the Malnutrition Universal Screening Tool is to aid to identify patients who are at risk or already malnourished on the basis of understanding about the association between compromised nutritional status, body composition as well as physical function.

With help of the above tool and integrating all information, the centre decided to categorize the patient group identified for this study-
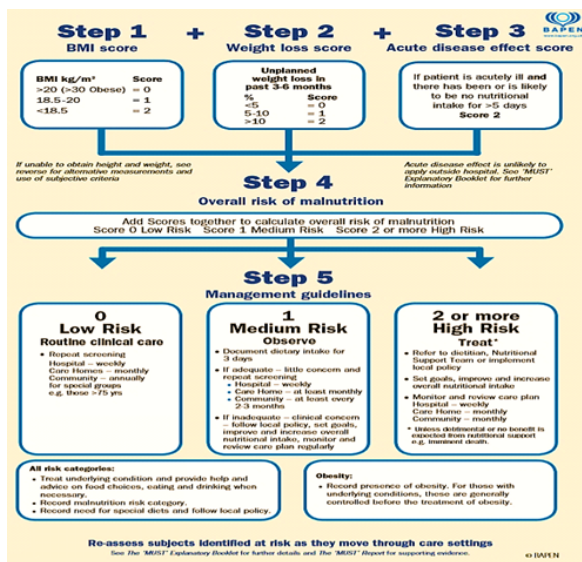
Fig. 2: Graphical Representation of the Malnutrition Screening Tool Calculation of Score for Malnutrition Screening. see www.bapen.org.uk for a free download of tool and an explanatory booklet[24].

2.2. LOW risk patients

No immediate action may be needed in this group of patients but pursue monitoring their weight for 3 months during their follow up visits and re-assess if necessary.

2.3. MEDIUM risk patients

Nutrition support can be formulated, any barriers to the patient eating normally like ill-fitting dentures, arthritis, unable to shop/cook for themselves, poor appetite should be identified, resolved and the patient reviewed after 4 weeks.

2.4. HIGH risk patients

Proper meal planning must be formulated, patient to be counselled, and detailed nutritional assessment to be done to review all underlying causes and resolving them with the dietetic support team and the care giving physician.

3. Study Objectives

This study, therefore, aims to 1) Screen the nutritional status of patients with Diabetes Mellitus Type 2 in the out-patient department of a MultiSpeciality hospital using Malnutrition Universal Screening Tool 'MUST, 2) Assess the nutritional adequacy of dietary intake relative to the 'MUST' of one hundred and ten patients selected at random as a next step of the study in a Multi-Speciality hospital in Mumbai. To our knowledge research of this nature has not yet been completed in Multi-Speciality hospital in Mumbai. This research will provide insight into the adequacy of the dietary intake in outpatient department setting so as to evoke

change where needed to ensure that patients are sufficiently nourished in order to recover appropriately and decrease the burden placed on our healthcare systems, in the face of malnutrition.

4. Materials And Methods

4.1. Study overview

A cross-sectional study which aims to assess the nutritional adequacy in patients with diabetes mellitus who came for consultation in out-patient department of a MultiSpeciality hospital in Mumbai using 'MUST' score. This study makes use of the Universal Malnutrition Screening Toolkit (MUST) in order to calculate malnutrition risk using the MUST tool. Approval to conduct this research was obtained from the said hospital management.

4.2. Data collection

The study spanning from February to June 2019, patients were selected from a convenience sample with inclusion criteria being adult patients with type 2 diabetes mellitus in the out-patient department of a multi-speciality hospital, consenting to participate in the study and if they were compos mentis, being able to communicate verbally. The exclusion criteria were patients who were pregnant or in the post-partum period and patients with ascites/oedema. Out of the 210 patients who initially consented to be part of this study, 24 patients later declined their further participation during follow up visit and for 18 patient's complete information was not available due to varied reason, thereby finally 168 patients were a part of this complete study. Written consent for participating in this study was taken from each participant and all data secured with only the principal investigator in lieu of patient confidentiality and hospital policy. Baseline data on demographics, health and medical history was obtained from medical records and case notes. The following characteristics of patients were also recorded namely use of tobacco, consumption of alcohol, history of unplanned weight loss in last 3-6 months, frequency of hospital admission in the past 12 months, use of poly-pharmacy (using more than 5 drugs), insulin therapy, duration of being diagnosed with diabetes mellitus, and finally the MUST score.

Further, a total of 91 patients with complete dietary intakes data and physical activity chart were also collected for the second phase of this study. Patients who did not complete food records or those whose total daily energy intake was lesser than 500 kcal or more than 3000 kcal were not included in the second phase of the study. MUST screening be completed electronically, as a part of initial assessment and a hard copy was inserted in the case notes.

4.3. For MUST scores

Option one required body mass index BMI, kg/m²<18.5 to define malnutrition[24]. Option two required the combined finding of unintentional weight loss (mandatory) and at least one of either reduced BMI or a low-fat free mass index (FFMI)- for this study we used reduced BMI. Weight loss could be either >10% of habitual weight indefinite of time, or >5% over 3 months. BMI for patients at risk of malnutrition for the purpose this out-patient department study was taken as 18.5- 20 kg/m² and malnourished patients were <18.5 kg/m². Between 20- 24.9kg/m²were considered as patients with normal nutritional status and above 24.9 kg/m² were considered as overweight or obese.

On the other spectrum of malnutrition is also overnutrition and obesity and this screening with MUST tool will also help us to evaluate the BMI and thereby address overnutrition too.

4.4. Data analysis

All the information after collecting stored in the form of data in a computer software viz. Microsoft Office Excel Worksheet and then carefully analyzed.

4.5. Statistical analysis

All analysis was computational using SPSS version 21.0 (IBM Incorporation, Armonk, NY, USA). Frequency distribution table was established for Qualitative variables; mean, variance; maximum value and minimum value were considered for quantitative variables. Univariate and multivariate logistic regression were given to correspond nutritional status and other factors. The test was contemplated statistically significant if the resulting P-value was less than < 0.05.

5. Results

Table 1 shows the socio-demographic characteristic of the participants. Mean age was 56 years. The proportion of female participants was 54.76% (n=92). The majority of the participants (98.2%) were living in the city or town. More than half (52.98%) of the participants had been diagnosed with diabetes for more than 1 year, and 9.52% patients had been treated with insulin and rest with oral medications. A total of 12 participants had MUST score of 2 or more points by MUST screening and 5 patients had a score of 1 and rest had a MUST score of 0 but 72.62% were overweight or obese. There was a statistically significant difference between nutritional status by body mass index and gender. The test was contemplated statistically significant if the resulting P-value was less than < 0.05. The 12 identified patients who were malnourished had stable blood glucose levels but they were further sent for immediate nutritional assessment and nutritional management for malnutrition.

The 5 identified patients at risk were also assessed further and referred to the dietetic unit for nutritional management. Thus 17 patients due to these simple three steps MUST screening got identified and were managed for nutritional optimization accordingly. Also, the 72.62% patients were referred to dietetic department for nutritional management of obesity. As metabolic control is better in patients with normal BMI. The screening also showed that only 36 patient subjects (21.43%) were in the category of normal nutritional status, which also is alarming as the 168 patients had no reflective acute disease and had visited the out-patient department for a routine follow up visit. Thus, the screening for nutritional status supports therapeutic management by addressing malnutrition or overnutrition and eventually aids to achieve the health goals. The various results are graphically represented below.
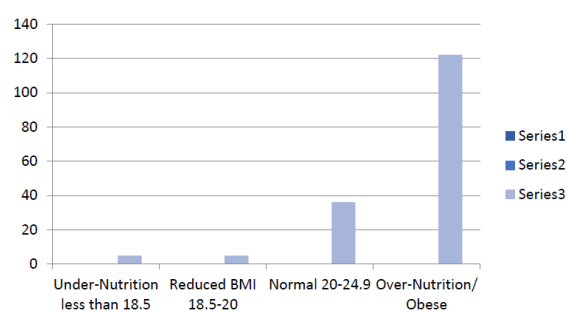
Fig. 3: Graphical Representation of study data for Body Mass Index (BMI)
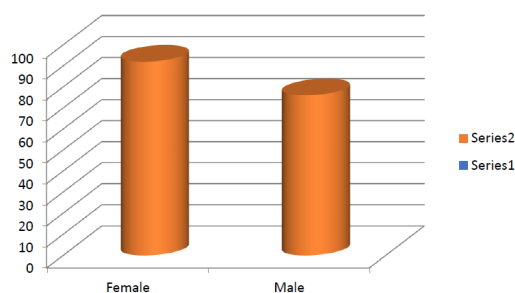
Fig. 4: Graphical Representation of Study Subject Demographics.

6. Discussion

This study found that 17 of the participants were malnourished or at risk of malnutrition according to the Malnutrition Universal Screening Tool scoring.in a cross-sectional study with demographic evaluation was carried out to assess the nutritional status of the elderly using the Mini Nutritional Assessment (MNA) tool by Agarwalla et al (2015)[25]. And this study was not necessarily only in diabetic patient population and adults but in elderly and hence use of the validated screening tool on elderly the MNA was

Table 1: Characteristics of Participants (n=168)

		At risk of malnutrition/Under Nutrition / Malnourished< 18.5 kg/m²		Reduced BMI18.5 kg/m²- 20 kg/m²		Normal Nutrition20 kg/m²- 24.9 kg/m²		Over Weight/ Obese>24.9 kg/m²		Total		P-value
		5	2.98	5	2.98	36	21.43	122	72.62	168	100	
		n	%	n	%	n	%	n	%	n	%	
Place of residence	City/ Town	5	100.00	5	100.00	35	85.37	120	98.36	165.00	98.21	0.023
	Village	0	0.00	0	0.00	1	2.44	2	1.64	3.00	1.79	
Gender	Male	2	40.00	1	20.00	17	41.46	56	45.90	76.00	45.24	0.008
	Female	3	60.00	4	80.00	19	46.34	66	54.10	92.00	54.76	
What is your age in years?	20-40	1	20.00	1	20.00	7	17.07	28	22.95	37.00	22.02	
	40-50	2	40.00	1	20.00	7	17.07	44	36.07	54.00	32.14	0.034
	>50	2	40.00	3	60.00	22	53.66	50	40.98	77.00	45.83	
Do you use to bacco (cigarette smoking, tobacco chewing etc)?	Yes	1	20.00	0	0.00	1	2.44	18	14.75	20.00	11.90	
	No	4	80.00	4	80.00	33	80.49	100	81.97	141.00	83.93	0.030
	Quit	0	0.00	1	20.00	2	4.88	4	3.28	7.00	4.17	
Do you consume alcohol?	yes	0	0.00	0	0.00	2	4.88	8	6.56	10.00	5.95	
	No	3	60.00	3	60.00	18	43.90	76	62.30	100.00	59.52	0.037
	Occasionally	2	40.00	2	40.00	16	39.02	38	31.15	58.00	34.52	
H/O unplanned weight loss in last 3-6 months	Yes	3	60.00	3	60.00	7	17.07	3	2.46	16.00	9.52	0.025
	No	2	40.00	2	40.00	29	70.73	119	97.54	152.00	90.48	
H/O > than 2 hospitalizations in year	Yes	2	40.00	2	40.00	7	17.07	3	2.46	14.00	8.33	0.024
	No	3	60.00	3	0.00	29	70.73	119	97.54	154.00	91.67	
Duration of diagnosis of Diabetes Mellitus	1 years	2	40.00	3	60.00	16	39.02	68	55.74	89.00	52.98	
	3 years	2	40.00	1	20.00	15	36.59	40	32.79	58.00	34.52	0.039
	> 5 years	1	20.00	1	20.00	5	12.20	14	11.48	21.00	12.50	
Use of polypharmacy(more than5 drugs)	Yes	2	40.00	0	0.00	1	2.44	9	7.38	12.00	7.14	0.024
	No	3	60.00	5	100.00	35	85.37	113	92.62	156.00	92.86	
Insulin Therapy	Yes	2	40.00	1	20.00	5	12.20	8	6.56	16.00	9.52	0.024
	No	3	60.00	4	80.00	31	75.61	114	93.44	152.00	90.48	
Must score	0	2	40.00	2	40.00	28	68.29	119	97.54	151.00	89.88	
	1	0	0.00	0	0.00	2	4.88	3	2.46	5.00	2.98	0.027
	2 or >2	3	60.00	3	60.00	6	14.63	0	0.00	12.00	7.14	

Table 2: A) BMI of participants were classified as shown in the below.

Under Nutrition /Malnourished		Reduced BMI		Normal Nutrition		Over Weight/ Obese	
5	2.98	5	2.98	36	21.43	122	72.62
N	%	N	%	N	%	N	%

Table 3: B) The study which was carried out involved a total of 168 patients were screened using MUST score questionnaire. Among them 76(45.24%) were males and 92(54.76%) were females and the youngest patient subject being 21 years and the oldest being 71 years of age.

No of Females	No of Males
92	76

Table 4: C) Unplanned weight loss in past 3-6 months

Unplanned weight loss in past 3-6 months NO	Unplanned weight loss in past 3-6 months Yes
152	16

Table 5: D) Duration of diagnosis of Diabetes Mellitus-

Duration of diagnosis of Diabetes Mellitus		
1 years	3 years	> 5 years
88	58	21

Table 6: E) Percentage of patient subjects categorized as Undernourished, Normal BMI, Overweight or Obese.
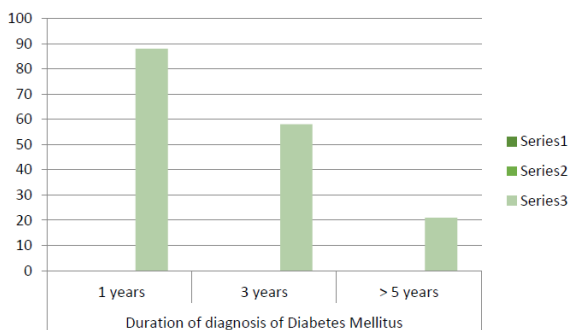
| Under Nutrition / Malnourished	Reduced BMI	Normal Nutrition	Over Weight/ Obese
2.976	2.976	21.43	72.62
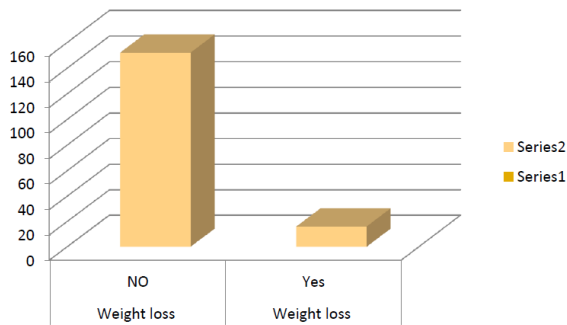
Fig. 5: Graphical Representation of Unplanned Weight Loss in Past 3-6 Months of the Subjects Selected for this Study.

Fig. 7: Graphical Representation of the Percentage of Patient Subjects Categorized as Undernourished, Normal BMI, Overweight or Obese.

Fig. 6: Graphical Representation of Duration of Diagnosis of Diabetes Mellitus in the study subjects.
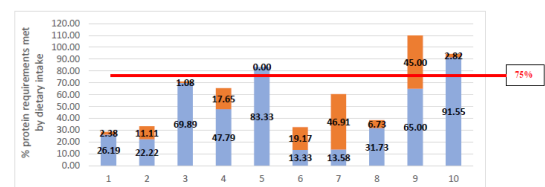
Fig. 8: Graphical Representation of Percentage of Protein Requirements being met by Dietary Intake in the study subjects.

used and showed that around 70% the older people were malnourished and at risk of malnutrition in Kamrup district, Assam, India showed the higher prevalence of malnutrition in elderly population[25].

The difference in this study can be explained that the majority of the participants in our study (98.21%) came from urban areas whereas most of the study population in the above study came from rural areas the living conditions in urban areas were likely to be generally better than those in rural areas, consequently leading to a better nutrition situation and overnutrition or obesity being more prevalent across adult population (72.62%) and in this specific study in patients with diabetes mellitus.Adults and especially elderly diabetes mellitus patients with substantial suboptimal nutritional status may increase the risk of hospitalization, nursing home admissions, physical disability[26].

Additionally, many participants might have a lack of knowledge of proper nutrition, especially diet and casual approach towards diabetes disease. Out-patients may have difficulties in seeking regular advice or recommendations for healthy meals from health professionals or nutritionists and especially if not referred by the consulting physician. Nutritional status assessment could provide a window of opportunity to prevent malnutrition as well as low physical activity levels in this population[27]. Examining patient's weight loss revealed that about 16 patients (9.52%) had unplanned weight loss in past 3-6 months and out of these there were 7 patients who were in the normal BMI category who had lost weight and 3 patients who were in the overweight or obese category who had lost weight. These patients need to be assessed further for the cause of weight loss and managed likewise. If screening is not routinely performed, these patients could be missed and their nutritional intervention would take a back seat. The 3 patients who were in underweight category needed immediate dietary intervention. A weight loss of just 5% over 6 months (3% in 1 month) is associated with a greater incidence of treatment complications, morbidity, and mortality in this population[28].

This also shows that at times, patients look fine and in good weight, but they may have actually lost weight in the last 3-6 months and they may be missed if not screened for nutritional screening. On the other side of the prism, the evaluation of BMI will help recognize obesity levels and with further analyses the dietary management and physical activity can be charted for optimal weight loss as well as blood glucose levels, priming health goals. And though the ratio of malnutrition screened is not high in this study, we need to also be mindful that this is in out-patient department where there may not be any added acute disease presentation, and the percentage of malnutrition or risk of malnutrition found needs to be addressed which otherwise would have been a missed opportunity. Also, in the ratio

of males to females, percentage of female population is higher and there may be other underlying nutritional deficiencies like iron deficiency, Vit B12 deficiency, etc. which are seen higher in women so further assessment my help us start required nutritional intervention immediately. The percentage of daily requirements from the total dietary intake of nourished patients (MUST score = 0 which indicates low risk of malnutrition), and at risk of malnourishment, malnourished or severely malnourished patients respectively (MUST score 1, 2 or 2)[24]. Both the nourished and malnourished groups had inadequate average protein intakes. Though this further ongoing assessment is beyond the preview of this MUST study, it does alarmingly reflect the need for nutritional screening so that optimal dietary needs are met as soon as possible. the 10 patients who were at risk or already malnourished (between BMI of 18.5 kg/m^{2}and 20 kg/m^2), further assessment for nutritional status showed that out of those 75% did not meet their daily dietary protein requirement.

Malnutrition in diseases like cancer where cancer cachexia is well recognised, so more attention for malnutrition in these patients is given, but malnutrition or overnutrition in diabetes mellitus patients may be overlooked as the therapeutic goals are to achieve best possible glucose and at times in doing so the patient vulnerability to nutritional needs may be overlooked. But with use of simple validated screening tools like MUST, possibly the identification of patients at risk or malnourished could be primed and even the use of MUST tool will help identify obese patients and then if required the identified patients can be further assessed and required nutritional interventions can be started accordingly. Despite the ease of use, Malnutrition Universal Screening Tool is not routinely used, and hence with minimal training the outpatient department health support staff can use it routinely in all patients coming for treatment in the out-patient department.

7. Limitations of This Study

The conclusions of this study should be considered in light of several limitations. Primarily this cross-sectional design curtails the ability to reach any conclusion regarding causal associations between factors. Secondly, the sample size was considerably small and was recruited by a convenience sampling scheme, thus cannot be said to be representative of the population of India. Also, this study was only carried out only in diabetic outpatients. Moreover, though this study considers life style factors like smoking and alcohol consumption, this study lacks consideration of other related factors that may have affected the nutritional status assessment like physical activity or fat free mass or handgrip strength; frailty, cognitive status especially in elderly which will aid us understand the fat mass and fat free mass[29] and thereby the nutritional status. Also, physical examination, rated by degree of the deficit of fat stores, muscle status

and fluid status were not examined.This calls out for more researches in the future which address the sample size issue and nutritional assessment in other patient populations.

Analysis of weight loss using validated assessment tools like PG SGA would help understand percent weight loss assessment hence necessary and required further intervention[29]. Obesity parameters were also not classified and hence this study may not identify cases of morbid obesity. The study lacks succedent evaluation of patients that will change in the PG-SGA score which may be used to exhibit fine changes in nutritional status. Subjects presented with different years of existing diabetes mellitus and different levels of nutritional status during the study.

8. Future Research

Further research needs in this regard with the PG-SGA applied at multiple time points with larger number of patients and appropriate nutrition interventional treatment plan and protocols need to be generated and applied to diabetes mellitus patients during treatment to combat nutrition related nutritional complications which effects patient's treatment and its outcome, quality of life, morbidity, mortality and cost of treatment.Since this was in out-patient department study, this can be with ease done in admitted patients too as diabetic patients with any acute condition may be already at risk or malnourished already.

9. Data Availability

The data used to uphold the conclusions of this study may be available from the corresponding author upon a request.

10. Conclusion

This study underlines the association between nutritional status and related factors in adult diabetic outpatients. Nearly one-third of the population studied was malnourished and at risk of malnutrition[30]. This number is high as only 21.43% of these subjects were in normal BMI and probable normal nutritional status zone, rest were either at risk or malnourished and overweight or obese[31]. Both underweight malnourished as well as overweight or obese though at opposite ends of the spectrum have altered structural and functional body composition and are considered to be nutritionally compromised[32], thus it is important for health care providers to focus on managing the diet of diabetic patients. Early screening, assessment and intervention can improve the nutritional status of adult diabetics. These findings also support the need for further studies on the assessment of the nutrition status in adult diabetic patients and also in non-diabetic patients coming for consultation in out-patient departments of any health care setting.

This observational study highlights the fact that nutritional issues are prevalent among diabetic patients during treatment. Nutritional screening is an important step needed to help intervene earlier in the diabetic patient's trajectory. Early detection of nutritional status may culminate in thorough nutritional assessments and/or interventions that may aid prevent further or impending malnutrition and weight loss during treatment and eventually improve the quality of life of these patients thus aiding health goals[32]. Nutrition intervention in diabetes mellitus patients can involve many strategies, including dietary counselling and oral nutritional supplementation. Studies concerning the consumption of foods by these adult diabetic patients are necessary to establish a relationship between intake values and organic levels, including the checking of the specific nutritional requirements of those on oral diets, who represent the great majority of these patients. MUST can be easily be used and study may be replicated across various inflammatory diseases as identifying undernutrition or malnutrition may be helpful even to understand disease outcomes and prevent or postpone comorbidities, improving quality of life and reduce costs of treatment[33]. It is strongly supported that nutritional education can be used as an effective measure to bring about favorable and significant changes in the dietary patterns of these patients.

11. Aberration

Abbreviations: MNA- mini-nutritional assessment; MUST- malnutrition universal screening tool; BMI- body mass index; PG SGA- Patient-Generated Subjective Global Assessment DM- Diabetes Mellitus; T1DM- Diabetes Mellitus Type 1; T2DM- Diabetes Mellitus Type 2.

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13. Conflict of Interest

None.

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