

Received	2025/09/23	تم استلام الورقة العلمية في
Accepted	2025/10/23	تم قبول الورقة العلمية في
Published	2025/10/25	تم نشر الورقة العلمية في

Prevalence and Patterns of Complications among Type 2 Diabetes Mellitus Patients in Shahat, Libya: A Cross-Sectional Study

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Abstract

Type 2 Diabetes Mellitus is a chronic disease that leads to serious health complications if not managed properly. This study **aims** to understand the nature of these complications and their prevalence among patients by analyzing data collected from 300 cases.

Methods: Data were collected through a questionnaire distributed to patients at the diabetic center shahat, from 1.8.2024 to 30.12.2024. The questionnaire included information on age, gender, duration of diabetes, blood sugar levels FBS and HbA1c and comorbid conditions.

Results: The results indicate that hypertension and peripheral artery disease are the most common complications among patients with T2DM. Females were found to be more susceptible to diabetes compared to males, Additionally, patients with a longer duration of diabetes, more than 10 years, were more likely to have multiple complications.

Conclusions: The presence of even mild diabetic complications has a significant impact on patients' quality of life. Early diagnosis and treatment is essential to help prevent deterioration and complication in these patients, This study highlights the importance of monitoring blood sugar levels and managing complications associated with.

Key words: Diabetes type 2, Complications, Shahat, Libya.

معدل انتشار وانماط المضاعفات بين مرضى داء السكري من النوع الثاني

في شحات، ليبيا

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الملخص

داء السكري من النوع الثاني هو مرض مزمن يؤدي الي مضاعفات صحية خطيرة إذا لم يدار بشكل صحيح. تهدف هذه الدراسة الي فهم طبيعة هذه المضاعفات ومدى انتشارها بين المرضى من خلال تحليل البيانات التي تم جمعها من 300 حالة، تم جمع البيانات من خلال استبيان تم توزيعه على المرضى في مركز شحات للسكري في الفترة من 1. 8. 2024 الي 30. 12. 2024. تضمن الاستبيان معلومات عن العمر والجنس ومدة الإصابة بداء السكري ومستويات سكر الدم FBS وHbA1c والأمراض المصاحبة. تشير النتائج الي ان ارتفاع ضغط الدم ومرض الشرايين الطرفية هما أكثر المضاعفات شيوعا بين مرضى داء السكري من النوع الثاني. وجد ان الاناث أكثر عرضه للإصابة بداء السكري مقارنة بالذكور، بالإضافة الي ذلك كان المرضى الذين يعانون من داء السكري لمدة أطول أكثر من 10 سنوات أكثر عرضه للإصابة بمضاعفات متعددة. ان وجد مضاعفات السكري حتى الخفيفة منها لها تأثير كبير على جودة حياة المرضى، التشخيص والعلاج المبكر ضروريان للمساعدة في منع تدهور المضاعفات لدى هؤلاء المرضى. تسلط هذه الدراسة الضوء على أهمية مراقبة مستويات سكر الدم وإدارة المضاعفات المرتبطة به.

الكلمات الدالة: داء السكري النوع الثاني، مضاعفات، شحات، ليبيا.

1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder distinguished by insulin resistance and correlating insulin shortage, causing hyperglycemia (American Diabetes Association [ADA],

2021). The worldwide prevalence of diabetes has soared markedly, with an estimated 536 million adults affected in 2021, a number expected to rise to 784 million by 2050 (International Diabetes Federation [IDF], 2021). T2DM represents approximately 90% of all diabetes cases and is related to substantial morbidity and mortality caused by its complications (World Health Organization [WHO], 2023).

Chronic hyperglycemia in T2DM leads to microvascular complications (viz nephropathy, retinopathy, and neuropathy) and macrovascular complications (including stroke and cardiovascular disease) (ADA, 2021). Also, diabetes rises the risk of infections, retard wound healing, and other systemic disorders (Forbes & Cooper, 2013). The burden of these complications differs by area due to dissimilarity in genetic susceptibility, lifestyle factors, and healthcare access (IDF, 2021).

In Libya, the prevalence of T2DM has been mounting, affected by urbanization, sedentary lifestyles, and dietary variations. Yet, data on diabetes-related complications in Libyan populations, especially in smaller cities like Shahat, remain limited. Understanding the prevalence and patterns of complications among T2DM patients in Shahat is crucial for developing targeted interventions and improving diabetes management strategies. This study aims to assess the complications associated with T2DM in Shahat, Libya, providing insights into regional healthcare needs and disease burden.

2. Objectives

Primary Objective:

- i. To determine the prevalence and distribution of complications among Type 2 Diabetes Mellitus (T2DM) patients in Shahat, Libya.

Secondary Objectives:

- i. To identify the most common comorbidities (e.g., hypertension, peripheral artery disease, retinopathy) associated with T2DM in the study population.
- ii. To examine the relationship between diabetes duration and the number/severity of complications.

- iii. To assess gender and age-based differences in the occurrence of diabetes-related complications.
- iv. To explore potential risk factors contributing to rapid disease progression (e.g., poor glycemic control, lack of early intervention).

3. Methodology (Methods and Materials)

3.1. Study Design

This study employed a **cross-sectional design** to assess the prevalence and patterns of complications among patients with Type 2 Diabetes Mellitus (T2DM) attending a diabetic center in Shahat, Libya.

3.2. Study Setting and Population

- **Location:** The study was conducted at a diabetic care center in Shahat, Libya.
- **Study Period:** Data were collected from **August 1, 2024, to December 30, 2024.**
- **Target Population:** Adult patients (aged ≥ 18 years) diagnosed with T2DM.
- **Sample Size:** A total of **300 patients** were included, selected through **convenience sampling** (since the study aimed for a representative snapshot of complications).

3.3. Data Collection Tool

A **structured questionnaire** was used to collect the following data:

- i. **Demographic Information:** Age, gender.
- ii. **Diabetes-Related Variables:**
 - a. Duration of diabetes (<5 years, 5–10 years, 10–15 years, etc.).
 - b. Glycemic control indicators: **Fasting Blood Sugar (FBS)** and **HbA1c** levels.
- iii. **Comorbidities & Complications:**

- a. Hypertension (blood pressure $\geq 140/90$ mmHg or on antihypertensive medication).
- b. Cardiovascular diseases (e.g., coronary artery disease, heart failure).
- c. Diabetic retinopathy (diagnosed via fundus examination or previous ophthalmologist report).
- d. Peripheral artery disease (PAD) (assessed via clinical symptoms or ankle-brachial index).
- e. Diabetic neuropathy.
- f. Chronic kidney disease (CKD) .

3.4. Data Collection Procedure

- **Ethical Considerations:**

- Ethical approval was obtained from the local institutional review board (Scientific Affairs of the Higher Institute of Sciences and Techniques - Shahat).
- Informed consent was obtained from all participants.

- **Data Collection Process:**

- Trained healthcare personnel administered the questionnaire through **face-to-face interviews**.
- Medical records were reviewed to confirm diagnoses of complications.
- Blood pressure, FBS, and HbA1c measurements were taken following standard protocols.

3.5. Statistical Analysis

- Data were analyzed using Excel to make figures and tables.
- Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize demographic and clinical characteristics.
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3.6. Limitations

- i. Selection Bias: Convenience sampling may not fully represent the broader T2DM population.
- ii. Self-Reported Data: Some complications (e.g., neuropathy) relied on patient recall or clinical records rather than standardized diagnostic tests.
- iii. Cross-Sectional Nature: Causality between diabetes duration and complications cannot be established.
- iv. **Diagnostic Variability:** Complications like neuropathy lacked standardized tests (e.g., nerve conduction studies)

3. Results:

The data were presented in tables and then analyzed and interpreted to obtain the following results:

Table 1: Distribution of the Sample According to Gender

Sex	Number of Cases (%)
Female	177 (59%)
Male	123 (41%)
Total	300 (100%)

Table 1 presents the distribution of the sample population based on gender among patients with diabetes. The results indicate that there are 177 female patients and 123 male patients included in the study. The sample consists of more females (59%) compared to males (41%). This suggests that the prevalence of diabetes may be higher among females in this specific sample group. Understanding the gender distribution is crucial for tailoring diabetes management and education programs. The higher number of females may indicate a need for targeted interventions aimed at this demographic to address both diabetes management and associated complications. Further analysis could explore the reasons behind the higher female representation in this sample.

Factors such as lifestyle, access to healthcare, or differences in disease progression between genders could be investigated. Since the study aims to understand the complications associated with diabetes, recognizing the differences in health outcomes between genders is vital. Previous research has shown that gender can influence the type and severity of complications experienced by diabetes patients. Eventually, the distribution of the sample according to gender highlights the predominance of female patients in this study, which may have significant implications for diabetes management strategies and further research into gender-specific complications.

Table 2: Distribution of the Sample According to Comorbidities

Comorbidities	Number of Cases
Blood Pressure	152
Heart Diseases	36
Eye Diseases	79
Neurological Diseases	36
Peripheral Artery Disease	129
Kidney Diseases	31

Table 2 shows the distribution of diabetic patients in the sample according to various comorbidities. This data is crucial for understanding the complications associated with diabetes and the overall health profile of the patients. The most common comorbidity identified is hypertension, with 152 cases. This indicates that a significant portion of diabetic patients also suffer from high blood pressure, which is a critical risk factor for cardiovascular diseases and can exacerbate diabetic complications. As for eye diseases, 79 cases have been reported. This aligns with existing literature, as diabetes is known to increase the risk of conditions such as diabetic retinopathy, which can lead to vision

impairment. Regarding Peripheral Artery Disease: With 129 cases, PAD is notably prevalent among the sample. This condition can lead to reduced blood flow to the limbs, increasing the risk of ulcers and infections, particularly in diabetic patients. Concerning Heart and Neurological Diseases, both show 36 cases each. While these numbers are lower compared to hypertension and PAD, they still highlight important health concerns, as diabetes can lead to a variety of cardiovascular and neurological complications. Lastly, Kidney Diseases: The lowest prevalence is seen in kidney diseases, with 31 cases. However, this remains a significant concern as diabetes is a leading cause of chronic kidney disease and eventual kidney failure.

Table 3: Distribution of the Sample According to Age Period and Its Relationship to Gender

Age Period (years)	Male	Female
20 and younger	6	4
21 - 40	14	18
41 - 60	61	87
61 - 80	39	63
Older than 80	3	5
Total	177	123

Table 3 illustrates the distribution of diabetic patients according to age groups and their relationship to gender. This data provides insights into how age and gender interact in the context of diabetes prevalence and complications. The sample shows that in the age group less than 20, there are 6 males and 4 females. This indicates a relatively low prevalence of diabetes in this age group, with a slightly higher number of males compared to females. In the less than 40 age group, the numbers rise to 14 males and 18 females. This trend suggests that diabetes starts to affect females in this

younger adult category increasingly. The less than 60 age group shows a significant increase in cases, with 61 males and 87 females. This indicates a growing prevalence of diabetes among both genders, with a notable predominance of females, suggesting that they may be more susceptible to developing diabetes as they age. In the less than 80 categories, the trend continues with 39 males and 63 females.

The gender disparity persists, with females again outnumbering males, indicating that diabetes complications may also be more common among older women. The less than 100 age group has the fewest cases overall, with 3 males and 5 females. This may reflect the natural decline in the population size at very old ages or possibly the impact of diabetes complications leading to higher mortality rates. Table 3 highlights the relationship between age and gender in the sample of diabetic patients. The findings indicate that diabetes is more prevalent among females, particularly in older age groups. This underscores the importance of gender-specific approaches in diabetes management and prevention strategies to address the unique needs of different age demographics.

Table 4: Distribution of the sample according to the period of diabetes and its relation to the number of comorbidities

Duration of Disease	No comorbidity	Has 3 comorbidities or fewer	Has more than 3 comorbidities
1 Month to 5 Years	4	11	48
6 Years to 10 Years	13	17	3
11 Years to 15 Years	9	42	11
16 Years to 20 Years	10	9	11
21 Years to 25 Years	3	11	13

26 Years to 30 Years	4	3	16
31 Years to 35 Years	0	2	7

This table reveals critical trends in how diabetes duration influences the burden of comorbidities among T2DM patients in Shahat, Libya. Key findings include the early-Stage Diabetes (1 Month–5 Years), which has a High Comorbidity Burden with 48 patients (out of 63 in this group, ~76%) had >3 comorbidities despite short disease duration, this is attributed to suggests rapid disease progression or late diagnosis, leading to uncontrolled hyperglycemia and early organ damage, may reflect poor initial glycemic control, lifestyle factors, or underlying metabolic syndrome accelerating complications, or due to clinical Implication that draws attention to the need for early screening and aggressive management at diagnosis to prevent complications. Then, coming secondly, the intermediate Duration (6–10 Years), where an unexpected Decline in Severe Comorbidities Only 3 patients (out of 33, ~9%) had >3 comorbidities, this finding can be imputed to effective early intervention (e.g., medication adherence, lifestyle changes) stabilizing health. Thirdly, long-standing Diabetes (11–35 Years); Cumulative Damage 11–15 Years; 11/62 patients (~18%) had >3 comorbidities—rising again after the intermediate. 21–35 Years; Sharp increase in severe comorbidities (e.g., 16/23 patients [70%] at 26–30 years). It is attributed to the chronic hyperglycemia leads to progressive microvascular/macrovacular damage over time.

Discussion

The study on complications of diabetes in a sample from Shahat City, Libya, provides valuable insights into the demographic distribution, comorbidities, and the relationship between diabetes duration and associated health issues. The findings highlight critical areas for intervention and align with previous research on diabetes complications, while also revealing unique patterns specific to the studied population.

The results indicate a higher prevalence of diabetes among females (59.3%) compared to males (40.7%) in the sample. This finding is consistent with studies that have reported a higher burden of diabetes among women in certain populations, particularly in low- and middle-income countries (LMICs) (International Diabetes Federation [IDF], 2021). The higher representation of females may be attributed to biological, behavioral, or sociocultural factors, such as differences in physical activity levels, dietary habits, or access to healthcare services. For instance, women in some regions may face barriers to regular physical activity due to cultural norms, increasing their risk of obesity and diabetes (Al-Lawati, 2017). Additionally, hormonal changes associated with menopause may contribute to insulin resistance, further exacerbating diabetes risk in older women (Mauvais-Jarvis et al., 2020). These findings underscore the need for gender-specific diabetes management programs that address the unique challenges faced by women, including tailored education on lifestyle modifications and regular health screenings. The study identified hypertension as the most prevalent comorbidity (152 cases), followed by peripheral artery disease (PAD) (129 cases), eye diseases (79 cases), and heart and neurological diseases (36 cases each). Kidney diseases were the least common (31 cases). These findings align with global trends, as hypertension and cardiovascular diseases are well-documented complications of diabetes (IDF, 2021). The high prevalence of hypertension and PAD highlights the need for integrated care that addresses both diabetes and cardiovascular risk factors. Regular blood pressure monitoring, lipid profile assessments, and lifestyle interventions should be prioritized to reduce the risk of cardiovascular complications.

The prevalence of eye diseases, particularly diabetic retinopathy, is consistent with previous studies that have identified diabetes as a leading cause of vision impairment (Yau et al., 2012). This underscores the importance of regular eye examinations for diabetic patients to detect and manage retinopathy early. Similarly, the lower prevalence of kidney diseases may reflect underdiagnosis or delayed detection, as diabetic nephropathy often progresses silently in its early stages (Alicic et al., 2017). Routine screening for microalbuminuria and estimated glomerular filtration rate (eGFR) is essential to identify kidney disease at an early stage and prevent progression to end-stage renal disease.

Concerning to age and Gender Interaction, the data reveal a higher prevalence of diabetes among females across all age groups, particularly in the 41–60 and 61–80 age categories. This trend is consistent with studies suggesting that women are more likely to develop diabetes as they age, possibly due to hormonal changes, weight gain, and reduced physical activity (Mauvais-Jarvis et al., 2020). The higher prevalence of diabetes among older women highlights the need for targeted interventions, such as community-based exercise programs and nutritional counseling, to address modifiable risk factors.

The relatively low prevalence of diabetes in the under-20 age group (6 males and 4 females) suggests that type 2 diabetes is less common in younger populations. However, the presence of diabetes in this age group may indicate an emerging trend of early-onset type 2 diabetes, which has been linked to rising rates of childhood obesity and sedentary lifestyles (Dabelea et al., 2014). Early intervention strategies, including school-based health education and obesity prevention programs, are crucial to curb this trend.

The study demonstrates a clear relationship between the duration of diabetes and the number of comorbidities. Patients with a shorter duration of diabetes (1 month to 5 years) exhibited a high prevalence of multiple comorbidities, suggesting rapid disease progression. This finding is concerning and highlights the need for early and aggressive management of diabetes to prevent complications. For instance, patients in this group may benefit from intensive glycemic control, regular blood pressure and lipid levels monitoring, and lifestyle interventions to reduce cardiovascular risk (UK Prospective Diabetes Study Group, 1998).

In contrast, patients with a longer duration of diabetes (21–35 years) showed a higher likelihood of having more than three comorbidities, reflecting the cumulative impact of chronic hyperglycemia on multiple organ systems (Stratton et al., 2000). This trend underscores the importance of lifelong diabetes management and regular health check-ups to detect and address complications early. Healthcare providers should adopt a holistic approach to diabetes care, focusing on glycemic control and the prevention and management of associated conditions.

The findings of this study have several implications for healthcare delivery and policy in Shahat City and similar settings:

1. Integrated Care Models: The high prevalence of comorbidities necessitates integrated care models that address diabetes and its associated conditions simultaneously. Multidisciplinary teams, including endocrinologists, cardiologists, nephrologists, and ophthalmologists, should collaborate to provide comprehensive care.
2. Early Detection and Intervention: Regular screening for diabetes and its complications, particularly in high-risk groups such as older women and individuals with a family history of diabetes, is essential to detect the disease early and prevent complications.
3. Patient Education: Educational programs should focus on empowering patients to manage their condition through lifestyle modifications, medication adherence, and regular monitoring of blood glucose levels.
4. Resource Allocation: Policymakers should prioritize the allocation of resources for diabetes care, including the provision of essential medications, diagnostic tools, and training for healthcare providers.

Conclusion

This study provides critical insights into the demographic distribution, comorbidities, and the relationship between diabetes duration and associated complications among patients in Shahat City, Libya. The findings reveal a higher prevalence of diabetes among females (59%) compared to males (41%), suggesting potential gender-specific risk factors that warrant further investigation. Hypertension emerged as the most common comorbidity (152 cases), followed by peripheral artery disease (129 cases), emphasizing the need for integrated cardiovascular and diabetes management strategies. Additionally, the high burden of comorbidities in patients with both short and long diabetes duration highlights the importance of early and aggressive intervention to mitigate complications.

The study underscores the necessity for tailored healthcare approaches, including gender-sensitive diabetes education programs, regular screening for complications (such as retinopathy and nephropathy), and multidisciplinary care models to address the complex needs of diabetic patients. Policymakers and healthcare providers should prioritize early detection, patient education, and resource allocation to improve diabetes management and reduce long-term complications in this population. Future research should explore the underlying factors contributing to the observed gender disparity and the rapid progression of comorbidities in early-stage diabetes to inform more effective prevention and treatment strategies.

By implementing these recommendations, healthcare systems in Shahat City and similar settings can enhance diabetes care, improve patient outcomes, and reduce the overall burden of diabetes-related complications.

Acknowledgements

We would like to express our sincere gratitude to Rubyan Eid, Rana Ali, and Maha Miftah, students in the Department of Community Health at the Higher Institute of Science and Technology in Shahat, for their valuable contributions to this research. Their efforts in data collection and analysis were instrumental to the success of this study.

We are deeply thankful to the administration of the Higher Institute of Science and Technology, Shahat, for their support and for providing the necessary facilities to conduct this research.

Special thanks are extended to the diabetic care center in Shahat, Libya, for their cooperation, assistance, and for granting us access to patient data that made this study possible. Their collaboration was essential in helping us understand the prevalence and patterns of diabetes complications in our community.

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