Original Article

Vajira Med J
Journal of Urban Medicine

Factors Associated with Malnutrition in Older Patients with Type 2 Diabetes in Bangkok, Thailand

Parit Hiri-O-tappa MD[1], Kasidid Lawongsa MD[1]

[1] *Family Practice Outpatient Department, Phramongkutklao Hospital, Bangkok 10400, Thailand*

ABSTRACT

OBJECTIVE: Malnutrition is a widespread but often neglected concern among older individuals with type 2 diabetes mellitus (T2DM), especially in Thailand, where research on this issue is limited. In this group, malnutrition can result in adverse outcomes, such as diminished physical function, decreased quality of life, longer hospitalizations, and increased mortality. This study aimed to examine the prevalence of malnutrition and the factors contributing to it among older adults with T2DM.

METHODS: This cross-sectional study was conducted in August and September 2024 at our local hospital. Older patients diagnosed with T2DM for at least 6 months were included in the analysis. Nutritional status was evaluated using the Global Leadership Initiative on Malnutrition criteria, which assess weight loss, low body mass index, and reduced muscle mass. Logistic regression was used to determine predictors of malnutrition.

RESULTS: Of the 176 participants, 30.1% were malnourished. Factors significantly associated with malnutrition included being underweight (adjusted odds ratio [AOR]: 11.07, 95% CI: 2.69–45.53), being married (AOR: 5.29, 95% CI: 1.14–24.64), living with diabetes for more than 10 years (AOR: 2.99, 95% CI: 1.23–7.25), poor medication adherence (AOR: 2.55, 95% CI: 1.06–6.17), and having a glomerular filtration rate below 60 (AOR: 4.70, 95% CI: 1.95–11.34).

CONCLUSION: Malnutrition is prevalent in older individuals with T2DM. Routine nutritional evaluations should be implemented to reduce health risks and improve patient outcomes in this population.

KEYWORDS: cross-sectional study, malnutrition, older individuals, type 2 diabetes mellitus

INTRODUCTION

Globally, diabetes mellitus (DM) is a prevalent chronic, noncommunicable disease[1]. In 2021, it was estimated that approximately 2.4 million people in Thailand were living with diabetes[2]. This condition is common among the older population, many of whom are undiagnosed[3]. In the United States, approximately 40% of people over 65 years of age have diabetes, and nearly half of these cases are undetected[4,5]. Managing diabetes in older adults is challenging because of the complexity of the disease, heightened risk of additional health issues, and increased susceptibility to frailty[6,7]. Furthermore, malnutrition rates among the older population can vary widely, from 12.0% to 77.1%[8].

Malnutrition and type 2 DM (T2DM) are closely interconnected, particularly among older adults. Although diabetes is often associated with excessive caloric intake and obesity, malnutrition can paradoxically occur alongside these conditions, especially in older patients. With advancing age, the risks of malnutrition and T2DM increase because of various physiological and lifestyle changes.

Corresponding author: Kasidid Lawongsa, kasidid.lawongsa@gmail.com
Received: 2 October 2024
Revised: 15 November 2024
Accepted: 27 November 2024
Vajira Med J 2025;69(1):e271338
http://dx.doi.org/10.62691/vmj.2024.271338

Older individuals often encounter challenges in maintaining proper nutrition, such as a reduced sense of hunger, difficulty in chewing or swallowing, and limited access to nutrient-rich foods, all of which increase the likelihood of malnutrition[9,10].

Malnutrition can occur in older individuals with T2DM, worsening diabetes management. Complications, such as peripheral neuropathy and gastroparesis, which are common in older patients with diabetes, can impair food intake by reducing appetite and causing digestive issues, including nausea, vomiting, and a sensation of early fullness[11]. Additionally, diabetes medications, especially insulin and oral hypoglycemics, can increase the risk of hypoglycemia. This results in patients limiting their food intake to avoid such episodes, thereby intensifying malnutrition[8,11]. This creates a harmful cycle in which poor nutrition negatively affects blood glucose control, leading to further complications and increased frailty.

Malnutrition can severely hinder diabetes management by exacerbating insulin resistance, increasing the risk of infection, and slowing wound healing[12]. It also contributes to sarcopenia and frailty and reduces the physical function and mobility of older patients with diabetes. Sarcopenia is closely linked to poor blood glucose control because reduced muscle mass leads to decreased glucose utilization[9]. These interactions between diabetes and malnutrition increase the risk of adverse outcomes, including falls, fractures and mortality rates[12].

Malnutrition in patients with diabetes often goes undiagnosed, further complicating treatment and worsening health outcomes[8]. Although the prevalence of diabetes in Thailand is well documented, malnutrition, particularly among older patients with diabetes and remains under-investigated. Early detection and appropriate nutritional interventions are essential to improve the care and outcomes of older patients with T2DM. This study aimed to assess the prevalence of and risk factors for malnutrition among older individuals with and without T2DM in Thailand, with the goal of developing strategies for managing malnutrition alongside diabetes[8,11-13].

METHODS

This cross-sectional study was conducted over 2 months at our local hospital from August to September 2024. The study population comprised patients with T2DM who had been receiving treatment at an outpatient clinic, diagnosed at least 6 months according to the Global Leadership Initiative on Malnutrition (GLIM) criteria[14].

Based on the study by Ahmed et al. (2022)[15], which reported a malnutrition prevalence of 10.6% among older adults with diabetes, the sample size for this study was calculated using a 95% confidence level and a 5% margin of error. The sample size formula used was $n = \frac{Z^2 \cdot p \cdot (1-p)}{d^2}$, where Z is the Z-score for a 95% confidence level (1.96), p is the prevalence (0.106), and d is the margin of error (0.05). Substituting these values, the calculated sample size was approximately 146 participants. To account for potential dropouts, the final sample size was adjusted to 176 participants, ensuring sufficient statistical power to assess malnutrition prevalence in this population accurately. The selection criteria for the diabetes group included patients who were 60 years or older, agreed to participate and did not have other chronic conditions, such as HIV, heart failure, thyroid disease, or chronic obstructive pulmonary disease.

Participants were recruited using a convenience sampling method from the Family Practice Outpatient Department at Phramongkutklao Hospital, which is located in an urban area of Bangkok, Thailand. This department primarily provides care to older adults with chronic conditions, including DM. The inclusion of patients from this setting allows the study to focus on a population representative of older adults receiving primary care for diabetes management.

Data collection and recording procedures were carried out in several stages. Initially, public relations efforts and volunteer recruitment took place, followed by obtaining written informed consent from all participants. The sample population consisted of individuals aged 60 years or above, diagnosed with T2DM, and able to communicate in Thai. Participants filled out personal information questionnaires and logged various factors while waiting for outpatient services. Nutritional status was assessed using the GLIM criteria. Additionally, participants' weight and height were measured to calculate their body mass index (BMI). Those at risk for malnutrition were referred to the clinical nutrition unit for muscle mass measurements using bioelectrical impedance analysis (BIA). Regarding data recording, all data were documented on a specially prepared data collection form. The confidentiality of participant data was rigorously maintained, stored separately from the consent forms, and all data was collected and recorded on a computer system exclusively by the researchers.

The assessment of malnutrition utilizes the GLIM criteria[14], which consist of five points divided into two groups to ensure comprehensive evaluation. The clinical characteristics assessed include unintentional weight loss, low BMI below the threshold, and decreased muscle mass, measured using standard methods. Additionally, the causes of malnutrition are evaluated, focusing on reduced food intake and malnutrition related to illness or inflammation. For the measurement of muscle mass, BIA is employed, which provides a detailed analysis of muscle mass critical for determining malnutrition severity and planning appropriate interventions.

Malnutrition, as assessed by the GLIM criteria, refers to a condition where the body lacks essential nutrients, which affects the growth and functioning of various systems[14]. Unintentional weight loss is defined as a reduction of more than 5% of body weight within six months or more than 10% beyond six months[16]. BMI below threshold is considered a BMI less than 18.5 for individuals under 70 years old, and less than 20 kg/m^2 for those over 70[17]. Decreased muscle mass involves a reduction measured by standard methods such as dual-energy X-ray absorptiometry or BIA[18]. Reduced food intake is defined as consuming less than 50% of the body's required intake for at least one week or reduced intake for more than two weeks[19]. Malnutrition related to illness or inflammation pertains to acute or chronic conditions associated with mild to moderate inflammation, such as cancer or other chronic diseases[20].

Anemia is defined by the World Health Organization as a packed cell volume of less than 36% in women and less than 39% in men[21]. Albuminuria is identified when the albumin-to-creatinine ratio exceeds 30 mg/g[22]. Kidney impairment is diagnosed when the estimated glomerular filtration rate falls below 60 mL/min/1.73 m^2 [23]. Good blood glucose control is characterized by a hemoglobin A1C level of less than 7.0%[24]. Regarding BMI, underweight is defined as a BMI of less than 18.5 kg/m^2, normal weight falls between 18.5 to 24.9 kg/m^2, overweight is a BMI from 25 to 29.9 kg/m^2, and obesity is considered a BMI of 30 kg/m^2 or higher[17].

This study was conducted in accordance with the principles of the Declaration of Helsinki and its later amendments. Ethical approval was obtained from the Research and Ethics Committee of the Office of the Subcommittee for Research Project Review, Royal Thai Army Medical Department (reference number IRBTA 1064/2567). Consent was obtained from all participants, and data confidentiality was ensured throughout the study.

The collected data were analyzed using the SPSS software version 26. Descriptive data were presented in a table format. Categorical variables in both groups were presented as proportions and percentages. Relationships between categorical variables were analyzed using the chi-square test. Logistic regression analysis was used to identify the predictors of malnutrition in older individuals with T2DM. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 176 older individuals with T2DM were included in the study: 61 (34.7%) were male. The average age of participants with T2DM was 70 ± 6 years. Seventy-three (41.5%) participants had an average monthly income below 10,000 Baht. Among the groups with and without malnutrition, a significantly higher proportion of those with malnutrition were older individuals with T2DM who were underweight [9 (17.3%) vs. 5 (4.1%)]; had low medical adherence [20 (37.7%) vs. 26 (21.1%)]; had a glomerular filtration rate (GFR) < 60 [20 (37.7%) vs. 23 (18.7%)] and had diabetes for more than 10 years [23 (43.4%) vs. 27 (22.0%)] ($p < 0.05$; Table 1).

Table 1 Basic characteristics of study participants

Variable (unit)		Non-malnutrition	Malnutrition	Total	P-value
No. participant		123 (69.9%)	53 (30.1%)	176	
Sex	male	39 (31.7%)	22 (41.5%)	61 (34.7%)	0.21
	female	84 (68.3%)	31 (58.5%)	115 (65.3%)	
Age (years)	< 70	71 (57.7%)	29 (54.7%)	100 (56.8%)	0.712
	≥ 70	52 (42.3%)	24 (45.3%)	76 (43.2%)	
BMI (kg/m^2)	underweight	5 (4.1%)	9 (17.3%)	14 (8.1%)	0.001*
	normal range	62 (51.2%)	33 (63.5%)	95 (54.9%)	
	overweight	40 (33.1%)	6 (11.5%)	46 (26.6%)	
	obesity	14 (11.6%)	4 (7.7%)	18 (10.4%)	
Status	single	20 (16.7%)	11 (22.0%)	31 (18.2%)	0.028*
	married	72 (60.0%)	36 (72.0%)	108 (63.5%)	
	divorced	28 (23.3%)	3 (6.0%)	31 (18.2%)	
Education	lower secondary education	66 (55.0%)	30 (60.0%)	96 (56.5%)	0.549
	secondary education and above	54 (45.0%)	20 (40.0%)	74 (43.5%)	
Living arrangement	alone	48 (40.0%)	14 (28.0%)	62 (36.5%)	0.139
	not alone	72 (60.0%)	36 (72.0%)	108 (63.5%)	
Income (Baht)	≤ 10,000	56 (44.2%)	17 (32.0%)	73 (41.5%)	0.141
	> 10,000	67 (54.5%)	36 (67.9%)	103 (58.5%)	
Glycemic control	good	21 (17.1%)	18 (34.0%)	39 (22.2%)	0.013*
	poor	102 (82.9%)	35 (66.0%)	137 (77.8%)	
Medical adherence	high	73 (59.3%)	22 (41.5%)	95 (54.0%)	0.047*
	medium	24 (19.5%)	11 (20.8%)	35 (19.9%)	
	low	26 (21.1%)	20 (37.7%)	46 (26.1%)	
Albuminuria	yes	59 (48.0%)	21 (39.6%)	80 (45.5%)	0.308
	no	64 (52.0%)	32 (60.4%)	96 (54.5%)	
GFR (mL/min/1.73 m^2)	≥ 60	100 (81.3%)	33 (62.3%)	133 (75.6%)	0.007*
	< 60	23 (18.7%)	20 (37.7%)	43 (24.4%)	
Duration of diabetes (years)	≥ 10	27 (22.0%)	23 (43.4%)	50 (28.4%)	0.004*
	< 10	96 (78.0%)	30 (56.6%)	126 (71.6%)	

Abbreviations: BMI, body mass index; GFR, glomerular filtration rate; kg/m^2, kilogram per square meter; m, meter; min, minute; mL, milliliters
*P-value < 0.05

For the multivariate analysis, variables were selected based on their significance in the univariate analysis, with a threshold of p-value < 0.05. This criterion ensures that only statistically significant factors are considered, reducing the risk of including irrelevant variables. Factors such as BMI, marital status, duration of T2DM, medical adherence, and GFR were included in the adjusted model as they showed significant associations with malnutrition in the univariate analysis or were deemed clinically relevant based on prior literature.

From the logistic regression analysis, significant predictors of malnutrition in patients with T2DM included being underweight compared to the normal BMI range of 18.5–24.9 (adjusted odds ratio [AOR] 11.07; 95% confidence interval [95% CI] 2.69–45.53), being married relative to being single (AOR 5.29; 95% CI 1.14–24.64), having been diagnosed with T2DM for more than 10 years compared to less than 10 years (AOR 2.99; 95% CI 1.23–7.25), having low medical adherence relative to high adherence (AOR 2.55; 95% CI 1.06–6.17), and having a GFR < 60 compared to a GFR ≥ 60 (AOR 4.70; 95% CI 1.95–11.34) (p < 0.05; Table 2).

DISCUSSION

This investigation evaluated the prevalence of malnutrition among older people with and without T2DM using markers such as low albumin levels, BMI, and the Mini Nutritional Assessment Short-Form. We also identified the factors linked to malnutrition in older patients with T2DM. The findings revealed a significantly higher malnutrition rate in older individuals with T2DM than in their age- and sex-matched counterparts without diabetes. Being underweight was more common in older individuals with diabetes in the malnourished group (17.3%) than in the non-malnourished group (4.1%). The underweight prevalence in this study was nearly identical to the 4.8% reported by Adebusoye et al.[25] in an older population in Nigeria, suggesting a link between diabetes and malnutrition in these groups. Diabetic autonomic neuropathy, which manifests as gastroparesis, diarrhea, and intestinal diseases and is common in older adults with diabetes, may contribute to malnutrition. The prevalence of malnutrition in older patients with diabetes was 30.1% in this study, which is closely aligned with the 29% prevalence reported by Vural Keskinler et al.[26] in Turkey.

Table 2 Association between sociodemographic factors among older adults with type 2 diabetes

		Crude OR (95% CI)	P-value	Adjusted* OR (95% CI)	P-value
BMI (kg/m^2)	Normal range	Ref.		Ref.	
	Underweight	3.85 (1.38–10.77)	0.01*	11.07 (2.69–45.53)	0.001*
Status	single	Ref.		Ref.	
	married	5.13 (1.27–20.81)	0.022*	5.29 (1.14–24.64)	0.034*
Duration of diabetes (years)	< 10	Ref.		Ref.	
	≥ 10	2.73 (1.37–5.44)	0.004*	2.99 (1.23–7.25)	0.016*
Medical adherence	high	Ref.		Ref.	
	medium	1.52 (0.65–3.59)	0.338	0.63 (0.21–1.84)	0.394
	low	2.55 (1.20–5.42)	0.015*	2.55 (1.06–6.17)	0.038*
GFR (mL/min/1.73 m^2)	≥ 60	Ref.		Ref.	
	< 60	2.64 (1.29–5.40)	0.008*	4.70 (1.95–11.34)	0.001*

Abbreviations: BMI, body mass index; CI, confidence interval; GFR, glomerular filtration rate; kg/m^2, kilogram per square meter; m, meter; min, minute; mL, milliliters; OR, odds ratio; Ref, reference
*P-value < 0.05

In patients with T2DM and a BMI in the underweight category, malnutrition risks are significantly elevated due to poor glycemic control. This condition accelerates the catabolic process, leading to the breakdown of muscle and fat stores to compensate for energy deficits. Over time, this metabolic imbalance results in reduced muscle mass, diminished physical strength, and increased frailty. Additionally, poor glycemic control can impair gastrointestinal function, leading to diminished nutrient absorption and exacerbating micronutrient deficiencies. Complications such as diabetic gastroparesis, which slows gastric emptying, further hinder nutrient intake by causing symptoms like nausea, early satiety, and vomiting, making it difficult for patients to maintain adequate nutritional levels. Furthermore, psychological factors, including anorexia and depression, are prevalent in underweight T2DM patients and can significantly reduce food consumption. These mental health conditions may be exacerbated by the chronic stress of managing diabetes, creating a vicious cycle that worsens both malnutrition and glycemic control[26,27]. Moreover, long-term malnutrition in this group can lead to sarcopenia, a condition characterized by severe muscle loss, which further diminishes glucose utilization and impairs insulin sensitivity. This interplay between malnutrition and T2DM complications highlights the critical need for early identification and intervention to address nutritional deficits and improve clinical outcomes[26,27].

Marital status changes, such as marriage, can affect the risk of malnutrition in T2DM due to various psychosocial factors. Marriage may introduce additional responsibilities, such as caregiving or managing household duties, which could interfere with the individual's ability to prioritize proper nutritional management, particularly if spousal support is inadequate or inconsistent. This aligns with findings from previous studies, which have demonstrated that the presence of a supportive spouse is associated with better adherence to dietary and medication regimens in chronic disease management, including diabetes[28,29]. Previous research also highlights that marital conflict or stress within the relationship may negatively impact nutritional intake. Emotional stress has been shown to affect meal patterns, often leading to reduced appetite or reliance on less nutritious, high-calorie convenience foods, further exacerbating malnutrition risks. However, supportive marital environments can buffer against these risks, fostering healthier eating habits and improved glycemic control, as documented in studies focusing on the psychosocial aspects of diabetes care[28,29]. These findings collectively emphasize the complex role of marital status and quality in shaping nutritional and health outcomes in patients with T2DM, suggesting that interventions aimed at improving spousal support and relationship quality could be beneficial in mitigating malnutrition risks in this population.

A duration of over 10 years with T2DM increases the risk of malnutrition, as long-term illness can lead to complications such as anorexia, muscle loss, and digestive system decline. Metabolic issues associated with chronic diabetes, such as chronic kidney disease (CKD) and peripheral neuropathy, can impair nutrient absorption and utilization. Thus, a long history of diabetes correlates with an increased risk of malnutrition[30].

Poor medical adherence dramatically increases the malnutrition risk in patients with T2DM. Inadequate adherence to dietary and medication guidelines can disrupt blood glucose balance, impacting metabolism and nutrient absorption. Neglecting regular health checks or failing to seek nutritional advice can result in poor dietary knowledge and unbalanced nutrient intake, increasing malnutrition risks[31].

A low GFR (below 60 mL/min/1.73 m^2) indicates possible CKD in patients with T2DM, greatly increasing malnutrition risks. Reduced kidney function disrupts waste removal and nutrient balance. CKD causes toxin buildup in the bloodstream, leading to symptoms such as appetite loss, nausea, and anorexia. It also reduces the capacity of the body to absorb and use proteins and essential nutrients, thereby promoting muscle loss and malnutrition. The dietary restrictions required to manage mineral levels in patients with CKD can also contribute to nutrient imbalances, increasing the risk of malnutrition[32,33].

This study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish causality between identified risk factors and malnutrition in older patients with T2DM. Longitudinal studies are needed to explore causal relationships and temporal associations. Second, the use of convenience sampling from a single urban hospital may limit the generalizability of the findings to rural or non-urban populations, as well as to healthcare settings with different patient demographics or resources. Third, while we relied on the GLIM criteria for malnutrition assessment, which include objective measures like BMI and BIA, subjective factors such as dietary intake and psychosocial influences were not comprehensively captured. Future studies should incorporate more detailed dietary assessments and psychosocial evaluations to provide a holistic understanding of malnutrition in this population. Lastly, although the study adjusted for several confounding variables, unmeasured confounders such as physical activity levels and comorbidities may have influenced the results. Addressing these limitations in future research could strengthen the understanding and management of malnutrition in older patients with T2DM.

CONCLUSION

This study assessed and compared the prevalence of malnutrition using the GLIM criteria among older patients with and without T2DM. It also identified risk factors associated with malnutrition in patients with T2DM. Significant risk factors included a BMI less than 18.5, a history of diabetes of more than 10 years, non-adherence to medical advice, low kidney filtration rates (GFR < 60 mL/min/1.73 m^2), and being married. This study highlights the importance of systematically assessing malnutrition in patients with T2DM to develop appropriate management strategies for malnutrition in this group.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENT

We gratitude to the Bioscience Research Center, Phramongkutklao Hospital, for their cooperation in conducting BIA measurement. We are also grateful to the participants who took part in the study and to the staff members for their contributions to this research.

DATA AVAILABILITY STATEMENT

The data underlying this study are openly available in PubMed. For further correspondence, please contact kasidid.lawongsa@gmail.com

REFERENCES

1. World Health Organisation. Noncommunicable diseases [internet]. 2023 [cited 2024 Sep 23]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
2. Aekplakorn W, Stolk RP, Neal B, Suriyawongpaisal P, Chongsuvivatwong V, Cheepudomwit S, et al. The prevalence and management of diabetes in Thai adults: the international collaborative study of cardiovascular disease in Asia. Diabetes Care 2003;26(10):2758-63.

3. Mordarska K, Godziejewska-Zawada M. Diabetes in the elderly. Prz Menopauzalny 2017;16(2):38-43.
4. Cannon A, Handelsman Y, Heile M, Shannon M. Burden of illness in type 2 diabetes mellitus. J Manag Care Spec Pharm 2018;24(9-a Suppl): S5-13.
5. The lancet diabetes endocrinology. Undiagnosed type 2 diabetes: an invisible risk factor. Lancet Diabetes Endocrinol 2024; 12(4):215.
6. Chen LK, Chen YM, Lin MH, Peng LN, Hwang SJ. Care of elderly patients with diabetes mellitus: a focus on frailty. Ageing Res Rev 2010;9 Suppl 1:S18-22.
7. Sanz-Cánovas J, López-Sampalo A, Cobos-Palacios L, Ricci M, Hernández-Negrín H, Mancebo-Sevilla JJ, et al. Management of type 2 diabetes mellitus in elderly patients with frailty and/or sarcopenia. Int J Environ Res Public Health 2022;19(14):8677.
8. Junaid OA, Ojo OA, Adejumo OA, Junaid FM, Ajiboye KJ, Ojo OE, et al. Malnutrition in elderly patients with type 2 diabetes mellitus in a Nigerian tertiary hospital: a cross-sectional study. Dialogues Health 2022;1:100030.
9. Thaenpramun R, Komolsuradej N, Buathong N, Srikrajang S. Association between glycaemic control and malnutrition in older adults with type 2 diabetes mellitus: a cross-sectional study. Br J Nutr 2024;131(9):1497-505.
10. Walker-Clarke A, Walase L, Meye C. Psychosocial factors influencing the eating behaviours of older adults: a systematic review. Ageing Res Rev 2022;77:101597.
11. Krishnasamy S, Abell TL. Diabetic gastroparesis: principles and current trends in management. Diabetes Ther 2018;9 Suppl 1:1-42.
12. Riddle E, Munoz N, Clark K, Collins N, Coltman A, Nasrallah L, et al. Prevention and treatment of malnutrition in older adults living in long-term care or the community: an evidence-based nutrition practice guideline. J Acad Nutr Diet 2024;124(7):896-916.
13. Zahid SA, Tated R, Mathew M, Rajkumar D, Karnik SB, Pramod Roy A, et al. Diabetic gastroparesis and its emerging therapeutic options: a narrative review of the literature. Cureus 2023;15(9):e44870.
14. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - a consensus report from the global clinical nutrition community. Clin Nutr 2019;38(1):1-9.
15. Ahmed I, Kaifi HM, Tahir H, Javed A. Malnutrition among patients with type-2 diabetes mellitus. Pak J Med Sci 2023;39(1): 64-9.
16. Stajkovic S, Aitken EM, Holroyd-Leduc J. Unintentional weight loss in older adults. CMAJ 2011;183(4):443-9.
17. Weir CB, Jan A. BMI classification percentile and cut off points. In: Ackley WB, Adolphe TS, Aeby TC, Aeddula NR, Agadi S, Agasthi P, et al., editors. Statpearls. StatPearls Publishing; 2023.
18. Lawongsa K, Srisuwan P, Tejavanija S, Gesakomol K. Sensitivity and specificity of Yubi-wakka (finger-ring) screening method for sarcopenia among older Thai adults. Geriatr Gerontol Int 2024;24(3):263-8.
19. Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Goisser S, Hooper L, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. Clin Nutr 2019;38(1): 10-47.
20. Stumpf F, Keller B, Gressies C, Schuetz P. Inflammation and nutrition: friend or foe? Nutrients 2023;15(5):1159.
21. Domenica Cappellini M, Motta I. Anemia in clinical practice-definition and classification: does hemoglobin change with aging? Semin Hematol 2015;52(4):261–9.
22. Nah EH, Cho S, Kim S, Cho HI. Comparison of urine albumin-to-creatinine ratio (ACR) between ACR strip test and quantitative test in prediabetes and diabetes. Ann Lab Med 2017;37(1):28-33.

23. Vaidya S, Aeddula N. Chronic kidney disease. In: Ackley WB, Adolphe TS, Aeby TC, Aeddula NR, Agadi S, Agasthi P, et al., editors. Statpearls. StatPearls Publishing; 2023.
24. American Diabetes Association. Understanding A1C | ADA [internet]. 2023 [cited 2024 Sep 23]. Available from: https://diabetes.org/about-diabetes/a1c
25. Adebusoye L, Ajayi I, Dairo M, Ogunniyi A. Factors associated with undernutrition and overweight in elderly patients presenting at a primary care clinic in Nigeria. S Afr Fam Pract 2011;53:355-60.
26. Vural Keskinler M, Feyİzoglu G, Yildiz K, Oguz A. The frequency of malnutrition in patients with type 2 diabetes. Medeni Med J 2021;36(2):117-22.
27. Kalantar-Zadeh K, Streja E, Kovesdy CP, Oreopoulos A, Noori N, Jing J, et al. The obesity paradox and mortality associated with surrogates of body size and muscle mass in patients receiving hemodialysis. Mayo Clin Proc 2010;85:991-1001.
28. Kutob RM, Yuan NP, Wertheim BC, Sbarra DA, Loucks EB, Nassir R, et al. Relationship between marital transitions, health behaviors, and health indicators of postmenopausal women: results from the women's health initiative. J Womens Health (Larchmt) 2017;26(4):313-20.
29. Kposowa AJ, Aly Ezzat D, Breault K. Diabetes mellitus and marital status: evidence from the National Longitudinal Mortality study on the effect of marital dissolution and the death of a spouse. Int J Gen Med 2021;14:1881-8.
30. Meneilly GS, Tessier D. Diabetes in elderly adults. J Gerontol A Biol Sci Med Sci 2001;56(1):M5-13.
31. Rhee MK, Slocum W, Ziemer DC, Culler SD, Cook CB, El-Kebbi IM, et al. Patient adherence improves glycemic control. Diabetes Educ 2005;31(2):240-50.
32. Kalantar-Zadeh K, Ikizler TA, Block G, Avram MM, Kopple JD. Malnutrition-inflammation complex syndrome in dialysis patients: causes and consequences. Am J Kidney Dis 2003;42(5):864-81.
33. Kopple JD. National kidney foundation K/DOQI clinical practice guidelines for nutrition in chronic renal failure. Am J Kidney Dis 2001;37(1 Suppl 2):S66-70.