

Assessment of malnutrition risk and its association with diabetes complications in hospitalised adult patients attending Marjan Teaching Hospital

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Abstract

Objective: Malnutrition is common among hospitalised diabetic patients and may worsen clinical outcomes. This study assessed the prevalence of malnutrition risk using the Malnutrition Universal Screening Tool (MUST) and examined its association with diabetes-related complications among hospitalised adults at Marjan Teaching Hospital, Iraq.

Methods: A hospital-based analytical cross-sectional study enrolled 200 adult patients with diabetes mellitus. Malnutrition risk was categorised using MUST (low=0, medium=1, high≥2). Associations with diabetes complications were analysed using chi-square tests and multivariable logistic regression, adjusting for age, sex, diabetes duration, body mass index (BMI), HbA1c, and length of stay.

Results: Overall, 71.5% of patients were at low malnutrition risk, 14% at medium risk, and 14.5% at high risk. The prevalence of at least one diabetes-related complication was 86.5%. MUST risk category was significantly associated with the presence of complications ($p=0.046$). Compared with the low-risk group, medium-risk (adjusted OR 0.34, 95% CI 0.11–0.96, $p=0.042$) and high-risk (adjusted OR 0.39, 95% CI 0.14–1.08, $p=0.071$) patients had lower adjusted odds of complications. Insulin therapy and fair glycaemic control (HbA1c 7-9%) were associated with higher malnutrition risk in unadjusted analyses.

Conclusion: Nearly 30% of hospitalised diabetic patients were at medium or high risk of malnutrition. Routine MUST screening is recommended to enable early nutritional intervention, particularly in resource-limited settings.

Keywords: Malnutrition, Diabetes complications, MUST score, Hospitalised patients, Iraq

Plain English Summary

When people with diabetes are admitted to the hospital, they may not eat well or may lose muscle strength – a problem called malnutrition. This can make their diabetes harder to manage and lead to more health problems. In this study, we used a simple checklist called the Malnutrition Universal Screening Tool (MUST) to check for malnutrition risk in 200 diabetic patients at Marjan Teaching Hospital in Iraq. We found that about three out of ten patients (28.5%) were at medium or high risk of malnutrition. Most patients (86.5%) already had at least one diabetes complication, such as eye, kidney, or nerve problems. Interestingly, patients at low malnutrition risk actually had more complications than those at higher risk – this may be because they were heavier and had poorer blood sugar control, which can hide underlying muscle loss. The study shows that checking for malnutrition risk should be a routine part of hospital care for diabetic patients, so that help with nutrition can start early.

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Introduction

Malnutrition in the context of chronic disease is a complex, multifactorial condition arising from an imbalance between nutrient intake and metabolic demand. It leads to progressive loss of skeletal muscle mass, impaired physical function, and worse clinical outcomes (1, 2). Among patients with diabetes mellitus, malnutrition is often categorised as disease-related malnutrition because persistent hyperglycaemia and chronic inflammation create a catabolic state that resists anabolic signals – a phenomenon known as anabolic resistance (3).

The relationship between diabetes and malnutrition is bidirectional. Hyperglycaemia and inflammatory cytokines increase protein catabolism and reduce muscle protein synthesis, while malnutrition worsens insulin resistance and accelerates the development of microvascular and macrovascular complications (3, 4). In hospital settings, this interplay is further amplified by fasting for diagnostic procedures, medication side effects, and the absence of routine nutritional screening (5).

The prevalence of malnutrition risk among diabetic patients varies widely depending on the population and screening tool used. Among older adults with diabetes, malnutrition prevalence exceeds 60% in some studies (6). In patients with diabetic foot ulcers, rates between 50% and 65% have been reported, driven by chronic inflammation and increased metabolic demand (7). Sarcopenia – the loss of muscle mass and function – affects 18-40% of persons with diabetes, and sarcopenic obesity (muscle wasting with excess fat) occurs in 10-29% (3, 8). In the Middle East, including Iraq, the double burden of overweight/obesity alongside micronutrient deficiencies (vitamin D, zinc, B12) makes malnutrition difficult to recognise using routine clinical assessments (9, 10). Hospital-based studies from Iraq have reported malnutrition in up to 58% of diabetic inpatients, often linked to poor glycaemic control (11, 12). Malnourished hospitalised patients experience longer stays, higher readmission rates, increased healthcare costs, and greater mortality (13, 14). The Malnutrition Universal Screening Tool (MUST) is an evidence-based, five-step instrument developed by the British Association for Parenteral and Enteral Nutrition (BAPEN). It calculates a risk score based on body mass index (BMI), unintentional weight loss over 3-6 months, and the presence of acute disease causing nil intake for more than five days (15, 16). MUST has been validated in hospital and community settings and is simple to use, making it suitable for routine clinical practice even in resource-limited environments.

Given the high burden of diabetes and its complications in Iraq, evaluating malnutrition risk using a standardised tool is both timely and necessary. This study aimed to (1) assess the prevalence of malnutrition risk among hospitalised adult diabetic patients at Marjan Teaching Hospital using MUST, and (2) examine the relationship between malnutrition risk and the presence of diabetes-related complications.

Materials and Methods

Study design and setting

We conducted a hospital-based analytical cross-sectional study at the endocrinology unit of Marjan Teaching Hospital, a 400-bed tertiary referral hospital in Hilla City, Babylon Governorate, Iraq. Data collection took place over five months (3 December 2025 to 15 May 2026). The study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies.

Study population and sampling

The target population comprised all adult patients (≥ 18 years) with a confirmed diagnosis of diabetes mellitus (type 1 or type 2) based on American Diabetes Association criteria, who were admitted to the endocrinology unit for any cause for at least 24 hours. Exclusion criteria were: age under 18 years; pregnancy or lactation; severe comorbid conditions affecting nutritional status (advanced cancer, end-stage renal disease, end-stage liver disease); inability to communicate; or refusal to participate.

Sample size calculation using the formula for a proportion ($n = Z^2 \times p \times (1-p) / d^2$) with $Z=1.96$ (95% confidence), expected prevalence of nutritional risk $p=27.7\%$ from a recent study (17), and margin of error $d=0.05$ gave a minimum required sample of 308. Due to logistical constraints and the single-centre nature of the study, we recruited a convenience sample of 200 participants. Consecutive eligible patients admitted during the study period were approached until the target sample was reached. The sample size provides 80% power to detect an odds ratio of approximately 2.0 for the association between malnutrition risk and complications, assuming a complication prevalence of 50% in the low-risk group.

Data collection tools and procedures

Data were collected by the principal investigator through face-to-face interviews using a structured, pre-tested questionnaire developed after a literature review. Anthropometric measurements followed standard protocols with calibrated equipment.

The questionnaire covered four domains

Socio-demographic data

Age, sex, marital status, educational level, occupation, residence, monthly income, and smoking status.

Clinical diabetes data

Type and duration of diabetes, current treatment (oral agents, insulin, or both), HbA1c level (most recent within the current admission or preceding 3 months), random blood glucose on admission, presence of diabetes complications (neuropathy, retinopathy, nephropathy, foot ulcer, cardiovascular disease), frequency of hospital follow-up, and comorbidities.

Nutritional assessment

Anthropometry: height, weight, BMI (kg/m²), history of weight change, presence of oedema or ascites.

Dietary intake and appetite: appetite over the past week, daily meal frequency, dietary restrictions, food intake compared with usual, swallowing/chewing difficulties, gastrointestinal symptoms.

Disease and stress factors: acute illness, metabolic stress, fever, inflammation.

MUST scoring – a validated five-step tool (15, 16)

Step 1: BMI > 20 kg/m² = 0; 18.5–20 = 1; < 18.5 = 2.

Step 2: Unintentional weight loss in past 3–6 months: <5% = 0; 5–10% = 1; >10% = 2.

Step 3: Acute disease effect (no nutritional intake for >5 days) = 2.

Step 4: Add scores from steps 1–3 to obtain total risk score: 0 = low risk; 1 = medium risk; ≥2 = high risk.

Laboratory data

Haemoglobin, serum creatinine, blood urea, serum cholesterol, and random blood glucose were extracted from electronic hospital records within 48 hours of admission. HbA1c was obtained from the admission record or the most recent value within the preceding 3 months.

Operational definitions

Malnutrition risk: low (MUST=0), medium (MUST=1), high (MUST≥2).

Diabetes complications: binary variable (yes/no) defined as the presence of at least one documented microvascular (neuropathy, retinopathy, nephropathy) or macrovascular (cardiovascular disease, cerebrovascular

disease, peripheral arterial disease) complication or diabetic foot ulcer.

BMI categories: underweight <18.5 kg/m²; normal 18.5–24.9; overweight 25–29.9; obese ≥30 (18).

Glycaemic control: poor (HbA1c >9% or random blood glucose >200 mg/dL on admission); fair (HbA1c 7–9%); good (HbA1c <7%) (19).

Statistical analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Descriptive statistics are presented as mean ± standard deviation for normally distributed continuous variables and as frequencies (percentages) for categorical variables. The chi-square test (or Fisher's exact test when expected cell counts were <5) was used to examine associations between categorical variables. One-way analysis of variance (ANOVA) with post-hoc Tukey test (after confirming normality and homogeneity of variance) compared continuous variables across MUST categories.

Binary logistic regression was performed to calculate crude and adjusted odds ratios (OR) with 95% confidence intervals (CI) for the association between MUST risk category (low risk as reference) and the presence of diabetes complications. The multivariable model adjusted for a priori confounders: age, sex, diabetes duration, BMI, HbA1c category, and length of hospital stay. Model assumptions were checked (linearity of logit for continuous predictors using Box-Tidwell test; no multicollinearity – variance inflation factor <2.5 for all variables). Missing data were minimal (<3% for any variable) and handled by complete case analysis. A two-sided p-value <0.05 was considered statistically significant.

Results

Socio-demographic characteristics

A total of 200 hospitalised diabetic patients participated. The mean age was 57.3 years (SD 14.1), with more than half (61.5%) aged 50–69 years. The sample was balanced by sex (49.5% male, 50.5% female). Most participants were married (76.5%). Educational level was low: 30.0% were illiterate, and 29.0% had only primary education. Occupationally, 49.0% were housewives and 22.0% were unemployed. Rural residence accounted for 54.5% of the sample (Table 1). These characteristics reflect a population with limited formal education and economic activity, typical of the region.

Table 1: Socio-demographic characteristics of study participants (n=200)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	<30	17	8.5
	30-39	10	5
	40-49	20	10
	50-59	51	25.5
	60-69	72	36
	≥70	30	15
Sex	Male	99	49.5
	Female	101	50.5
Marital status	Married	153	76.5
	Single	11	5.5
	Widowed	23	11.5
	Divorced	13	6.5
Education	Illiterate	60	30
	Primary	58	29
	Secondary	48	24
	College or higher	34	17
Occupation	Employed	15	7.5
	Unemployed	44	22
	Retired	43	21.5
	Housewife	98	49
Residence	Urban	91	45.5
	Rural	109	54.5

Clinical and metabolic characteristics

Type 2 diabetes was present in 86.0% of patients, type 1 in 14.0%. Oral hypoglycaemic agents alone were used by 71.5%, insulin alone by 14.0%, and both by 14.5%. More than half (51.5%) had diabetes for over 10 years. The mean HbA1c was 8.61% (SD 1.96), indicating generally suboptimal glycemic control. The mean random blood glucose on admission was 11.29

mmol/L (SD 4.57; equivalent to 203 mg/dL). According to BMI, 42.5% were obese, 32.0% overweight, and 25.5% normal weight; no patient was underweight (Table 2). The proportion of patients with at least one diabetes-related complication was 86.5% (Figure 1). Regular hospital follow-up visits were attended by 62.0% of patients.

Table 2: Clinical and metabolic characteristics of study participants (n=200)

Characteristic	Category / Statistic	n (%) or mean (SD)
Type of diabetes	Type 1	28 (14.0%)
	Type 2	172 (86.0%)
Treatment	Oral hypoglycaemics	143 (71.5%)
	Insulin	28 (14.0%)
	Both	29 (14.5%)
Diabetes duration	<5 years	33 (16.5%)
	5-10 years	64 (32.0%)
	>10 years	103 (51.5%)
HbA1c (%)	Mean (SD)	8.61 (1.96)
	Median (min-max)	8.5 (5.0-18.5)
Random blood glucose (mmol/L)	Mean (SD)	11.29 (4.57)
	Median (min-max)	10.5 (4.9-38.4)
BMI category	Obese (≥30)	85 (42.5%)
	Overweight (25-29.9)	64 (32.0%)
	Normal (18.5-24.9)	51 (25.5%)
	Underweight (<18.5)	0 (0%)
Diabetes complications	Yes (≥1)	173 (86.5%)
	No	27 (13.5%)
Hospital follow-up	Yes	124 (62.0%)
	No	76 (38.0%)

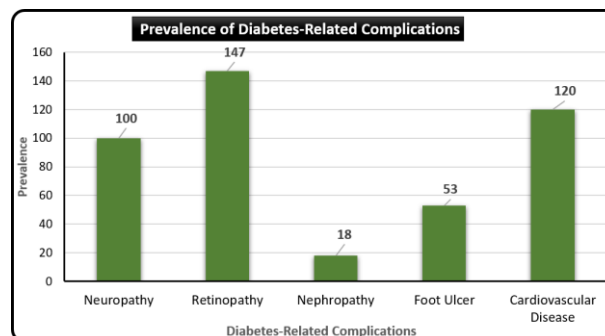


Figure 1: Prevalence of diabetes-related complications

Of 200 patients, 86.5% had at least one complication. The most frequent were retinopathy (73.5%), neuropathy (49.5%), cardiovascular disease (40.0%), foot ulcer (27.0%), and nephropathy (9.0%). (Note: percentages sum >100% because patients could have multiple complications.)

Prevalence of malnutrition risk (MUST)

The MUST score distribution showed that 71.5% (n=143) of patients were at low risk, 14.0% (n=28) at medium risk, and 14.5% (n=29) at high risk (Figure 2). Thus, 28.5% of hospitalised diabetic patients required nutritional attention.

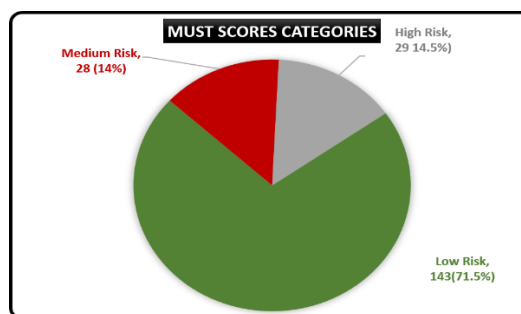


Figure 2: Malnutrition risk categories by MUST

Low risk (score 0): 71.5%; medium risk (score 1): 14.0%; high risk (score ≥2): 14.5%

Factors associated with malnutrition risk

Table 3 shows the bivariate associations between clinical variables and MUST risk category. Diabetes duration was not significantly associated ($p=0.704$). Type of diabetes showed borderline significance ($p=0.076$), with a higher proportion of type 1 patients in the medium-risk group. Treatment modality was significantly associated ($p=0.020$): insulin-treated patients

had the highest rate of medium risk (26.7%). HbA1c category showed a strong association ($p=0.001$), but in an unexpected direction: patients with fair control (7-9%) had the highest proportion of high risk (21.1%), while those with poor control (>9%) were mostly low risk (87.8%). Hospital follow-up visits were not associated with malnutrition risk ($p=0.641$).

Table 3: Association of malnutrition risk with diabetes characteristics and clinical factors

Characteristic	Category	Low risk (n, %)	Medium risk (n, %)	High risk (n, %)	P value*
Diabetes duration	<5 years	24 (72.7%)	6 (18.2%)	3 (9.1%)	0.704
	5-10 years	43 (67.2%)	10 (15.6%)	11 (17.2%)	
	>10 years	76 (73.8%)	12 (11.7%)	15 (14.6%)	
Type of diabetes	Type 1	59 (66.3%)	18 (20.2%)	12 (13.5%)	0.076
	Type 2	84 (75.7%)	10 (9.0%)	17 (15.3%)	
Treatment	Oral hypoglycaemics	84 (75.7%)	10 (9.0%)	17 (15.3%)	0.02
	Insulin	36 (60.0%)	16 (26.7%)	8 (13.3%)	
	Both	23 (79.3%)	2 (6.9%)	4 (13.8%)	
HbA1c category	<7% (good)	29 (58.0%)	12 (24.0%)	9 (18.0%)	0.001
	7-9% (fair)	49 (64.5%)	11 (14.5%)	16 (21.1%)	
	>9% (poor)	65 (87.8%)	5 (6.8%)	4 (5.4%)	
Hospital follow-up	Yes	88 (71.0%)	16 (12.9%)	20 (16.1%)	0.641
	No	55 (72.4%)	12 (15.8%)	9 (11.8%)	

*Chi-square test; Fisher's exact test used where expected cell count <5

Association between malnutrition risk and diabetes complications

A statistically significant association was found between MUST risk category and the presence of at least one diabetes complication ($p=0.046$, Table 4). The proportion of patients with complications was 90.2% in the low-risk group, 75.0% in the medium-risk group, and 79.3% in

the high-risk group. When examining individual complications, no single type reached statistical significance, although foot ulcers tended to be more prevalent in the high-risk group (34.5%) compared with low (25.9%) and medium (21.4%) risk ($p=0.510$). BMI and other biochemical parameters did not differ significantly across risk groups (Table 4).

Table 4: Associations between malnutrition risk (MUST) and diabetes complications, comorbidities, and laboratory parameters

Relationship	Details	P value
MUST risk × any diabetes complication	Low risk: 90.2% (129/143); Medium: 75.0% (21/28); High: 79.3% (23/29)	0.046
MUST risk × neuropathy	Low: 53.1%; Medium: 35.7%; High: 48.3%	0.236
MUST risk × retinopathy	Low: 78.0%; Medium: 67.9%; High: 62.1%	0.128
MUST risk × nephropathy	Low: 8.4%; Medium: 7.1%; High: 13.8%	0.608
MUST risk × foot ulcer	Low: 25.9%; Medium: 21.4%; High: 34.5%	0.51
MUST risk × cardiovascular disease	Low: 39.9%; Medium: 42.9%; High: 37.9%	0.929
Mean BMI (kg/m ²) by risk	Low: 29.0; Medium: 28.1; High: 30.9	0.977

Comparison of clinical parameters across malnutrition risk categories

Analysis of variance revealed significant differences in mean HbA1c and mean BMI across MUST categories (Table 5). Patients in the low-risk group had a significantly higher mean HbA1c (8.89%) compared with medium-risk (7.89%) and high-risk (7.93%) groups

($p=0.0057$). Mean BMI was highest in the low-risk group (29.83 kg/m²) and lowest in the medium-risk group (26.80 kg/m²) ($p=0.0126$). This paradoxical pattern – lower malnutrition risk associated with worse glycemic control and higher body weight – persisted across the analysis.

Table 5: Comparison of clinical parameters across malnutrition risk categories

Parameter	Low risk (n=143)	Medium risk (n=28)	High risk (n=29)	P value*
Mean HbA1c (%)	8.89	7.89	7.93	0.0057
Mean BMI (kg/m ²)	29.83	26.8	28.17	0.0126
Mean MUST score	0	1	2	<0.0001

*One-way ANOVA

Diabetes duration did not significantly influence BMI ($p=0.062$), with the highest mean BMI

observed in patients with duration <5 years (31.0 kg/m²) (Table 6).

Table 6: Clinical characteristics by duration of diabetes

Metric	<5 years (n=33)	5-10 years (n=64)	>10 years (n=103)	P value
Mean BMI (kg/m ²)	31	28.3	29.11	0.062

Multivariable logistic regression analysis

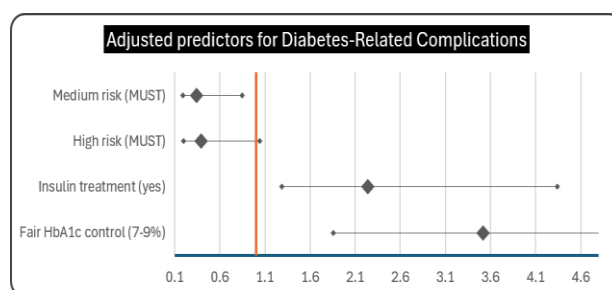
Binary logistic regression was performed to assess the independent association between MUST risk category and the presence of diabetes-related complications, adjusting for age, sex, diabetes duration, BMI, HbA1c category, and length of hospital stay (Table 7, Figure 3). The overall model was statistically significant (omnibus test $p=0.012$). Compared with the low-risk reference group: Medium risk: adjusted OR = 0.34 (95% CI 0.11–0.96, $p=0.042$) High risk: adjusted OR = 0.39 (95% CI 0.14–1.08, $p=0.071$)

The overall association between MUST risk category and diabetes complications remained statistically significant ($p=0.046$). Insulin treatment (yes vs. no) was independently associated with higher odds of complications (adjusted OR 2.24, 95% CI 1.15–4.36, $p=0.018$). Fair glycemic control (HbA1c 7-9%) compared with poor control (>9%) was also associated with increased complication odds (adjusted OR 3.52, 95% CI 1.71–7.25, $p=0.001$). Crude (unadjusted) ORs showed a similar pattern: medium risk OR 0.34 (95% CI 0.13–0.89, $p=0.028$), high risk OR 0.42 (95% CI 0.16–1.08, $p=0.072$).

Table 7: Multivariable logistic regression analysis for diabetes-related complications

Variable	Adjusted OR	95% CI	P value
MUST risk category (ref: low risk)			0.046*
Medium risk	0.34	0.11-0.96	0.042
High risk	0.39	0.14-1.08	0.071
Insulin treatment (yes vs. no)	2.24	1.15-4.36	0.018
HbA1c category (ref: poor control >9%)			0.001*
Fair control (7-9%)	3.52	1.71-7.25	0.001
Good control (<7%)	1.82	0.73-4.54	0.199
Age (per 1 year)	1.01	0.98-1.04	0.581
Sex (female vs. male)	1.01	0.47-2.17	0.98
Diabetes duration (per 1 year)	0.99	0.95-1.03	0.573
BMI (per 1 kg/m ²)	1.01	0.96-1.07	0.698
Length of hospital stay (per 1 day)	0.95	0.86-1.04	0.234

*Overall p-value for the categorical variable

**Figure 3: Forest plot of adjusted odds ratios for diabetes-related complications**

Points represent adjusted ORs; horizontal lines show 95% confidence intervals

Discussion

This study provides important insights into the prevalence of malnutrition risk and its complex relationship with diabetes complications among hospitalised adults in a tertiary hospital in Iraq. Using the MUST tool, we found that 28.5% of diabetic inpatients were at medium or high risk of malnutrition – a proportion that demands clinical attention. Routine nutritional screening is not yet standard in many Iraqi hospitals, and our findings suggest that its implementation could identify a substantial subset of patients who might benefit from early nutritional support.

The 86.5% prevalence of at least one diabetes complication in our cohort is notably high, reflecting both the advanced disease stage of patients admitted to a tertiary referral centre and possible selection bias towards more severe cases. This figure exceeds the complication rates reported in some outpatient Iraqi studies (12) but aligns with hospital-based studies of long-standing diabetes (17). The high complication burden underscores the need for comprehensive inpatient care that includes nutritional assessment.

A striking and initially counterintuitive finding was that patients classified as low malnutrition risk had a higher prevalence of complications (90.2%) compared with those at medium (75.0%) or high (79.3%) risk, and that low-risk patients had significantly higher mean HbA1c (8.89% vs. 7.9%) and higher mean BMI (29.8 vs. 26.8-28.2

kg/m²). This paradoxical association persisted after multivariable adjustment, with medium- and high-risk patients showing lower adjusted odds of complications than the low-risk reference group. Several explanations for this paradox warrant consideration. First, the “obesity paradox” is well described in diabetes and cardiovascular disease, where patients with higher BMI often have better short-term outcomes despite worse metabolic profiles (20). Second, sarcopenic obesity – the coexistence of excess adiposity with reduced muscle mass – can mask malnutrition when BMI alone is used. Patients with normal or high BMI may have significant muscle wasting that is not captured by weight-based metrics, yet they remain at risk for complications (8, 21). Third, the MUST score’s weighting of acute disease effect (no intake >5 days) may capture a different phenotype of malnutrition – one associated with acute illness and possibly shorter diabetes duration – while chronic, smouldering malnutrition with obesity may go undetected. Fourth, reverse causation cannot be excluded: patients with long-standing complications may receive more intensive dietary counselling and pharmacological management (e.g., GLP-1 agonists, SGLT2 inhibitors) that inadvertently improve nutritional risk scores while not reducing complication burden.

The association between insulin treatment and higher odds of complications (adjusted OR 2.24) is consistent with the natural history of diabetes:

insulin is typically initiated after oral agents fail, in patients with longer disease duration and more advanced β -cell dysfunction, both of which correlate with higher complication risk (22). However, insulin therapy itself may also influence nutritional status through weight gain or hypoglycaemia-related dietary changes (23). Fair glycaemic control (HbA1c 7-9%) was associated with higher complication odds compared with poor control (>9%). This counterintuitive finding may reflect survival bias: patients with very poor control may have shorter diabetes duration or may die before developing multiple complications, whereas those with fair control survive long enough to accumulate complications. Alternatively, the “J-curve” phenomenon in diabetes suggests that both very low and very high HbA1c levels can be associated with adverse outcomes, with a nadir in the 7-8% range for some complications (24). Our finding of a paradoxical relationship between HbA1c and malnutrition risk (Table 3) further supports the need for a nuanced interpretation of glycaemic targets in hospitalised patients.

Comparison with previous studies

Our prevalence of malnutrition risk (28.5%) is like the 27.7% reported by Chang et al. using the Nutritional Risk Screening 2002 (NRS-2002) among hospitalised diabetic patients (17). However, it is lower than the 58% prevalence reported in some Iraqi studies (11), possibly due to differences in screening tools, patient mix, or the absence of underweight patients in our sample. The “double burden” of obesity with hidden malnutrition has been documented in Middle Eastern populations (9, 10), and our findings add to this literature by demonstrating that low MUST risk does not equate to low complication risk.

Studies from global south settings, including a recent report in *Global South Health Horizons*, have similarly highlighted the need for culturally adapted nutritional screening tools in resource-limited environments (25). Our experience with MUST – a simple, rapid tool – supports its feasibility in such settings.

Strengths and limitations

Strengths include the use of a validated, internationally recognised screening tool (MUST); the collection of detailed clinical and laboratory data; adjustment for multiple confounders; and the focus on an understudied population (hospitalised diabetic patients in Iraq). Limitations are substantial and must be considered when interpreting the findings. First, the cross-sectional design precludes any causal inference regarding the direction of the association between malnutrition risk and

complications. Second, the sample size (200) was smaller than the calculated target (308), reducing statistical power and precision. The wide confidence intervals for the high-risk OR (0.14-1.08) reflect this limitation; the failure to reach statistical significance for the high-risk group ($p=0.071$) may be due to insufficient power rather than a true absence of effect. Third, convenience sampling (even with consecutive recruitment) may introduce selection bias; our sample may overrepresent patients with longer hospital stays or more severe disease. Fourth, the absence of underweight patients (BMI <18.5) limits generalisability to the broader diabetic population and may have affected the MUST score distribution. Fifth, we lacked data on key confounders such as specific medication types (metformin, GLP-1 agonists, SGLT2 inhibitors), socioeconomic status, food security, physical activity, and inflammatory markers (C-reactive protein, albumin). Sixth, laboratory parameters were not uniformly obtained at admission for all patients; HbA1c values from the preceding three months may not reflect acute illness status. Seventh, the single-centre design limits external validity to other hospitals in Iraq or elsewhere. Future directions should include multicentre prospective cohort studies with larger samples to confirm these paradoxical associations and to examine whether MUST-guided nutritional interventions improve clinical outcomes. Research should also explore the utility of adding muscle mass assessment (e.g., bioelectrical impedance or mid-upper arm circumference) to BMI-based screening in populations with high obesity prevalence. Finally, implementation science studies are needed to identify barriers and facilitators to routine MUST screening in resource-limited hospital settings.

Conclusion

Nearly three in ten hospitalised diabetic patients at Marjan Teaching Hospital are at medium or high risk of malnutrition as assessed by the MUST tool. Malnutrition risk is significantly associated with the presence of diabetes complications, but the relationship is complex and non-linear: patients with low malnutrition risk paradoxically have higher complication rates, poorer glycaemic control, and higher BMI. This finding underscores the limitations of BMI-based nutritional assessment and highlights the importance of screening tools that capture both undernutrition and sarcopenic obesity. Routine use of MUST should be implemented in hospital settings to enable early identification of nutritional risk, even in patients who appear overweight or obese. Targeted nutritional interventions, including protein supplementation and resistance

exercise where feasible, may improve outcomes in this high-risk population.

List of Abbreviations

ADA: American Diabetes Association
ANOVA: Analysis of variance
BAPEN: British Association for Parenteral and Enteral Nutrition
BMI: Body mass index
CI: Confidence interval
DFD: Diabetic foot disease
DRM: Disease-related malnutrition
GLP 1: Glucagon-like peptide 1
HbA1c: Glycated haemoglobin
MUST: Malnutrition Universal Screening Tool
NRS 2002: Nutritional Risk Screening 2002
OR: Odds ratio
SD: Standard deviation
SGLT2: Sodium glucose co-transporter 2
SPSS: Statistical Package for the Social Sciences
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Institutional Review Board of Marjan Teaching Hospital and the College of Medicine, University of Babylon (approval reference 233, dated 24 April 2025). The study complied with the Declaration of Helsinki. All participants provided written informed consent after receiving a detailed explanation of the study's purpose, procedures, risks, and benefits. Participants could withdraw at any time without affecting their medical care. Data were anonymised and stored securely, accessible only to the research team.

Consent for Publication

All authors have given their consent for the publication of this work under the Creative Commons Attribution Non-Commercial 4.0 license.

Data Availability

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Author Contributions

OAK worked on the conceptualisation, methodology, investigation, data curation, formal analysis, writing the original draft, writing the review & editing and project administration.

HSM worked on the conceptualisation, methodology, validation, writing the review & editing and supervision.

ADM worked on the conceptualisation, methodology, validation, writing the review & editing and supervision.

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