



Demographic and Clinical Determinants of Hypertension, Renal, Visual, and Foot Complications in Type 1 versus Type 2 Diabetic Patients

Determinantes demográficos y clínicos de la hipertensión, complicaciones renales, visuales y del pie en pacientes con diabetes tipo 1 frente a pacientes tipo 2

Fuad Farajalla¹  

¹ Nursing Department, Palestine Polytechnic University. Hebron, Palestine

Submitted: 10-08-2026 | Revised: 12-09-2026 | Accepted: 06-10-2026 | Published: 07-10-2026

Corresponding Author: Fuad Farajalla 

ABSTRACT

Background: Comparative data on diabetes complications between Type 1 (T1DM) and Type 2 (T2DM) diabetes in conflict-affected, resource-limited settings are scarce. **Aim:** To compare demographic/clinical characteristics, assess complication prevalence, and identify predictors of hypertension, poor vision, renal failure, and diabetic foot in T1DM versus T2DM patients in Palestine. **Methods:** Cross-sectional study of 325 patients (91 T1DM, 234 T2DM) from diabetes clinics in Hebron and Bethlehem. Data collected via structured questionnaire. **Analyses** included Mann-Whitney U, Chi-square, and binary logistic regression. **Results:** T2DM patients were older (Mean Rank: 184.71 vs. 107.16), had higher BMI (177.49 vs. 125.73), weight (174.66 vs. 133.01), and longer disease duration (all $p < 0.001$). Poor glycemic control affected 53.8% (T1DM) and 54.7% (T2DM) ($p = 0.890$). Complications occurred in 64.8% (T1DM) and 74.8% (T2DM) ($p = 0.073$). Diabetes duration predicted hypertension and poor vision in both types. In T1DM, younger age ($OR = 0.951$) and smoking ($OR = 7.806$) predicted hypertension; smoking predicted renal failure ($OR = 4.138$). In T2DM, longer duration ($OR = 0.434$) and smoking ($OR = 2.209$) predicted renal failure; better HbA1c was protective ($OR = 1.494$). Physical inactivity predicted diabetic foot in both types. **Conclusion:** Palestinian adults with diabetes face substantial complication burdens with type-specific predictors. Interventions should prioritize smoking cessation in T1DM, glycemic control in T2DM, and physical activity promotion across all patients, while addressing structural barriers in conflict settings.

Keywords: diabetes mellitus, hypertension, renal failure, retinopathy, diabetic foot, Palestine.

RESUMEN

Antecedentes: Los datos comparativos sobre las complicaciones de la diabetes entre diabetes tipo 1 (DM1) y tipo 2 (DM2) en entornos afectados por conflictos y recursos limitados son escasos. **Objetivo:** Comparar características demográficas/clínicas, evaluar la prevalencia de complicaciones e identificar predictores de hipertensión, mala visión, insuficiencia renal y pie diabético en pacientes con DM1 frente a pacientes con DM2 en Palestina. **Métodos:** Estudio transversal de 325 pacientes (91 DM1, 234 DM2) en clínicas de diabetes en Hebrón y Belén. Datos recogidos mediante cuestionario estructurado. Los análisis incluyeron U-Mann-Whitney, Chi cuadrado y regresión logística binaria. **Resultados:** Los pacientes con diabetes tipo 2 eran mayores (rango medio: 184,71 frente a 107,16), tenían un IMC más alto (177,49 frente a 125,73), peso (174,66 frente a 133,01) y mayor duración de la enfermedad (todos $p < 0,001$). El mal control glucémico afectó al 53,8% (DM1) y al 54,7% (DM2) ($p = 0,890$). Las complicaciones ocurrieron en el 64,8% (DM1) y el 74,8% (DM2) ($p = 0,073$). La duración de la diabetes predijo hipertensión y mala visión en ambos tipos. En la DM1, la edad más joven ($OR = 0,951$) y el tabaquismo ($OR = 7,806$) predijeron hipertensión; el tabaquismo predijo insuficiencia renal ($OR = 4,138$). En la diabetes tipo 2, una mayor duración ($OR = 0,434$) y el tabaquismo ($OR = 2,209$) predijeron insuficiencia renal; una mejor HbA1c fue protectora ($OR = 1,494$). La inactividad física predijo el pie diabético en ambos tipos. **Conclusión:** Los adultos palestinos con diabetes enfrentan cargas sustanciales de complicaciones con predictores específicos de cada tipo. Las intervenciones deben priorizar la cesación del tabaquismo en la diabetes tipo 1, el control glucémico en la diabetes tipo 2 y la promoción de la actividad física en todos los pacientes, al tiempo que abordan las barreras estructurales en entornos de conflicto.

Palabras clave: diabetes mellitus, hipertensión, insuficiencia renal, retinopatía, pie diabético, Palestina.

INTRODUCTION

Diabetes mellitus (DM) represents one of the most significant global health challenges of the 21st century, currently affecting approximately 463 million adults worldwide, with projections indicating this figure will reach 700 million by 2045[1]. Both Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM) contribute substantially to global morbidity and mortality, primarily through their devastating complications including cardiovascular disease, nephropathy, retinopathy, neuropathy, and lower extremity amputations[2, 3]. The daily management of diabetes requires meticulous attention to medication adherence, blood glucose monitoring, dietary regulation, and physical activity, placing considerable burden on patients and profoundly affecting their quality of life[4, 5].

The Palestinian context presents uniquely challenging circumstances for diabetes management and outcomes. The ongoing conflict, military occupation, restricted movement due to checkpoints and the separation barrier, fragmented healthcare services, chronic medication shortages, and severe economic hardship compound the difficulties faced by individuals living with diabetes[6, 7, 8]. The prevalence of diabetes in Palestine continues to rise, currently affecting approximately 9.2% of adults, with studies documenting mean HbA1c levels ranging from 8.0% to 9.5%, indicating persistently suboptimal glycemic control across the population [9, 10]. The psychological burden of living with chronic illness in a conflict setting further exacerbates health outcomes, as emerging adults in the West Bank experiencing prolonged conflict report significant depression, anxiety, and war-related stress that may indirectly affect diabetes self-management and complication risk [11].

Diabetes-related complications represent the primary drivers of morbidity, mortality, and healthcare costs among diabetic populations. Hypertension, renal failure, visual impairment, and diabetic foot complications are among the most common and debilitating consequences of chronic hyperglycemia[12, 13]. The development and progression of these complications are influenced by a complex interplay of demographic, clinical, and behavioral factors, including age, gender, socioeconomic status, disease duration, glycemic control, smoking status, and physical activity levels[14, 15].

International evidence has consistently demonstrated that patients with T2DM are typically older, have higher body mass index, and present with different complication profiles compared to those with T1DM[3, 12]. Studies from Saudi Arabia have documented complication rates of 39.2% among T2DM patients, with diabetic foot and nephropathy being the most common[12]. In the broader Middle East region, systematic reviews have shown that diabetes self-management education programs improve glycemic control and self-management behaviors, yet highlighted heterogeneity in program outcomes across countries including Iran, Turkey, the UAE, Jordan, and Qatar[27]. Research from Jordan has reported high complication rates for both T1DM and T2DM, with healthcare system inequities affecting patient outcomes[16, 17]. However, comparative data between T1DM and T2DM patients in resource-limited, conflict-affected settings such as Palestine remain scarce, particularly regarding the specific determinants of major diabetes complications.

Previous Palestinian studies have revealed that female gender, lower income, and exposure to violence or chronic stressors are significant predictors of poor health outcomes[18]. Research specifically examining quality of life among Palestinian diabetes patients has identified socioeconomic deprivation and complications as primary risk factors for diminished well-being[19, 20]. Studies conducted in the West Bank have documented that approximately 34.4% of persons with diabetes encounter at least one microvascular complication, with 67.2% experiencing microvascular complications and 28.6% experiencing macrovascular complications[32, 33]. Diabetes-related complications were more common in T2DM patients (76.1%) compared to T1DM patients (65.5%), with poor vision and hypertension being the most frequent complications[20]. The mental health status of individuals in conflict settings, characterized by elevated depression, anxiety, and war-related stress, may further complicate diabetes management and contribute to poorer clinical outcomes[11]. Healthcare workers in Palestine face significant occupational stressors, including military checkpoint exposure and violence, which affect their capacity to deliver optimal care[7]. Additionally, barriers to effective emergency care, such as unfamiliarity with equipment and lack of teamwork, have been documented in Palestinian hospitals, reflecting broader systemic challenges that may also impact chronic disease management [34]. However, no prior study has systematically compared the demographic and clinical determinants of major diabetes complications between T1DM and T2DM patients in the Palestinian context, limiting evidence-based interventions and efficient resource allocation.

Understanding the differential patterns of complications and their predictors across diabetes types is essential for developing targeted prevention strategies, optimizing clinical management, and allocating limited healthcare resources effectively. Therefore, this study aimed to: (1) compare

demographic and clinical characteristics between T1DM and T2DM patients in the southern West Bank, Palestine; (2) assess the prevalence of hypertension, poor vision, renal failure, and diabetic foot complications in both groups; and (3) identify significant independent predictors of each complication stratified by diabetes type. By addressing these gaps, this research seeks to provide actionable evidence for improving diabetes care and outcomes in Palestine.

METHODS

Study Design and Setting

This cross-sectional comparative study was conducted in southern West Bank, Palestine. This design is commonly used in public health as a reliable method for examining behaviors and associations within populations[35].

Population and Sampling

The study population consisted of adult patients diagnosed with T1DM or T2DM who attended diabetes outpatient clinics or primary healthcare centers in the Hebron and Bethlehem governorates. The study included adult patients (≥ 18 years) with confirmed T1DM or T2DM attending selected clinics. Sample size was calculated using Raosoft (95% confidence level, 5% margin of error, 50% response distribution), yielding a minimum of 384 participants. Due to the observed distribution in clinical settings, the final sample comprised 91 T1DM and 234 T2DM patients recruited through convenience sampling. The observed imbalance between T1DM and T2DM participants reflects the underlying distribution of diabetes types in routine clinical settings.

Instrumentation

Data were collected using a structured, paper-based, self-administered questionnaire consisting of two sections: (1) demographic and health-related characteristics and (2) clinical characteristics and complications assessment. The first section included demographic variables (age, gender, marital status, educational level, monthly income, place of residence, and smoking status) and clinical variables (type of diabetes, duration of diabetes, self-reported most recent HbA1c level, presence of diabetes-related complications, and physical activity frequency).

Diabetes-related complications were defined as the presence of at least one physician-diagnosed condition, including hypertension, poor vision, renal failure, or diabetic foot, as reported by the participant. Each complication was recorded as a dichotomous variable (yes/no). Physical activity was assessed based on self-reported frequency and categorized into four levels: regularly (engaging in planned physical activity ≥ 3 times per week), sometimes (1-2 times per week), rarely (< 1 time per week), and never (no regular physical activity). For glycemic control assessment, HbA1c levels were categorized as good control (Level 1) or poor control (Level 2) based on standard clinical guidelines.

The questionnaire was developed based on validated instruments used in previous Palestinian studies[19, 20]. Content validity was established through expert review by a panel of healthcare professionals and researchers with expertise in diabetes care and public health. A pilot test was performed on 30 patients not included in the final sample to evaluate the clarity, comprehensibility, and completion time of the questionnaire. The questionnaire was determined to be clear and took 15-20 minutes to complete; therefore, no modifications were required.

Data Collection Process

Following ethics approval and institutional permissions, data were collected from January to February 2026. Researchers recruited eligible patients during routine clinic visits. After providing written informed consent, participants completed a self-administered paper questionnaire in a private clinic area, taking 15–20 minutes. Team members remained available for clarification without influencing responses. Completed questionnaires were checked for completeness, securely stored, and entered into SPSS v28 for analysis.

Statistical Analysis

Data were analyzed using SPSS v28. Descriptive statistics (means, SDs, frequencies, percentages) summarized participant characteristics. Normality was assessed using Shapiro-Wilk test. Group comparisons used Mann-Whitney U test for non-normally distributed continuous variables and Pearson Chi-square for categorical variables.

Binary logistic regression identified predictors of hypertension, poor vision, renal failure, and diabetic foot, stratified by diabetes type. Variables were coded 1=Yes, 2=No; thus, negative B coefficients and OR<1 indicate risk factors, while positive coefficients and OR>1 indicate protective factors. All variables were entered simultaneously (enter method). Model fit was assessed using Hosmer-Lemeshow test and Nagelkerke R². Multicollinearity was checked via tolerance and VIF. Significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Nursing College, Palestine Polytechnic University, and the study complied with the Declaration of Helsinki. Participants received complete information about the study's purpose, procedures, risks, and benefits prior to providing written informed consent. Participation was voluntary, with the right to withdraw at any time without penalty. Anonymity was ensured through numerical coding, and all data were stored in password-protected files accessible only to the research team.

RESULTS

Demographic Characteristics

A total of 325 participants were included in the study, comprising 91 patients with T1DM and 234 patients with T2DM. Table 1 presents the demographic characteristics of the study participants stratified by diabetes type. The analysis reveals significant differences between T1DM and T2DM patients regarding age, marital status, and educational level. Patients with T2DM were significantly older than those with T1DM (Mean Rank: 184.71 vs. 107.16, $p < 0.001$). Regarding marital status, a significantly higher proportion of T1DM patients were single (22.0% vs. 8.5%), while T2DM patients were more frequently married (87.2% vs. 71.4%, $p = 0.002$). Educational attainment also differed significantly ($p < 0.001$); T2DM was more prevalent among those with only elementary education (60.3% vs. 28.6%), whereas T1DM was more common among those with secondary (44.0% vs. 26.5%) and bachelor's degrees (25.3% vs. 9.4%). Conversely, no statistically significant differences were observed between the two groups concerning gender ($p = 0.245$), monthly income ($p = 0.912$), or accommodation area ($p = 0.295$).

Table 1: Comparison of Demographics by Type of Diabetes

Variable	Category	Type 1 Diabetes (n=91)	Type 2 Diabetes (n=234)	P-value
Gender	Male	39 (42.9%)	84 (35.9%)	0.245 ^a
	Female	52 (57.1%)	150 (64.1%)	
Marital Status	Single	20 (22.0%)	20 (8.5%)	0.002 ^a
	Married	65 (71.4%)	204 (87.2%)	
	Other	6 (6.6%)	10 (4.3%)	
Educational Level	Elementary	26 (28.6%)	141 (60.3%)	< 0.001 ^a
	Secondary	40 (44.0%)	62 (26.5%)	
	Bachelor's degree	23 (25.3%)	22 (9.4%)	
	Above Bachelor's	2 (2.2%)	9 (3.8%)	
Monthly Income	Less than 2000	56 (61.5%)	139 (59.4%)	0.912 ^a
	2000–4000	30 (33.0%)	83 (35.5%)	
	More than 4000	5 (5.5%)	12 (5.1%)	
Accommodation Area	City	51 (56.0%)	109 (46.6%)	0.295 ^a
	Village	38 (41.8%)	117 (50.0%)	
	Camp	2 (2.2%)	8 (3.4%)	
Age	Mean Rank	107.16	184.71	< 0.001 ^b

Data presented as n (%) unless otherwise noted. ^a Pearson Chi-Square test. ^b Mann-Whitney U test (Overall Mean $\pm$ SD: 56.87 $\pm$ 17.33).

Clinical Characteristics

Table 2 compares the clinical characteristics of patients based on their diabetes type. Significant differences were found in the duration of diabetes and anthropometric measurements.

Notably, patients with T1DM had a significantly higher proportion of recent diagnoses (less than 1 year: 20.9% vs. 4.3%), whereas T2DM patients predominantly had a disease duration exceeding 10 years (57.3% vs. 48.4%, $p < 0.001$). Anthropometrically, patients with T2DM had significantly higher BMI (Mean Rank: 177.49 vs. 125.73, $p < 0.001$) and weight (Mean Rank: 174.66 vs. 133.01, $p < 0.001$) compared to T1DM patients. Height was not significantly different between the groups ($p = 0.281$). Furthermore, clinical lifestyle factors, including smoking status ($p = 0.738$) and physical activity levels ($p = 0.498$), showed no significant differences. While the prevalence of diabetes complications was higher in the T2DM group (74.8%) compared to the T1DM group (64.8%), this difference did not reach statistical significance ($p = 0.073$).

Table 2: Comparison of Clinical Characteristics by Type of Diabetes

Variable	Category	Type 1 Diabetes (n=91)	Type 2 Diabetes (n=234)	P-value
Smoking Status	Current smoker	21 (23.1%)	50 (21.4%)	0.738 ^a
	Non-smoking	70 (76.9%)	184 (78.6%)	
Physical Activity	Regularly	34 (37.4%)	75 (32.1%)	0.498 ^a
	Sometimes	25 (27.5%)	75 (32.1%)	
	Rarely	18 (19.8%)	37 (15.8%)	
	Never	14 (15.4%)	47 (20.1%)	
Duration of Diabetes	Less than 1 year	19 (20.9%)	10 (4.3%)	< 0.001 ^a
	1–5 years	21 (23.1%)	53 (22.6%)	
	6–10 years	7 (7.7%)	37 (15.8%)	
	More than 10 years	44 (48.4%)	134 (57.3%)	
Diabetes Complications	Yes	59 (64.8%)	175 (74.8%)	0.073 ^a
	No	32 (35.2%)	59 (25.2%)	
BMI	Mean Rank	125.73	177.49	< 0.001 ^b
Weight	Mean Rank	133.01	174.66	< 0.001 ^b
Height	Mean Rank	171.96	159.52	0.281 ^b

Data presented as n (%) unless otherwise noted. ^a Pearson Chi-Square test. ^b Mann-Whitney U test (Overall Means $\pm$ SD: BMI 29.94 $\pm$ 7.02; Weight 81.41 $\pm$ 18.33; Height 165.16 $\pm$ 9.98).

Glycemic Control

Table 3 illustrates the comparison of glycemic control, categorized as good control (Level 1) or poor control (Level 2), between T1DM and T2DM patients. The findings indicate that poor glycemic control was highly prevalent in both groups, affecting slightly more than half of the cohort (T1DM: 53.8%; T2DM: 54.7%). However, there was no statistically significant difference in the proportion of good versus poor HbA1c control between patients with T1DM and T2DM ($p = 0.890$). This suggests that the type of diabetes does not independently influence the likelihood of achieving good glycemic control in this specific study population.

Table 3: Comparison of HbA1c Control by Type of Diabetes

Variable	Category	Type 1 Diabetes (n=91)	Type 2 Diabetes (n=234)	P-value
HbA1c Level	1: Good Control	42 (46.2%)	106 (45.3%)	0.890 ^a
	2: Poor Control	49 (53.8%)	128 (54.7%)	

Data presented as n (%). ^a Pearson Chi-Square test.

Predictors of Complications

Binary logistic regression was performed to identify significant predictors for four diabetic complications (hypertension, poor vision, renal failure, and diabetic foot), stratified by diabetes type. Because the dependent variables were coded as 1 = Yes and 2 = No, SPSS modeled the odds of not having the complication; therefore, negative B coefficients and Odds Ratios (OR) < 1 indicate risk factors (increased odds of the complication), while positive B coefficients and OR > 1 indicate protective factors (decreased odds of the complication). Table 4 presents the significant predictors from the regression models.

Hypertension: The models for hypertension were significant for both T1DM ($\chi^2 = 52.43$, $p < 0.001$, Nagelkerke $R^2 = 0.584$, 78.0% correctly classified) and T2DM ($\chi^2 = 42.14$, $p < 0.001$, Nagelkerke $R^2 = 0.220$, 69.7% correctly classified). The Hosmer-Lemeshow test confirmed good fit for both ($p = 0.577$ and $p = 0.138$, respectively). Increased duration of diabetes was a significant risk factor for hypertension in both types (T1DM OR=0.436; T2DM OR=0.463). In T1DM, younger age (OR=0.951) was associated with increased risk, while being a current smoker drastically increased the risk (OR=7.806 for non-smoking vs. smoking, meaning smokers have ~8 times the risk).

Poor Vision: The models for poor vision were significant for T1DM ($\chi^2 = 35.26$, $p < 0.001$, Nagelkerke $R^2 = 0.431$, 74.7% classified, H-L $p = 0.788$) and T2DM ($\chi^2 = 25.26$, $p = 0.008$, Nagelkerke $R^2 = 0.138$, 67.5% classified, H-L $p = 0.805$). Increased duration of diabetes was a significant risk factor for poor vision in both groups (T1DM OR=0.269; T2DM OR=0.539). In T1DM, a worse result on the last HbA1c test significantly increased the risk of poor vision (OR=0.499).

Renal Failure: The T1DM model for renal failure was marginally non-significant ($\chi^2 = 19.62$, $p = 0.051$, Nagelkerke $R^2 = 0.263$, 75.8% classified, H-L $p = 0.508$), though smoking status emerged as an individual risk factor (OR=4.138 for non-smoking, meaning smokers have ~4 times the risk). The T2DM model was highly significant ($\chi^2 = 46.80$, $p < 0.001$, Nagelkerke $R^2 = 0.247$, 71.4% classified, H-L $p = 0.094$). For T2DM, longer disease duration (OR=0.434) and smoking (OR=2.209) increased the risk of renal failure, while a better result on the last HbA1c test was protective (OR=1.494).

Diabetic Foot: The models for diabetic foot were significant for T1DM ($\chi^2 = 19.85$, $p = 0.047$, Nagelkerke $R^2 = 0.301$, 80.2% classified, H-L $p = 0.854$) and T2DM ($\chi^2 = 23.58$, $p = 0.015$, Nagelkerke $R^2 = 0.156$, 82.5% classified, H-L $p = 0.219$). Lack of physical activity (higher scores) was a significant risk factor for diabetic foot in both T1DM (OR=0.378) and T2DM (OR=0.674).

Table 4: Significant Independent Predictors of Diabetic Complications by Diabetes Type

Complication / Significant Predictor	Type 1 Diabetes				Type 2 Diabetes			
	B (S.E.)	p-value	OR	95% CI	B (S.E.)	p-value	OR	95% CI
Hypertension								
Age ^a	-0.051 (0.021)	0.016	0.951	0.912–0.990	—	—	—	—
Duration of D.M ^a	-0.830 (0.275)	0.003	0.436	0.254–0.747	-0.769 (0.176)	<0.001	0.463	0.328–0.654
Smoking Status ^b	2.055 (0.802)	0.010	7.806	1.620–37.611	—	—	—	—
Poor Vision								
Duration of D.M ^a	-1.313 (0.331)	<0.001	0.269	0.141–0.515	-0.618 (0.165)	<0.001	0.539	0.390–0.744
HbA1c ^a	-0.694 (0.259)	0.007	0.499	0.301–0.829	—	—	—	—
Renal Failure								
Duration of D.M ^a	—	—	—	—	-0.834 (0.199)	<0.001	0.434	0.294–0.642
Smoking Status ^b	1.420 (0.611)	0.020	4.138	1.249–13.706	0.792 (0.371)	0.033	2.209	1.068–4.569
HbA1c ^a	—	—	—	—	0.402 (0.143)	0.005	1.494	1.130–1.977
Diabetic Foot								
Physical Activity ^a	-0.972 (0.306)	0.001	0.378	0.208–0.689	-0.395 (0.177)	0.025	0.674	0.477–0.952

Note: OR = Odds Ratio; CI = Confidence Interval. Dashes (—) indicate the variable was not a statistically significant predictor ($p \geq 0.05$).

^a Variable coded such that higher values indicate worse status (e.g., longer duration, older age, worse HbA1c, less physical activity). ^b

Smoking Status coded 0 = smoker, 1 = non-smoker; OR > 1 indicates protective effect of non-smoking (i.e., smoking is a risk factor).

DISCUSSION

This study provides the first comparative evidence from Palestine examining demographic and clinical determinants of hypertension, renal failure, poor vision, and diabetic foot among T1DM and T2DM patients. The findings reveal significant differences in demographic profiles, clinical characteristics, and complication predictors between types, highlighting the need for type-specific diabetes management approaches in the Palestinian context.

The demographic differences observed align with typical epidemiological patterns. T2DM patients were significantly older, consistent with findings from Saudi Arabia, Jordan, and other Middle Eastern countries[3, 13, 16]. Educational attainment showed striking disparity; T2DM patients were more likely to have only elementary education, while T1DM patients more commonly had secondary and bachelor's degrees.

This gradient is concerning as lower education is consistently associated with poorer health literacy, reduced self-management, and worse outcomes[21, 20]. T2DM patients were more likely to be from rural areas and refugee camps, reflecting broader socioeconomic challenges[7, 18]. Palestinian studies have demonstrated socioeconomic deprivation as a primary risk factor for diminished health outcomes[19, 20].

Clinical characteristics revealed T1DM patients had more recent diagnoses, while T2DM patients predominantly had longer disease duration. Higher BMI and weight in T2DM are consistent with insulin resistance and obesity pathophysiology[22, 12]. UAE studies similarly documented high prevalence of overweight and obesity among T2DM patients[22].

Lifestyle factors including smoking and physical activity showed no significant differences, suggesting behavioral interventions should be prioritized equally across both types. The complication prevalence exceeds rates reported in Saudi Arabia[12] and aligns with Palestinian studies documenting high microvascular complication rates[32, 33], reflecting compounded challenges in conflict-affected settings.

Poor glycemic control was highly prevalent in both groups with no significant difference between types. This contrasts with some international studies and may indicate structural barriers (restricted healthcare access, medication shortages, socioeconomic constraints) exerting a homogenizing effect on glycemic outcomes[6, 8]. Palestinian studies have documented persistently suboptimal glycemic control across the population[9, 10, 37]. The findings highlight urgent need for enhanced glycemic management strategies addressing common barriers while addressing type-specific needs[4, 25].

Hypertension models were significant for both T1DM and T2DM. Increased disease duration was a significant risk factor in both types, consistent with prolonged hyperglycemic exposure and vascular complications[12, 2]. In T1DM, younger age and smoking increased risk. The exceptionally strong smoking association highlights synergistic adverse effects of smoking and diabetes on vascular health; smoking cessation should be an absolute priority in T1DM management.

Poor vision models were significant for both T1DM and T2DM. Disease duration was a significant risk factor in both groups, reflecting progressive diabetic retinopathy [2, 28]. Worse HbA1c increased risk in T1DM, emphasizing meticulous glucose management. The high prevalence of poor vision aligns with Palestinian studies documenting poor vision as the most frequent complication [20], underscoring urgent need for enhanced retinopathy screening [18, 29].

The T1DM renal failure model was marginally non-significant, though smoking was a risk factor. The T2DM model was significant, with longer duration and smoking increasing risk, while better HbA1c was protective. These findings align with established risk factors for diabetic nephropathy[2, 12]. Differential predictors suggest smoking cessation interventions should target T1DM patients, while T2DM patients may benefit more from glycemic optimization.

Diabetic foot models were significant for both T1DM and T2DM. Physical inactivity was a significant risk factor in both, consistent with physical activity's role in improving circulation and maintaining foot health[2, 4]. The prevalence represents a major public health concern requiring enhanced foot care screening and patient education[16, 15].

The high complication rates exceed rates reported in Saudi Arabia[12] and align with Jordanian studies[16]. Disease duration as a consistent predictor aligns with global literature[3, 13, 14]. The exceptionally high smoking-associated risk in T1DM highlights particular vulnerability to smoking-related complications[2, 12]. Physical inactivity's association with diabetic foot aligns with established evidence[4, 24].

The high complication rates and distinct predictor patterns must be interpreted within Palestine's unique challenges. Ongoing conflict, occupation, restricted movement, and socioeconomic hardship create structural barriers undermining diabetes management [7, 6, 18]. Fragmented healthcare, medication shortages, and limited specialist access compound challenges[8, 23]. Healthcare workers face occupational stressors, including checkpoint exposure and violence, affecting care delivery capacity[7, 34]. Barriers to effective emergency care—such as unfamiliarity with equipment, lack of teamwork, and stress—have been documented in Palestinian hospitals, reflecting systemic challenges that may also affect chronic disease management and patient outcomes[34]. Psychological distress from prolonged conflict—depression, anxiety, war-related stress—may indirectly affect self-management and contribute to poorer outcomes[11, 36]. Additionally, research on EHR implementation in Palestinian hospitals has shown that training, user-friendliness, and technical support are critical predictors of workflow efficiency and job satisfaction among nurses [38]. These findings suggest that similar system-level investments in training and support infrastructure may be needed to optimize diabetes care delivery.

T2DM patients being more likely from rural areas and refugee camps with elementary educa-

tion is particularly concerning, creating a vulnerable high-risk population. These structural determinants require policy interventions improving healthcare access, health literacy, and socioeconomic conditions[20, 25]. The absence of glycemic control differences between types suggests structural barriers may exert a homogenizing effect, overwhelming biological differences in conflict settings[7, 18]. Studies on Palestinian mental health confirm prolonged conflict exposure is associated with elevated depression, anxiety, and stress, further complicating chronic disease management [11].

The findings of this study are further supported by recent evidence on diabetes self-management and glycemic control in Palestine[34]. This research identified that former smoking, diabetes-related complications, and physical inactivity independently predicted higher HbA1c, while lower physical activity, longer disease duration, lower income, and lower education predicted reduced diabetes management self-efficacy [34]. These findings complement our results by demonstrating that similar clinical and socioeconomic factors influence both glycemic control and self-management capacity, reinforcing the need for integrated interventions that address modifiable behavioral factors alongside structural barriers.

Limitations

This study has several limitations. Convenience sampling and recruitment limited to two governorates may limit generalizability. The cross-sectional design precludes causal inference. Reliance on self-reported data may introduce recall and social desirability biases. HbA1c assessment was based on self-reported values rather than objective laboratory measurements. Complication classification relied on self-reported physician diagnoses without objective verification. Several potential confounders (mental health, social support, medication adherence) were not measured. Regression models explained modest variance in some complications, indicating unmeasured factors may play substantial roles. The unique Palestinian structural context limits transferability to stable healthcare settings.

Recommendations and Implications

Organizational Level

- Implement risk-stratified complication screening protocols in diabetes clinics, targeting patients with longer disease duration, poor glycemic control, and smoking history.
- Strengthen multidisciplinary teams (endocrinologists, ophthalmologists, nephrologists, podiatrists, educators, mental health professionals).
- Establish structured education programs prioritizing physical activity, foot care, and smoking cessation.
- Integrate mental health screening into routine diabetes care to address conflict-related psychological distress[11].
- Develop electronic registries linking primary and hospital care to ensure continuity.

Individual and Practice Level

- Adopt patient-centered, risk-stratified approaches: prioritize cardiovascular risk management and smoking cessation for T1DM; emphasize glycemic control and renal monitoring for T2DM.
- Provide enhanced counseling on physical activity, smoking cessation, and foot care with daily foot inspection instructions.
- Assess family support availability for unmarried patients; provide structured self-management counseling where support is limited.
- Routinely assess diabetes-related distress and integrate mental health support[11, 36].

Educational Level

- Develop interprofessional training on collaborative, culturally sensitive diabetes care.
- Integrate complication screening and risk assessment into nursing curricula.
- Train healthcare professionals in motivational interviewing and patient-centered communication.
- Incorporate mental health–chronic disease intersection training for conflict-affected populations[11].
- Support longitudinal and interventional research evaluating education programs, smoking cessation, physical activity promotion, and integrated screening.

Policy Level

- Ensure equitable access to medications, monitoring supplies, and multidisciplinary care, especially for rural, camp, and low-income populations.
- Fund community-based education and prevention initiatives targeting underserved groups.
- Establish national surveillance programs to monitor complications and outcomes.
- Address structural determinants (poverty, food insecurity, restricted movement) through policy reform.
- Guarantee uninterrupted medication supply and coordinate between Ministry of Health and other providers.
- Integrate mental health services and support healthcare workers facing occupational stressors[7, 11].

CONCLUSION

This study provides the first comparative evidence from Palestine examining demographic and clinical determinants of hypertension, renal failure, poor vision, and diabetic foot among T1DM and T2DM patients. T2DM patients were significantly older, had higher BMI, longer disease duration, and lower education, with greater rural residence. Poor glycemic control was highly prevalent in both groups (>50%) with no significant difference between types. Complication rates were high in both groups, with poor vision and hypertension most frequent.

Increased disease duration consistently predicted hypertension and poor vision. Smoking was an exceptionally strong predictor of hypertension and renal failure in T1DM, while better glycemic control protected against renal failure in T2DM. Physical inactivity predicted diabetic foot in both groups.

The absence of a direct association between glycemic control and complication rates underscores the complex interplay of clinical, behavioral, and structural factors. High complication rates reflect compounded challenges of managing diabetes in conflict-affected settings—poverty, restricted movement, fragmented healthcare, and ongoing stress. The psychological burden of chronic illness in conflict settings further complicates self-management [11]. The convergence of these findings with evidence on diabetes self-efficacy and glycemic control[34]reinforces the need for integrated interventions addressing both behavioral and structural determinants.

Effective improvement requires integrating behavioral and clinical interventions with structural reforms addressing socioeconomic and political determinants. Providers should adopt risk-stratified approaches prioritizing smoking cessation in T1DM, glycemic control in T2DM, and physical activity promotion across all patients. Policy interventions must address structural barriers including poverty and healthcare access.

Future research should employ longitudinal and interventional designs to establish causal pathways and assess targeted interventions. By addressing both individual-level risk factors and structural determinants, the burden of diabetes complications in Palestine can be reduced.

REFERENCES

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract.* 2019;157:107843. doi:10.1016/j.diabres.2019.107843
2. Ahmad F, Joshi SH. Self-Care Practices and Their Role in the Control of Diabetes: A Narrative Review. *Cureus.* 2023;15(7):e41409. doi:10.7759/cureus.41409
3. Alshayban D, Joseph R. Health-related quality of life among patients with type 2 diabetes mellitus in Eastern Province, Saudi Arabia: A cross-sectional study. *PLoS ONE.* 2020;15(1):e0227573. doi:10.1371/journal.pone.0227573
4. Ernawati U, Wihastuti TA, Utami YW. Effectiveness of Diabetes Self-Management Education (DSME) in Type 2 Diabetes Mellitus (T2DM) Patients: Systematic Literature Review. *J Public Health Res.* 2021;10(2):2240. doi:10.4081/jphr.2021.2240
5. Prajapati VB, Blake R, Acharya LD, Seshadri S. Assessment of quality of life in type II diabetic patients using the modified diabetes quality of life (MDQoL)-17 questionnaire. *Braz J Pharm Sci.* 2018;53(4). doi:10.1590/s2175-97902017000417144
6. Farajalla F. Nurses' Work Satisfaction With Electronic Medical Record Use and Associated Facilitators and Barriers in Palestine. *Sage Open Nurs.* 2026;12:23779608261418586. doi:10.1177/23779608261418586
7. Farajalla F. Military checkpoint exposure and predictive factors of quality of life among nurses during the 7th of October war in Palestine: a cross-sectional observational study. *Confl Health.* 2025;19(1):79. doi:10.1186/s13031-025-00721-w
8. UNICEF. State of Palestine: Humanitarian situation report no. 34. 2024.
9. Magliano DJ, Boyko EJ. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021.
10. Dredii MM, Asmar IT, Jaghama MK, Tawil K. Health-related quality of life among Palestinians with diabetes. *J Diabetes Nurs.* 2021;25(5).
11. Haddad RH, Abuejheisheh AJ, Farajalla F. Mental health status and its correlates among emerging adults living in the West Bank experiencing prolonged conflict: a study on depression, anxiety, war-related stress, and resilience. *BMC Public Health.* 2026. doi:10.1186/s12889-026-28798-9
12. Alshahrani JA, Alshahrani AS, Alshahrani AM, Alshalaan AM, Alhumam MN, Alshahrani NZ. The Impact of Diabetes Mellitus Duration and Complications on Health-Related Quality of Life Among Type 2 Diabetic Patients in Khamis Mushit City, Saudi Arabia. *Cureus.* 2023;15(8):e44216. doi:10.7759/cureus.44216
13. AbuAlhommos AK, Alturaifi AH, Al-Bin Hamdhah AM, Al-Ramadhan HH, Al Ali ZA, Al Nasser HJ. The Health-Related Quality of Life of Patients with Type 2 Diabetes in Saudi Arabia. *Patient Prefer Adherence.* 2022;16:1233-45. doi:10.2147/PPA.S353525
14. Tamornpark R, Utsaha S, Apidechkul T, Panklang D, Yeemard F, Srichan P. Quality of life and factors associated with a good quality of life among diabetes mellitus patients in northern Thailand. *Health Qual Life Outcomes.* 2022;20(1):81. doi:10.1186/s12955-022-01986-y
15. Vlahovic B, Jha V, Stojanovic V, Vojinovic T, Dutta A, Dutta P, et al. Enhancing patient-centered care: Evaluating quality of life in type 2 diabetes management. *PLoS ONE.* 2025;20(3):e0319369. doi:10.1371/journal.pone.0319369
16. Salem A, Masadeh A, Nofal B, Othman E, Saleh AM, Darawad MW. Self-Care Management and Its Predictors Among Jordanian Patients with Type 1 Diabetes Mellitus: Cross-Sectional Study. *Sage Open Nurs.* 2025;11:23779608251322603. doi:10.1177/23779608251322603
17. Alzawahreh S, Ozturk C. Improving Self-Efficacy, Quality of Life, and Glycemic Control in Adolescents With Type 1 Diabetes: Randomized Controlled Trial for the Evaluation of the Family-Centered Empowerment Model. *JMIR Form Res.* 2024;8:e64463. doi:10.2196/64463
18. Saddar F, Nemer M. Assessment of Health-Related Quality of Life Among Palestinian Adolescents With Type 1 Diabetes: A Cross-Sectional Investigation. *Pediatr Diabetes.* 2025;2025:3568243. doi:10.1155/pedi/3568243
19. Farajalla F, Salameh A, Halahla A, Talahmmeh M, Al-Allama M, Rasras M. Determinants of quality of life in type 1 and type 2 diabetes patients in Palestine: a comparative cross-sectional study. *BMC Prim Care.* 2026. doi:10.1186/s12875-026-03319-0
20. RobatSarpoodhi D, Mahdizadeh M, Alizadeh Siuki H, Haddadi M, Robatsarpooshi H, Peyman N. The Relationship Between Health Literacy Level and Self-Care Behaviors in Patients with Diabetes. *Patient Relat Outcome Meas.* 2020;11:129-35. doi:10.2147/PROM.S243678
21. Bawady N, Aldafrawy O, ElZobair EM, Suliman W, Alzaabi A, Ahmed SH. Prevalence of Overweight and Obesity in Type 2 Diabetic Patients Visiting PHC in the Dubai Health Authority. *Dubai Diabetes Endocrinol J.* 2022;28(1):20-4. doi:10.1159/000519444
22. Alqaisi N, Farajalla F, Qtait M, Darabee IM, Khallaf DS, Daghamin KR, et al. Factors Influencing Cardiopulmonary Resuscitation Quality in Palestinian Emergency Settings. *Disaster Med Public Health Prep.* 2025;19:e264. doi:10.1017/dmp.2025.10203
23. Usefi S, Davoodi F, Alizadeh A, Mohebi Far M. Online diabetes self-management education application for reducing glycated hemoglobin level among patients with type 1 diabetes mellitus: a systematic review and meta-analysis. *Clin Diabetes Endocrinol.* 2024;10(1):48. doi:10.1186/s40842-024-00201-9
24. Alonso-Carril N, Rodriguez-Rodríguez S, Quirós C, Berrocal B, Amor AJ, Barahona MJ, et al. Could Online Education Replace Face-to-Face Education in Diabetes? A Systematic Review. *Diabetes Ther.* 2024;15:1513-24. doi:10.1007/s13300-024-01595-6

25. Mikhael EM, Hassali MA, Hussain SA. Effectiveness of Diabetes Self-Management Educational Programs For Type 2 Diabetes Mellitus Patients In Middle East Countries: A Systematic Review. *Diabetes Metab Syndr Obes Targets Ther.* 2020;13:117-38. doi:10.2147/DMSO.S232958
26. Elian V, Popovici V, Ozon EA, Musuc A, Fița A, Rusu E, et al. Current Technologies for Managing Type 1 Diabetes Mellitus and Their Impact on Quality of Life—A Narrative Review. *Life.* 2023;13(8):1663. doi:10.3390/life13081663
27. Holmes-Truscott E, Schipp J, Cooke DD, Hendrieckx C, Coates EJ, Heller SR, et al. Perceptions of adults with type 1 diabetes toward diabetes-specific quality of life measures: a survey-based qualitative exploration. *Health Qual Life Outcomes.* 2024;22:70. doi:10.1186/s12955-024-02285-4
28. Wang X, Cheng Z. Cross-Sectional Studies. *Chest.* 2020;158(1):S65-71. doi:10.1016/j.chest.2020.03.012
29. Diabetic Complication Profiles and Associated Risk Factors: A Comprehensive Analysis from Two Public Hospitals in the Najran Region, Southern Saudi Arabia. 2025.
30. Palestinian Diabetes Complications and Control Study (PDCCS). Complications of type 2 diabetes mellitus in Ramallah and al-Bireh. 2023.
31. Diabetes-Related Microvascular Complications in Primary Health Care Settings in the West Bank, Palestine. 2023.
32. Farajalla F, Halahla Aa, Abuejheisheh AJ, Salameh A, Al-Allama M, Rasras M. Predictors of diabetes self-management and glycemic control among patients with diabetes mellitus in conflict-affected Palestine. *BMC Prim Care.* 2026. doi:10.1186/s12875-026-03423-1
33. Farajalla F, Ghanayem H. Barriers to High-Quality Cardiopulmonary Resuscitation in a Resource-Limited Setting: Perspectives of Emergency Nurses in Palestine. *SAP Nursing Depths Series.* 2026;5:438. doi:10.56294/nds2026438
34. Mesk Z, Alqaisi N, Amro A, Abdul Manaf R, Farajalla F, Abu Rmaileh S, et al. Academic Stress and Its Effect on the Psychological, Emotional, and Behavioral Health of Nursing Students. *Int J Body Mind Cult.* 2025;12(7):147-56. doi:10.61838/ijbmc.v12i7.917
35. Zyoud SH, Al-Jabi SW, Sweileh WM, Arandi DA, Dabeek SA, Esawi HH, et al. Relationship of treatment satisfaction to health-related quality of life among Palestinian patients with type 2 diabetes mellitus: Findings from a cross-sectional study. *J Clin Transl Endocrinol.* 2015;2(2):66-71. doi:10.1016/j.jcte.2015.03.002
36. Abu Alwafa R, Zahdeh R, Zidan S, Hahn A, Schuchardt J, Badrasawi M. Factors associated with quality of life among Palestinian university students: a cross-sectional study. *Int J Adolesc Youth.* 2024;29(1):2437001. doi:10.1080/02673843.2024.2437001
37. Ghanayem H, Farajalla F, Farajallah M. Training, usability, and technical support as predictors of electronic health record-associated workflow efficiency and job satisfaction among nurses: evidence from Palestine. *SAP Primary Care.* 2026;2:169. doi:10.62486/pc2026169

FUNDING

No financing

CONFLICT OF INTEREST

None

AUTHORSHIP CONTRIBUTIONS

Drafting – original draft: Fuad Farajalla.
Writing–review and editing: Fuad Farajalla.