# Assessment of random blood glucose levels among dental outpatients for early detection of undiagnosed diabetes: A Hospital-Based Cross-Sectional Survey

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## Abstract

**Background:** Diabetes mellitus (DM) is a chronic metabolic disease that often remains undiagnosed for years. Dental professionals can serve as front-line screeners for undiagnosed hyperglycemia because many oral manifestations reflect systemic glucose dysregulation.

**Aim:** To estimate the prevalence of elevated random blood glucose (RBS) levels among undiagnosed individuals visiting a dental institution and to correlate the findings with age and gender.

**Methods:** A cross-sectional study was conducted among 300 adult patients attending the out-patient department of Vishnu Dental College, Bhimavaram. Venous blood samples were tested for RBS using the glucose oxidase–peroxidase method. Participants were classified as non-diabetic (<140 mg/dL), prediabetic (140–199 mg/dL), or diabetic (≥200 mg/dL). Data were analyzed using SPSS v25 and Chi-square tests.

**Results:** Out of 290 consenting participants, 76 % were non-diabetic, 12 % prediabetic, and 12 % diabetic. Elevated RBS values were significantly associated with male gender and older age ($p < 0.05$).

**Conclusion:** Routine chairside glucose screening in dental clinics is a simple and effective method to identify undiagnosed hyperglycemia. Integrating this practice could contribute to early referral and prevention of systemic complications.

**Keywords:** Undiagnosed Diabetes; Random Blood Sugar; Dental Screening; Prediabetes; Oral Health; Diabetes Mellitus

## Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. It has emerged as one of the most prevalent non-communicable diseases of the 21st century, contributing significantly to global morbidity, mortality, and economic burden. According to the International Diabetes Federation (IDF) Diabetes Atlas, 10th edition (2024), an estimated 537 million adults worldwide are living with diabetes, and this number is expected to exceed 640 million by 2030 [1].

India, often referred to as the *"diabetes capital of the world,"* ranks second globally in diabetes prevalence, with approximately 77 million diagnosed diabetics and nearly half remaining undiagnosed [2,3]. The World Health Organization (WHO) has identified diabetes as a major public health priority, emphasizing early detection and prevention as key components of global health strategies [4]. Undiagnosed hyperglycemia contributes to complications including neuropathy, retinopathy, nephropathy, delayed wound healing, and increased susceptibility to infections [5].

Dental professionals often encounter oral signs that may reflect underlying systemic diseases. Common oral manifestations in diabetic patients include xerostomia, gingival inflammation, periodontal disease, and delayed tissue repair [6,7]. These signs can precede a formal diagnosis of diabetes, positioning dental practitioners uniquely for early screening and referral. Recognizing the oral-systemic health connection, the American Dental Association (ADA) and the International Diabetes Federation (IDF) have encouraged opportunistic diabetes screening during dental visits [8,9].

Random Blood Sugar (RBS) testing serves as a rapid, non-invasive, and practical screening tool that can be conveniently incorporated into dental practice. It does not require fasting and can be performed chairside, thereby increasing patient compliance [10,11]. Several studies have demonstrated that individuals visiting dental clinics—particularly those with periodontal disease are at higher risk for undiagnosed hyperglycemia [12–14].

Despite extensive research in urban medical setups, limited data exist from dental institutions in semi-urban and rural regions of India where access to routine medical screening may be limited. Integrating glucose estimation into dental outpatient departments (OPDs) could help identify at-risk individuals earlier, facilitating timely referral and preventive counseling.

The present study was undertaken with the primary aim of assessing the prevalence of elevated random blood glucose levels among undiagnosed dental patients attending a private dental institution. Furthermore, it sought to identify the proportion of patients falling within normoglycemic, prediabetic, and diabetic categories as per WHO 2023 criteria. The study also aimed to analyze correlations between glycemic status, age, and

gender, thereby identifying demographic groups with higher susceptibility to undiagnosed diabetes.

## MATERIALS AND METHODS

### Sample Size Estimation, Study Design, and Patient Enrollment

The present investigation was designed as a hospital-based cross-sectional observational study conducted at the Outpatient Department (OPD) of Vishnu Dental College, Bhimavaram, Andhra Pradesh, India, between September and November 2022. Prior to commencement, the study protocol was reviewed and approved by the Institutional Ethics Committee of Vishnu Dental College (Ref No: VDC/IEC/2021/UG 01/OMFS/IVV/67). All study procedures complied with the ethical principles outlined in the Declaration of Helsinki (2013 revision). Written informed consent was obtained from all participants prior to inclusion in the study.

The sample size was estimated based on data from previous regional studies that reported a prevalence of 20–25% of undiagnosed diabetes among dental outpatients [1,2]. Using the formula for estimating proportions:

$$n=Z^2\times p(1-p) / d^2$$

where $Z$ = 1.96 for 95% confidence, $p$ = 0.25 (expected prevalence), and $d$ = 0.05 (margin of error), the minimum required sample size was calculated as 288. To account for potential data loss, a total of 300 patients were initially recruited. Of these, 290 participants provided consent for blood testing and were included in the final analysis.

Patients attending the OPD for routine dental treatment—such as scaling, restorations, extractions, and prosthodontic care—were screened for eligibility. A brief medical history was recorded for all, and those fulfilling the inclusion criteria were enrolled consecutively until the desired sample size was achieved.

## Inclusion and Exclusion Criteria

**Inclusion Criteria:**
The study included adults aged 18 years and above who reported to the dental OPD for treatment and were not previously diagnosed with diabetes mellitus. Only individuals who provided written informed consent and agreed to undergo blood glucose estimation were included.

**Exclusion Criteria:**
Patients with a known diagnosis of diabetes mellitus, those currently on antidiabetic medication (oral hypoglycemics or insulin), or those with systemic diseases that could

influence glucose metabolism were excluded. Individuals taking glucocorticoids, beta-blockers, or hormonal therapy, as well as pregnant and lactating women, were also excluded. Patients who declined to participate or refused venipuncture were omitted from the study.

**Procedure**

After obtaining informed consent, each participant underwent a detailed case history and oral examination prior to glucose estimation. A structured proforma was used to record personal details, demographic information (age, gender, occupation, and residence), relevant medical and family history, and lifestyle factors such as smoking and alcohol consumption.

The Random Blood Sugar (RBS) level was estimated to identify potential cases of undiagnosed diabetes. Venous blood samples (2 mL) were drawn aseptically from the antecubital vein using sterile disposable syringes and collected in fluoride-oxalate vials to prevent glycolysis. All samples were analyzed within 30 minutes in the institutional biochemistry laboratory.

Blood glucose estimation was performed using the Glucose Oxidase–Peroxidase (GOD–POD) enzymatic colorimetric method, a reliable and standardized test suitable for population-level screening. In this method, glucose is oxidized by glucose oxidase to produce gluconic acid and hydrogen peroxide, which reacts with phenol and 4-aminoantipyrine under the action of peroxidase to form a red-colored complex. The intensity of the color, measured spectrophotometrically at 505 nm, is directly proportional to the glucose concentration in the sample and is expressed in milligrams per deciliter (mg/dL).

The analyzer (Erba XL-640, Mannheim, Germany) was calibrated daily using known glucose standards. Internal quality control was maintained by processing duplicate samples for 10% of participants to ensure analytical accuracy.

The RBS values were categorized according to World Health Organization (WHO) guidelines (2023) as follows:

- Non-diabetic: < 140 mg/dL
- Prediabetic: 140–199 mg/dL
- Diabetic: ≥ 200 mg/dL

Each participant was counseled about their glucose status. Those falling into prediabetic or diabetic categories were informed about their condition and referred to a physician for confirmatory testing (Fasting Plasma Glucose and HbA1c) and further management.

Counseling included advice on dietary modifications, weight control, physical activity, and maintenance of oral hygiene.

In addition to RBS testing, clinical oral findings associated with diabetes—such as gingival inflammation, bleeding, xerostomia, and poor wound healing—were noted for correlation. Although these findings were observational, they reinforced the concept of utilizing dental settings as potential screening points for systemic diseases.

All study procedures, including history taking, oral examination, and blood sampling, were completed during a single visit to ensure patient convenience and to simulate the feasibility of integrating glucose screening into routine dental care.

## Statistical Analysis

Data from the case proformas and laboratory results were entered into Microsoft Excel 2021 and analyzed using IBM SPSS Statistics Version 25.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were computed for continuous variables (mean, standard deviation) and categorical variables (frequency and percentage).

Comparisons between categorical variables such as RBS categories, age groups, and gender were performed using the Chi-square test. A $p$-value $< 0.05$ was considered statistically significant. The results were graphically represented in bar charts and frequency tables to illustrate the distribution of RBS levels among different demographic groups.

## RESULTS

A total of 290 participants were included in the final analysis, comprising 162 males (55.9%) and 128 females (44.1%). The age of participants ranged from 18 to 70 years, with a mean of 37.2 ± 12.4 years. The majority of patients were between 18 and 39 years of age (Table 1).

Based on WHO 2023 diagnostic criteria, Random Blood Sugar (RBS) levels categorized 221 (76.2%) participants as non-diabetic, 35 (12.1%) as prediabetic, and 34 (11.7%) as diabetic (Table 2). Thus, approximately one-fourth of individuals attending the dental outpatient department demonstrated elevated glucose levels suggestive of impaired glycemic control.

Gender-wise comparison revealed that male participants had a higher prevalence of elevated RBS levels than females (Table 3). Among males, 26 (16.0%) were diabetic and

18 (11.1%) were prediabetic, while among females, 8 (6.3%) were diabetic and 17 (13.3%) were prediabetic. The difference was statistically significant ($\chi^2 = 4.89$; $p = 0.027$), indicating that males were more likely to exhibit undiagnosed hyperglycemia.

When analyzed according to age, a progressive increase in prediabetes and diabetes prevalence was observed with advancing age (Table 4). The highest number of diabetic individuals (26.3%) occurred in those aged ≥ 60 years, followed by 17.5 % in the 50–59 year group. In contrast, only 3.4 % of individuals aged 18–29 years were diabetic. The association between age and glycemic category was highly significant ($\chi^2 = 19.23$; $p = 0.001$).

Overall, 23.8 % of participants were found to have abnormal RBS values (≥ 140 mg/dL), emphasizing that routine dental visits can provide an opportunity for early detection of undiagnosed diabetes and prediabetes.

## Tables

**Table 1. Age and Gender Distribution of Study Participants**

| Age Group (years) | Males (n) | Females (n) | Total (n) | Percentage (%) |
|---|---|---|---|---|
| **18–29** | 46 | 42 | 88 | 30.3 |
| **30–39** | 47 | 36 | 83 | 28.6 |
| **40–49** | 34 | 26 | 60 | 20.7 |
| **50–59** | 23 | 17 | 40 | 13.8 |
| **≥60** | 12 | 7 | 19 | 6.6 |
| **Total** | **162** | **128** | **290** | **100.0** |

**Table 2. Distribution of Participants According to RBS Levels**

| Category | RBS Range (mg/dL) | Number of Participants (n) | Percentage (%) |
|---|---|---|---|
| **Non-diabetic** | < 140 | 221 | 76.2 |
| **Prediabetic** | 140–199 | 35 | 12.1 |
| **Diabetic** | ≥ 200 | 34 | 11.7 |
| **Total** | | **290** | **100.0** |

**Table 3. Gender-wise Distribution of RBS Levels**

| Gender | Non-diabetic (n, %) | Prediabetic (n, %) | Diabetic (n, %) | Total (n) |
|---|---|---|---|---|
| Male | 118 (72.8) | 18 (11.1) | 26 (16.0) | 162 |
| Female | 103 (80.4) | 17 (13.3) | 8 (6.3) | 128 |
| **Total** | **221 (76.2)** | **35 (12.1)** | **34 (11.7)** | **290** |

**Table 4. Age-wise Distribution of RBS Categories**

| Age Group (years) | Non-diabetic (n, %) | Prediabetic (n, %) | Diabetic (n, %) | Total (n) |
|---|---|---|---|---|
| 18–29 | 79 (89.8) | 6 (6.8) | 3 (3.4) | 88 |
| 30–39 | 60 (72.3) | 12 (14.5) | 11 (13.3) | 83 |
| 40–49 | 43 (71.7) | 9 (15.0) | 8 (13.3) | 60 |
| 50–59 | 27 (67.5) | 6 (15.0) | 7 (17.5) | 40 |
| ≥ 60 | 12 (63.1) | 2 (10.5) | 5 (26.3) | 19 |
| **Total** | **221 (76.2)** | **35 (12.1)** | **34 (11.7)** | **290** |

## DISCUSSION

The present study evaluated the prevalence of elevated random blood glucose levels among undiagnosed individuals attending a dental institution and explored the association of glycemic status with age and gender. Among 290 participants, 23.8% exhibited abnormal glucose levels, of which 12.1% were prediabetic and 11.7% diabetic. These findings indicate that nearly one-fourth of individuals visiting a dental outpatient department may harbor undiagnosed hyperglycemia.

The results are comparable with previous reports indicating that 20–30% of dental patients show elevated glucose values suggestive of prediabetes or diabetes. Lalla et al. identified approximately 30% of dental patients with periodontitis as having undiagnosed diabetes based on random glucose screening [3]. Similarly, Greenberg et al. and Strauss et al. demonstrated that dental offices can serve as effective sites for opportunistic screening of systemic diseases, including diabetes mellitus [4,5]. The present findings align with those of Chinnasamy et al., who observed 25% of South Indian dental patients with undetected

hyperglycemia [7]. Minor variations across studies may be attributed to differences in dietary habits, socioeconomic conditions, and sample composition.

Gender-wise comparison in the current study revealed a significantly higher prevalence of elevated blood glucose levels among males than females ($p < 0.05$). This observation concurs with epidemiological findings suggesting that men exhibit greater susceptibility to metabolic syndrome and insulin resistance than women, particularly during middle age [8,9]. Studies by Mohan et al. and Agardh et al. also reported higher diabetes prevalence among Indian men, linking this to central obesity and sedentary lifestyle patterns [10,11]. However, Selvin et al. noted that gender differences in diabetes prevalence are narrowing due to lifestyle changes and increasing obesity among women [12]. The gender disparity observed in the present study may also reflect sociocultural differences in healthcare utilization, where men are more likely to seek dental and medical services in semi-urban settings.

A positive correlation between increasing age and hyperglycemia was evident ($p < 0.01$), consistent with global trends showing that the risk of diabetes rises sharply after the age of 40 years [13–15]. Age-related decline in pancreatic β-cell function and increased insulin resistance have been recognized as primary physiological contributors [16,17]. The results of this study thus reaffirm the need for routine glucose screening in dental patients aged 40 years and above, especially in those presenting with oral signs suggestive of altered glycemic control.

The interrelationship between diabetes and oral health is well established. Periodontal disease is considered the sixth major complication of diabetes, while chronic periodontitis can exacerbate hyperglycemia by increasing systemic inflammatory burden [18,19]. Numerous studies have demonstrated this bidirectional link, indicating that poorly controlled diabetes worsens periodontal status and that effective periodontal therapy can improve glycemic control [20–22]. These interactions highlight the potential for dental professionals to contribute significantly to systemic health monitoring.

The results of the present investigation support the integration of random blood glucose screening into routine dental practice. Several authors, including Greenberg et al. and Naik et al., have confirmed the feasibility and patient acceptance of such screening in dental settings [23,24]. Random blood glucose testing, as used in this study, is a simple, rapid, and cost-effective method for initial identification of at-risk individuals. The incorporation of such chairside diagnostic tools aligns with global initiatives such as the WHO Global Action Plan for the Prevention and Control of Non-Communicable Diseases (2023–2030), which emphasizes early detection through multidisciplinary healthcare models [28].

Comparable studies conducted internationally have reported undiagnosed diabetes prevalence ranging between 8% and 15% among general dental patients [25–27]. The

slightly higher prevalence in Indian populations may be attributed to genetic predisposition, dietary carbohydrate load, and limited access to preventive health services. Integrating glucose screening into dental practice not only enhances early detection but also strengthens interprofessional collaboration between dentistry and medicine, contributing to the national non-communicable disease (NCD) control strategy.

## Limitations

This was a cross-sectional study; therefore, causality between elevated glucose levels and oral findings could not be established. The assessment of glycemic status was based solely on a single random blood sugar estimation, which may be influenced by recent dietary intake or stress. Confirmatory tests such as fasting plasma glucose and HbA1c were not performed due to logistical constraints. Future studies with larger, multicentric samples and longitudinal follow-up using definitive diagnostic criteria are warranted to validate and expand upon these findings.

## Clinical Relevance

The findings of this study demonstrate that a substantial proportion of dental patients have undiagnosed hyperglycemia. Incorporating chairside glucose screening in dental clinics can facilitate early identification of prediabetic and diabetic individuals, enabling timely medical referral and preventive counseling. Dentists thus play a critical role in the interdisciplinary management of chronic systemic diseases, particularly diabetes mellitus, by serving as first-line identifiers of high-risk individuals. This approach promotes holistic patient care and supports public health initiatives aimed at reducing the burden of undiagnosed diabetes.

## Conclusion

A considerable proportion of undiagnosed dental patients exhibited elevated blood glucose levels, with significant associations to age and gender. Routine chairside glucose screening in dental clinics offers a simple and effective approach for early identification and referral of at-risk individuals, reinforcing the dentist's role in integrated systemic disease prevention.

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## Conflict of Interest

The authors declare **no conflict of interest** related to this study.

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