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Assessment of Gastrointestinal Symptoms in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

Abdulrhman Khaled Al Abdulqader[1], Ahmed Abdullah Albadrani[2], Saleh Khalid Al Mogairen[1], Aeshah Salem Alsharidah[3], Wafa Yahya Alqahtani[3], Reem Khalid Buzaid[3]

[1]Department of Internal Medicine, College of Medicine, King Faisal University, Al-Ahsa 31982, Saudi Arabia

[2]Department of Internal Medicine, College of Medicine, Prince Sattam bin Abdulaziz University, Al-Kharj 11942, Saudi Arabia

[3]College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia

***Corresponding Author:**

Abdulrhman Khaled Al Abdulqader.

Email ID: alabdulqader@kfu.edu.sa

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ABSTRACT

Background: Gastrointestinal (GI) symptoms are common but often underrecognized complications of type 2 diabetes mellitus (T2DM), contributing to poor quality of life and suboptimal glycemic control.

Aim: To assess the prevalence, severity, and predictors of GI symptoms among patients with T2DM attending outpatient clinics.

Methods: A cross-sectional study was conducted among 548 adults with T2DM at the polyclinics of King Faisal University, Saudi Arabia. Data on demographics, clinical profiles, and GI symptoms were collected using structured interviews and the validated Gastrointestinal Symptom Rating Scale (GSRS). Logistic regression was used to identify independent predictors of moderate-to-severe symptoms.

Results: The overall prevalence of ≥1 moderate-to-severe GI symptom was 75.2%, with indigestion (46.7%), reflux (38.9%), and constipation (37.8%) being most common. Nearly 49% had moderate and 26.5% had severe symptom scores. Female gender (OR=1.42, p=.006), diabetes duration ≥10 years (OR=1.37, p=.034), HbA1c ≥9% (OR=1.58, p=.001), BMI ≥35 kg/m² (OR=1.41, p=.028), and metformin-only therapy (OR=1.26, p=.043) were significantly associated with higher symptom burden.

Conclusion: GI symptoms are highly prevalent among patients with T2DM and are linked to multiple modifiable clinical factors. Routine screening and individualized interventions are essential to enhance symptom control and optimize overall diabetes management.

Keywords: *Type 2 diabetes mellitus; gastrointestinal symptoms; glycemic control; obesity; metformin; symptom severity; Saudi Arabia.*

1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder that affects hundreds of millions globally and poses a substantial burden on healthcare systems due to its progressive nature and multisystem complications [1]. Characterized primarily by insulin resistance and relative insulin deficiency, T2DM often leads to long-term microvascular and macrovascular damage, impacting various organ systems including the cardiovascular, renal, and nervous systems [2]. However, despite growing attention to cardiovascular and renal complications, the gastrointestinal (GI) system remains a relatively underexplored domain in the context of diabetes-related morbidity.

Gastrointestinal symptoms are frequently reported by individuals with T2DM, often manifesting in subtle yet distressing forms that affect patients' quality of life and complicate glycemic control [3]. Symptoms range from early satiety, nausea, and bloating to diarrhea, constipation, and fecal incontinence, reflecting dysfunctions in both the upper and lower

gastrointestinal tracts. Studies estimate that up to 75% of patients with diabetes experience at least one gastrointestinal symptom, with many experiencing multiple symptoms concurrently, yet these manifestations often go undetected or underreported in clinical practice [4]. The exact prevalence rates vary across populations and are influenced by several factors including disease duration, glycemic control, autonomic neuropathy, and lifestyle behaviors [5].

The pathophysiological link between diabetes and gastrointestinal symptoms is complex and multifactorial. Diabetic autonomic neuropathy is considered a principal mechanism, leading to delayed gastric emptying (gastroparesis), altered intestinal motility, and impaired neural regulation of the gut [6]. Hyperglycemia itself further impairs smooth muscle function and affects gastrointestinal hormone secretion, exacerbating symptoms and creating a vicious cycle that complicates diabetes management [7]. Moreover, the use of certain antidiabetic medications such as metformin has been associated with gastrointestinal side effects, further contributing to symptom burden [8, 9]. In many cases, these symptoms are misattributed to dietary indiscretion or aging, resulting in a diagnostic and therapeutic gap that undermines patient-centered care.

Emerging evidence has highlighted the potential impact of gastrointestinal symptoms on diabetes self-management and treatment outcomes. For instance, symptoms such as nausea, bloating, or altered bowel habits may interfere with dietary adherence, timing of medication, and absorption of oral hypoglycemics [10]. Additionally, gastrointestinal discomfort can negatively influence physical activity, a cornerstone of diabetes care, thereby indirectly contributing to poor glycemic control and heightened risk of complications [11]. The chronicity and unpredictability of these symptoms can also precipitate psychological distress, fatigue, and diminished health-related quality of life (HRQoL), underscoring the need for comprehensive symptom assessment in routine diabetes care [12].

Despite the clinical significance of gastrointestinal disturbances in diabetic populations, the literature remains sparse in some regions, including the Middle East, where cultural, dietary, and healthcare-seeking behaviors may modulate symptom expression and reporting [13]. In Saudi Arabia, the prevalence of T2DM has reached alarming levels, affecting approximately 25% of the adult population and ranking among the highest globally [14]. Yet, systematic assessments of gastrointestinal symptomatology among Saudi patients with T2DM are limited. Most existing studies focus on glycemic indices, cardiovascular risk, or renal impairment, while gastrointestinal symptoms remain largely overlooked in epidemiological and clinical research agendas [15].

Several international studies have attempted to quantify the burden of gastrointestinal symptoms in diabetic populations, yet reported prevalence rates vary widely due to differences in study designs, symptom definitions, and measurement tools. A cross-sectional study from India found that 44% of T2DM patients experienced lower gastrointestinal symptoms, with constipation being the most prevalent (10). Another study in Italy reported upper gastrointestinal symptoms such as epigastric discomfort and nausea in nearly 60% of diabetic participants [16]. These inconsistencies highlight the need for population-specific studies that consider sociodemographic variables, dietary patterns, glycemic control, and medication profiles. Furthermore, standardized assessment tools are necessary to ensure comparability and improve clinical utility [17].

Given this context, there is a compelling need to assess the prevalence, pattern, and predictors of gastrointestinal symptoms among patients with T2DM in Saudi Arabia. Such data are essential to inform screening strategies, enhance symptom recognition among clinicians, and support the development of holistic care models that integrate gastrointestinal health into diabetes management [18]. Furthermore, understanding the correlates of gastrointestinal symptoms—such as disease duration, HbA1c levels, BMI, and medication use—can facilitate risk stratification and targeted interventions.

This cross-sectional study therefore aims to bridge this knowledge gap by evaluating the burden and distribution of gastrointestinal symptoms among adults with type 2 diabetes mellitus attending outpatient clinics in a tertiary hospital setting. The study will also explore associations between GI symptoms and clinical-demographic variables to provide a nuanced understanding of their determinants in this high-risk population. By doing so, the study intends to contribute valuable evidence that can support clinical decision-making and guide integrated care approaches for diabetes management in the Saudi context and beyond.

Aim of the Study

This study aims to assess the prevalence, patterns, and severity of gastrointestinal (GI) symptoms among patients with type 2 diabetes mellitus (T2DM) attending outpatient clinics. Additionally, the study seeks to examine the associations between GI symptoms and selected clinical and demographic variables, including disease duration, glycemic control (HbA1c), body mass index (BMI), and antidiabetic medication use.

Research Questions

1. What is the prevalence and distribution of gastrointestinal symptoms among patients with type 2 diabetes mellitus?
2. What types of gastrointestinal symptoms (upper, lower, or generalized) are most frequently reported by patients with T2DM?
3. Are there statistically significant associations between gastrointestinal symptoms and clinical variables such as disease duration, HbA1c levels, body mass index (BMI), and type of antidiabetic medication?

2. METHODOLOGY

Study Design

This study employed a cross-sectional descriptive analytical design to investigate the prevalence and associated factors of gastrointestinal (GI) symptoms among individuals diagnosed with type 2 diabetes mellitus (T2DM). The design is appropriate for identifying the distribution and correlates of GI symptoms at a single point in time, enabling the exploration of associations between symptoms and clinical or demographic variables.

Study Setting

The study was conducted at the polyclinics of King Faisal University (KFU), located in Al-Ahsa, Eastern Province, Saudi Arabia. These polyclinics serve as a primary healthcare facility affiliated with the university, providing outpatient services to a large population of students, faculty members, staff, and their families, in addition to individuals from the surrounding community. The setting was selected due to its diverse patient base and its role as a referral center for chronic disease management, including diabetes care.

Sample and Sampling Technique

The study included a convenience sample of 550 adult patients with a confirmed diagnosis of type 2 diabetes mellitus who were attending the outpatient diabetes or internal medicine clinics at KFU polyclinics between October 2024 and February 2025.

Inclusion criteria were:

- Adult patients aged 18 years and above.
- Diagnosed with T2DM for at least one year.
- Able to understand and communicate in Arabic.
- Provided written informed consent.

Exclusion criteria included:

- Patients with type 1 diabetes mellitus.
- Individuals with diagnosed gastrointestinal diseases unrelated to diabetes (e.g., inflammatory bowel disease, colorectal cancer, peptic ulcer).
- Pregnant women.
- Patients with severe cognitive impairment or psychiatric illness affecting their ability to respond reliably.

A sample size of 548 participants was determined to provide adequate power to detect significant associations between GI symptoms and independent variables using multivariate regression analysis. The sample size also accounts for possible non-response or incomplete data and exceeds the minimum requirement for cross-sectional studies analyzing multiple variables concurrently.

Data Collection Tools

Data were collected using a structured, interviewer-administered questionnaire composed of three main sections:

1. **Sociodemographic and Clinical Characteristics:** Included age, gender, marital status, education level, employment status, smoking history, physical activity, duration of diabetes, body mass index (BMI), HbA1c levels (retrieved from medical records), and type of antidiabetic medications.
2. **Gastrointestinal Symptom Assessment:** The Gastrointestinal Symptom Rating Scale (GSRS) was used, a validated tool consisting of 15 items grouped into five symptom clusters: reflux, abdominal pain, indigestion, diarrhea, and constipation. Each item is scored on a 7-point Likert scale (1 = no discomfort, 7 = very severe discomfort), allowing for both subscale and total scores to assess severity and distribution of GI symptoms (1).
3. **Medication Profile and Glycemic Control:** Information on current use of medications such as metformin, insulin, and GLP-1 receptor agonists was collected to explore associations with GI symptom patterns.

The GSRS was translated into Arabic and previously validated in Middle Eastern populations. Internal consistency reliability in the present study yielded a Cronbach's alpha of 0.88, indicating high reliability.

Data Collection Procedure

After obtaining ethical approval, data collection was carried out by trained research assistants, including nursing students and healthcare staff, under supervision. Participants were approached in the waiting areas of diabetes and general medicine clinics. Eligible individuals who provided informed consent were interviewed in private consultation rooms to ensure

confidentiality and minimize response bias. Anthropometric measurements (weight and height) were taken using standardized equipment to calculate BMI. Clinical data such as HbA1c values and medication history were retrieved from patients' electronic health records with their permission. Each interview lasted approximately 20–25 minutes. Data collection was conducted over a five-month period from October 2024 to February 2025.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 28.0. Descriptive statistics were used to summarize participant characteristics and prevalence of GI symptoms. Continuous variables were presented as means and standard deviations, while categorical variables were expressed as frequencies and percentages.

Bivariate analysis (Chi-square tests, t-tests, or ANOVA as appropriate) was conducted to assess differences in GI symptoms across demographic and clinical subgroups. Multivariate logistic regression was used to identify independent predictors of moderate-to-severe GI symptoms, controlling for potential confounders such as age, sex, BMI, diabetes duration, and medication type. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Participants were provided with detailed information about the study's purpose, procedures, risks, and benefits. Written informed consent was obtained from all participants prior to data collection.

Confidentiality was strictly maintained by assigning each participant a unique identifier and storing data on password-protected devices. Only the principal investigator and designated research team members had access to the data. Participation was entirely voluntary, and patients were assured they could withdraw from the study at any point without affecting their clinical care.

3. RESULTS

Of the 548 eligible adults with type 2 diabetes mellitus (T2DM) who completed the survey, just over half were men and almost two-thirds were middle-aged or older. Slightly fewer than one-quarter had lived with diabetes for < 5 years, whereas a comparable proportion reported ≥ 15 years' duration. More than half of the cohort was classified as overweight or obese class II+, and more than one-third presented with markedly elevated HbA1c (≥ 9 %). Metformin-based therapy was the most common regimen, while fewer than one in six relied on insulin. The full distribution of background variables is presented in Table 1.

Table 1:Participant Characteristics

Characteristic	**n (%)**
Gender	
– Male	289 (52.7 %)
– Female	259 (47.3 %)
Age category (years)	
– 18–29	112 (20.4 %)
– 30–44	173 (31.6 %)
– 45–59	187 (34.1 %)
– ≥ 60	76 (13.9 %)
Duration of diabetes	
– < 5 y	134 (24.5 %)
– 6–9 y	149 (27.2 %)
– 10–14 y	139 (25.4 %)
– ≥ 15 y	126 (23.0 %)
BMI category	
– Normal (18.5–24.9)	97 (17.7 %)

– Overweight (25–29.9)	156 (28.5 %)
– Obesity I (30–34.9)	137 (25.0 %)
– Obesity II+ (≥ 35)	158 (28.8 %)
HbA1c category	
– < 7 %	143 (26.1 %)
– 7–8.9 %	217 (39.6 %)
– ≥ 9 %	188 (34.3 %)
Medication regimen	
– Metformin only	223 (40.7 %)
– Insulin ± OAD	94 (17.2 %)
– Combination OAD (non-Metformin)	131 (23.9 %)
– GLP-1 RA regimen	97 (17.7 %)
– Other	3 (0.5 %)

Indigestion was the most frequently reported moderate-to-severe symptom (46.7 %), followed by reflux (38.9 %) and constipation (37.8 %). Fully three-quarters of respondents experienced at least one symptom cluster at a moderate or greater intensity. Detailed prevalence figures appear in Table 2.

Table 2:Prevalence of Gastrointestinal (GI) Symptoms

Symptom cluster	n	Prevalence (%)
Reflux	213	38.9
Abdominal pain	198	36.1
Indigestion	256	46.7
Diarrhea	176	32.1
Constipation	207	37.8
≥ 1 symptom (moderate-severe)	412	75.2

Nearly half the cohort registered a moderate global GSRS score, and just over one-quarter met the threshold for severe symptomatology. The severity profile is summarised in Table 3.

Table 3: Overall Symptom Severity

GSRS severity category	n	Proportion (%)
Mild (< 3)	136	24.8
Moderate (3–4)	267	48.7
Severe (≥ 5)	145	26.5

Female patients recorded a higher mean GSRS score than males (3.57 ± 1.29 vs 3.31 ± 1.21). Symptom burden rose progressively with age, peaking in the 45–59 year group (mean = 3.64 ± 1.28). Between-group differences for gender and age were statistically significant (χ^2 and ANOVA, $p < .05$). Descriptive means are displayed in Table 4.

Table 4: Symptom Burden by Demographic Subgroup

Subgroup	Mean GSRS ± SD
Male	3.31 ± 1.21
Female	3.57 ± 1.29
18–29 y	3.12 ± 1.18
30–44 y	3.43 ± 1.27
45–59 y	3.64 ± 1.28
≥ 60 y	3.51 ± 1.19

Multivariate logistic regression identified five independent predictors of moderate-to-severe symptoms. Poor glycaemic control (HbA1c ≥ 9 %) conferred the highest risk (adjusted OR 1.58). Long diabetes duration, female gender, severe obesity, and exclusive metformin therapy also showed significant associations. Model outputs are presented in Table 5.

Table 5: Predictors of Moderate–Severe GI Symptoms

Predictor	Adjusted OR (95 % CI)	*p*-value
Female gender	1.42 (1.11–1.83)	.006
Diabetes duration ≥ 10 y	1.37 (1.02–1.82)	.034
HbA1c ≥ 9 %	1.58 (1.21–2.07)	.001
BMI ≥ 35 kg m^{-2}	1.41 (1.03–1.93)	.028
Metformin-only regimen	1.26 (1.01–1.58)	.043

Patients receiving GLP-1 receptor agonists reported the greatest relative burden of indigestion (48.5 %), whereas constipation predominated among those on combination oral agents. Although absolute counts varied, the pattern of multi-symptom experience was broadly similar across therapeutic groups (see Table 6).

Table 6: Symptom Patterns Across Medication Regimens

Medication regimen	Reflux n (%)	Indigestion n (%)	Abdominal pain n (%)	Diarrhea n (%)	Constipation n (%)
Metformin only (n = 223)	97 (43.5)	103 (46.2)	85 (38.1)	69 (30.9)	83 (37.2)
Insulin ± OAD (n = 94)	39 (41.5)	42 (44.7)	37 (39.4)	28 (29.8)	33 (35.1)
Combination OAD (n = 131)	52 (39.7)	61 (46.6)	57 (43.5)	44 (33.6)	49 (37.4)
GLP-1 RA regimen (n = 97)	36 (37.1)	47 (48.5)	38 (39.2)	42 (43.3)	37 (38.1)
Other (n = 3)	1 (33.3)	1 (33.3)	1 (33.3)	1 (33.3)	1 (33.3)

4. DISCUSSION

This study investigated the prevalence and determinants of gastrointestinal (GI) symptoms among patients with type 2 diabetes mellitus (T2DM) attending outpatient clinics at King Faisal University in Saudi Arabia. The findings revealed a high burden of GI symptoms, with approximately 75% of participants reporting at least one moderate-to-severe symptom. Notably, indigestion, reflux, and constipation were the most commonly reported symptoms. These results align with previous

studies indicating a high prevalence of GI symptoms among individuals with diabetes .

The association between poor glycemic control and increased GI symptomatology observed in this study is consistent with existing literature. Hyperglycemia has been implicated in the development of diabetic autonomic neuropathy, which can affect gastrointestinal motility and function [19, 20]. Moreover, studies have demonstrated that poor glycemic control is linked to a higher prevalence of both upper and lower GI symptoms . Therefore, maintaining optimal glycemic control is crucial not only for preventing microvascular and macrovascular complications but also for mitigating GI symptoms in patients with T2DM [21].

The study also identified female gender, longer duration of diabetes, higher body mass index (BMI), and metformin monotherapy as significant predictors of moderate-to-severe GI symptoms [22]. The higher prevalence of GI symptoms among females has been reported in previous studies and may be attributed to hormonal differences, heightened visceral sensitivity, and psychosocial factors . Additionally, longer duration of diabetes is associated with an increased risk of developing diabetic complications, including autonomic neuropathy, which can lead to GI dysmotility [23].

Obesity, particularly severe obesity (BMI ≥35 kg/m²), was found to be associated with a higher risk of GI symptoms. Obesity can exacerbate gastroesophageal reflux disease (GERD) and other GI conditions due to increased intra-abdominal pressure and altered gut hormone levels . Therefore, weight management should be an integral part of diabetes care to reduce the burden of GI symptoms [24].

Metformin, a first-line therapy for T2DM, was associated with an increased risk of GI symptoms in this study. Metformin-induced GI side effects, such as diarrhea, nausea, and abdominal discomfort, are well-documented and can affect up to 20% of patients [25]. Strategies to mitigate these side effects include initiating therapy at a low dose, using extended-release formulations, and administering the medication with meals [26].

The high prevalence of GI symptoms among patients with T2DM underscores the need for routine screening and comprehensive management of these symptoms in clinical practice. Healthcare providers should proactively inquire about GI symptoms during consultations and consider appropriate diagnostic evaluations and therapeutic interventions [27]. Addressing GI symptoms can improve patients' quality of life, enhance adherence to diabetes treatment regimens, and potentially improve glycemic control [28].

Furthermore, patient education on the potential GI side effects of antidiabetic medications, dietary modifications, and the importance of glycemic control is essential [29]. Multidisciplinary approaches involving endocrinologists, gastroenterologists, dietitians, and primary care providers can facilitate the comprehensive management of GI symptoms in patients with T2DM [30].

5. IMPLICATIONS OF THE STUDY

The findings of this study have several important clinical and public health implications. First, the high prevalence of gastrointestinal (GI) symptoms among patients with type 2 diabetes mellitus (T2DM) highlights the need for systematic GI symptom screening in routine diabetes care. These symptoms, often underreported or overlooked, can negatively impact patients' quality of life, interfere with medication adherence, and contribute to poor glycemic control.

Second, the identification of specific risk factors—such as poor glycemic control (HbA1c ≥9%), longer diabetes duration, female gender, obesity, and metformin monotherapy—provides a basis for risk stratification and individualized patient management. Healthcare providers can use this information to monitor high-risk subgroups more closely and offer timely interventions, including dietary counseling, medication review, and referrals to gastroenterology as needed.

Third, these results support the integration of gastrointestinal symptom assessments into multidisciplinary diabetes management programs. This approach aligns with a person-centered care model that addresses not only metabolic targets but also the broader physical and psychosocial challenges faced by individuals living with diabetes.

Finally, the study adds to the growing body of evidence on diabetes-related complications in Middle Eastern populations and underscores the need for context-specific strategies in diabetes education, clinical assessment, and care delivery in Saudi Arabia and similar settings.

6. LIMITATIONS OF THE STUDY

Despite its strengths, this study is subject to several limitations. First, the cross-sectional design precludes any causal inference between the observed GI symptoms and their associated risk factors. Longitudinal studies are needed to establish temporal relationships and causality.

Second, the study relied on self-reported symptoms using the Gastrointestinal Symptom Rating Scale (GSRS), which, although validated, may still be subject to recall bias and subjective interpretation. The inclusion of objective clinical assessments such as endoscopy or motility studies would provide more diagnostic precision.

Third, the sample was drawn from a single academic polyclinic setting at King Faisal University, which may limit the

generalizability of the findings to other healthcare settings or regions within Saudi Arabia. Patients attending university-affiliated clinics may differ in educational background or health-seeking behavior compared to the general population.

Fourth, the study did not assess psychological variables such as anxiety, depression, or quality of life, which may mediate or moderate the relationship between diabetes and GI symptoms. Future research should incorporate these dimensions to provide a more comprehensive understanding of patient experience.

Lastly, although the study captured various medication types, it did not assess medication adherence or dosage variability, which could influence the severity of GI symptoms.

7. CONCLUSION

This study revealed a high burden of gastrointestinal symptoms among adults with type 2 diabetes mellitus attending outpatient clinics in Saudi Arabia, with over 75% reporting at least one moderate-to-severe symptom. Indigestion, reflux, and constipation were the most prevalent. Female gender, poor glycemic control, long diabetes duration, obesity, and metformin monotherapy were identified as significant predictors of symptom severity.

The findings underscore the clinical importance of incorporating gastrointestinal health assessments into diabetes care protocols. Addressing these symptoms through early detection, patient education, and interdisciplinary management may not only improve patient comfort and treatment adherence but also contribute to better metabolic outcomes.

Given the rising burden of diabetes in Saudi Arabia and globally, prioritizing gastrointestinal health in diabetic populations is both timely and essential. Future research should focus on longitudinal tracking, interventional trials, and integration of psychosocial and behavioral variables to deepen the understanding of this important yet underexplored complication of diabetes.

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