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Malnutrition and Their Association with Diabetes Complications Among Hospitalized Type 2 Diabetes Patients in Gaza Strip, Palestine

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Abstract

Background: Malnutrition is a health problem of huge magnitude among hospitalized patients. However, the role of malnutrition in the origin of diabetes complications is not understood well. This study was conducted to evaluate the association between malnutrition and diabetes complications among patients with type 2 diabetes mellitus in Gaza Strip, Palestine.

Methods: This cross sectional study was conducted among a representative sample of Palestinian type 2 diabetes patients (both genders, aged 30-80 years), patients receiving care at Al Shifa Medical Complex in Gaza Strip, Palestine. Patients' nutritional status was evaluated on the first day of admission using the nutritional risk screening tool (NRS 2002). Additional information regarding demographic-socioeconomic and medical history variables was obtained with an interview-based questionnaire.

Results: Based on the nutritional screening scores, 31.5% of the patients had malnutrition, (55.2% females, and 44.8% males). The prevalence of low risk, at risk, and high risk of malnutrition was 68.5%, 22.1%, and 9.4% respectively. After adjustment for confounding variables, patients with the low risk of malnutrition had a lower odds for (high blood pressure, eyes problems, kidney problems, heart problems, and extremities problems), (OR 0.063 CI 95% (.013-.305)), (OR 0.391 CI 95% (.225-.680)), (OR 0.431 CI 95% (.197-.942)), (OR 0.167 CI 95% (.050-.557)) and (OR 0.499 CI 95% (.281-.885)) respectively, (P value < 0.05 for all), compared with those in the high risk of malnutrition.

Conclusion: The low risk of malnutrition are associated with a lower prevalence of diabetes complications among type 2 diabetes patients.

Keywords: Diabetes complications; Malnutrition; Palestine; Prevalence; Type 2 Diabetes Mellitus

Abbreviations

NRS: Nutritional Risk Screening Tool; DM: Diabetes Mellitus; T2DM: Type 2 Diabetes Mellitus; BP: Blood Pressure; WC: Waist Circumference; BMI: Body Mass Index; FPG: Fasting Plasma Glucose; IPAQ: International Physical Activity Questionnaire; SD: Stander Deviation; OR: Odds Ratio; CI: Confidence Interval; MET: Metabolic Equivalent

Introduction

Malnutrition is a health problem of huge magnitude among hospitalized patients [1]. It is associated with many adverse clinical outcomes including prolonged hospitalization, infections, muscle wasting, and impaired wound healing, and increased morbidity and mortality [2,3]. In addition, malnutrition increases health care costs, reduces productivity and slows economic growth, which can perpetuate a cycle of poverty and ill health [4]. Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients [5]. The World Health Organization estimates that, 1.9 billion adults are overweight or obese, while 462 million are underweight [6]. It is estimated that, the prevalence rate of malnutrition in hospitalized patients varies from 20% to 60% [7,8]. Furthermore, the developmental, economic, social, and medical impacts of the global burden of malnutrition are serious and lasting, for individuals and their families, for communities and for countries [9]. Every country in the world is affected by one or more forms of malnutrition, and these mostly occur in low- and middle-income countries [10]. Combating malnutrition in all its forms is one of the greatest global health challenges [6].

On the other hand, the prevalence of diabetes mellitus (DM) is steadily increasing everywhere, most markedly in the world's low and middle-income countries [11]. DM is recognized as an important cause of premature death and disability [12]. Globally, more than 422 million adults were living with DM, and about 1.6 million death are directly attributed to DM each year [13]. Most of DM deaths (More than 80%) occur in low and middle-income countries [12]. In Palestine, the prevalence rate of DM was 10.5% in the West Bank and 11.8% in the Gaza Strip among the registered Palestinian refugees [14]. When DM is uncontrolled, it has dire consequences for health and well-being [14]. Moreover, DM and its complications impact harshly on the finances of individuals and their families and to health

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Table 1: Characteristics of the study population by sex.

Variables		T2DM (n=213)	Male (n=83)	Female (n=130)	P Value
		No. (%)	No. (%)	No. (%)	
Age (years)	Mean±SD	53.1±10.6	51.7±10.5	54.0±10.6	0.744
Marital status	Married	209.0 (98.1)	82.0 (39.2)	127.0 (60.8)	0.492
	Unmarried	4.0 (1.9)	1.0 (25.0)	3.0 (75.0)	
Educational level	Low education	104.0 (48.8)	31.0 (29.8)	73.0 (70.2)	0.005
	High education	109.0 (51.2)	52.0 (47.7)	57.0 (52.3)	
Family size	Less than five	67.0 (31.5)	29.0 (43.3)	38.0 (56.7)	0.234
	Five or more	146.0 (68.5)	54.0 (37.0)	92.0 (63.0)	
Employment status	Yes	40.0 (18.8)	22.0 (55.0)	18.0 (45.0)	0.017
	No	173.0 (81.2)	61.0 (35.3)	112.0 (64.7)	
Monthly income	≤ 2000 (NIS)	182.0 (85.4)	69.0 (37.9)	113.0 (62.1)	0.284
	> 2000 (NIS)	31.0 (14.6)	14.0 (45.2)	17.0 (54.8)	
History of smoking	Yes	24.0 (11.3)	24.0 (100.0)	0.0 (00.0)	0.001
	No	189.0 (88.7)	59.0 (31.2)	130.0 (68.8)	
History of alcohol intake	No	213.0 (100.0)	83.0 (39.0)	130.0 (61.0)	-
Diabetes duration (years)	Less than five	37.0 (17.4)	15.0 (40.5)	22.0 (59.5)	0.304
	Five to ten	83.0 (39.0)	37.0 (44.6)	46.0 (55.4)	
	More than ten	93.0 (43.7)	31.0 (33.3)	62.0 (66.7)	
Use diabetes medications	Yes	213.0 (100.0)	83.0 (39.0)	130.0 (61.0)	-
Type of diabetes medications used	Diabetes pills	82.0 (38.5)	42.0 (51.2)	40.0 (48.8)	0.012
	Insulin injections	114.0 (53.5)	37.0 (32.5)	77.0 (67.5)	
	Pills & injections	17.0 (8.0)	4.0 (23.5)	13.0 (76.5)	
Received diabetes care instructions	Yes	103.0 (48.4)	43.0 (41.7)	60.0 (58.3)	0.253
	No	110.0 (51.6)	40.0 (36.4)	70.0 (63.6)	
Number of meals per day	Less than 3 meals	59.0 (27.7)	20.0 (33.9)	39.0 (66.1)	0.793
	Three meals	104.0 (48.8)	42.0 (40.4)	62.0 (59.6)	
	More than 3 meals	50.0 (23.5)	21.0 (42.0)	29.0 (58.0)	
Have a meal plan for diabetes	Yes	99.0 (46.5)	37.0 (37.4)	62.0 (62.6)	0.381
	No	114.0 (53.5)	46.0 (40.4)	68.0 (59.6)	
Who describe diet regimen	Physician	70.0 (32.9)	28.0 (40.0)	42.0 (60.0)	0.641
	Self-reading	29.0 (13.6)	9.0 (31.0)	20.0 (69.0)	
	Do not fellow diet regimen	114.0 (53.5)	46.0 (40.4)	68.0 (59.6)	
Multivitamin supplement use	Yes	98.0 (46.0)	5.0 (5.1)	93.0 (94.9)	0.001
	No	115.0 (54.0)	78.0 (67.8)	37.0 (32.2)	
Body mass index (kg/m²)	Mean±SD	31.02±6.40	28.2±4.6	32.8±6.7	0.001
Waist circumference (cm)	Mean±SD	106.1±15.3	100.3±13.0	109.7±15.7	0.167
Fasting plasma glucose (mg/dl)	Mean±SD	166.1±29.6	163.1±24.8	168.0±32.3	0.068
Physical activity (Total MET)	Mean±SD	1145.6±1255.8	1438.1±1403	958.8±1117	0.170
Systolic blood pressure (mmHg)	Mean±SD	131.5±12.5	130.3±12.1	132.3±12.7	0.411
Diastolic blood pressure (mmHg)	Mean±SD	83.8±7.7	83.4±7.7	84.0±7.8	0.882

Data are expressed as means ± SD for continuous variables and as percentage for categorical variables. The differences between means were tested by using independent sample t test. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant. SD, stander deviation.

systems and national economies through direct medical costs and loss of work and wages [15]. Complications can arise as the disease progresses. Long term complications such as coronary heart disease which can lead to a heart attack, cerebrovascular disease which can

lead to stroke, retinopathy which can lead to blindness, nephropathy which can lead to kidney failure and the need for dialysis, and neuropathy which increases the chance of foot ulcers, infection and the eventual need for limb amputation may be attenuated by dietary interventions [14].

Although measurement of malnutrition varied depending on the hospital setting and method of nutritional assessment [16]. In the present study, the Nutritional Risk Screening tool (NRS 2002) was used on the first day of admission to evaluate the nutritional status of type 2 diabetes mellitus (T2DM) patients [17]. The NRS 2002, documented by a retrospective analysis of 128 randomized controlled trials of nutritional supports, is a reliable, easily applied and reproducible tool for identifying patients at nutritional risk [18]. It contains the nutritional components of malnutrition universal screening tool, and in addition, a grading of severity of disease as a reflection of increased nutritional requirements [19]. The NRS 2002 appears to have higher sensitivity and specificity for predicting complications than other nutritional assessment tools [17,19].

In conclusion, the etiology of DM complications is poorly understood [14]. In addition, malnutrition is highly prevalent in hospitalized patients, and is associated with many adverse clinical outcomes, including longer length of stay, increased morbidity and mortality, and increased hospital costs. Furthermore, in Palestine the prevalence of malnutrition in hospitalized patients is not well studied. However, few studies have explored the relationship between malnutrition and DM complications. Therefore, understanding the association between malnutrition with DM complications may be helpful in reducing DM related premature mortality and improve outcomes among T2DM patients. To our knowledge, this is the first study, which examined this association among T2DM patients in Gaza Strip, Palestine. Our study was conducted to evaluate the association between malnutrition and DM complications among hospitalized patients with T2DM.

Methods and Materials

Study population

This cross sectional study was conducted in the years 2019 among a representative sample of Palestinian T2DM patients, selected by a cluster random sampling method. A total of 213 hospitalized patients, aged 30 to 80 years receiving care in medical and surgical departments at Al Shifa Medical Complex in Gaza Strip, Palestine, were included in the study. The total number of medical and surgical departments at Al Shifa Medical Complex is eleven, with 224 beds [20]. The medical and surgical beds were distributed in each department as follows (twenty-four, eighteen, ten, twenty-two, nineteen, twenty-two, twenty-five, twenty-one, twenty-seven, eighteen and eighteen beds respectively). The study sample was distributed according to the number of beds in each department as follows (23, 17, 9, 21, 18, 21, 24, 20, 26, 17 and 17 patients respectively). Pregnant, lactating women and patients with other types of serious illness such as cancer, thyroid diseases, acute myocardial infarction, or end-stage kidney disease were excluded from the study.

The study protocol was approved by the Ethics Committee of Al Azhar University of Gaza and by the Palestinian Health Research Council (Helsinki Ethical Committee). Moreover, written informed consent was also obtained from each participant.

Assessment of nutritional status

The NRS 2002 was used on the first day of admission to evaluate the nutritional status of T2DM patients [17]. The NRS 2002, documented by a retrospective analysis of 128 randomized controlled trials of nutritional supports, is a reliable, easily applied and reproducible tool for identifying patients at nutritional risk [18]. The purpose of the NRS-2002 tool is to detect the presence of undernutrition and the risk of developing undernutrition in the hospital setting [17]. It contains the nutritional components of malnutrition universal screening tool, and in addition, a grading of severity of disease as a reflection of increased nutritional requirements [19]. The NRS 2002 appears to have higher sensitivity and specificity for predicting complications than other nutritional assessment tools [19]. It includes four questions as a pre-screening for departments with few at risk patients [17]. Furthermore, according to the NRS 2002, nutritional risk is evaluated by three components: Nutritional status, severity of disease and patient age. It contains a total of 7 points. Impaired nutritional status is scored from 0 - 3 according to changes of BMI, weight loss and food intake. Severity of disease is scored 0 - 3 according to different kinds of disease. If age ≥ 70 years: add 1 to the total score [18]. In the present study, patients are classified as being at nutritional risk (score 4), high risk (score 5 to 7), or not (score 3 or less) according to the total score obtained [17].

Assessment of anthropometric measurements and blood pressure (BP): Height, weight, and waist circumference (WC) were measured in all patients using standard methods [21]. Then, the standard formula, weight (kg) divided by height (m^2), was used to calculate body mass index (BMI) [22]. In addition, BP was measured from the left arm (mmHg) by mercury sphygmomanometer. Three readings on different days, while the patient was seated after relaxing for at least fifteen minutes in a quiet environment, empty bladder. The average of three measurements was recorded [23].

Biochemical analysis: After 12 hours fasting, venous blood samples (4.0 ml), were collected from all patients by well-trained and experienced nurses and was used for blood chemistry analysis. Serum was separated immediately, and the extracted serum was investigated for fasting plasma glucose (FPG) mg/dl. Mindray BS-300 chemistry analyzer instrument was used for blood chemistry analysis [24].

Assessment of other variables: Additional information regarding demographic socioeconomic, DM complications and medical history variables was obtained with an interview-based questionnaire. Diagnosis and classification of DM complications was defined according to Palestinian guidelines for diagnosis and management of DM criteria [25]. Past history of DM complications and any previous treatment for these complications was recorded by doctors on the patients files. In the present study, reports and all relevant documentation, including medical records were checked. Additionally, data on physical activity were obtained using the International Physical Activity Questionnaire (IPAQ short version) [26]. Pilot study was carried out on thirty patients to enable the researcher to examine the tools of the study. The questionnaire and data collection process were modified according to the result of the pilot study. The data was collected by six qualified data collectors who were given a full explanation and training by the researcher about

Table 2: The nutritional screening scores for the study population by sex.

Variables		T2DM (n=213) No. (%)	Male (n=83) No. (%)	Female (n=130) No. (%)	P Value
Initial Screening: If "Yes" to any, proceed to final screening					
BMI < 20.5 kg/m²	Yes	38.0 (17.8)	22.0 (57.9)	16.0 (42.1)	0.008
	No	175.0 (82.2)	61.0 (34.9)	114.0 (65.1)	
Weight loss within 3 months	Yes	56.0 (26.3)	23.0 (41.1)	33.0 (58.9)	0.412
	No	157.0 (73.7)	60.0 (38.2)	97.0 (61.8)	
Reduced dietary intake in the last week	Yes	119.0 (55.9)	44.0 (37.0)	75.0 (63.0)	0.298
	No	94.0 (44.1)	39.0 (41.5)	55.0 (58.5)	
ICU patient	Yes	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
	No	213.0 (100.0)	83.0 (39.0)	130.0 (61.0)	
Final Screening: addition of the selected points					
Nutritional impairment:					
None	0 points	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.225
Mild: weight loss > 5% in 3 months or food intake < 50 - 75% of normal requirement in the preceding week	1 point	148.0 (69.5)	53.0 (35.8)	95.0 (64.2)	
Moderate: weight loss > 5% in 2 months or BMI 18.5 - 20.5 plus impaired general condition or food intake 25 - 60% of normal requirement in preceding week	2 points	45.0 (21.1)	19.0 (42.2)	26.0 (57.8)	
Severe: weight loss > 5% in 1 month (> 15% in 3 months) or BMI < 18.5 plus impaired general condition or food intake 0 - 25% of normal requirement in preceding week	3 points	20.0 (9.4)	11.0 (55.0)	9.0 (45.0)	
Severity of disease:					
Normal nutritional requirement	0 points	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.017
Hip fracture, chronic illness (may have acute complications, e.g. cirrhosis or COPD), chronic dialysis, diabetes, cancer	1 point	113.0 (53.1)	36.0 (31.9)	77.0 (68.1)	
Major abdominal surgery, stroke, severe pneumonia, hematologic malignancy	2 points	100.0 (46.9)	47.0 (47.0)	53.0 (53.0)	
Head injury, bone marrow transplant, ICU patient with APACHE >10	3 points	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	
Age:					
< 70 years	0 points	203.0 (95.3)	82.0 (40.4)	121.0 (59.6)	0.049
≥ 70 years	1 point	10.0 (4.7)	1.0 (10.0)	9.0 (90.0)	
Nutritional screening scores: interpretation					
0-3	Low risk	146.0 (68.5)	53.0 (36.3)	93.0 (63.7)	0.267
4	At risk	47.0 (22.1)	19.0 (40.4)	28.0 (59.6)	
5-7	High risk	20.0 (9.4)	11.0 (55.0)	9.0 (45.0)	

Data are expressed as percentage for categorical variables. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant.

the study.

Statistical analysis

All statistical analysis was performed using SPSS version 20. Data are expressed as means ± stander deviation (SD) for continuous variables and as percentage for categorical variables. The chi-square test was used to determine the significant differences between different categorical variable. The differences between mean were tested by independent samples t-test and one-way ANOVA. Finally, the odds ratio (OR) and confidence interval (CI) for the DM complications across categories of nutritional screening scores were tested by binary logistic regression. P value less than 0.05 was considered as statistically significant.

Results

Baseline characteristics of the study population by sex

A total of 213 hospitalized patients with T2DM, aged 30 to 80 years old (61.0% females, 39.0% males) were included in the present study. Table 1 show the characteristics of the study population by sex. The findings of this study demonstrated that the mean age (years) for male patients was 51.7±10.5 vs. 54.0±10.6 for females. In addition, for the following variables (educational level, employment status, history of smoking, type of DM medications used, multivitamin supplement use, and BMI (kg/m²)), the difference was statistically significant in both sexes (P value < 0.05 for all).

The nutritional screening scores for the study population by sex

As shown in Table 2**,** based on the nutritional screening scores, 31.5% of T2DM patients had malnutrition (55.2% females, and 44.8% males). The prevalence of low risk, at risk, and high risk of malnutrition among T2DM patients was 68.5%, 22.1%, and 9.4% respectively. No statistically significant associations was found between the different categories of nutritional screening scores in

Table 3: Distribution of diabetes complications for the study population by sex.

Variables		T2DM (n=213) No. (%)	Male (n=83) No. (%)	Female (n=130) No. (%)	P Value
High BP (≥130/85 mmHg) or treatment of previously diagnosed hypertension	Yes	158.0 (74.2)	53.0 (33.6)	105.0 (66.4)	0.005
	No	55.0 (25.8)	30.0 (54.5)	25.0 (45.5)	
Eyes problems	Yes	133.0 (62.4)	41.0 (30.8)	92.0 (69.2)	0.001
	No	80.0 (37.6)	42.0 (52.5)	38.0 (47.5)	
Kidney problems	Yes	26.0 (12.2)	6.0 (23.1)	20.0 (76.9)	0.057
	No	187.0 (87.8)	77.0 (41.2)	110.0 (58.8)	
Heart problems	Yes	15.0 (7.0)	3.0 (20.0)	12.0 (80.0)	0.096
	No	198.0 (93.0)	80.0 (40.4)	118.0 (59.6)	
Extremities problems	Yes	58.0 (27.2)	24.0 (41.4)	34.0 (58.6)	0.387
	No	155.0 (72.8)	59.0 (38.1)	96.0 (61.9)	
Neurological problems	Yes	205.0 (96.2)	80.0 (39.0)	125.0 (61.0)	0.619
	No	8.0 (3.8)	3.0 (37.5)	5.0 (62.5)	

Data are expressed as percentage for categorical variables. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant.

both sexes (P value = 0.267).

Distribution of diabetes complications for the study population by sex

On the other hand, Table 3 shows that 74.2% of the patients had high BP (≥130/85 mmHg) or treatment of previously diagnosed hypertension, 62.4% of the patients had eyes problems, 12.2% had kidney problems, 7.0% had heart problems, 27.2% had extremities problems, and 96.2% of the patients had neurological problems. Moreover, for the following variables (high BP or treatment of previously diagnosed hypertension, and eyes problems), the difference was statistically significant in both sexes (P value < 0.05).

Characteristics of the study population in relation to the categories of nutritional screening scores

Then, the characteristics of the study population in relation to different categories of nutritional screening scores are shown in Table 4. Our results revealed that, the mean age (years) for patients with low risk of malnutrition was 43.5±11.0 vs. 55.0±9.4 for patients with high risk. In addition, for the following factors (age, educational level, employment status, monthly income, DM duration, received DM care instructions, BMI, WC, FPG, and physical activity (Total MET)), the difference was statistically significant across different categories of nutritional screening scores (P value < 0.05 for all).

OR and CI for the diabetes complications across categories of nutritional screening scores

Finally, we computed the OR and CI for the DM complications across different categories of nutritional screening scores (Table 5). Our results revealed that, after adjustment for confounding variables, patients with the low risk of malnutrition had a lower odds for (high blood pressure, eyes problems, kidney problems, heart problems, and extremities problems), (OR 0.063 CI 95% (.013-.305)), (OR 0.391 CI 95% (.225-.680)), (OR 0.431 CI 95% (.197-.942)), (OR 0.167 CI 95% (.050-.557)) and (OR 0.499 CI 95% (.281-.885)) respectively, (P value < 0.05 for all), compared with those in the high risk of malnutrition. No statistically significant association was found between the low risks of malnutrition with the neurological problems.

Discussion

Malnutrition is a health problem of huge magnitude among hospitalized patients [1]. It is associated with many adverse clinical outcomes including prolonged hospitalization, infections, muscle wasting, and impaired wound healing, and increased morbidity and mortality [2,3]. However, DM and its complications impact harshly on the finances of individuals and their families and to health systems and national economies through direct medical costs and loss of work and wages [15]. In addition, research consistently demonstrates that malnutrition is a hidden cause of poor health outcomes, rising health care costs, increased utilization of resources, increased length of hospital stay, increased re-admission rates, and contributes to higher morbidity and mortality [10]. To the best of our knowledge, this is the first study, which describes the malnutrition among T2DM patients and its association with DM complications in Gaza Strip, Palestine. The findings of the present study revealed that, based on the nutritional screening scores, 31.5% of hospitalized T2DM patients had malnutrition, (55.2% females, and 44.8% males). The prevalence of low risk, at risk, and high risk of malnutrition was 68.5%, 22.1%, and 9.4% respectively. Many of the previous studies demonstrated that, at least one third of hospitalized patients in developed countries are malnourished on admission to the hospital, and if left untreated, approximately two thirds of those patients will experience a further decline in their nutrition status during their hospitalization [7,8]. Lovesley et al. show that, malnutrition is serious but under-diagnosed problem among hospitalized patients as approximately one-third patients may become malnourished during their stay [27]. In addition, according to previous studies, the prevalence rate of malnutrition in hospitalized patients varies from 20% to 60% [7,8]. The results of our study support these findings.

Furthermore, measurement of malnutrition varied depending on the hospital setting and method of nutritional assessment [16]. In the present study, the NRS 2002 tool was used to evaluate the nutritional

Table 4: Characteristics of the study population in relation to the categories of nutritional screening scores.

Variables		T2DM (n=213)			P Value
		Low risk	At risk	High risk	
		No. (%)	No. (%)	No. (%)	
Age (years)	Mean±SD	43.5±11.0	51.0±11.4	55.0±9.4	0.001
Marital status	Married	144.0 (68.9)	46.0 (22.0)	19.0 (9.1)	0528
	Unmarried	2.0 (50.0)	1.0 (25.0)	1.0 (25.0)	
Educational level	Low education	82.0 (78.8)	17.0 (16.3)	5.0 (4.8)	0.005
	High education	64.0 (58.7)	30.0 (27.5)	15.0 (13.8)	
Family size	Less than five	43.0 (64.2)	14.0 (20.9)	10.0 (14.9)	0.172
	Five or more	103.0 (70.5)	33.0 (22.6)	10.0 (6.8)	
Employment status	Yes	22.0 (55.0)	10.0 (25.0)	8.0 (20.0)	0.025
	No	124.0 (71.7)	37.0 (21.4)	12.0 (6.9)	
Monthly income	≤ 2000 (NIS)	131.0 (72.0)	36.0 (19.8)	15.0 (8.2)	0.032
	> 2000 (NIS)	15.0 (48.4)	11.0 (35.5)	5.0 (16.1)	
History of smoking	Yes	16.0 (66.7)	3.0 (12.5)	5.0 (20.8)	0.086
	No	130.0 (68.8)	44.0 (23.3)	15.0 (7.9)	
Diabetes duration (years)	Less than five	17.0 (45.9)	11.0 (29.7)	9.0 (24.3)	0.003
	Five to ten	58.0 (69.9)	18.0 (21.7)	7.0 (8.4)	
	More than ten	71.0 (76.3)	18.0 (19.4)	4.0 (4.3)	
Use diabetes medications	Yes	146.0 (68.5)	47.0 (22.1)	20.0 (9.4)	-
Type of diabetes medications used	Diabetes pills	54.0 (65.9)	17.0 (20.7)	11.0 (13.4)	0.419
	Insulin injections	80.0 (70.2)	25.0 (21.9)	9.0 (7.9)	
	Pills & injections	12.0 (70.6)	5.0 (29.4)	0.0 (0.0)	
Received diabetes care instructions	Yes	60.0 (58.3)	24.0 (23.3)	19.0 (18.4)	0.001
	No	86.0 (78.2)	23.0 (20.9)	1.0 (0.9)	
Number of meals per day	Less than 3 meals	38.0 (64.4)	16.0 (27.1)	5.0 (8.5)	0.653
	Three meals	76.0 (73.1)	20.0 (19.2)	8.0 (7.7)	
	More than 3 meals	32.0 (64.0)	11.0 (22.0)	7.0 (14.0)	
Have a meal plan for diabetes	Yes	65.0 (65.7)	23.0 (23.2)	11.0 (11.1)	0.630
	No	81.0 (71.1)	24.0 (21.1)	9.0 (7.9)	
Who describe diet regimen	Physician	47.0 (67.1)	16.0 (22.9)	7.0 (10.0)	0.856
	Self-reading	18.0 (62.1)	7.0 (24.1)	4.0 (13.8)	
	Do not fellow diet regimen	81.0 (71.1)	24.0 (21.1)	9.0 (7.9)	
Multivitamin supplement use	Yes	73.0 (74.5)	20.0 (20.4)	5.0 (5.1)	0.095
	No	73.0 (63.5)	27.0 (23.5)	15.0 (13.0)	
Body mass index (kg/m²)	Mean±SD	32.3±5.0	30.2±8.5	22.8±0.85	0.001
Waist circumference (cm)	Mean±SD	109.4±12.2	104.2±19.3	86.1±9.1	0.001
Fasting plasma glucose (mg/dl)	Mean±SD	156.3±30.1	167.9±27.1	169.0±29.4	0.037
Physical activity (Total MET)	Mean±SD	2410.2±1215	1366.4±1277	901.30±1139	0.001
Systolic blood pressure (mmHg)	Mean±SD	132.5±12.2	129.3±13.5	130.0±11.6	0.268
Diastolic blood pressure (mmHg)	Mean±SD	84.1±7.8	82.5±7.9	84.0±6.8	0.459

Data are expressed as means ± SD for continuous variables and as percentage for categorical variables. The differences between means were tested by using one-way ANOVA. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant. SD, stander deviation.

status of hospitalized T2DM patients. The NRS 2002 documented by a retrospective analysis of 128 randomized controlled trials of nutritional supports, is a reliable, easily applied and reproducible tool for identifying patients at nutritional risk [18]. It contains the nutritional components of malnutrition universal screening tool, and in addition, a grading of severity of disease as a reflection of increased

Table 5: Odd ratio and confidence interval for the diabetes complications across categories of nutritional screening scores.

Low risk	At risk	High risk	P value	OR (95% CI)
High BP (≥130/85 mmHg) or treatment of previously diagnosed HTN (74.2%)				
79.7	19.0	1.3	0.058	0.190 (.034-1.058)
Adjusted*			0.001	0.063 (.013-.305)
Eyes problems (62.4%)				
73.7	18.8	7.5	0.139	0.841 (.668-1.058)
Adjusted*			0.001	0.391 (.225-.680)
Kidney problems (12.2%)				
80.8	11.5	7.7	0.231	0.834 (.619-1.123)
Adjusted*			0.035	0.431 (.197-.942)
Heart problems (7.0%)				
86.7	13.3	0.0	0.361	0.641 (.247-1.663)
Adjusted*			0.004	0.167 (.050-.557)
Extremities problems (27.2%)				
79.3	20.7	0.0	0.130	0.833 (.657-1.055)
Adjusted*			0.017	0.499 (.281-.885)
Neurological problems (96.2%)				
70.2	21.5	8.3	0.145	0.290 (.055-1.534)
Adjusted*			0.295	0.422 (.084-2.119)

The OR and CI for the diabetes complications across categories of nutritional screening scores were tested by binary logistic regression. *Adjusted for age (years), educational level, employment status, monthly income, diabetes duration (years), received diabetes care instructions, body mass index (kg/m²), waist circumference (cm), fasting plasma glucose (mg/dl), and physical activity (total met). P value less than 0.05 was considered as statistically significant. OR, odds ratio; CI, confidence interval.

nutritional requirements [19]. Moreover, the NRS 2002 appears to have higher sensitivity and specificity for predicting complications than other nutritional assessment tools [17,19]. Hospitalized patients, regardless of their BMI, usually suffer from undernutrition because of reduced nutrient intake due to illness-induced poor appetite, gastrointestinal symptoms, reduced ability to chew or swallow, or nil by mouth for diagnostic and therapeutic procedures. In addition, they may have increased energy, protein, and essential micronutrient needs because of inflammation, infection, or other catabolic conditions [27]. In our study, the high prevalence of malnutrition may be related in part to the burden of living with DM and its complications which may plays an important role in the etiology of malnutrition [14]. Malnutrition predisposes patients to disease, delays recovery from illness, and adversely affects body function, wellbeing and clinical outcome [2,3]. Moreover, people with DM are already at risk of poor healing and poor health outcomes because of the complications of the disease [28].

On the other hand, the main findings of this study indicate that, after adjustment for confounding variables, patients with the low risk of malnutrition had a lower odds for (high blood pressure, eyes problems, kidney problems, heart problems, and extremities problems), compared with those in the high risk of malnutrition. In fact, very few studies have explored the relationship between malnutrition and DM complications in patients with T2DM, which made the comparison of our results with previous studies difficult. Most studies have examined the associations between malnutrition and one of DM complications [29-31]. Laghari et al. in a cross sectional study show that, there was a close relationship between malnutrition, and risk of hypertension, and myocardial infarction in patients with T2DM [29]. Daien et al. show that, malnutrition was identified as an additional factor associated with retinopathy [30]. In addition, Saxena et al. show that, medical nutritional management is important for the prevention of malnutrition, which associated with diabetes nephropathy [31]. Furthermore, Little et al. show that, nutrition assessment and intervention can help patients with diabetic foot ulcers and maximize their nutritional status to promote wound healing [32]. The results of our study support these findings.

Additionally, the findings of our study revealed that, 74.2% of the patients had high BP (≥130/85 mmHg) or treatment of previously diagnosed hypertension, 62.4% of the patients had eyes problems, 12.2% had kidney problems, 7.0% had heart problems, 27.2% had extremities problems and 96.2% of the patients had neurological problems.

Diabetic patients have an increased risk of developing complications such as coronary heart disease, heart attack, cerebrovascular disease and stroke. However, complications such as retinopathy, nephropathy, and neuropathy can have a distressing impact on patient's quality of life and a significant increase in financial burden [14]. The prevalence reported from studies conducted worldwide on DM complications showed varying rates. According to previous studies, the prevalence of retinopathy was 17-50%, nephropathy 17-28%, cardiovascular complications 10-22.5%, neuropathy 19-42%, and foot problems 5-23% [33,34]. In Palestine, El Bilbeisi et al. show that, 64.25% of T2DM patients had high BP (≥130/85 mmHg) or treatment of previously diagnosed hypertension, 57.8% of the patients had eyes problems, 10.8% had kidney problems, 7.25% had heart problems, 22.0% had extremities problems and 92.1% of the patients had neurological problems [14]. The results of our study support these findings. In the present study, increasing DM duration, and patients' age could contribute to these results. Furthermore, our study not adjusted for other confounding variables such as genetics factors, and different diagnostic methods and criteria used, which could contribute to these results. Actually, the relationship between malnutrition with DM complications need more studies in the future.

The main limitations of this study is its cross sectional design; the causal relationship could not be determined, and it limits the generalizability of our results. The main strength of our study was its being the first study, which describes the malnutrition among T2DM patients and its association with DM complications in Gaza Strip, Palestine.

Finally, we conclude that the low risk of malnutrition are associated with a lower prevalence of DM complications among T2DM patients. Further future multi-center studies are required to confirm these findings.

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