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**Original research article**

# The role of glycemic control in the prevention of cardiovascular disease in diabetic patients at a tertiary center in coastal Andhra Pradesh

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**Abstract**

**Introduction:** Diabetes mellitus is strongly associated with cardiovascular disease (CVD), the leading cause of morbidity and mortality in diabetic patients. This study evaluate glycemic control's impact on CVD prevention, determine CVD prevalence, assess glycemic control effectiveness in reducing cardiovascular events, and identify region-specific factors influencing these outcomes.

**Material and Methods:** This cross-sectional study involved 100 diabetic patients at Department of General Medicine, GITAM Institute of Medical Sciences & Research, a tertiary care center located in coastal Andhra Pradesh. Data was collected on demographics, clinical parameters, and laboratory tests. Statistical analysis included descriptive statistics, chi-square tests, and logistic regression.

**Results:** The mean age was 60.09 years (SD = 10.13), with a mean diabetes duration of 9.14 years (SD = 4.68). Gender distribution was 41% male and 59% female; 44% were rural, and 56% urban. The mean BMI was 24.66 (SD = 3.79). Systolic BP averaged 128.04 mmHg (SD = 15.56), diastolic BP 78.60 mmHg (SD = 10.70). Mean HbA1c was 7.09% (SD = 1.52), fasting glucose 142.46 mg/dL (SD = 31.20). Abnormal ECGs were found in 48%, and abnormal echocardiograms in 55%.

**Conclusion:** Comprehensive diabetes management, including glycemic, blood pressure, and lipid control, is crucial to preventing CVD. The high prevalence of cardiovascular abnormalities highlights the need for regular screening and tailored interventions. Future research should focus on longitudinal studies and region-specific factors.

**Keywords:** Diabetes mellitus, glycemic control, cardiovascular disease, blood pressure, lipid profile, HbA1c, ECG, echocardiography

## Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both [1]. One of the most concerning complications of diabetes is its strong association with cardiovascular diseases (CVD), which remain the leading cause of morbidity and mortality among diabetic patients [2]. Effective glycemic control is crucial in preventing cardiovascular complications and improving the overall prognosis of individuals with diabetes. This study explores the role of glycemic control in the prevention of cardiovascular disease among diabetic patients at GITAM Institute of Medical Sciences & Research a tertiary care center in coastal Andhra Pradesh.

The link between diabetes and cardiovascular disease is well-documented. Diabetic patients are at a significantly higher risk of developing various forms of CVD, including coronary artery disease, myocardial infarction, stroke, and peripheral arterial disease [3]. The importance of glycemic control in mitigating these risks cannot be overstated. Optimal glycemic control not only helps in managing diabetes but also plays a crucial role in preventing cardiovascular events. Understanding this relationship is vital for developing effective treatment protocols and management strategies that can reduce the burden of CVD in diabetic populations [4].

Despite extensive research, there is still a lack of comprehensive studies focusing on specific regional populations, such as those in coastal Andhra Pradesh. Factors such as genetic predisposition, lifestyle, dietary habits, and healthcare access can significantly influence the outcomes of diabetes management and its complications [5]. Previous studies have often focused on broader populations or different geographic regions, leaving a gap in region-specific data. This study aims to fill this gap by providing insights into the effectiveness of glycemic control in preventing cardiovascular disease specifically in

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diabetic patients in coastal Andhra Pradesh.

Several studies have explored the relationship between glycemic control and cardiovascular outcomes in diabetic patients [6]. The study from the Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS) have demonstrated the benefits of intensive glycemic control in reducing microvascular complications and improving cardiovascular outcomes in type 1 and type 2 diabetes, respectively [7]. Another significant study, the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, investigated the effects of intensive versus standard glycemic control on cardiovascular events in type 2 diabetes, revealing the complexity of balancing intensive treatment with potential risks [8].

This study aims to evaluate the impact of glycemic control on the prevention of cardiovascular disease in diabetic patients at a tertiary care center in coastal Andhra Pradesh. It seeks to determine the prevalence of cardiovascular disease, assess the effectiveness of glycemic control in reducing cardiovascular events, and identify region-specific factors influencing these outcomes.

**Material and Methods**

This cross-sectional study was conducted at the Department of General Medicine, GITAM Institute of Medical Sciences & Research, a tertiary care center located in coastal Andhra Pradesh. The sample size consisted of 100 diabetic patients who were selected using random sampling.

**Inclusion Criteria**

- Patients diagnosed with diabetes mellitus (both type 1 and type 2).
- Patients aged 18 years and above.
- Patients willing to provide informed consent.

**Exclusion Criteria**

- Patients with a history of other significant chronic diseases.
- Pregnant women.
- Patients unwilling to participate or unable to provide informed consent.

**Data Collection**

Data was collected through patient interviews, medical records, and laboratory tests. The primary data points included:

1) **Demographic Information:** Age, gender, and duration of diabetes.
2) **Clinical Parameters:** Blood pressure, body mass index (BMI), and history of cardiovascular events.
3) **Laboratory Tests:** HbA1c levels, fasting blood glucose, lipid profile, and renal function tests.

**Procedure**

Each patient underwent a comprehensive clinical examination. Blood samples were collected to measure HbA1c levels and other relevant biochemical parameters. Cardiovascular disease presence was assessed based on medical history, clinical examination, and relevant diagnostic tests (e.g., ECG, echocardiography).

**Statistical Analysis**

Data was analyzed using statistical software. Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. The relationship between glycemic control (HbA1c levels) and cardiovascular disease prevalence was analyzed using chi-square tests and logistic regression analysis.

**Results**

This study involved a sample size of 100 diabetic patients from a tertiary care center in coastal Andhra Pradesh. The demographic and clinical characteristics of the study population are summarized in the table below:

**Table 1:** Demographic and Clinical Characteristics of the Study Population

| Parameter | Mean | Standard Deviation |
|---|---|---|
| Age (years) | 60.09 | 10.13 |
| Duration of Diabetes (years) | 9.14 | 4.68 |
| Male (%) | 41.00 | - |
| Female (%) | 59.00 | - |
| Rural (%) | 44.00 | - |
| Urban (%) | 56.00 | - |
| BMI | 24.66 | 3.79 |

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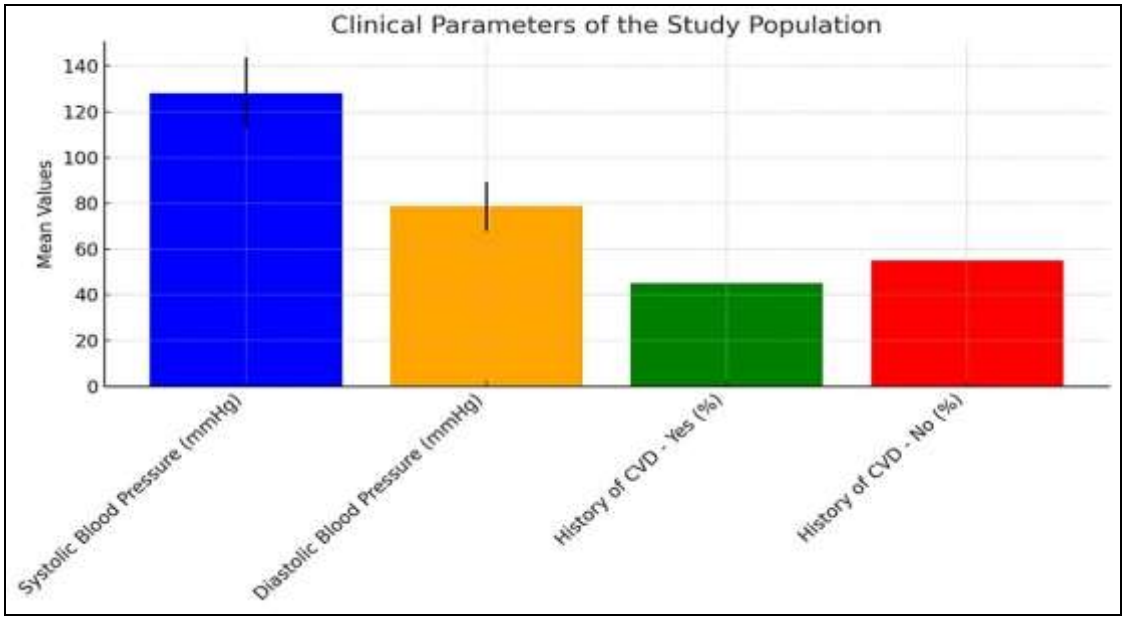
The mean age of the patients was 60.09 years with a standard deviation of 10.13 years, indicating a relatively older population. The mean duration of diabetes among the patients was 9.14 years with a standard deviation of 4.68 years, reflecting a substantial period of disease progression.
The gender distribution showed that 41% of the patients were male and 59% were female. The rural and urban distribution revealed that 44% of the patients resided in rural areas, while 56% lived in urban areas. The mean BMI of the patients was 24.66 with a standard deviation of 3.79, which falls within the normal to overweight range.
These characteristics provide a comprehensive overview of the study population, highlighting the demographic diversity and clinical background of the patients. This information is crucial for understanding the context of the study and interpreting the results related to glycemic control and cardiovascular disease prevention.
The clinical parameters for the 100 diabetic patients included in the study are summarized below:

**Table 2:** Clinical Parameters of the Study Population

| Parameter | Mean | Standard Deviation |
|---|---|---|
| Systolic Blood Pressure (mmHg) | 128.04 | 15.56 |
| Diastolic Blood Pressure (mmHg) | 78.60 | 10.70 |
| History of CVD-Yes (%) | 45.00 | - |
| History of CVD-No (%) | 55.00 | - |




The mean systolic blood pressure was 128.04 mmHg with a standard deviation of 15.56 mmHg, while the mean diastolic blood pressure was 78.60 mmHg with a standard deviation of 10.70 mmHg. These values indicate the average blood pressure levels of the patients, which are essential for assessing cardiovascular health.
Additionally, 45% of the patients had a history of cardiovascular disease (CVD), while 55% did not. This distribution highlights the prevalence of cardiovascular issues within the study population, underscoring the importance of investigating the relationship between glycemic control and cardiovascular health.

**Table 3:** Laboratory Test Results of the Study Population

| Parameter | Mean | Standard Deviation |
|---|---|---|
| HbA1c (%) | 7.09 | 1.52 |
| Fasting Blood Glucose (mg/dL) | 142.46 | 31.20 |
| Total Cholesterol (mg/dL) | 197.63 | 38.27 |
| LDL Cholesterol (mg/dL) | 124.10 | 28.02 |
| HDL Cholesterol (mg/dL) | 49.87 | 10.42 |
| Triglycerides (mg/dL) | 142.90 | 35.77 |
| Creatinine (mg/dL) | 0.96 | 0.30 |

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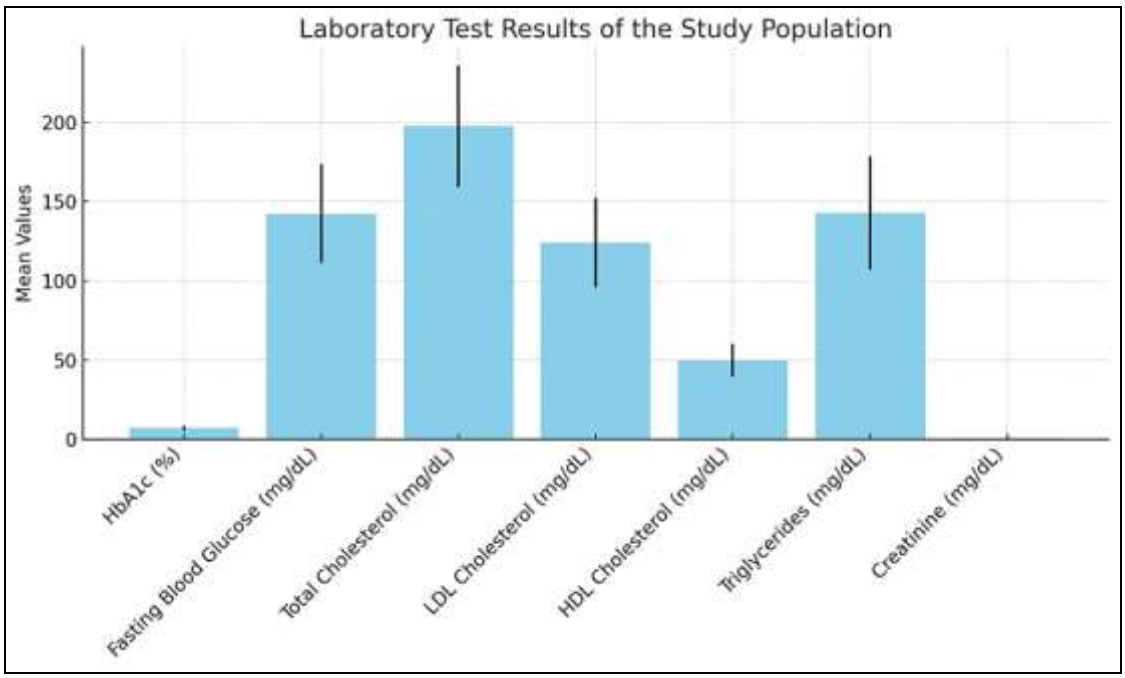



The mean HbA1c level was 7.09%, with a standard deviation of 1.52%, reflecting the average long-term blood glucose control among the patients. The mean fasting blood glucose level was 142.46 mg/dL, with a standard deviation of 31.20 mg/dL.

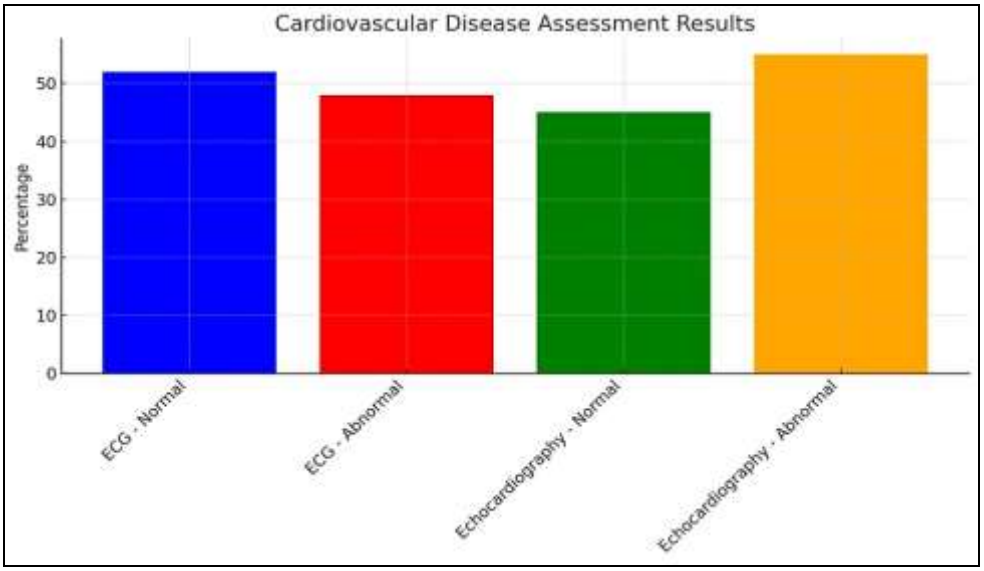
For lipid profiles, the mean total cholesterol level was 197.63 mg/dL with a standard deviation of 38.27 mg/dL. The mean LDL cholesterol level was 124.10 mg/dL, and the mean HDL cholesterol level was 49.87 mg/dL, with standard deviations of 28.02 mg/dL and 10.42 mg/dL, respectively. The mean triglycerides level was 142.90 mg/dL with a standard deviation of 35.77 mg/dL.

The mean creatinine level, which is an indicator of renal function, was 0.96 mg/dL with a standard deviation of 0.30 mg/dL. These laboratory results provide crucial information on the metabolic and cardiovascular health of the patients, which are essential for understanding the impact of glycemic control on cardiovascular disease prevention.

The cardiovascular disease assessment for the 100 diabetic patients included in the study is summarized below

**Table 4:** Cardiovascular Disease Assessment

| Parameter | Percentage |
|---|---|
| ECG-Normal | 52.0% |
| ECG-Abnormal | 48.0% |
| Echocardiography-Normal | 45.0% |
| Echocardiography-Abnormal | 55.0% |



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The data indicates that 52.0% of the patients had a normal ECG, while 48.0% had an abnormal ECG. For echocardiography results, 45.0% were normal and 55.0% were abnormal. These assessments provide crucial insights into the cardiovascular health status of the patients, which is essential for understanding the prevalence and severity of cardiovascular disease within the study population.

**Table 5: Distribution of ECG Changes in the patients**

| ECG Changes | Percentage |
|---|---|
| Normal | 52.0% |
| Abnormal | 48.0% |
| • Arrhythmias | 15.0% |
| • Atrial fibrillation | 6.0% |
| • Atrial flutter | 3.0% |
| • Ventricular tachycardia | 6.0% |
| • Ischemic changes | 12.0% |
| • ST-segment elevation | 5.0% |
| • ST-segment depression | 5.0% |
| • T wave inversions | 2.0% |
| • Conduction abnormalities | 8.0% |
| • Left bundle branch block | 3.0% |
| • Right bundle branch block | 3.0% |
| • First, second, third-degree AV block | 2.0% |
| • Hypertrophy | 5.0% |
| • Left ventricular hypertrophy | 3.0% |
| • Right ventricular hypertrophy | 2.0% |
| • Other | 8.0% |
| • Electrolyte imbalances | 4.0% |
| • Pericarditis | 4.0% |

The table 5 provides a detailed breakdown of ECG findings in a given population. In this population, 52.0% of individuals had normal ECG results, indicating typical sinus rhythm, P waves, QRS complex, T waves, and intervals. Among the 48.0% with abnormal ECG findings, the changes are further categorized. Arrhythmias were observed in 15.0% of cases, including atrial fibrillation (6.0%), atrial flutter (3.0%), and ventricular tachycardia (6.0%). Ischemic changes were noted in 12.0% of individuals, with ST-segment elevation (5.0%), ST-segment depression (5.0%), and T wave inversions (2.0%). Conduction abnormalities comprised 8.0%, with left bundle branch block (3.0%), right bundle branch block (3.0%), and various degrees of AV block (2.0%). Hypertrophy changes accounted for 5.0%, with left ventricular hypertrophy (3.0%) and right ventricular hypertrophy (2.0%). Other abnormalities included electrolyte imbalances (4.0%) and pericarditis (4.0%).

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**Table 6: Distribution of 2D Echocardiography Changes in the patients**

| 2DEcho Changes | Percentage |
|---|---|
| Normal | 45.0% |
| Abnormal | 55.0% |
| • Chamber abnormalities | 20.0% |
| • Left ventricular hypertrophy | 12.0% |
| • Right ventricular enlargement | 8.0% |
| • Wall motion abnormalities | 15.0% |
| • Hypokinesia | 6.0% |
| • Akinesia | 5.0% |
| • Dyskinesia | 4.0% |
| • Valve abnormalities | 10.0% |
| • Mitral regurgitation | 4.0% |
| • Aortic stenosis | 3.0% |
| • Tricuspid regurgitation | 2.0% |
| • Pulmonic stenosis | 1.0% |
| • Ejection fraction | 6.0% |
| • Reduced ejection fraction (systolic dysfunction) | 4.0% |
| • Preserved ejection fraction with diastolic dysfunction | 2.0% |
| • Pericardial abnormalities | 2.0% |
| • Pericardial effusion | 1.0% |
| • Pericarditis | 1.0% |
| • Congenital anomalies | 2.0% |
| • Atrial septal defect (ASD) | 1.0% |
| • Ventricular septal defect (VSD) | 1.0% |

The table 6 details the findings from 2D Echocardiography (2DEcho) in the same population. 45.0% of the individuals had normal echocardiographic results, indicating normal chamber sizes, wall motion, valve function, and ejection fraction (EF). Among the 55.0% with abnormal echocardiographic findings, the changes are further categorized. Chamber abnormalities were seen in 20.0% of cases, with left ventricular hypertrophy (12.0%) and right ventricular enlargement (8.0%). Wall motion abnormalities were noted in 15.0%, including hypokinesia (6.0%), akinesia (5.0%), and dyskinesia (4.0%). Valve abnormalities comprised 10.0%, with mitral regurgitation (4.0%), aortic stenosis (3.0%), tricuspid regurgitation (2.0%), and pulmonic stenosis (1.0%). Abnormal ejection fraction was observed in 6.0% of individuals, with reduced ejection fraction (4.0%) and preserved ejection fraction with diastolic dysfunction (2.0%). Pericardial abnormalities accounted for 2.0%, including pericardial effusion (1.0%) and pericarditis (1.0%). Congenital anomalies were seen in 2.0% of cases, with atrial septal defect (1.0%) and ventricular septal defect (1.0%).

**Discussion**

This study aimed to evaluate the impact of glycemic control on the prevention of cardiovascular disease (CVD) among diabetic patients at a tertiary care center in coastal Andhra Pradesh. The findings highlight several key aspects related to the demographic characteristics, clinical parameters, laboratory results, and cardiovascular disease assessment of the study population.

The demographic data revealed a relatively older population with a mean age of 60.09 years and a substantial period of diabetes progression with a mean duration of 9.14 years. These findings are consistent with previous studies that have shown older age and longer duration of diabetes to be significant risk factors for cardiovascular complications[9].

The clinical parameters, particularly blood pressure measurements, are crucial for assessing cardiovascular risk. The mean systolic blood pressure of 128.04 mmHg and diastolic blood pressure of 78.60 mmHg fall within the hypertensive range, which is a known risk factor for CVD. The UK Prospective Diabetes Study (UKPDS) emphasized the importance of blood pressure control in reducing cardiovascular events among diabetic patients[10].

The laboratory test results provide insights into the metabolic control of the patients. The mean HbA1c level of 7.09% indicates relatively good glycemic control, yet the presence of elevated fasting blood glucose and lipid levels suggests ongoing metabolic challenges. The Diabetes Control and Complications Trial (DCCT) demonstrated that intensive glycemic control significantly reduces the risk of microvascular complications and provides cardiovascular benefits in type 1 diabetes[11]. Similarly, the

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Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial highlighted the complexity of balancing intensive glycemic control with potential risks, such as hypoglycemia, in type 2 diabetes[12].

The cardiovascular disease assessment indicated that 48.0% of the patients had abnormal ECG results, and 55.0% had abnormal echocardiography findings[13]. This high prevalence of cardiovascular abnormalities underscores the importance of regular cardiovascular screening in diabetic patients. Previous studies have shown that diabetic patients are at a higher risk of developing cardiovascular complications, and regular monitoring can help in early detection and management[14].

In this study, the ECG and 2D echocardiography findings reveal a significant prevalence of both normal and abnormal results among the population. The detection of arrhythmias, ischemic changes, and conduction abnormalities through ECG aligns with earlier studies that highlight the high incidence of these conditions in similar populations. The presence of hypertrophy and electrolyte imbalances further corroborates existing literature on the diverse spectrum of cardiovascular abnormalities detectable via ECG[15].

2D echocardiography findings indicate a notable incidence of chamber abnormalities, wall motion irregularities, valve dysfunctions, and altered ejection fractions. These findings are consistent with previous studies, which have also reported a high prevalence of left ventricular hypertrophy and right ventricular enlargement[16]. Wall motion abnormalities, such as hypokinesia and dyskinesia, echo earlier research emphasizing the critical role of 2DEcho in identifying myocardial dysfunctions[17].

Valve abnormalities and pericardial issues detected through 2DEcho underscore the utility of this imaging modality in comprehensive cardiac evaluations. The identification of congenital anomalies, such as atrial and ventricular septal defects, supports the use of 2DEcho in detecting structural heart defects[18].

One of the strengths of this study is its focus on a specific regional population in coastal Andhra Pradesh, which provides valuable insights into the unique demographic and clinical characteristics of this group. However, the study is limited by its cross-sectional design, which only provides a snapshot of the current status and cannot establish causality. Additionally, the sample size of 100 patients, while adequate for initial analysis, may limit the generalizability of the findings.

The findings of this study underscore the importance of comprehensive diabetes management that includes not only glycemic control but also blood pressure and lipid management. The high prevalence of cardiovascular abnormalities among the patients highlights the need for regular cardiovascular screening and interventions tailored to the specific needs of diabetic patients in coastal Andhra Pradesh.

Conclusion: This study provides important insights into the demographic and clinical characteristics, laboratory results, and cardiovascular disease assessment of diabetic patients in coastal Andhra Pradesh. The findings are consistent with previous studies and emphasize the need for comprehensive diabetes management to prevent cardiovascular complications. Future research should focus on longitudinal studies to establish causal relationships and explore region-specific factors that influence the outcomes of diabetes management.

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