Malnutrition in elderly patients with type 2 diabetes mellitus in a Nigerian tertiary hospital: A cross-sectional study

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ABSTRACT

Introduction: The global population of the elderly with type 2 diabetes mellitus (T2DM) is growing due to improvement in DM care and increased life expectancy. Malnutrition is a recognized complication of DM especially in the elderly. However, despite the impact of malnutrition on the overall outcome of the elderly with DM, it has not received adequate attention.

Aim: To determine the prevalence of malnutrition and associated factors in the elderly with T2DM.

Methods: This was a cross-sectional study that involved 96 elderly with T2DM and 96 age and sex matched elderly without T2DM as controls. Malnutrition was assessed using mini-nutritional assessment-short form (MNA-SF), hypoalbuminemia and body mass index (BMI). The factors associated with some malnutrition indices were determined.

Results: The mean age of T2DM and non-T2DM groups were 66.73 ± 5.18 years and 66.78 ± 5.25 years respectively. The observed malnutrition indices among elderly with T2DM and controls were hypoalbuminemia (79.2% vs 25.0%; $P \leq 0.001$); overweight and obesity (58.3% vs 24.0%); and underweight (16.7% vs 4.2%). According to MNA-SF, malnutrition (7.3% vs 0%) and at risk of malnutrition (42.7% vs 16.7%) were significantly more prevalent among elderly with T2DM compared to controls ($P \leq 0.001$). On logistic regression, the significant predictors of malnutrition were male gender (AOR:2.70; CI:1.11–6.55; $P = 0.028$) and albuminuria (AOR:3.14; CI:1.18–8.35; $P = 0.022$) and poor glycemic control (AOR:7.05; CI:2.01–24.71; $P = 0.002$).

Conclusion: Malnutrition is highly prevalent in elderly with T2DM. Poor glycemic control, albuminuria and male gender were significant predictors of malnutrition in this study. Nutritional assessment should be included in the routine DM care especially among the elderly.

1. Introduction

Diabetes mellitus (DM) is one of the most common non-communicable diseases (NCDs) globally [1]. As at 2021, about 24 million adults in the African region have DM and this may increase to about 33 million by the year 2030 [2]. DM is common in older people and is often undiagnosed [3]. Approximately 20% of individuals over 60 years of age have DM in the United States of America, and almost half of these individuals have not been diagnosed [4,5]. DM in ageing population is characterized by complexity of illness, an increased risk of medical co-morbidities, and the early development of functional decline and risk of frailty [6,7].

Malnutrition is common in elderly population due to age-related changes in some of their physiological functions which include alteration in taste, smell, and gastric acidity which increases the risk of nutritional deficiency [8,9]. The interplay of medical, social and psychological factors also contributes significantly to malnutrition in elderly [10]. Older people with DM appears to be at a greater risk of micronutrients deficiencies [9]. Some previous reports have shown that the prevalence of malnutrition in elderly ranges between 12.0 and 77.1% [11–14]. In addition to those with confirmed diagnosis of malnutrition, a significant proportion of the elderly population is at of increased risk of malnutrition [11–13,15,16]. The prevalence of malnutrition is higher among elderly with DM compared

to those without DM [11,17]. partly because of higher prevalence of autonomic neuropathy in them [18]. Autonomic neuropathy may manifest as gastroparesis, diarrhea, enteropathy which may contribute to increase risk of malnutrition in the elderly [19].

Malnutrition in elderly with DM is associated with adverse consequences which include functional decline, reduced quality of life, prolonged hospital stay, and increase in the cost of health care and mortality [17,20-22]. Despite the high prevalence and importance of malnutrition in elderly with DM, it is not routinely assessed in clinical practice. There is limited information on malnutrition among elderly with DM in Sub-Saharan Africa especially in Nigeria. This may be partly due to the fact that geriatric medicine is an evolving field in this part of the world. The aim of this study therefore was to determine and compare the prevalence of malnutrition among elderly with and without type 2 DM (T2DM) in a tertiary hospital in Southwest Nigeria. The study also determined factors associated with malnutrition among elderly with T2DM.

2. Materials and methods

2.1. Study design and study site

This was a cross-sectional study conducted over a 6-month period between December 2016 and May 2017 at the Federal Medical Centre, Owo, Ondo State, Southern Nigeria. The Federal Medical Centre, Owo is a tertiary health institution located in Southwest Nigeria. The study population was made up of patients with T2DM presenting at the endocrinology outpatient clinic of the Federal Medical Centre, Owo who have been diagnosed for at least six months in line with the World Health Organization (WHO) criteria [23].

2.2. Sample size

The minimum sample size for this study was calculated using Fisher's formula with a reported prevalence of DM in the elderly taken as 6% based on a previous study [24] and an absolute precision limit of 5%. The minimum sample size after inclusion of 10% attrition was 96. A total of 96 elderly with T2DM and 96 elderly without DM who fulfilled the inclusion criteria were consecutively recruited for the study Inclusion criteria for the DM group were consenting patients with T2DM who were 60 years and above without chronic illness such as human immunodeficiency virus infection, heart failure, thyroid disorders and chronic obstructive pulmonary disease. Inclusion criteria for controls were consenting individuals who were 60 years and above and did not have DM, glucose intolerance or any chronic disease. The controls were recruited from the general out-patient department of FMC, Owo.

2.3. Data collection

An interviewer administered proforma was used to obtain demographic characteristics, medical and social history of study participants. Mini-nutritional assessment short form (MNA-SF) was used to obtain information on nutritional status [25]. All study participants were examined. Weight and height were measured using a stadiometer with participants in light clothing and without shoes. Body Mass Index (BMI) was calculated using the formula weight/height^2 expressed in unit of kg/m^2 [26]. Drug history and medication adherence was assessed using Morisky Medication Adherence scale (MMA-4) [27]. Light touch perception on the feet was assessed using a single-use disposable 10-g Semmes-Weinstein monofilament. Vibratory perception testing (VPT) was carried out using a biothesiometer.

Ten mls of fasting venous blood was taken for packed cell volume (PCV), serum albumin, serum vitamin B12, serum ferritin, serum creatinine, serum lipid profile, glycated hemoglobin and fasting blood glucose. Five mls of urine was collected for albumin-creatinine ratio (ACR).

2.4. Definition of variables

Anemia was defined as PCV <36% in females and < 39% in males using the WHO criteria [28].

Albuminuria was defined as ACR of >30 mg/g [29].

Estimated glomerular filtration rate (eGFR) was calculated using the modification of diet in renal disease (MDRD) formula that has been previously validated in Nigerians [30].

Renal impairment was defined as eGFR less than 60mls/min/1.73m^2 [31].

Good glycemic control was defined as glycated hemoglobin <7.0% [32].

Hypoalbuminemia was defined as serum albumin of <35 g/L [33].

Mean VPT >25 V was regarded as abnormal [34].

Low serum vitamin B12 was defined as serum vitamin B12 < 200 pg/dl [35].

Low serum ferritin was defined as serum ferritin <100 ng/ml [36].

Underweight was defined as BMI < 18.5 kg/m^2, normal weight as BMI between 18.5 and 24.9 kg/m^2, overweight as BMI between 25 and 29.9 kg/m^2, and obesity as BMI ≥30 kg/m^2 [26].

Malnutrition using MNA-SF scores was defined as a score ≤7; score between 8 and 11 was at risk of malnutrition and score ≥12 was regarded as normal [37].

2.5. Ethical approval and consideration

Ethical approval was obtained from Human Research and Ethical Committee of Federal Medical Centre, Owo. The approved protocol reference number was FMC/OW/380/VOL.XLII/185. Informed consent was obtained from all participants in the study. Confidentiality of provided information was ensured throughout the study.

2.6. Data analysis

Data obtained were entered and analyzed using the statistical package of social sciences (SPSS) software version 20. Descriptive data were presented as tables. Categorical variables of the two groups studied were expressed as proportions and percentages. Associations between categorical variables were analyzed using Chi-square. Logistic regression was used to determine predictors of malnutrition in the elderly with type 2 DM. P-value of <0.05 was taken as significant.

3. Results

There were 192 study participants comprising of 96 elderly with T2DM and 96 elderly without T2DM as controls. There were equal males and females in each group. The mean age of the group with T2DM and group without T2DM were 66.73 ± 5.18 years and 66.78 ± 5.25 years, respectively. About a third of the study participants had average monthly income of greater than 50,000 naira (145 USD) and tertiary education. Table 1.

The prevalence rates of the malnutrition indices were significantly higher in elderly with T2DM compared to the elderly without T2DM. The observed malnutrition indices were hypoalbuminemia (79.2% vs 25.0%; P ≤0.001); low ferritin (68.8% vs 0%; P ≤0.001); low vitamin B12 (72.9% vs 24.0%; P ≤0.001). Among the study participants, the proportion of those that were malnourished using MNA-SF was significantly higher among the elderly with T2DM (7.3% vs 0%). Also, the proportion of those at risk of malnutrition was significantly higher among the elderly with T2DM (42.7% vs 16.7%). This was statistically significant (P ≤0.001). A significantly higher proportion of elderly T2DM were underweight (16.7% vs 4.2%); overweight and obese (58.3% vs 24.0%) compared to the non-diabetic controls. This was also statistically significant (P = 0.001). Table 2.

The significant factors that associated with hypoalbuminemia were poor glycemic control (P ≤0.001); low ferritin (P ≤0.001); low vitamin B 12 (P ≤0.001); low level of education (P = 0.01); abnormal vibration

Table 1

Socio-demographic Characteristics of Study Participants (N = 192).*

Socio-demographic Variable	Elderly with T2DM (n = 96) n (%)	Elderly without T2DM (n = 96) n (%)	P-value
Age in years			
(Mean ± SD)	66.73 ± 5.18	66.78 ± 5.25	0.902
60–69	71(74.0)	70(72.9)	
70–79	22(22.9)	21(21.9)	0.767
>79	3(3.1)	5(5.2)	
Gender			
Males	48(50.0)	48(50.0)	
Females	48(50.0)	48(50.0)	1.000
Ethnicity			
Yoruba	88(91.6)	83(86.4)	
Igbo	4(4.2)	10(10.4)	0.239
Hausa	4(4.2)	3(3.2)	
Religion			
Christianity	77(80.2)	71(73.8)	0.086
Muslim	19(19.8)	25(26.2)	
Educational status			
None	29(30.2)	29(30.2)	
Primary	27(28.2)	20(20.8)	0.486
Secondary	10(10.4)	16(16.7)	
Tertiary	30(31.2)	31(32.3)	
Occupation			
Retiree	37(38.6)	33(34.4)	
Trading	24(25.0)	19(19.8)	
Farming	20(20.8)	23(24.0)	0.685
Artisans	8(8.3)	13(13.5)	
Civil servants	7(7.3)	8(8.3)	
Marital status			
Married	72(75.0)	74(77.0)	
Widow/widower	20(20.8)	20(20.8)	0.707
Separated/divorced	4(4.2)	2(2.2)	
Average monthly income			
<10,000 naira (30 USD)	21(21.8)	28(29.2)	
10,000–50,000 naira (30–145 USD)	43(44.8)	48(50.0)	0.128
>50,000 naira (>145 USD)	32(33.4)	20(20.8)	

* 1USD = 350 Naira, USD: United States Dollar.

sensation (P ≤0.001); albuminuria (P = 0.034); low eGFR (P = 0.011); poor adherence to medication (P = 0.003); and peripheral neuropathy (P ≤0.001). Table 3.

The significant factors associated with malnutrition and increased risk of malnutrition based on MNA-SF were poor glycemic control

Table 2

Prevalence of Some Malnutrition Indices in Study Participants (N = 192).

Malnutrition Indices	Elderly with Type 2DM (n = 96) n (%)	Elderly without Type 2DM (n = 96) n (%)	P-value
MNA-SF			
Normal	48 (50.0)	80 (83.3)	<0.001
At risk of malnutrition	41 (42.7)	16 (16.7)	
Malnourished	7 (7.3)	0 (0)	
Hypoalbuminemia			
Present	76 (79.2)	24 (25.0)	<0.001
Absent	20 (20.8)	72 (75.0)	
Low Serum Ferritin			
Present	66 (68.8)	0 (0)	<0.001
Absent	30 (31.2)	100 (100.0)	
Low Serum Vitamin B12			
Present	70 (72.9)	23 (24.0)	<0.001
Absent	26 (27.1)	73 (76.0)	
Body Mass Index			
Underweight	16(16.7)	4(4.2)	<0.001
Normal	24(25.0)	69(71.9)	
Overweight	41(42.7)	17(17.7)	
Obesity	15(15.6)	6(6.2)	

MNA-SF: mini nutritional assessment-short form, T2DM: Type 2 diabetes mellitus.

Table 3

Association between Hypoalbuminemia and some Socio-demographic and Clinical Factors among Elderly with T2DM (N = 96).*

Socio-demographic Variable	Hypoalbuminemia (n = 76) n (%)	Normoalbuminemia (n = 20) n (%)	P-value
Male	41 (53.9)	7 (35.0)	0.104
Female	35 (46.1)	13 (65)	
Age			
<69 years	55 (77.5)	16 (80.0)	0.357
≥70 years	21 (27.6)	4 (20.0)	
Marital Status			
Married	58 (76.3)	14 (70.0)	0.376
Widow/widower	15 (19.7)	5 (25.0)	
Separated/divorced	3(4.0)	1(5.0)	
Level of Education			
Below Secondary	49 (64.5)	7 (35.0)	0.017
Secondary and above	27 (35.5)	13 (65.0)	
Average monthly income			
<10,000 naira (30 USD)	15 (19.7)	6 (30.0)	0.242
≥10,000 naira (30 USD)	61 (80.3)	14 (70.0)	
Duration of DM			
<10 years	60 (78.9)	17 (85.0)	0.401
≥ 10 years	16 (21.1)	3 (15.0)	
Glycemic Control			
Good	10 (13.2)	12 (60.0)	<0.001
Poor	66 (86.8)	8 (40.0)	
Anemia			
Present	43 (56.6)	8 (40.0)	0.142
Absent	33 (43.4)	12 (60.0)	
Medication Adherence			
High	16 (21.1)	12 (60.0)	0.003
Medium	35 (46.1)	5 (25.0)	
Low	25(32.9)	3 (15.0)	
Albuminuria			
Present	19 (25.3)	10 (50.0)	0.034
Absent	56 (74.7)	10 (50.0)	
Estimated GFR			
< 60mls/min/1.72m^2	39 (51.3)	4 (20.0)	0.011
≥60mls/min/m^2	37 (48.7)	16 (80.0)	
Vibration Perception Test			
Normal	9 (11.8)	10 (50.0)	0.001
Abnormal	67 (88.2)	10 (50.0)	
Light touch Perception			
Present	9 (11.8)	11 (55.0)	< 0.001
Absent	67 (88.2)	9 (45.0)	
Serum Ferritin			
Low	60 (78.9)	6 (30.0)	< 0.001
Normal	16 (21.1)	14 (70.0)	
Serum Vitamin B 12			
Low	64 (84.2)	6 (30.0)	< 0.001
Normal	12 (15.8)	14 (70.0)	

* 1USD = 350 Naira, USD: United States Dollar, DM: diabetes mellitus, GFR: glomerular filtration rate.

(P = 0.049); male gender (P = 0.040); and albuminuria (P = 0.015). Table 4.

On logistic regression, the only significant predictor of hypoalbuminemia was poor glycemic control (AOR:7.05; CI:2.01–24.71; P = 0.002). Table 5. Significant predictor of malnutrition and increased risk of malnutrition using MNA-SF were male gender (AOR:2.70; CI:1.11–6.55; P = 0.028) and albuminuria (AOR:3.14; CI:1.18–8.35; P = 0.022). Table 6.

4. Discussion

This study assessed and compared the prevalence of malnutrition using hypoalbuminemia, BMI and MNA-SF among elderly population with and without T2DM. It also determined some associated factors with malnutrition among elderly with T2DM. The prevalence of malnutrition using these malnutrition indices were significantly higher in elderly with T2DM compared to age and sex matched controls without T2DM. This also suggests that DM is associated with malnutrition among elderly with T2DM.

Table 4
Association between Malnutrition based on MNA-SF and some Socio-demographic and Clinical Factors among Elderly with T2DM.

	Absence of Malnutrition and Malnutrition Risk (n = 48) n (%)	Presence of Malnutrition and Malnutrition Risk (n = 47) n (%)	P-value
Sex			
Male	19 (39.6)	28 (59.6)	0.040
Female	29 (60.4)	19 (40.4)	
Age			
<69 years	38 (79.2)	33 (70.2)	0.221
≥70 years	10 (20.8)	14 (29.8)	
Marital Status			
Married	36 (75.0)	35 (74.5)	0.570
Widow/widower	8(16.7))	12 (25.5)	
Separated/divorced	4(8.3)	0(0)	
Level of Education			
Below Secondary	30 (62.5)	26 (55.3)	0.308
Secondary and above	18 (35.5)	21 (44.7)	
Average monthly income			
<10,000 naira (30 USD)	12 (25.0)	8 (17.0)	0.242
≥10,000 naira (30 USD)	36 (75.0)	39 (83.0)	
Duration of DM			
< 10 years	39 (81.3)	38 (80.9)	0.584
≥ 10 years	9 (18.8)	9 (19.1)	
Glycemic Control			
Good	15 (31.3)	7(14.9)	0.049
Poor	33 (68.8)	40(85.1)	
Anemia			
Present	25 (52.1)	20 (42.6)	0.234
Absent	23(47.9))	27 (57.4)	
Medication Adherence			
High	17 (35.4)	11 (23.4)	0.081
Medium	21 (43.8)	19 (40.4)	
Low	10 (20.8)	17 (36.2)	
Albuminuria			
Absent	20 (41.7)	9 (19.1)	0.015
Present	28 (58.3)	38 (80.9)	
Estimated GFR			
< 60mls/min/1.72m^2	20 (41.7)	22 (46.8)	0.383
≥60mls/min/1.72m^2	28 (58.3)	25 (53.2)	
Vibration Perception Test			
Normal	11 (22.9)	8 (17.0)	0.523
Abnormal	37 (71.1)	39 (83.0)	
Light Touch Perception			
Present	12 (25.0)	8 (17.0)	0.242
Absent	36 (75.0)	39 (83.0)	
Low Serum Ferritin			
Low	30 (62.5)	35 (74.5)	0.151
Normal	18 (37.5)	12 (25.5)	
Low Serum Vitamin B 12			
Present	34 (70.8)	35 (74.5)	0.434
Absent	14 (29.2)	12 (25.5)	

Table 5
Predictors of Hypoalbuminemia among Elderly with Type 2 DM.

	AOR (95%CI)	P- value
Glycemic Control		
Good (ref)	1	
Poor	7.05 (2.01–24.71)	0.002
Glomerular Filtration Rate		
≥60mls/1.73/m^2 (ref)	1	
<60mls/1.73/m^2	0.40 (0.40–1.11)	0.484
Albuminuria		
Absent (ref)	1	
Present	1.81 (0.05–7.91)	0.635
Educational level		
Secondary and above (ref)	1	
Below Secondary	2.52 (0.76–8.33)	0.129

AOR: Adjusted Odd Ratio, T2DM: type 2 diabetes mellitus.

Table 6
Predictors of Malnutrition and at Risk of Malnutrition among Elderly with Type 2 DM.

	AOR (95%CI)	P- value
Gender		
Female (ref)	1	
Male	2.70 (1.11–6.55)	0.028
Glycemic Control		
Good (ref)	1	
Poor	2.72 (0.92–8.04)	0.072
Albuminuria		
Absent (ref)	1	
Present	3.14 (1.18–8.35)	0.022

AOR: Adjusted Odd Ratio, T2DM: type 2 diabetes mellitus.

The prevalence of combination of malnutrition and at risk of malnutrition among elderly with T2DM was 50% in our study. This is comparable with 51% reported by Menadi et al. [12] among an elderly population in Algeria. Our finding is however, lower than 77.1% reported in Switzerland by Vischer et al. [15] and 61.2% reported by Sanz Paris et al. [22] in a study done in Spain. The higher prevalence rates in these studies compared to our study may be due to the fact that their studies were conducted among hospitalized elderly with DM who were more likely to be ill.

The prevalence of hypoalbuminemia among elderly with T2DM in this study was 79.2% which was higher than 25.0% among the control. The prevalence is higher than 53.4% and 42.4% reported by Vischer et al. [15] and Menandi et al. [12], respectively. The higher prevalence in our study compared to the study by Vischer et al. [15] may be partly explained by the fact that a higher cut off of less than 35 g/L was used to define hypoalbuminaemia in our study unlike the study by Vischer et al. [15] where a lower cut off of less than 30 g/L was used. Also, the prevalence observed in our study was higher than 42.2% reported by Menandi et al. [12] even though similar cut off values of serum albumin was used in diagnosis of hypoalbuminemia.

The prevalence of serum vitamin B12 deficiency in this study was 72.9% which was higher than 24.0% among the control. This is higher than 30.5% reported by Owhin et al. [35] among patients with T2DM in a tertiary hospital in South-south Nigeria. Metformin may be associated with serum vitamin B12 deficiency by reducing its gastrointestinal absorption [40,41]. The higher prevalence of vitamin B 12 deficiency in our study may be due to the fact that our study participants were elderly unlike the study by Owhin et al. [35] where only 28% of the study population were elderly. It should be noted that study participants in both studies consisted of those on metformin and those who were not on metformin. This therefore suggests that there may be other causes of vitamin B12 deficiency among patients with T2DM patients. Jawa et al. [42] reported nutrition-related mechanisms of vitamin B 12 deficiency in their study where about 50% of patients with T2DM who were not on metformin had vitamin B 12 deficiency.

The proportion of elderly with T2DM who were overweight and obese was 58.3%. This was significantly higher than 24.0% observed among controls without T2DM. This finding may be due to weight gain that is specifically associated with insulin resistance [38]. In addition, underweight was also more common in the elderly with T2DM (16.7%) compared to controls (4.2%) in this study. The prevalence of underweight in this study is higher than 4.8% reported by Adebusoye et al. [39] in a study among the elderly in Nigeria.

In this study, 42.7% of elderly with T2DM were at risk of malnutrition while 7.3% were malnourished. This was significantly higher than 16.7% that was found to be at risk of malnutrition among the elderly controls without T2DM. In addition, none of the control group was malnourished. This also suggests that DM is associated with malnutrition among the elderly population. Diabetic autonomic neuropathy such as gastroparesis, diarrhea and enteropathy which are common in elderly with DM may contribute to malnutrition in them. This finding is similar to a previous report by Ayub et al. [11].

The prevalence of low serum ferritin among elderly with T2DM in this study was 68.8% while none of the controls had low serum ferritin. Serum ferritin is an acute phase reactant and a marker of iron stores in the body. Some previous studies have reported significantly higher ferritin levels in patients with DM compared to controls [43,44]. Age-related changes in some of the physiological functions in elderly with DM such as alteration in gastric acidity may increase their risk of iron deficiency iron [9]. This study showed that elderly with T2DM are at a higher risk of iron deficiency.

Microvascular complications of DM such as albuminuria, reduced GFR and peripheral neuropathy were significantly associated with malnutrition in this study. This is also corroborated by reports from some previous studies [22,45]. Poor adherence with glucose lowering medications was also significantly associated with malnutrition in this study. Patients with DM who are poorly compliant with their glucose lowering medications are more likely to have poor glycemic control and chronic DM complications such as autonomic neuropathy and diabetic kidney disease which may predispose them to malnutrition. This is in keeping with report by Woo et al. [46] that showed that elderly with DM who have poor glycemic control are at higher risk of malnutrition.

Low serum ferritin and low serum vitamin B 12 were also significantly associated with malnutrition. This agrees with a report that malnutrition is associated with deficiency of certain microelements such as iron and vitamin B 12 [46]. Low level of education was also significantly associated with malnutrition in our study. This is similar to findings from studies involving the elderly with T2DM and without T2DM [13,47]. Lower level of education is commonly associated with low economic status which may adversely affect household expenditure on food thereby leading to a decrease in the quality of nutrient intake [48,49].

Malnutrition was significantly associated with male gender in this study. This finding is different from reports from some previous studies [11,22]. While Ayub and Ismail [11] did not find significant association between gender and malnutrition in their study, Sanz París et al. [22] reported significant association between the female gender and malnutrition in their study. The differences in some socio-demographic characteristics of the study participants and presence of co-morbidities may partly account for the observed differences in these studies.

Poor glycemic control was significantly associated with malnutrition in this study. Patients with poor glycemic control are likely to have complications such as gastroparesis, diarrhea, vomiting and malabsorption which may predispose them to malnutrition. Elderly with T2DM who have poor glycemic control were 7 times more likely to develop malnutrition compared to their counterparts with optimal glycemic control. This underscores the need to optimize glycemic control in elderly with DM in order to reduce their risk of malnutrition.

The limitation of the study is the relatively small sample size. However, the strength of this study lies in the fact that this is the first study to the best of our knowledge that assessed malnutrition in elderly T2DM in this region.

5. Conclusion

Malnutrition is highly prevalent in elderly with T2DM compared to elderly without DM. Poor compliance with glucose lowering medications, poor glycemic control, microvascular diabetic complications, low level of education, low serum ferritin, low serum vitamin B 12 were significantly associated with malnutrition. Significant predictor of malnutrition identified in this study were poor glycemic control, albuminuria and male gender. We recommend that nutritional assessment should be included in DM care especially among the elderly in order to reduce malnutrition associated morbidity and mortality in them.

Data availability

The authors can provide the data of this research on reasonable request.

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