Prevalence of celiac disease among Type 1 diabetes mellitus in Diabetic center of Tabuk City, Saudi Arabia 2024: a cross sectional retrospective medical record-based study

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Abstract

Background: Celiac disease (CD) is an autoimmune enteropathy triggered by gluten ingestion in genetically susceptible individuals. It is frequently associated with other autoimmune conditions, particularly type 1 diabetes mellitus (T1DM). Early identification of CD in T1DM patients is essential to prevent complications and improve outcomes.

Objective: To determine the prevalence of celiac disease among patients with T1DM at the Diabetic Center in Tabuk City, Saudi Arabia, and to identify associated risk factors, common symptoms, and diagnostic patterns.

Methods: A cross-sectional, retrospective study was conducted based on medical records of 373 patients with T1DM attending the Diabetic Center of King Fahad Hospital in Tabuk City between May and August 2024. Data were collected using a structured and validated form covering demographic, clinical, and diagnostic details. Statistical analysis was performed using SPSS version 18, with descriptive statistics and inferential tests including Fisher's Exact Test, t-tests, and ANOVA. A p-value < 0.05 was considered statistically significant.

Results: The prevalence of diagnosed celiac disease among T1DM patients was 2.4% (n=9). All cases were diagnosed using anti-tTG antibodies, and common presenting symptoms included abdominal pain (44.4%) and diarrhea (33.3%). A significant association was found between CD and being underweight ($p = 0.049$). Other variables such as age, gender, insulin dosage, and DKA frequency showed no significant correlation with CD. However, males and patients diagnosed with T1DM at an older age were found to have a significantly later diagnosis of CD ($p = 0.001$).

Conclusion: Celiac disease is relatively uncommon but clinically relevant among T1DM patients in Tabuk City. Underweight status may serve as a useful clinical indicator for CD screening. Given the variable presentation of CD, universal screening in T1DM patients remains important for early diagnosis and management.

Keywords
Celiac disease, Type 1 diabetes mellitus, Prevalence, Risk factors, Saudi Arabia, Gluten, Anti-tTG antibodies.

Introduction

Celiac disease [CD] is an immune-mediated systemic disorder triggered by the ingestion of gluten a protein found in wheat, rye, and barley in genetically susceptible individuals [1]. It involves both intestinal and extra intestinal manifestations, with hallmark features including small intestinal mucosal injury, malabsorption, and specific serologic autoantibodies such as anti-tissue transglutaminase [anti-tTG] [2]. Clinically, CD can present with classical gastrointestinal symptoms like diarrhea and weight loss or with non-classical features such as anemia, delayed puberty, and fatigue [3].

Diagnosis of CD requires a combination of clinical assessment, serologic testing, and confirmation by duodenal biopsy [4]. A positive anti-tTG test followed by evidence of villous atrophy is considered diagnostic. In selected cases, HLA typing for DQ2 or DQ8 may support the diagnosis [5]. Effective treatment consists of lifelong adherence to a strict gluten-free diet [GFD], which typically leads to symptom resolution, histological improvement, and normalization of antibody levels [6]. However, GFD poses challenges such as nutritional deficiencies, psychological burdens, and increased costs, making routine dietary counseling essential [7].

Delayed diagnosis of CD may elevate the risk of certain malignancies, including lymphoma, though recent studies suggest a potentially reduced risk for colorectal cancer, possibly due to altered fat metabolism [8]. Immunologically, CD shares characteristics with autoimmune diseases like type 1 diabetes mellitus [T1DM], including HLA associations and autoantibody production [9].

T1DM is a prevalent autoimmune endocrine disorder in children and adolescents, characterized by insulin deficiency due to autoimmune destruction of pancreatic β-cells [10]. It typically presents in youth and requires lifelong insulin therapy. Despite advancements in diabetes care such as insulin pumps and continuous glucose monitoring T1DM is still associated with reduced life expectancy and serious long-term complications. In Saudi Arabia, the prevalence of T1DM has risen markedly, particularly among younger age groups, consistent with global trends in autoimmune disorders [11]. The current study aimed to measure prevalence of celiac disease among individuals with type 1 diabetes mellitus in a Diabetic center of Tabuk City.

Methodology

A cross-sectional, retrospective medical record-based study was conducted to assess the prevalence of celiac disease [CD] among individuals with type 1 diabetes mellitus [T1DM] attending the Diabetic Center of King Fahad Hospital in Tabuk City, Saudi Arabia. The center provides comprehensive diabetic services, including routine clinical care, health education, diabetic foot care, and retinopathy screening. The study population included all registered patients diagnosed with T1DM in the center. A total population of 12,460 T1DM patients was identified, and the minimum required sample size was calculated to be 373 patients, using a 95% confidence level, 5% margin of error, and assuming a prevalence of 50%. The finite population formula was applied for this calculation. All patients with a confirmed diagnosis of type 1 diabetes who were receiving care at the Diabetic Center were eligible for inclusion. Records not meeting these inclusion criteria were excluded. Data were collected retrospectively over a three-month period, from May 2024 to August 2024.

Patient data were extracted from medical records using a previously validated data collection form. The tool was structured into three main sections. The first section included socio-demographic data such as age, gender, weight, and height. The second section focused on diabetes-related clinical information, including age at T1DM diagnosis, diagnostic methods, total daily insulin dose, and frequency of diabetic ketoacidosis [DKA] episodes. The third section addressed information on celiac disease, including diagnostic methods [anti-tissue transglutaminase [anti-tTG] antibodies or endoscopic biopsy], age at CD diagnosis, and presenting symptoms and signs.

Data Analysis

The collected data were coded, entered, and statistically analyzed using the Statistical Package for the Social Sciences [SPSS] software, version 18 [SPSS Inc., Chicago, IL, USA]. Descriptive statistics were used to summarize the bio-demographic and clinical characteristics of the study participants. Frequencies and numbers were presented for categorical variables, while means and standard deviations were calculated for continuous variables. To explore associations between categorical variables, such as the presence of celiac disease and other demographic or clinical factors, the exact probability test [Fisher's Exact Test] was applied when appropriate, particularly in the presence of small cell counts. For comparisons involving continuous variables, such as age at celiac disease diagnosis across different patient subgroups, independent samples t-tests were used when comparing two groups and one-way analysis of variance [ANOVA] was used when comparing more than two groups. A p-value of less than 0.05 was considered statistically significant in all analyses.

Results

The study included 373 patients with type 1 diabetes attending the diabetic center in Tabuk City, Saudi Arabia. The majority were adolescents and young adults, with 50.7% aged 15–30 years [n=189], and 49.3% aged 0–14 years [n=184]. Females constituted a slightly higher proportion than males, accounting for 53.4% [n=199] and 46.6% [n=174], respectively. Most participants had a body weight of less than 50 kg [81.8%, n=305] and a height of less than 150 cm [79.6%, n=297]. Regarding BMI, 46.1% [n=172] were underweight, 38.6% [n=144] had normal weight, while 12.9% [n=48] were obese and only 2.4% [n=9] were overweight. The most common age at diagnosis was 10–12 years [42.9%, n=160], with a mean age of diagnosis of 12.6 ± 3.0 years. In terms of insulin therapy, more than half of the patients [51.2%, n=191] used less than 20 international units daily, with an average dose of 22.6 ± 13.4 IU. Diabetic ketoacidosis [DKA] was reported at least once in all participants, with 50.7% [n=189] experiencing it once, 25.7% [n=96] twice, and 18.0% [n=67] three times. A smaller proportion had four [2.9%, n=11] or five [2.7%, n=10] DKA episodes.

Figure 1 illustrates the prevalence of celiac disease among patients with type 1 diabetes mellitus at the Diabetic Center in Tabuk City, Saudi Arabia, in 2024. Out of 373 patients, only 9 [2.4%] were known cases of celiac disease, while the vast majority, 364 patients [97.6%], had no history of the condition.

Figure 1. The Prevalence of celiac disease among Type 1 diabetes mellitus in Diabetic center of Tabuk City, Saudi Arabia 2024 (N=373)

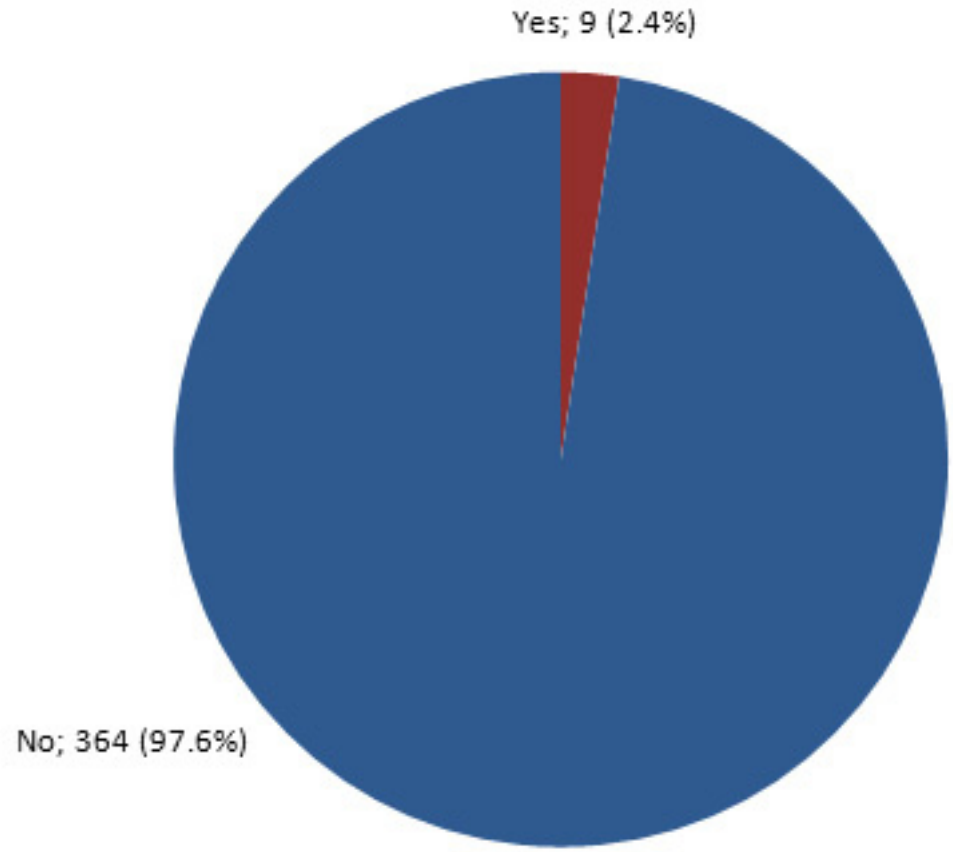

Table 1. Bio-Demographic Characteristics of Type 1 Diabetic Patients in Diabetic center of Tabuk City, Saudi Arabia 2024 (N=373)

Bio-demographics	No	%
Age in years		
0-14	184	49.3%
15-30	189	50.7%
Gender		
Male	174	46.6%
Female	199	53.4%
Weight in Kg		
< 50 Kg	305	81.8%
> 50 Kg	68	18.2%
Height in cm		
< 150 cm	297	79.6%
> 150 cm	76	20.4%
Body mass index		
Underweight	172	46.1%
Normal weight	144	38.6%
Overweight	9	2.4%
Obese	48	12.9%
Age of type 1 diabetes mellitus diagnosis		
7-9 years old	63	16.9%
10-12 years old	160	42.9%
13-16 years old	98	26.3%
17-18 years old	52	13.9%
Mean ± SD	12.6 ± 3.0	
Total daily insulin Doses		
< 20 iu	191	51.2%
20-30 iu	124	33.2%
> 30 iu	58	15.5%
Mean ± SD	22.6 ± 13.4	
Frequency of DKA		
1 time	189	50.7%
2 times	96	25.7%
3 times	67	18.0%
4 times	11	2.9%
5 times	10	2.7%

Table 2 presents the clinical and diagnostic characteristics of the 9 patients with type 1 diabetes mellitus who were also diagnosed with celiac disease at the Diabetic Center in Tabuk City. The age at diagnosis varied, with the majority being diagnosed at 12 and 17 years [33.3% each], followed by 10 years [22.2%] and 18 years [11.1%]. Regarding presenting symptoms, abdominal cramping or pain was the most commonly reported [44.4%], followed by diarrhea [33.3%] and bloating [22.2%]. Notably, all patients were reported to be in a "well" physical condition at the time of diagnosis [100%]. Glycemic control, as reflected by HbA1c levels at the time of celiac disease diagnosis, ranged from 7.0% to 8.0%, with most patients falling between 7.0% and 7.3%. Serological testing using anti-tTG antibodies were utilized in all cases for diagnosis [100%].

Table 2. Clinical and Diagnostic Characteristics of Type 1 Diabetic Patients Diagnosed with Celiac Disease at the Diabetic Center of Tabuk City, Saudi Arabia (N=9)

Items	No	%
Age diagnosis of celiac disease		
10 years	2	22.2%
12 years	3	33.3%
17 years	3	33.3%
18 years	1	11.1%
Celiac disease symptoms at time of diagnosis		
Abdominal Cramping / pain	4	44.4%
Bloating	2	22.2%
Diarrhea	3	33.3%
Physical examination at time of diagnosis		
Well	9	100.0%
HGA1C at time of celiac disease diagnosis:		
7.0%	2	22.2%
7.10%	3	33.3%
7.3%	3	33.3%
8.0%	1	11.1%
Diagnostic tests used for celiac disease		
anti-tTG	9	100.0%
Other autoimmune diseases		
No	9	100.0%

Table 3 explores the factors associated with the presence of celiac disease among patients with type 1 diabetes mellitus at the Diabetic Center in Tabuk City. Overall, none of the demographic or clinical variables showed statistically significant associations with celiac disease, except for body mass index [BMI], which demonstrated a significant relationship [p = 0.049]. Among underweight patients, 4.7% had celiac disease compared to 0% in the normal weight and overweight groups, and 2.1% in the obese group. Other factors, including age group [p = 0.705], gender [p = 0.893], weight [p = 0.575], and height [p = 0.485], did not show statistically significant associations. For example, 2.7% of children aged 0–14 years and 2.1% of those aged 15–30 years had celiac disease. Males and females had similar prevalence rates [2.3% vs. 2.5%, respectively]. Likewise, no significant associations were found between celiac disease and age at diabetes diagnosis [p = 0.226], daily insulin dose [p = 0.094], or frequency of diabetic ketoacidosis [DKA] episodes [p = 0.215], though higher celiac prevalence was observed among those who had experienced DKA three times [6.0%].

Table 3. Factors Associated With Celiac Disease among Type 1 Diabetic Patients Diagnosed with Celiac Disease at the Diabetic Center of Tabuk City, Saudi Arabia (N=9).

Factors	Patient known case of celiac?				p-value
	Yes		No		
	No	%	No	%	
Age in years					
0-14	5	2.7%	179	97.3%	.705
15-30	4	2.1%	185	97.9%	
Gender					
Male	4	2.3%	170	97.7%	.893
Female	5	2.5%	194	97.5%	
Weight in Kg					
< 50 Kg	8	2.6%	297	97.4%	.575
> 50 Kg	1	1.5%	67	98.5%	
Height in cm					
< 150 cm	8	2.7%	289	97.3%	.485
> 150 cm	1	1.3%	75	98.7%	
Body mass index					
Underweight	8	4.7%	164	95.3%	
Normal weight	0	0.0%	144	100.0%	.049*
Overweight	0	0.0%	9	100.0%	
Obese	1	2.1%	47	97.9%	
Age of type1 diabetes mellitus diagnosis					
7-9 years old	0	0.0%	63	100.0%	.226
10-12 years old	5	3.1%	155	96.9%	
13-16 years old	4	4.1%	94	95.9%	
17-18 years old	0	0.0%	52	100.0%	
Total daily insulin Doses					
< 20 iu	2	1.0%	189	99.0%	.094
20-30 iu	6	4.8%	118	95.2%	
> 30 iu	1	1.7%	57	98.3%	
Frequency of DKA					
1 time	2	1.1%	187	98.9%	
2 times	3	3.1%	93	96.9%	.215
3 times	4	6.0%	63	94.0%	
4 times	0	0.0%	11	100.0%	
5 times	0	0.0%	10	100.0%	

P: Exact probability test
* P < 0.05 (significant)

Table 4 presents the distribution of the age at celiac disease diagnosis among type 1 diabetic patients according to various bio-demographic and clinical factors [n=9]. The results show statistically significant associations between age of celiac diagnosis and both gender [p = 0.001] and age at type 1 diabetes mellitus [T1DM] diagnosis [p = 0.001]. Males were diagnosed with celiac disease at a significantly older age [mean = 17.3 ± 0.5 years] compared to females [mean = 11.2 ± 1.1 years]. Similarly, patients who were diagnosed with T1DM at ages 13–16 were found to have a later celiac diagnosis [mean = 17.3 ± 0.5 years] compared to those diagnosed with T1DM at 10–12 years [mean = 11.2 ± 1.1 years].

Other factors, such as BMI [p = 0.204], total daily insulin dose [p = 0.080], and frequency of DKA [p = 0.069], did not reach statistical significance, although trends were noted. Underweight patients were diagnosed with celiac disease at a mean age of 13.4 years, while obese patients were diagnosed later at 18.0 years. Similarly, patients using >30 IU insulin daily or experiencing three DKA episodes also tended to receive a later diagnosis [18.0 and 17.3 years, respectively].

Table 4. Distribution of age of celiac diseases diagnosis by type 1 diabetic patients bi-demographic characteristics (n=9)

Factors	Age diagnosis of celiac disease		p-value
	Mean	SD	
Gender			
Male	17.3	0.5	.001*#
Female	11.2	1.1	
Body mass index			
Underweight	13.4	3.1	.204#
Obese	18.0	0.0	
Age of type1 diabetes mellitus diagnosis			
10-12 years old	11.2	1.1	.001*#
13-16 years old	17.3	0.5	
Total daily insulin Doses			
< 20 iu	10.0	0.0	.080
20-30 iu	14.5	2.7	
> 30 iu	18.0	0.0	
Frequency of DKA			
1 time	10.0	0.0	.069
2 times	12.0	0.0	
3 times	17.3	0.5	

P: One-Way ANOVA # Independent samples t-test* P < 0.05 (significant)

Discussion

The study assessed 373 patients with type 1 diabetes at a diabetic center in Tabuk City, Saudi Arabia. Most were adolescents and young adults, with nearly equal numbers between ages 0–14 and 15–30. Slightly more females than males were included. The majority had a low body weight and short height, and almost half were underweight, while only a small portion was overweight or obese. Most were diagnosed around ages 10–12, with the average age of diagnosis being around 12–13 years.

When it came to insulin use, over half took less than 20 units per day. All patients had experienced diabetic ketoacidosis [DKA] at least once, with many having one to three episodes, and a few having up to five.

The high rate of DKA across all patients highlights how common this serious complication is, possibly pointing to difficulties in diabetes control or delayed diagnosis. The insulin doses used were relatively low, which might reflect the younger age and lower body weight of the group. The finding that over half of the patients used less than 20 units of insulin daily aligns with studies on type 1 diabetes in younger populations, where lower insulin requirements are common due to lower body weight and residual beta-cell function in early disease stages [12]. However, the average dose [22.6 ± 13.4 IU] appears slightly lower than reported in some Western cohorts, possibly due to differences in body composition or dietary habits [13]. The universal history of DKA in this study contrasts with global data, where DKA rates at diagnosis vary widely [20–70%] but are not universally present in all patients [14]. The high recurrence of DKA [up to five episodes in some cases] reflects challenges in diabetes management, consistent with studies from regions with limited access to continuous glucose monitoring or insulin pumps [15]. Similar patterns of frequent DKA episodes have been reported in other Middle Eastern populations, possibly due to delayed diagnosis or socioeconomic barriers to optimal care [16].
With regard to celiac disease prevalence, our study found that 2.4% of type 1 diabetes [T1DM] patients at the Diabetic Center in Tabuk City had a confirmed diagnosis of celiac disease [CD]. This prevalence is substantially lower than global and regional estimates. A large meta-analysis by Elfström et al. [2014] involving 26,605 T1DM patients across multiple countries reported a pooled CD prevalence of 6.0%, with higher rates in Europe compared to North America and Asia [17]. This suggests that our observed prevalence in Tabuk is below the global average, possibly due to regional genetic differences, lower screening rates, or environmental factors such as dietary habits.

However, studies from Saudi Arabia generally report much higher CD prevalence in T1DM patients than our findings. For instance, Aljulifi et al. [2021] found that 11.5% of T1DM patients in Riyadh were seropositive for CD, though only 2.4% had biopsy-confirmed disease [18]. Similarly, Saadah et al. [2012] reported 21.2% seropositivity and 11.2% biopsy-proven CD in Jeddah, indicating that the western region of Saudi Arabia may have particularly high CD-T1DM overlaps [19]. A national meta-analysis by Safi et al. [2018] estimated a 12.0% biopsy-confirmed CD prevalence among Saudi T1DM patients double the global average [20]. Even in southwestern Saudi Arabia [Aseer region], Al-Hakami [2014] found that 10.4% of T1DM patients had CD [21].

The lower prevalence in Tabuk could be attributed to several factors including underdiagnosis due to limited screening: If CD testing was not routine, asymptomatic cases may have been missed and regional variations; Genetic susceptibility or dietary gluten exposure, may differ across Saudi Arabia. Also, there may be Methodological differences as some studies relied on serological screening [which overestimates prevalence], whereas our study only included previously diagnosed cases.

Our study also found that most demographic and clinical factors were not significantly associated with celiac disease (CD) among patients with type 1 diabetes mellitus (T1DM), except for body mass index (BMI), where underweight patients had a significantly higher prevalence of CD ($p = 0.049$). Although other variables like age, gender, and DKA frequency showed no significant associations, a higher CD rate was noted in those with recurrent DKA. The limited number of CD cases (n = 9) may have influenced the statistical outcomes. These findings highlight BMI as a potential clinical indicator for CD screening, though broader screening remains important due to the variable presentation of CD in T1DM patients.

Conclusion and Recommendations

In conclusion, this study found that the prevalence of celiac disease (CD) among patients with type 1 diabetes mellitus (T1DM) in the Diabetic Center of Tabuk City was relatively low (2.4%). Most patients were adolescents and young adults, with nearly half being underweight. While most demographic and clinical factors were not significantly linked to CD, being underweight was a notable exception and was significantly associated with a higher likelihood of having CD. Additionally, males and those diagnosed with T1DM at an older age tended to receive a later CD diagnosis. Based on these findings, we recommend maintaining routine screening for celiac disease in all patients with T1DM, especially those who are underweight or have recurrent DKA episodes. Early detection through serological testing such as anti-tTG remains crucial to prevent long-term complications. Clinicians should also be aware of the variable symptoms of CD and consider it even in well-appearing patients.

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