RESEARCH PAPER

Influence of Occupational, Demographic, and Lifestyle Factors on Glycemic Control in Young Diabetic Patients: A Cross-Sectional Study

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ABSTRACT

Introduction: Diabetes mellitus is a long-term metabolic condition marked by consistently high blood sugar levels resulting from inadequate insulin production or ineffective action. The increasing occurrence of diabetes in young adults raises alarms as chronic high blood sugar levels heighten the likelihood of complications. Glycemic regulation, measured by glycated hemoglobin (HbA1c), can be affected by various demographic, professional, and lifestyle influences.

Aim: To evaluate the influence of occupational activity, demographic variables, and lifestyle factors on glycemic control among diabetic patients aged 20–40 years.

Materials and Methods: This institution-based cross-sectional study was conducted at a tertiary care hospital in Chennai from August 2023 to August 2024. A total of 191 diabetic patients with HbA1c >6.5% were included. Data on occupational activity, family history, smoking, alcohol consumption, age, sex, and body mass index (BMI) were collected using a structured questionnaire. HbA1c levels were assessed using the immunoturbidimetric technique, while plasma glucose was evaluated through the glucose oxidase–peroxidase (GOD-POD) method. Statistical analysis was conducted using SPSS version 26.

Results: Multiple regression identified family history, smoking, occupational activity, BMI, and age as significant predictors of HbA1c, while sex showed no significant association. The regression model explained about 46% of HbA1c variability.

Conclusion: Both genetic predisposition and modifiable lifestyle factors significantly influence glycemic control in young diabetic patients, highlighting the importance of early identification and lifestyle interventions.

Keywords: Diabetes mellitus, Glycemic control, HbA1c, Young adults, Occupational activity, Lifestyle factors.

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Introduction

Diabetes mellitus is a long-term metabolic condition characterized by ongoing high blood sugar levels due to issues with insulin production, insulin effectiveness, or a combination of both. The worldwide occurrence of diabetes has surged significantly, positioning it as a major public health issue globally (1,2). As reported by the International Diabetes Federation, more than 463 million adults were diagnosed with diabetes in 2019, with forecasts predicting that this number will surpass 700 million by 2045(3).

India bears a disproportionate share of the global diabetes burden and has witnessed a marked rise in early-onset diabetes. Rapid urbanization, sedentary occupations, unhealthy dietary patterns, and lifestyle transitions are major contributors to this trend (4,5). Early-onset diabetes is particularly concerning as it exposes individuals to a longer duration of hyperglycemia, increasing the risk of microvascular and macrovascular complications.

Glycemic control, commonly assessed using HbA1c, is central to preventing diabetes-related complications. However, optimal control is influenced not only by pharmacological therapy but also by occupational activity, lifestyle behaviors such as smoking and alcohol use, and demographic characteristics (6–11). Sedentary work patterns, irregular work schedules, and occupational stress have been associated with poor glycemic outcomes, possibly due to reduced adherence to treatment, unhealthy dietary habits, and limited time for physical exercise.

Although several studies have investigated lifestyle and demographic factors affecting glycemic control in older adults, evidence focusing specifically on young adults (20–40 years) is limited. This age group often faces unique challenges such as work-related stress, irregular eating patterns, and lower health awareness, which may negatively influence diabetes management. Additionally, the interaction between occupational activity and glycemic control is not fully understood, especially in the Indian context where a significant portion of the workforce is engaged in physically demanding jobs.

Therefore, this study aims to evaluate the influence of occupational activity, demographic variables, and lifestyle factors on glycemic control among young diabetic patients aged 20–40 years. Identifying these determinants will help in designing targeted interventions and workplace-based health programs to improve glycemic outcomes and prevent long-term complications in this vulnerable population.

Materials and Methods

Study Design and Participants

This institution-based cross-sectional study was conducted at Sree Balaji Medical College and Hospital, Chennai, from August 2023 to August 2024. Diabetic patients aged 20–40 years who provided informed consent were included. Non-diabetic individuals, patients with endocrine or genetic disorders, and those receiving steroid therapy were excluded. Only participants with HbA1c >6.5% were enrolled.

Data Collection

Demographic details, family history of diabetes, smoking status, alcohol consumption, and occupational activity were collected using a structured questionnaire. Occupational activity was categorized as sedentary (desk-based or office work) or physically active (manual labor or prolonged physical activity at work).

Ethical Approval

Ethical clearance was obtained from the Institutional Ethics Committee (Approval No. 002/SBMCH/IHEC/2023/1994).

Anthropometric and Biochemical Analysis

Standard methods were used to measure height and weight, and BMI was computed as weight (kg) divided by height (m^2). The immunoturbidimetric technique was used to measure HbA1c. The GOD-POD method was used on a Mindray BS-600 analyzer to assess plasma glucose levels while fasting and after meals.

Statistical Analysis

Statistical analysis was performed using SPSS version 26. Pearson correlation analysis assessed associations between HbA1c and study variables. Multiple linear regression analysis identified independent predictors of HbA1c. A p-value <0.05 was considered statistically significant.

Results

Multiple Linear Regression Analysis

Multiple linear regression was performed to identify independent predictors of HbA1c among young diabetic patients. The model included occupational activity, family history of diabetes, smoking status, age, sex, and BMI. Family history of diabetes was the strongest predictor of HbA1c ($\beta = 1.1$, 95% CI: 0.75–1.45, $p < 0.001$). Smoking ($\beta = 0.6$, 95% CI: 0.3–0.9, $p < 0.001$), occupational activity ($\beta = 0.4$, 95% CI: 0.1–0.7, $p = 0.004$), BMI ($\beta = 0.05$, 95% CI: 0.03–0.07, $p < 0.001$), and age ($\beta = 0.03$, 95% CI: 0.022–0.038, $p < 0.001$) were also significant predictors. Sex did not show a significant association with HbA1c ($\beta = 0.2$, 95% CI: −0.06–0.46, $p = 0.064$). The regression model explained approximately 46% of the variance in HbA1c levels (adjusted $R^2 \approx 0.46$). The regression coefficients, confidence intervals, and significance levels are summarized in **Table 1**.

Table 1: Multiple linear regression analysis

Variable	Coefficient (β)	95% Confidence Interval (approx.)	Interpretation
Intercept	7.1	(6.7, 7.5)	Baseline HbA1c when all predictors are zero (reference categories & zero age/BMI, hypothetical)
Occupational activity	0.4	(0.1, 0.7)	Being a hard worker increases HbA1c by about 0.4 units compared to sedentary workers, significant
Family history	1.1	(0.75, 1.45)	Having a diabetic family history increases HbA1c by about 1.1 units, highly significant
Smoking	0.6	(0.3, 0.9)	Smokers have HbA1c higher by about 0.6 units than non-smokers, highly significant
Age	0.03	(0.022, 0.038)	Each additional year of age increases HbA1c by ~0.03 units, highly significant
Sex	0.2	(-0.06, 0.46)	Males tend to have 0.2 units higher HbA1c than females, but this is not statistically significant
BMI	0.05	(0.03, 0.07)	Each unit increase in BMI raises HbA1c by approximately 0.05 units, highly significant

Correlation Analysis

Pearson correlation analysis revealed significant positive correlations between HbA1c and family history of diabetes ($r = 0.489$, $p < 0.001$), age ($r = 0.449$, $p < 0.001$), BMI ($r = 0.374$, $p < 0.001$), smoking ($r = 0.365$, $p < 0.001$), and occupational activity ($r = 0.287$, $p < 0.001$). Sex showed a weak and non-significant correlation with HbA1c ($r = 0.118$, $p = 0.064$). Inter-correlations among predictors were generally low to moderate, suggesting minimal multicollinearity. The correlation coefficients and corresponding p-values are presented in **Table 2**.

Table 2: Correlation matrix showing relationships between HbA1c and study variables

Variable	HbA1C	work	family history	smokers	Age	Sex	BMI
HbA1C	1.000	0.287	0.489	0.365	0.449	0.118	0.374
Work	0.287	1.000	0.151	0.107	0.053	0.068	0.057
Family history	0.489	0.151	1.000	0.178	0.220	0.047	0.208
Smokers	0.365	0.107	0.178	1.000	0.022	0.033	0.104
Age	0.449	0.053	0.220	0.022	1.000	0.010	0.272
Sex	0.118	0.068	0.047	0.033	0.010	1.000	0.017
BMI	0.374	0.057	0.208	0.104	0.272	0.017	1.000

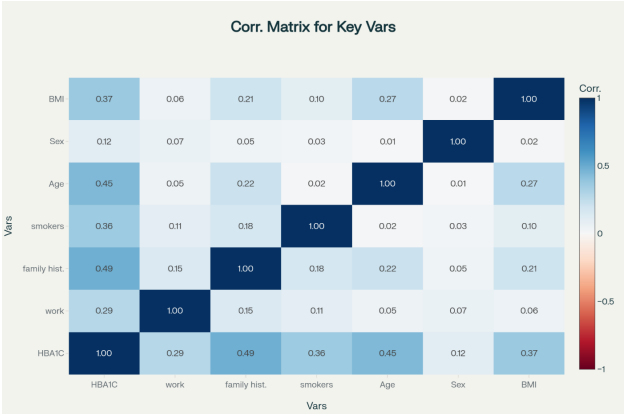
Table2(p-values)

HbA1c showed significant positive correlations with family history ($p < 0.001$), age ($p < 0.001$), BMI ($p < 0.001$), smoking ($p < 0.001$), and occupational activity ($p < 0.001$). Sex did not show significant correlation with HbA1c ($p = 0.064$).

Heatmap Visualization

The correlation matrix was visualized using a heatmap, which demonstrated moderate positive correlations between HbA1c and family history, age, BMI, smoking, and occupational activity, while sex showed no meaningful association. **Figure 1** illustrates the heatmap of the correlation matrix.

Figure 1. Heatmap of Pearson correlation matrix showing relationships between HbA1c and predictors (occupational activity, family history, smoking, age, sex, BMI).



Discussion

This study demonstrates that glycemic control among young adults with diabetes is influenced by both genetic predisposition and modifiable lifestyle factors. Family history emerged as the strongest determinant of HbA1c ($\beta = 1.1$, $p < 0.001$), indicating that inherited susceptibility significantly affects glycemic regulation even in early-onset diabetes (1–3, 17). The moderate positive correlation between HbA1c and family history ($r = 0.489$, $p < 0.001$) further supports the importance of familial risk in glycemic outcomes.

Lifestyle factors such as smoking and higher BMI were also significantly associated with poorer glycemic control. Smoking was associated with a 0.6 unit increase in HbA1c ($\beta = 0.6$, $p < 0.001$) and showed a moderate positive correlation with HbA1c ($r = 0.365$, $p < 0.001$), which is consistent with evidence that smoking increases insulin resistance and glycemic levels (12–15, 18). Similarly, BMI showed a significant positive relationship with HbA1c ($\beta = 0.05$, $p < 0.001$; $r = 0.374$, $p < 0.001$), reinforcing the contribution of obesity to poor glycemic control (14–16).

Occupational activity was another significant predictor of HbA1c ($\beta = 0.4$, $p = 0.004$; $r = 0.287$, $p < 0.001$). The higher HbA1c observed among "hard workers" may reflect occupational stress, irregular working hours, limited access to healthy food, reduced adherence to medication, and inadequate time for structured exercise (6–11, 19). These factors may negate the expected benefits of physical

activity, emphasizing that the quality and context of occupational activity, not merely physical effort, influences glycemic outcomes.

Age also showed a significant but modest effect on HbA1c ($\beta = 0.03$, $p < 0.001$; $r = 0.449$, $p < 0.001$). Although the study population was limited to 20–40 years, the positive association suggests that glycemic control worsens with increasing age even within this young cohort, possibly due to longer disease duration, progressive β-cell dysfunction, or lifestyle changes associated with aging (1–5, 20).

Sex did not show a statistically significant association with HbA1c ($\beta = 0.2$, $p = 0.064$; $r = 0.118$, $p = 0.064$), indicating that gender differences may be less important than genetic and lifestyle factors in this age group. The low inter-correlations among predictors suggest minimal multicollinearity, supporting the robustness of the regression model. The model explained approximately 46% of the variability in HbA1c, indicating that while significant determinants were identified, additional factors such as medication adherence, diet, physical activity patterns, psychological stress, and socioeconomic status may also contribute to glycemic control.

Overall, the findings underscore that pharmacological therapy alone is insufficient for optimal glycemic management. Integrated strategies focusing on early risk identification, lifestyle modification, smoking cessation, weight management, and workplace-based interventions are essential to improve outcomes among young adults with diabetes (6–11, 12–16, 21).

Conclusion

Glycemic control in young diabetic patients aged 20–40 years is strongly influenced by family history, smoking, occupational activity, BMI, and age. Family history showed the greatest effect on HbA1c, while modifiable lifestyle factors further contributed to poor control. Integrated management strategies focusing on lifestyle modification, patient education, and early identification of high-risk individuals are essential to improve long-term outcomes.

Limitations

Causal inference is limited by the cross-sectional design. The sample may not be representative of the general community because the study was carried out in a single tertiary care facility. Because lifestyle data was self-reported, reporting bias may have been introduced. It is advised that future longitudinal studies include bigger, community-based samples and thoroughly evaluate medication adherence, physical activity, and eating habits.

Abbreviations

HbA1c – Glycated hemoglobin
BMI – Body mass index
IDF – International Diabetes Federation
GOD-POD – Glucose oxidase–peroxidase
SPSS – Statistical Package for the Social Sciences

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Conflict of Interest

The authors declare no conflict of interest.

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