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Original Article

Risk Factor Analysis in Diabetes and Hypertension Patients from Odisha, India: A Cross-Sectional Study

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ABSTRACT

Objectives: This study aims to investigate the incidence of poor glycemic control among elderly diabetic individuals with hypertension in urban areas of Odisha, India. This observational cross-sectional study was conducted in an urban area of Odisha involving individuals with a diabetes duration of over five years. **Materials and Methods:** Participants were categorized into two groups based on their glycemic control status: those with good control (HbA_{1C}<7%) and those with poor control (HbA_{1C}≥7%). Multivariate analysis was employed to identify independent determinants. **Results:** Poor glycemic control was detected in 70.15% of 449 patients with diabetes for more than five years, indicating substantial relationships between numerous variables and glycemic control. A multivariate logistic regression study indicated significant links with poor glycemic control in people with diabetes mellitus. Participants who cohabitated with a partner had an increased risk of poor glycemic control (p=0.02). Financial dependence was identified as a protective factor, considerably lowering the risk of poor glycemic control (p=0.02). Among the study participants, the number of patients with chronic co-morbidities particularly hypertension and hyperlipidaemia were comparatively higher than only diabetic conditions. In contrast, poor medication adherence substantially increased the risk of poor glycemic control (p=0.04). **Conclusion:** The study highlights the significant impact of factors such as a lack of social support, poor medication adherence, and the presence of hypertension on poor glycemic control in diabetics, emphasising the importance of targeted interventions to address these issues and improve treatment outcomes.

Keywords: Glycemic Control, HbA_{1C}, Diabetes, Hypertension.

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INTRODUCTION

Diabetes is a widespread chronic metabolic disorder characterized by elevated blood sugar levels due to impaired insulin secretion, action, or both.[1,2] Globally, it affects over 463 million people, and projections indicate this figure could reach 700 million by 2045. In India, the second-largest diabetic population worldwide, over 77 million individuals were diagnosed with the condition in 2019. According to the fifth round of National Family Health Survey (NFHS) conducted between 2019 and 2020, the prevalence of high blood sugar levels among adults aged 18-69 in India was 6.2%, with urban residents exhibiting a higher rate (7.9%) compared to rural residents (5.4%).[1] The prevalence of diabetes among urban participants in India is reported to be one of the highest globally, comparable to the high prevalence countries of West Asia and the Pacific region.[3]

The World Health Organization (WHO) and United Nations (UN) have set global targets to address Noncommunicable Diseases (NCDs) like diabetes and hypertension, emphasizing India's vital role due to its large population. India is witnessing a significant increase in NCDs, notably diabetes and hypertension, attributed to aging, urbanization, and improving living standards. This is concerning given the heightened susceptibility of individuals of Indian ethnicity to cardiovascular diseases associated with obesity and other risk factors.[4]

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Hypertension poses a significant challenge for diabetic patients globally, occurring nearly twice as often as in non-diabetics.[5] It's the most common comorbidity in diabetes and can have severe consequences if left untreated. Type 2 diabetes patients often develop hypertension, which greatly increases the risk of cardiovascular issues.[6] Hypertension contributes to millions of deaths annually, with a majority occurring in developing countries. Its coexistence with diabetes greatly escalates the risk of complications, complicates treatment, and increases healthcare expenses. Moreover, hypertension substantially elevates the risk of death and cardiovascular events in diabetic individuals compared to those with diabetes alone, emphasizing its critical management in diabetes care.[6,7]

The Glycosylated Haemoglobin (HbA_{1C}) test is currently regarded as the most often recognised and accurate outcome measure for assessing long-term glycemic management, providing an indication of average blood glucose levels over the previous 2-3 months.[8] HbA_{1C} is the most commonly used marker because it contains the majority of glycosylated haemoglobin and is least impacted by recent variations in blood glucose.[9] Furthermore, vulnerable persons with low socioeconomic position are more likely to have poor glycemic control as a result of eating too many unhealthy foods like grains and sugary drinks, as well as not adhering to prescriptions and treatment. The fact that chronic social and economic hardship is associated with poor health outcomes adds to this.[10] There is also a programme called Healthy People 2020 that aims to reduce the risk of type 2 diabetes and its effects. Evidence-based therapies aimed at addressing the causes of poor glycemic control are critical to achieving the aims of this worldwide programme.[11]

Despite increased acknowledgment of the combined burden of diabetes and hypertension, there is still a significant study and enclosure about the unique issues experienced by elderly persons living with both illnesses, especially in the urban areas of Odisha, India. Existing research either applies to findings across age groups or fails to effectively capture the distinct clinical, socioeconomic, and cultural aspects impacting illness care and outcomes in the elderly population. Additionally, while many studies have looked at the separate risk factors for poor glycemic control or uncontrolled hypertension, few have looked at how these disorders interact and affect each other's treatment and health consequences. Understanding the complex interplay between diabetes and hypertension care in the setting of ageing is critical for developing tailored therapies and improving clinical outcomes in this vulnerable group.

The key objective is to estimate the incidence of poor glycemic control among elderly diabetics who have hypertension in urban area of Bhubaneswar in the state of Odisha, India. The study's goal is to better understand the complicated interplay between hypertension and diabetes treatment in elderly people living in cities. Its specific goal is to examine how hypertension affects glycemic control and vice versa, focusing on potential bidirectional interactions and synergistic impacts that could influence the progression of illness and consequences. Furthermore, the study seeks to assess the relationship between poor glycemic control and negative clinical outcomes in elderly diabetes patients with hypertension. Afterwards, the study aims to investigate healthcare-seeking behaviours, medication adherence patterns, and perceived impediments to optimum disease management in older diabetes patients with concomitant hypertension in urban city Bhubaneswar of Odisha.

MATERIALS AND METHODS

Study Design

The cross-sectional observational study allowed it to be possible to investigate the incidence of poor glycemic control and identify related indicators of risk among elderly diabetes patients with hypertension in the urban region of Odisha, India. Participants were drawn from the target demographic, which consisted of people aged 50 and over who had been diagnosed with both diabetes and hypertension for a 5-year history. Structured interviews and health care record assessments were used to collect data on demographic variables, medical history (including the duration of diabetes and hypertension), lifestyle factors (such as smoking and alcohol consumption), medication adherence, and family history of chronic diseases. In addition, clinical data such as glycemic control status (measured by HbA_{1C} levels) were retrieved from medical records.

Study Setting

The study was carried out in an urban region of Odisha, India, providing a diverse and representative context for evaluating the variables associated with poor glycemic control in senior diabetes patients with hypertension. This area included a wide range of communities, from heavily crowded metropolitan districts to suburban areas. Because the research location was located in Odisha, an eastern Indian state, it was most likely close to healthcare services such as hospitals, clinics, and primary care centres. Residents of metropolitan regions presumably had better access to healthcare services than those in rural areas, as several healthcare facilities were placed in close proximity. This accessibility may have helped to bring in research participants and guaranteed enough access to medical treatment for those with chronic diseases such as diabetes and hypertension. The urban landscape may also have had a mix of residential, commercial, and industrial zones, reflecting the residents' different social origins and lifestyles. This area has been shaped by its cultural and social background, which includes eating patterns, lifestyle choices, and healthcare-seeking activities. Cultural ideas, family relationships, and supportive community networks may have had an impact on the health of the participants attitudes, treatment regimen adherence, and general well-being.

Sample Size

We predicted that around half of the elderly diabetes patients with hypertension in our urban research region would have poor glycemic control. Our study aims to examine this theory and identify the related risk factors that contribute to the prevalence of poor glycemic control in this urban population. In Bhubaneswar, Odisha, India, we may apply the method for determining sample size for a single percentage.

$$n = \frac{Z^2 \times p \times (1 - p)}{d^2}$$

Where: *n*=the needed sample size, Z = the Z-score corresponding to the desired confidence level (e.g., 95% confidence level, Z = 1.96), *p*=the estimated proportion with poor glycemic control (hypothesised proportion), and d = the margin of error (precision). Given that the hypothesis is 50% poor glycemic control (*p*=0.50), we will utilise this number in the computation. Assuming a target margin of error of *d*=0.05, we aim for our estimate to be within 5 percentage points of the actual proportion. As a result, we would require a minimum sample size of about 385 individuals. However, it is frequently recommended to raise the sample size to allow for possible dropouts or non-response. Thus, rounding up to the closest whole number, a sample size of around 386 people would be adequate for this study. In order to account for dropouts and non-responses and assure robustness in our analysis, the sample size was expanded to 449 individuals. This change allowed for a more thorough assessment of the variables linked with poor glycemic control, which improved the reliability and validity of our results.

Ethical Considerations

Ethical approval was obtained from the KIDS Ethics Committee, Bhubaneswar, Odisha, India. Written Informed consent was obtained in convenient to each participant (Odia/English/Hindi) before data collection. Confidentiality of participants' information was strictly maintained throughout the study according to ethical guidelines.

Data Collection

Information has been collected via structured interviews and medical record inspections. A standardised questionnaire was used to collect details about participants' demographics, medical history, lifestyle factors, medication adherence, and other pertinent data. Clinical data such as glycemic control status (HbA_{1C} level), hypertension status, and comorbidities were extracted from medical records.

Variables

The key outcome variable was poor glycemic control, defined as HbA_{1C} levels of 7% or above. The independent variables comprised age, gender, cohabitation status, education, financial dependency, lifestyle factors (smoking history, alcohol use), medical background (presence of chronic comorbidities, duration of DM, current treatment), family history of diseases (hypertension, hyperlipidemia, DM), and medication adherence.

Statistical Analysis

The statistical analysis of the data was carried out in various phases using Microsoft Excel and SPSS. At first, descriptive statistics were employed to summarise participant characteristics and the incidence of poor glycemic control across several factors. Bivariate analysis, using Excel and SPSS, examined the connection between each independent variable and poor glycemic control, calculating Odds Ratios (ORs), 95% Confidence Intervals (CIs), and *p*-values. Following that, a multivariate logistic regression analysis was conducted in SPSS to find independent predictors of poor glycemic control while accounting for relevant confounders. The logistic regression model provided Adjusted Odds Ratios (AORs) with 95% confidence intervals to assess the correlations between each predictor and poor glycemic control after correcting other factors. The final analysis sought to give insights into major predictors of poor glycemic control in senior diabetes patients with hypertension, hence improving understanding of related risk variables in the research group. A *p*-value <0.05 was considered statistically significant.

RESULTS

The study was done in Bhubaneswar, Odisha's capital. Thus, complete data and blood samples from 449 individuals were obtained. The average age of participants was 61.39±6.91 years with poor glycemic control (315 people) and 61.46±7.34 years with excellent glycemic control (134 participants). Women participated at a lower rate (34.53%) than men (65.47%). The poorly glycemic control group had a systolic blood pressure of 135.28±6.65 mmHG, whereas the good glycemic control group had 134.51±6.52 mmHg. The diastolic range was 99.80±26.17 mmHg for the poorly glycemic control group and 92.36±5.50 mmHg for the good glycemic group.

Table 1 depicted the analysis aimed to identify associations between socio-demographic factors, smoking, alcohol use, and glycaemic control, as measured by HbA_{1C} levels. Among individuals aged 50-60 years, poor glycaemic control was observed in 47.62% of cases compared to 47.76% with good control, showing no significant difference (OR = 0.93, 95% CI: 0.60-1.44, *p*=0.74). For the age group 61-70 years, 41.59% had poor control versus 38.80% with good control, with an odds ratio of 1.33 (95% CI: 0.69 - 2.57, *p*=0.39). Those aged 70 and above had poorer glycaemic control compared to the reference group (age 50-60), but the association was not statistically significant. Cohabitation status emerged as a significant factor, with individuals living with a spouse exhibiting better glycaemic control compared to those living without a spouse (OR = 2.15, 95% CI: 1.20 - 3.86, *p*=0.01). There was no significant difference in glycaemic control between males and females (OR = 0.78,

95% CI: 0.50 - 0.20, p=0.25). Literate individuals did not show a significantly different glycaemic control compared to illiterate individuals (OR = 1.25, 95% CI: 0.78 - 2.02, p=0.34). Financial dependency also significantly influenced glycaemic control, with dependent individuals demonstrating poorer control compared to independent ones (OR = 0.44, 95% CI: 0.28 - 0.69, p<0.001). There was no significant association between smoking status (current, past, or never smoked) and glycaemic control. There was no significant association between alcohol use status (current, past, or never used) and glycaemic control.

These findings underscore the importance of social support structures, particularly spousal cohabitation, and financial independence in managing glycaemic control among individuals with diabetes.

Table 2 provides a comprehensive analysis of the association between co-morbidities and family history factors with glycaemic control among the study participants, measured by their HbA_{1C} levels.

Participants with chronic comorbidities had poorer glycaemic control compared to those without comorbidities. The Odds Ratio (OR) of having poor glycaemic control when having chronic comorbidities compared to not having them is 0.38, indicating a lower likelihood of good glycaemic control among those with comorbidities. However, the p-value is 0.06, which suggests that this result is not statistically significant at the conventional level of 0.05.

Individuals with hypertension had significantly poorer glycaemic control compared to those without hypertension. The odds ratio is 1.94, indicating that individuals with hypertension are nearly twice as likely to have poor glycaemic control compared to those without hypertension. The p-value is 0.01, indicating statistical significance.

There was no significant association found between hyperlipidaemia and glycaemic control, although there was a trend towards poorer control among those with hyperlipidaemia. The odds ratio is 0.66, suggesting a slightly lower likelihood of

Table 1: Association of Socio-demographic profile, smoking and alcohol use with glycaemic control.

Variable	Poor Glycaemic control (%) (HbA_{1C}≥7%) (n=315)	Good Glycaemic control (%) (HbA_{1C}<7%) (n=134)	OR	95% CI	p Value
Age (years)					
50-60	150 (47.62)	64 (47.76)	0.93	0.60 - 1.44	0.74
61-70	131 (41.59)	52 (38.80)	1.33	0.69 - 2.57	0.39
70≤	34 (10.79)	18 (13.44)			
Cohabitation status					
Living with spouse	286 (90.8)	110 (82.1)	2.15	1.20 - 3.86	0.01
Living without spouse	29 (9.2)	24 (17.9)			
Gender					
Male	201 (63.8)	93 (69.4)	0.78	0.50-0.20	0.25
Female	114 (36.2)	41 (30.6)			
Education					
Literate	248 (78.7)	100 (74.6)	1.25	0.78 - 2.02	0.34
Illiterate	67 (21.3)	34 (25.4)			
Financial dependency					
Dependent	62 (19.7)	48 (35.8)	0.44	0.28 - 0.69	0.00
Independent	253 (80.3)	86 (64.2)			
History of smoking					
Current smoker	38 (12.1)	14 (10.4)	1.01	0.44 - 2.34	0.98
Past smoker	43 (13.7)	16 (12.0)	1.19	0.64 - 2.22	0.57
Never smoked	234 (74.2)	104 (77.6)			
History of alcohol use					
Current user	34 (10.8)	21 (15.7)	0.69	0.31 - 1.51	0.35
Past user	40 (12.7)	17 (12.7)	0.94	0.51 - 1.73	0.84
Never used	241 (76.5)	96 (71.6)			

Table 2: Association of co-morbidities and family history of co-morbidities with glycaemic control.

Variable	Poor Glycaemic control (%) (HbA_{1C}≥7%) (*n*=315)	Good Glycaemic control (%) (HbA_{1C}<7%) (*n*=134)	OR	95% CI	*p* Value
Presence of any chronic comorbidities					
Yes	255 (81.0)	123 (91.80)	0.38	0.19 - 0.75	0.06
No	60 (19.0)	11 (8.20)			
Hypertension					
Yes	268 (85.10)	100 (74.6)	1.94	1.18 - 3.19	0.01
No	47 (14.90)	34 (25.40)			
Hyperlipidaemia					
Yes	93 (29.50)	52 (38.80)	0.66	0.43 - 1.09	0.06
No	222 (70.50)	82 (61.2)			
Thyroid disease					
Yes	13 (4.10)	12 (9.0)	0.44	0.19 - 0.99	0.05
No	302 (95.9)	122 (91.0)			
Family history of Hypertension					
Yes	43 (13.70)	39 (29.10)	0.39	0.24 - 0.63	0.00
No	272 (86.30)	95 (70.90)			
Family history of Hyperlipidaemia					
Yes	17 (5.40)	15 (11.20)	0.45	0.22 - 0.94	0.32
No	298 (94.60)	119 (88.80)			
Family history of DM					
Yes	83 (26.30)	33 (24.60)	1.10	0.69 - 1.75	0.70
No	232 (73.70)	101 (75.40)			

good glycaemic control among those with hyperlipidaemia, but the result is not statistically significant (*p*=0.06).

Participants with thyroid disease had significantly better glycaemic control compared to those without thyroid disease. The odds ratio is 0.44, indicating a lower likelihood of poor glycaemic control among those with thyroid disease. The *p*-value is 0.05, indicating statistical significance.

Individuals with a family history of hypertension had significantly better glycaemic control compared to those without such a family history. The odds ratio is 0.39, indicating a lower likelihood of poor glycaemic control among those with a family history of hypertension. The *p*-value is 0.00, indicating statistical significance.

There was no significant association found between a family history of hyperlipidaemia and glycaemic control. The odds ratio is 0.45, suggesting a slightly lower likelihood of good glycaemic control among those with a family history of hyperlipidaemia, but the result is not statistically significant (*p*=0.32).

There was no significant association found between a family history of diabetes and glycaemic control. The odds ratio is 1.10, indicating no significant difference in the likelihood of poor glycaemic control between those with and without a family history of diabetes (*p*=0.70).

Overall, the results suggest that hypertension and a family history of hypertension are significantly associated with poorer glycaemic control, while thyroid disease is associated with better control. However, the associations with hyperlipidaemia and family history of hyperlipidaemia, as well as family history of diabetes, are not statistically significant.

Conversely, associations with a family history of hyperlipidaemia or diabetes did not reach statistical significance, suggesting limited independent influence on glycaemic outcomes. These findings underscore the multifaceted nature of factors influencing glycaemic control in diabetes management, emphasizing the need for tailored approaches considering both individual and familial medical histories.

The Table 3 outlines the relationship between various clinical factors and glycaemic control in individuals with diabetes, shedding light on key determinants of disease management. Notably, while factors such as diabetes duration, current treatment modalities, BMI, and the use of non-allopathic treatments for diabetes do not exhibit statistically significant associations with

glycaemic control, medication adherence emerges as a crucial predictor.

The table compares individuals with diabetes for 5 to 10 years against those with diabetes for more than 10 years. For individuals with diabetes duration of 5 to 10 years, 58.09% had poor glycaemic control, while for those with more than 10 years of diabetes, 41.91% had poor control. However, the Odds Ratio (OR) of having poor glycaemic control for individuals with diabetes for 5 to 10 years compared to more than 10 years is 1.23, indicating a slightly higher likelihood of poor control in the former group, but this association is not statistically significant (p=0.32).

Three treatment categories are considered: Oral Hypoglycaemic Agents (OHA) only, Insulin only, and a combination of Insulin and OHA. Among those on OHA only, 77.14% had poor glycaemic control, compared to 69.41% for those on Insulin only and 20.32% for those on a combination therapy. The Odds Ratio (OR) suggests that individuals on OHA only are 1.96 times more likely to have poor glycaemic control compared to those on a combination therapy, but this association is not statistically significant (p=0.22).

Individuals with a BMI greater than 24 kg/m2 comprised 86.66% of the poor control group compared to 90.30% in the good control group. The Odds Ratio (OR) indicates that individuals with a BMI greater than 24 kg/m2 are 0.70 times as likely to have poor glycaemic control compared to those with a BMI of 24 or less, but this association is not statistically significant (p=0.28).

A small proportion of individuals reported using non-allopathic treatments for diabetes. Among those using non-allopathic treatments, 4.80% had poor glycaemic control, compared to 8.20% among those not using such treatments. The Odds Ratio (OR) suggests that individuals using non-allopathic treatments are 0.56 times as likely to have poor glycaemic control compared to those not using such treatments, but this association is not statistically significant (p=0.16).

Medication adherence is categorized as either poor or good. Among those with poor adherence, 69.80% had poor glycaemic control, compared to only 16.40% among those with good adherence. The Odds Ratio (OR) indicates that individuals with poor medication adherence are 2.20 times more likely to have poor glycaemic control compared to those with good adherence, and this association is statistically significant (p<0.05).

In summary, this table suggests that medication adherence is strongly associated with glycaemic control, with individuals having poor adherence being significantly more likely to have poor control. However, other factors such as diabetes duration, current treatment, BMI, and non-allopathic treatment do not show statistically significant associations with glycaemic control in this study.

Table 4 represents the multivariate logistic regression analysis conducted on individuals with diabetes mellitus revealing several significant associations with poor glycemic control. Cohabitation status emerged as a notable factor, with participants living with

Table 3: Association of clinical variables related to diabetes with glycaemic control.

Variable	Poor Glycaemic control (%) (HbA_{1C}≥7%) (n=315)	Good Glycaemic control (%) (HbA_{1C}<7%) (n=134)	OR	95% CI	p Value
Duration of DM (years)					
5 to 10	183 (58.09)	71 (52.98)	1.23	0.82 - 1.85	0.32
>10	132 (41.91)	63 (47.02)			
Current treatment					
Oral Hypoglycaemic Agents (OHA)	243 (77.14)	93 (69.41)	1.96	0.66 - 5.80	0.22
Only Insulin	8 (2.54)	6 (4.47)	0.73	0.23 - 2.27	0.59
Insulin + OHA	64 (20.32)	35 (26.12)			
BMI (kg/m2)					
>24	273 (86.66)	121 (90.30)	0.70	0.36 - 1.35	0.28
≤24	42 (13.34)	13 (9.70)			
Any other non-allopathy treatment for diabetes					
Yes	15 (4.80)	11 (8.2)	0.56	0.25 - 1.25	0.16
No	300 (95.20)	123 (91.8)			
Medication adherence*					
Poor	95 (69.80)	22 (16.40)	2.20	1.31 - 3.68	0.00
Good	220 (30.20)	112 (83.60)			

* Patient skipping any dose of prescribed medicine during last one week was considered as poor medication adherence.

a spouse exhibiting an adjusted Odds Ratio (OR) of 2.03 (95% CI [1.11 - 3.72]), indicating more than double the odds of poor glycemic control compared to those living without a spouse. Financial dependency was identified as a protective factor, as individuals dependent on others financially demonstrated an OR of 0.56 (95% CI [0.35 - 0.90]), signifying significantly lower odds of poor glycemic control. Additionally, the presence of chronic comorbidities, particularly hypertension and hyperlipidemia, was associated with better glycemic control, with ORs of 1.53 (95% CI [0.90 - 2.59]) and 0.63 (95% CI [0.39 - 1.02]), respectively, though the latter did not reach statistical significance. Family history of hypertension and hyperlipidemia also showed significant associations with improved glycemic control, with ORs of 0.39 (95% CI [0.23 - 0.65]) and 0.43 (95% CI [0.20 - 0.90]), respectively. Conversely, poor medication adherence significantly increased the odds of poor glycemic control, with an OR of 1.80 (95% CI [1.03 - 3.14]) (Figure 1). These findings underscore the complex interplay of social, economic, and health-related factors in diabetes management, emphasizing the importance of tailored interventions to optimize glycemic control and overall health outcomes.

DISCUSSION

Previously reported studies outline the prevalence of type 2 Diabetes Mellitus (DM) among individuals over 60 due to insulin resistance, noting the potential decline in insulin secretion at advanced stages.[12] It highlights various studies indicating an increased risk of hypertension in middle-aged diabetic populations across different ethnicities, citing examples such as the Strong Heart Study among American Indian participants, studies involving Hispanic and non-Hispanic whites, and research conducted in Iran.[13-16] Our study focusing on different age groups' glycemic control. In individuals aged 50-60, no significant difference was found between poor and good glycemic control. Similarly, in the 61-70 age group, there was no statistically significant distinction. However, individuals aged 70 and above showed a trend towards poorer glycemic control compared to the reference group (age 50-60), though not statistically significant.

Our study describes the presence of a supportive spouse appears to play a crucial role in diabetes management, as individuals cohabiting with a spouse demonstrate better glycemic control compared to those without. The Odds Ratio (OR) of 2.15 with a *p*-value of 0.01 suggests that individuals living with a spouse have more than double the odds of having good glycemic control compared to those living without a spouse. This association is statistically significant at the conventional level of 0.05. This underscores the importance of social support structures, particularly within familial relationships, in facilitating adherence to treatment regimens and lifestyle modifications, ultimately leading to improved disease management and glycemic outcomes.[17] Additionally, another research reveals a significant association between having a spouse with diabetes and

Table 4: Multivariate logistic regression of variables associated with poor glycaemic control.

Variable	Adjusted Odds Ratios (OR)	95% Confidence Intervals (CI)	*p*-values
Cohabitation status (Living with spouse)	2.03	1.11 - 3.72	0.02*
Gender (Male)	0.85	0.54 - 1.34	0.49
Education (Literate)	1.21	0.74 - 1.99	0.45
Financial dependency (Dependent)	0.56	0.35 - 0.90	0.02*
History of smoking (Past smoker)	1.12	0.58 - 2.14	0.73
History of alcohol use (Past user)	1.01	0.54 - 1.87	0.97
Presence of any chronic comorbidities (Yes)	0.36	0.17 - 0.75	0.01*
Hypertension (Yes)	1.53	0.90 - 2.59	0.11
Hyperlipidaemia (Yes)	0.63	0.39 - 1.02	0.06
Thyroid disease (Yes)	0.48	0.20 - 1.14	0.10
Family history of Hypertension (Yes)	0.39	0.23 - 0.65	0.001*
Family history of Hyperlipidaemia (Yes)	0.43	0.20 - 0.90	0.03*
Family history of DM (Yes)	0.98	0.60 - 1.62	0.93
Duration of DM (years) (>10)	1.10	0.73 - 1.67	0.65
Current treatment (Only Insulin)	0.61	0.19 - 1.97	0.41
BMI (kg/m2) (>24)	0.70	0.35 - 1.38	0.30
Any other non-allopathy treatment for diabetes (Yes)	0.62	0.27 - 1.41	0.26
Medication adherence (Poor)	1.80	1.03 - 3.14	0.04*
*Statistically significant ($p<0.05$)			

an individual's risk of developing diabetes themselves, with those having a diabetic spouse being nearly twice as likely to develop the condition. This highlights the potential influence of a spouse's health status on one's own health outcomes and underscores the importance of considering familial risk factors in diabetes prevention and management strategies.[18]

Few studies examine the relationship between gender and multimorbidity involving diabetes mellitus, hypertension, and obesity. Their findings, derived from multiple multinomial regression, indicated that females were more likely to be obese but less likely to be hypertensive compared to males. However, the odds for hypertension were statistically insignificant, potentially influenced by obesity's role in hypertension development, which may diminish the protective effect of estrogen among females.[19] In our study, analyzing glycemic control by gender, we observed that a higher proportion of males had good glycemic control compared to females, although the difference was not statistically significant. Specifically, 63.8% of males and 36.2% of females exhibited poor glycemic control, while 69.4% of males and 30.6% of females demonstrated good control, resulting in an odds ratio of 0.78 (95% CI: 0.50-0.20, p=0.25), indicating a trend where males are less likely to have poor glycemic control compared to females.

In our study, we observed that among the literate group of 248 individuals, 78.7% had poor glycemic control (HbA_{1C}≥7%), while 74.6% had good control (HbA_{1C}<7%). Conversely, in the illiterate group of 67 individuals, 21.3% had poor glycemic control, and 25.4% had good control. Despite these differences, the odds ratio (OR) for poor glycemic control among literate individuals compared to illiterate ones was 1.25 (95% CI: 0.78 - 2.02), with a p-value of 0.34, indicating no statistically significant association between education level and glycemic control in our study. Conversely, other research highlights poor performance in Health Literacy (HL) among subjects, particularly in patients with Type 2 Diabetes (T2D), with the lowest HL scores associated with health and numeracy skills.[20] This finding aligns with previous investigations,[21,22] emphasizing the importance of numeracy skills in making informed decisions regarding health implications.

Among current smokers (38 individuals), 12.1% and past smokers (43 individuals), 13.7% had poor control, and 12.0% had good control. The odds ratios (OR) for poor glycemic control compared to never smoked were 1.01 (95% CI: 0.44 - 2.34, p=0.98) for current smokers and 1.19 (95% CI: 0.64 - 2.22, p=0.57) for past smokers, indicating no statistically significant association between smoking history and glycemic control. Similarly, for alcohol use history, individuals were classified as current users, past users, or those who never used. Among current users (34 individuals), 10.8% had poor glycemic control, and 15.7% had good control. Among past users (40 individuals), 12.7% had poor control, and 12.7% had good control. The odds ratios for poor glycemic control compared to never used were 0.69 (95% CI: 0.31 - 1.51, p= 0.35) for current users and 0.94 (95% CI: 0.51 - 1.73, p=0.84) for past users, indicating no statistically significant association between alcohol use history and glycemic control. This outcome is consistent with earlier research from India.[23,24]

Another research study emphasises how hypertension, dyslipidemia, and type 2 diabetes frequently coexist and share similar routes. This clustering, referred to as metabolic syndrome, might result in cardiovascular problems. The increased prevalence of type 2 diabetes may indicate a coming cardiovascular disease epidemic due to the synergistic impact of metabolic syndrome components such as hypertension,

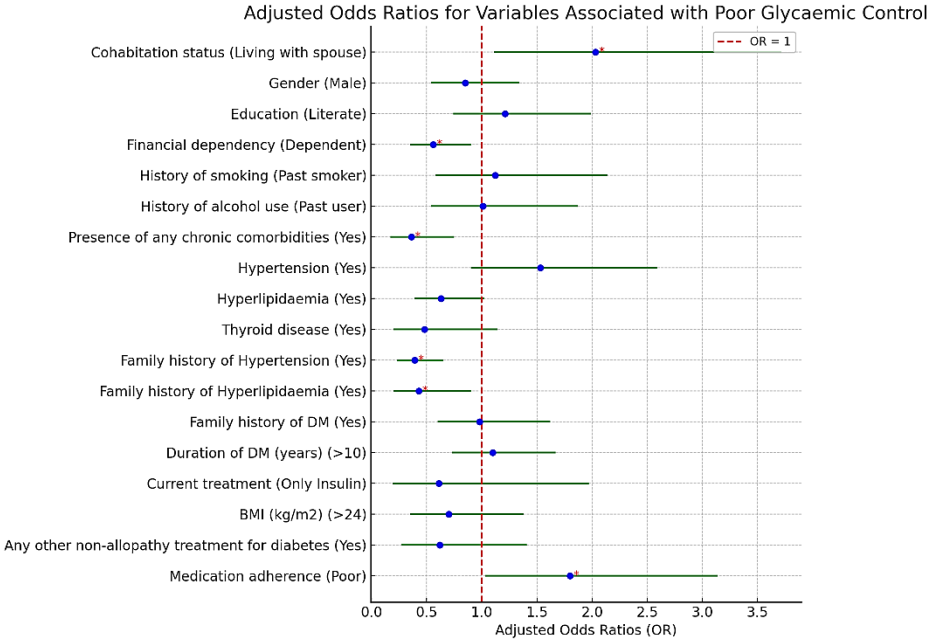

Figure 1: Adjusted Odd's Ratio Plot.

dyslipidemia, insulin resistance, and abdominal obesity.[25] This study suggests that individuals without chronic comorbidities tend to have better control (81.0% with poor control vs. 91.80% with good control), this association isn't statistically significant (OR = 0.38, 95% CI: 0.19 - 0.75, p=0.06). However, hypertension status significantly impacts glycemic control, with hypertensive individuals more likely to have poor control (OR = 1.94, 95% CI: 1.18 - 3.19, p=0.01). Similarly, a family history of hypertension is associated with poorer control (OR = 0.39, 95% CI: 0.24 - 0.63, p=0.00). Conversely, no significant association is found between glycemic control and family history of DM (OR = 1.10, 95% CI: 0.69 - 1.75, p=0.70). Individuals suffering from thyroid illness, on the other hand, had better glycemic control than those without the ailment. While the mechanism behind this link has to be investigated further, it shows that thyroid dysfunction may have a protective impact on glycemic control, potentially through changes in metabolic pathways or hormone regulation.

Earlier study highlights that the link between the duration of Diabetes Mellitus (DM) and both glycemic control and hypertension in middle-aged and older Chinese adults which shows that long-term hyperglycemia, as indicated by high HbA_{1C} values, may raise the risk of hypertension.[26] The findings emphasise the need of constantly monitoring and properly managing glycemic control, especially in those with diabetes for a prolonged period of time, to lower the risk of hypertension and its consequences.[26] According to our findings, 58.09% of those with diabetes for 5 to 10 years (183 participants) had poor control, while 52.98% had adequate control. Individuals with diabetes for more than ten years (41.91%) had poor control, whereas 47.02% had good control. However, the Odds Ratio (OR) for poor glycemic control when comparing DM duration >10 years to 5-10 years was 1.23 (95% CI: 0.82-1.85, p=0.32), demonstrating no statistically significant relationship between DM length and glycemic control.

Current research compares glycemic control among individuals with diabetes based on their current treatment methods. Among those using Oral Hypoglycaemic Agents (OHA) only, 77.14% had poor control and 69.41% had good control. For Insulin-only users, 2.54% had poor control and 4.47% had good control. Among those using both Insulin and OHA, 20.32% had poor control and 26.12% had good control. However, no significant associations were found between treatment method and glycemic control, with odds ratios (OR) of 1.96 (95% CI: 0.66 - 5.80, p=0.22) for OHA only users and 0.73 (95% CI: 0.23 - 2.27, p=0.59) for Insulin users only. García-Pérez *et al.*, found that adherence to medication, especially insulin therapy, is critical for diabetes management. They observed that poor medication adherence, including insulin, can lead to impaired glycemic control, increasing the risks associated with diabetes complications. Their findings are consistent with previous research showing that medication nonadherence is associated with raised levels of HbA_{1C}, blood pressure, and LDL cholesterol in diabetics, hence increasing morbidity and death rates. Research found that noncompliance with insulin therapy is an independent risk factor for all-cause death in type 2 diabetes patients receiving insulin treatment. These findings highlight the need of taking prescribed drugs, particularly insulin, to properly control diabetes and avoid negative health effects.[27] Our study compares glycemic control among individuals with diabetes based on their Body Mass Index (BMI). Among those with a BMI >24 kg/m^2, 86.66% had poor control and 90.30% had good control. For individuals with a BMI ≤24 kg/m^2, 13.34% had poor control and 9.70% had good control. However, there was no statistically significant association between BMI and glycemic control, with an Odds Ratio (OR) of 0.70 (95% CI: 0.36 - 1.35, p=0.28). Hu *et al.*, elucidate the interplay between abnormal BMI, hypertension, and the risk of Type 2 Diabetes Mellitus (T2DM). Their findings suggest that the simultaneous presence of abnormal BMI and hypertension increases the risk of T2DM beyond what would be expected from each factor alone. This underscores the importance of considering both BMI and blood pressure levels in assessing diabetes risk. Their study indicates that the accumulation of body fat in individuals with abnormal BMI contributes to hyperinsulinemia and insulin resistance, ultimately leading to impaired glucose utilization and the development of T2DM. Their findings are consistent with previous research highlighting abnormal BMI and high blood pressure as independent risk factors for diabetes. Additionally, studies did not observe a multiplicative interaction between adjusted BMI abnormality and hypertension on T2DM risk, the combined effect of these factors still significantly increases the risk of diabetes.[28]

The present research examines glycemic control among diabetics based on the usage of non-allopathic medications. Among the 15 patients who used non-allopathy therapy, 4.80% had poor control and 8.2% had good control. Among non-users (300 people), 95.20% had poor control and 91.8% had strong control. However, there was no statistically significant relationship between the use of non-allopathy therapies and glycemic control (OR = 0.56, 95% CI: 0.25 - 1.25, p=0.16).

In other studies, the prevalent issue of low pharmacological adherence among patients with Diabetes Mellitus (DM) or hypertension, a phenomenon documented across various literature sources. Their findings underscore the critical role of medication adherence in the management of chronic diseases such as DM and hypertension.[29] Our study complements this understanding by comparing glycemic control based on medication adherence among individuals with diabetes. Among those with poor adherence (95 individuals), 69.80% had poor control and 16.40% had good control. For those with good adherence (220 individuals), 30.20% had poor control and 83.60% had good control. There was a significant association

between poor medication adherence and poor glycemic control, with an Odds Ratio (OR) of 2.20 (95% CI: 1.31 - 3.68, p=0.00).

The study's limitations included a cross-sectional design that limited the ability to demonstrate causation, as well as a dependence on self-reported data for some variables, which might introduce recall bias. Furthermore, the study was done in a specific metropolitan region of Odisha, which limits the findings' applicability to other populations.

CONCLUSION

The study's findings represent that social support systems, specifically marital cohabitation and financial independence, have a substantial impact on glycemic management in people with diabetes mellitus. Chronic comorbidities, medication adherence, and lifestyle decisions all have a significant impact on glycemic control results. Certain characteristics, including gender, education level, and treatment methods, did not have significant relationships with glycemic control in this investigation. Future study might focus on understanding the processes behind the association between social support and glycemic control, developing creative techniques to improve medication adherence, and evaluating the influence of lifestyle variables on diabetes treatment. Longitudinal studies are needed to determine the long-term consequences of these characteristics and to design tailored therapies to improve glycemic control outcomes and reduce diabetes-related complications in varied groups. Furthermore, community-based programmes that address social determinants of health should be prioritised to reduce inequities in diabetes treatment and outcomes.

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ABBREVIATIONS

NFHS: National Family Health Survey; **WHO:** World Health Organization; **UN:** United Nations; **NCDs:** Noncommunicable diseases; **HbA_{1C}:** Glycosylated Haemoglobin; **ORs:** odds ratios; **CIs:** Confidence Intervals; **AORs:** Adjusted Odds Ratios; **BMI:** Body Mass Index; **T2DM:** Type 2 Diabetes Mellitus.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS APPROVAL

Ethical approval was obtained from the KIDS Ethics Committee, Bhubaneswar, Odisha, India. Written Informed consent was obtained in convenient to each participant (Odia/English/Hindi) before data collection.

SUMMARY

Estimating the prevalence of poor glycemic control in older diabetics with hypertension in the Bhubaneswar metropolitan area of the Indian state of Odisha is the main goal. The purpose of the study is to gain a better understanding of the complex interactions between the treatment of diabetes and hypertension in older adults residing in urban areas. Its objective is to investigate the relationship between hypertension and glycemic management, with an emphasis on possible reciprocal interactions and synergistic effects that may alter the course of the disease and its outcomes. The results of the study show that glycemic control in individuals with diabetes mellitus is significantly influenced by social support networks, particularly financial independence and marital cohabitation. Glycemic control outcomes are significantly impacted by lifestyle choices, medication adherence, and chronic comorbidities. In this analysis, glycemic control did not significantly correlate with some factors, such as gender, education level, and treatment approaches.

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