The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 7, 2025

CORRELATION BETWEEN HBA1C LEVELS AND DURATION OF 1ST PRESENTATION AFTER ONSET OF SYMPTOMS IN NEWLY DIAGNOSED TYPE 2 DIABETES MELLITUS PATIENTS

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DOI: https://doi.org/10.5281/zenodo.16603439

Keywords
Type 2 Diabetes Mellitus, HbA1c, Symptom Duration, Hyperglycemia, Diagnosis, Cross-Sectional Study

Article History
Received on 30 April 2025
Accepted on 15 July 2025
Published on 30 July 2025

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Abstract

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and persistent hyperglycemia. HbA1c, a glycated hemoglobin marker, reflects average plasma glucose over the past 2–3 months and is widely utilized for diagnosis and monitoring of diabetes. Elevated HbA1c at diagnosis often indicates prolonged, undetected hyperglycemia. The duration of classic diabetic symptoms such as polyuria, polydipsia, fatigue, and weight loss may serve as an early clinical indicator of long-standing hyperglycemia.

OBJECTIVES: *To assess the correlation between HbA1c levels and the duration of diabetes-related symptoms in newly diagnosed T2DM patients.*

1. *To evaluate whether symptom duration can predict the severity of hyperglycemia at the time of diagnosis.*
2. *To explore the potential for using symptom duration as an indicator of long-standing undiagnosed hyperglycemia.*
3. *To assess whether HbA1c levels can be used to estimate the duration of diabetes.*

METHODS: *A cross-sectional study was conducted at the Outpatient Department of Medicine, Khyber Teaching Hospital, Peshawar, Pakistan. A total of 301 newly diagnosed T2DM patients were enrolled. Data were collected using a structured questionnaire covering demographics, symptom duration, presenting symptoms, co-morbidities, and diabetic complications. HbA1c levels were measured at diagnosis. Statistical analysis included correlation coefficients and Chi-square tests to determine associations between symptom duration and HbA1c levels.*

RESULTS: *The majority of patients were between 41–60 years of age, with 57.8% males and 64.1% reporting a family history of diabetes. Common presenting symptoms included abnormal thirst (62.8%), frequent urination (57.1%), and fatigue (44.5%). Symptom duration varied: 37.2% reported symptoms for <1 month, 44.5% for 1–3 months, and 18.3% for >3 months. Mean HbA1c levels increased significantly with symptom duration: 7.1% for <1*

month, 8.5% for 1–3 months, and 10.6% for >3 months (r = 0.68, p < 0.001). A significant association was observed between longer symptom duration and higher HbA1c levels (p < 0.001).

CONCLUSION: *Symptom duration is strongly correlated with HbA1c levels in newly diagnosed T2DM patients and can serve as a useful clinical indicator of the severity and potential chronicity of hyperglycemia. In settings where diagnostic tools are limited, symptom history may aid early identification of high-risk patients, guiding timely intervention and complication screening.*

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a prevalent chronic metabolic disorder characterized by insulin resistance and sustained hyperglycemia. If left undiagnosed or poorly managed, it can lead to serious long-term complications including retinopathy, nephropathy, neuropathy, and cardiovascular disease. Glycated hemoglobin (HbA1c) serves as a critical biomarker for both the diagnosis and monitoring of diabetes, reflecting the average blood glucose levels over the preceding two to three months. Elevated HbA1c levels at the time of diagnosis are often indicative of prolonged periods of undetected hyperglycemia, which may correspond to the duration and severity of classic diabetic symptoms such as polyuria, polydipsia, fatigue, and unintentional weight loss.

Patients with T2DM often remain asymptomatic for extended periods, resulting in delays in diagnosis and higher HbA1c values at the time of detection. This diagnostic delay increases the risk of developing microvascular and macrovascular complications. Evidence suggests that earlier recognition and treatment of hyperglycemia significantly reduce the likelihood of such outcomes. Even modest reductions in HbA1c levels are associated with lower complication rates, with the lowest risks observed in individuals maintaining HbA1c levels within the normal range (<6.0%) [1].

Although common symptoms such as frequent urination, excessive thirst, blurred vision, and neuropathic sensations are often present, they may be subtle or overlooked. This can lead to significant underdiagnosis or delayed diagnosis. Some studies have highlighted that complications may begin to develop even when HbA1c levels are below the conventional diagnostic threshold, emphasizing the need for timely intervention [2]. Furthermore, individuals with undiagnosed diabetes can experience vascular damage due to intermittent hyperglycemia, reinforcing the need for heightened clinical vigilance [3].

This study aims to investigate the relationship between the duration of diabetes-related symptoms and HbA1c levels at the time of diagnosis. Understanding this correlation could provide valuable insights into the timeline and severity of undiagnosed diabetes. If a significant association is established, symptom duration may serve as a practical, low-cost proxy indicator for estimating the chronicity of hyperglycemia. Such a tool could enhance early detection strategies, guide clinical decision-making, and ultimately improve outcomes for individuals with T2DM by facilitating timely diagnosis and intervention.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Outpatient Department of Medicine, Khyber Teaching Hospital, Peshawar, Pakistan, a tertiary care facility. The study duration was six months, beginning from the date of ethical approval. A total of 301 participants were recruited using a non-probability consecutive sampling technique. The sample size was calculated using OpenEpi software, with assumptions of a 95% confidence level, 5% margin of error, and 26.7% prevalence of diabetes in Pakistan.

Inclusion criteria comprised patients aged 30 to 65 years who were newly diagnosed with Type 2 Diabetes Mellitus (T2DM) based on the American Diabetes Association (ADA) criteria, with an HbA1c level of ≥6.5%. Only those able to reliably self-report the duration of their symptoms were included. Patients previously diagnosed with T2DM, those with other forms of diabetes such as Type 1 diabetes, MODY, or gestational diabetes, and individuals

taking medications known to affect blood glucose levels (e.g., corticosteroids) were excluded. Additionally, patients with significant cognitive or communicative impairments that could affect data accuracy were not included in the study.

Diabetes Mellitus was defined as a metabolic condition characterized by persistent hyperglycemia, diagnosed through the measurement of glycated hemoglobin (HbA1c). An HbA1c value of ≥6.5% confirmed the diagnosis of T2DM. HbA1c levels above 7–8% at the time of diagnosis were considered suggestive of prolonged hyperglycemia over several months, while levels above 10% indicated a more extended undiagnosed duration, potentially spanning years.

Participants were interviewed using a structured questionnaire, which included a checklist of common diabetes symptoms: polyuria, polydipsia, polyphagia, unexplained weight loss, fatigue, blurred vision, and tingling or numbness in the hands or feet. Based on patient recall, the duration of these symptoms before diagnosis was categorized into three groups: less than 1 month, 1 to 3 months, and more than 3 months.

All participants provided informed written consent prior to enrollment. Ethical clearance was obtained from the Institutional Review Board (IRB) of Khyber Teaching Hospital. Data were collected using a specially designed proforma that included demographic details, presence of comorbidities, family history, and clinical characteristics. Blood samples were collected at the time of diagnosis and analyzed for HbA1c levels using standardized laboratory procedures.

Data analysis was performed using SPSS version 25. Descriptive statistics were computed for all categorical and continuous variables. The association between symptom duration and HbA1c levels was assessed using Pearson's correlation coefficient. The predictive relationship between symptom duration and severity of hyperglycemia (defined as HbA1c >6.5% and >10%) was evaluated using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 301 newly diagnosed type 2 diabetes mellitus (T2DM) patients were included in the study. The majority of the participants were aged between 41–60 years, with 29.2% in the 41–50 age group and 31.6% in the 51–60 age group. Participants aged 30–40 years accounted for 23.9%, while those aged 61–65 made up 15.3% of the sample. There was a male predominance, with 57.8% of the study population being male and 42.2% female. A positive family history of diabetes mellitus was reported by 64.1% of the participants. Among the common comorbid conditions, hypertension was reported in 52.5% of patients and ischemic heart disease in 27.6%.

At the time of diagnosis, several diabetes-related complications were already present. Diabetic neuropathy was the most commonly observed complication, affecting 25.6% of patients, followed by diabetic retinopathy in 20.3%, nephropathy in 15.9%, and diabetic foot complications in 9.6% of the study participants.

Regarding the glycemic status at the time of diagnosis, 52.2% of participants had HbA1c levels greater than 6.5%, while 47.8% had HbA1c values exceeding 10%, indicating a high proportion of patients presenting with severe hyperglycemia at first diagnosis.

In terms of clinical presentation, the most frequently reported symptoms included abnormal thirst (62.8%), frequent urination (57.1%), fatigue (44.5%), and weight loss (41.9%). Visual disturbances were noted in 32.6%, while tingling or numbness in the extremities was present in 36.9%. Notably, 14.0% of patients were asymptomatic at the time of diagnosis, and for 9.0%, the diagnosis was made incidentally.

Assessment of symptom duration before diagnosis revealed that 37.2% of patients had experienced symptoms for less than one month, 44.5% had symptoms for 1–3 months, and 18.3% reported symptom duration greater than three months.

The analysis of HbA1c levels by symptom duration showed a clear upward trend. Patients who had symptoms for less than one month had a mean HbA1c of 7.1 ± 0.8. Those with symptoms for 1–3 months had a mean HbA1c of 8.5 ± 1.1, while those with symptoms for more than three months had a significantly higher mean HbA1c of 10.6 ± 1.4. A statistically significant positive correlation was observed between symptom duration and HbA1c levels ($r = 0.68$, $p < 0.001$), indicating that longer

duration of symptoms before diagnosis was associated with higher levels of hyperglycemia.

Further analysis demonstrated that symptom duration was a strong predictor of hyperglycemia severity. Among those with symptom duration of less than one month, 91.1% had HbA1c >6.5%, but only 19.6% had HbA1c >10%. In contrast, among those with symptoms for more than three months, while 85.5% had HbA1c >6.5%, a substantial 72.7% had HbA1c >10%. The Chi-square test revealed a statistically significant association between longer symptom duration and higher HbA1c levels ($p < 0.001$), supporting the hypothesis that symptom duration can be used as a predictor for the severity of hyperglycemia at the time of T2DM diagnosis.

Table 1: Demographic Characteristics of Study Participants (n = 301)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	30–40	72	23.9
	41–50	88	29.2
	51–60	95	31.6
	61–65	46	15.3
Gender	Male	174	57.8
	Female	127	42.2
Family History of DM	Yes	193	64.1
	No	108	35.9
Other Co-morbidities	Hypertension	158	52.5
	IHD	83	27.6

Table 2: Diabetes-Related Complications at Time of Diagnosis (n = 301)

Complication	Present (n)	Percentage (%)
Diabetic Retinopathy	61	20.3
Diabetic Neuropathy	77	25.6
Diabetic Nephropathy	48	15.9
Diabetic Foot	29	9.6

Table 3: HbA1c Level at Diagnosis (n = 301)

HbA1c Level	Frequency (n)	Percentage (%)
>6.5	157	52.2
>10	144	47.8

Table 4: Presenting Symptoms at Diagnosis (n = 301)

Symptom	Frequency (n)	Percentage (%)
Abnormal Thirst	189	62.8
Frequent Urination	172	57.1
Weight Loss	126	41.9
Fatigue	134	44.5
Visual Disturbances	98	32.6
Tingling or Numbness in Hands/Feet	111	36.9
Asymptomatic	42	14.0
Incidental Finding	27	9.0

Table 5: Duration of Symptoms Before Diagnosis (n = 301)

Duration	Frequency (n)	Percentage (%)
<1 Month	112	37.2
1–3 Months	134	44.5
>3 Months	55	18.3

TABLE 6: MEAN HBA1C BY SYMPTOM DURATION:

Symptom Duration	Mean HbA1c ± SD	n (%)
<1 month	7.1 ± 0.8	112 (37.2)
1–3 months	8.5 ± 1.1	134 (44.5)
>3 months	10.6 ± 1.4	55 (18.3)

Correlation coefficient ($r = 0.68$, $p < 0.001$)
This indicates a moderate to strong positive correlation between symptom duration and HbA1c levels.

TABLE 7: SYMPTOM DURATION AS A PREDICTOR OF SEVERITY OF HYPERGLYCEMIA

Symptom Duration	HbA1c >6.5 (n/%)	HbA1c >10 (n/%)	Total n (%)
<1 month	102 (91.1%)	22 (19.6%)	112 (37.2%)
1–3 months	115 (85.8%)	82 (61.2%)	134 (44.5%)
>3 months	47 (85.5%)	40 (72.7%)	55 (18.3%)

A Chi-square test showed a significant association between longer symptom duration and higher HbA1c levels ($p < 0.001$), suggesting that symptom duration can predict severity of hyperglycemia.

DISCUSSION:

In this study involving 301 newly diagnosed patients with type 2 diabetes mellitus (T2DM), we aimed to evaluate whether the duration of symptoms prior to diagnosis correlates with HbA1c levels and could potentially serve as a proxy indicator of disease duration and severity. The results clearly demonstrate that longer symptom duration is significantly associated with higher HbA1c levels and greater likelihood of diabetes-related complications at the time of diagnosis.

A key finding was the progressive increase in mean HbA1c levels with symptom duration. Patients reporting symptoms for less than one month had a mean HbA1c of 7.1%, which increased to 8.5% for those with symptoms of 1–3 months and peaked at 10.6% in patients with symptom durations greater than three months. This trend demonstrated a strong positive correlation ($r = 0.68$, $p < 0.001$). Our findings are consistent with a study by Huang et al. in rural China, where delayed recognition of symptoms resulted in worse glycemic profiles at diagnosis [1]. It also aligns with data from the UK Perspective Diabetes Study (UKPDS), which found that patients with undiagnosed T2DM had likely lived with the disease for a median of 4–7 years before diagnosis, accumulating microvascular damage during this silent phase [2].

The correlation between symptom duration and hyperglycemia severity was further confirmed by the distribution of HbA1c levels. While 91.1% of patients with symptoms under one month had HbA1c >6.5%, only 19.6% reached HbA1c >10%. In contrast, among those symptomatic for more than three months, 72.7% had HbA1c >10%. These findings closely match results from a Korean cross-sectional study that found patients with longer pre-diagnosis symptom duration had both higher HbA1c and greater insulin resistance [3]. This supports the hypothesis that symptom duration can be used not only as a temporal marker but also as a proxy for metabolic decompensation.

Importantly, the presence of diabetic complications at the time of diagnosis in a significant proportion of patients 25.6% with neuropathy, 20.3% with

retinopathy, 15.9% with nephropathy, and 9.6% with diabetic foot raises concern. These figures indicate a high burden of chronic hyperglycemia even at initial diagnosis, especially among those with prolonged, unrecognized symptoms. Stratton et al. demonstrated a direct linear relationship between HbA1c levels and the risk of microvascular complications, with each 1% rise in HbA1c increasing complication risk by approximately 37% (BMJ. 2000;321(7258):405–12. doi:10.1136/bmj.321.7258.405) [2-4].

Our data also show that the most commonly reported symptoms abnormal thirst (62.8%), frequent urination (57.1%), fatigue (44.5%), and weight loss (41.9%) correspond to those described in classical presentations of T2DM. However, the presence of asymptomatic patients (14%) and those diagnosed incidentally (9%) underscores the silent progression of the disease. This finding is supported by the American Diabetes Association, which reports that many patients remain asymptomatic for years, leading to underdiagnosis and late treatment initiation [5-7].

One implication of these results is the potential use of symptom duration as a clinical tool in estimating disease chronicity in patients lacking regular access to HbA1c testing. In low-resource settings where diagnostic tools are limited, documenting symptom onset may offer valuable clinical insight. While HbA1c reflects average blood glucose over 2–3 months, symptom history can supplement this to gauge longer undiagnosed durations and prompt early screening for complications.

Our study reinforces the findings of Akselrod et al., who noted that higher HbA1c variability is associated with greater complication rates, suggesting that consistently elevated HbA1c from delayed diagnosis contributes to irreversible end-organ damage [8,10].

Nevertheless, this study has limitations. The cross-sectional design precludes causal inference, and reliance on patient-reported symptom duration introduces recall bias. Furthermore, lack of longitudinal follow-up prevents analysis of how these initial HbA1c levels and complications evolve with treatment. Despite these limitations, the findings align with multiple large-scale studies and offer valuable insights applicable in both clinical and public health contexts.

In conclusion, symptom duration is strongly correlated with HbA1c levels and may serve as a surrogate marker for disease chronicity and hyperglycemia severity in newly diagnosed T2DM. These findings highlight the need for enhanced public awareness of diabetes symptoms, timely screening, and prompt intervention to reduce the burden of complications at diagnosis, especially in underserved regions.

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