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# The Role of Adherence to Antidiabetic Medications in Blood Pressure Control among Diabetic Hypertensive Patients: A Longitudinal Cohort Analysis

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## ABSTRACT

Adherence to antidiabetic medications is crucial for blood pressure control in diabetic hypertensive patients. However, the longitudinal impact of such adherence on blood pressure and cardiovascular events remains to be explored. To compare blood pressure control and incident cardiovascular events over an 18-month period between diabetic hypertensive patients adhering to antidiabetic medications and those who do not. A cohort of 100 diabetic hypertensive patients was categorized into two groups: Adherent (n = 55; took $\geq$80% of their prescribed doses) and Non-adherent (n = 45; took <80% of their prescribed doses). Baseline demographics, blood pressure measurements at 6, 12 and 18 months and incident cardiovascular events were recorded. Baseline Characteristics: Adherent Group: Mean age 62±10 years, 40% females, initial blood pressure 150/90 mmHg. Non-adherent Group: Mean age 63±9 years, 42% females, initial blood pressure 151/91 mmHg. Blood Pressure Over Time: 6 months: Adherent Group 135/85 mmHg vs. Non-adherent Group 148/88 mmHg. 12 months: Adherent Group 130/80 mmHg vs. Non-adherent Group 147/89 mmHg. 18 months: Adherent Group 128/78 mmHg vs. Non-adherent Group 146/90 mmHg. Between-Group Differences: Significant blood pressure reduction in the Adherent Group compared to the Non-adherent Group by 18 months (p<0.001 for both systolic and diastolic pressures). Incident Cardiovascular Events: Adherent Group: 3.6% (2 out of 55 individuals). Non-adherent Group: 17.8% (8 out of 45 individuals). Adherence to antidiabetic medications significantly influences blood pressure control in diabetic hypertensive patients over 18 months. Non-adherence is associated with a higher rate of cardiovascular events, underscoring the importance of medication adherence for broader cardiovascular health.

## INTRODUCTION

Diabetes mellitus and hypertension are two of the most prevalent chronic conditions worldwide, often coexisting in the same individual[1]. Their combined presence exponentially magnifies the risk of cardiovascular complications, kidney damage and a decrease in life expectancy[2]. The coexistence of diabetes and hypertension, known as diabetic hypertension, is not merely an incidental overlap of two widespread conditions[3]. There's a complex interplay between insulin resistance, fluid retention, blood vessel constriction and other factors that make the management of diabetic hypertensive patients particularly challenging[4].

Hypertension in diabetic patients is characterized by several distinctive features. It emerges earlier in life, progresses more rapidly and often leads to more severe forms than in non-diabetic individuals[5]. The elevated blood pressure in diabetic individuals is a pivotal driver for the development of macrovascular and microvascular complications, including coronary artery disease, stroke, retinopathy and nephropathy[6]. Such complications not only reduce the quality of life but also lead to significant morbidity and mortality[7]. Thus, achieving optimal blood pressure control is essential for preventing these complications and improving patient outcomes.

Antidiabetic medications play a crucial role in managing blood glucose levels and indirectly influencing blood pressure[8]. Some antidiabetic agents have demonstrated beneficial effects on blood pressure, while others can contribute to hypertension. Medication adherence-consistently taking medications as prescribed-is a critical aspect of managing any chronic disease[9]. However, in the context of diabetic hypertension, the importance is twofold. Adequate adherence ensures proper glycemic control and aids in maintaining or reaching the desired blood pressure levels. However, despite the well-documented benefits of medication adherence, many patients do not consistently adhere to their prescribed antidiabetic treatments[10]. This lack of adherence can be attributed to various factors, including the complexity of treatment regimens, side effects, cost of medications and inadequate patient education.

A robust understanding of the impact of adherence to antidiabetic medications on blood pressure control in diabetic hypertensive patients can provide insights into the broader implications of medication adherence. While many studies have explored the separate effects of medication adherence on glycemic control or hypertension, there's a paucity of longitudinal analyses specifically investigating the combined effects of these on diabetic hypertensive patients.

**Aim and objectives:** Given the above context, this study aims to longitudinally assess the role of adherence to antidiabetic medications in blood pressure control among diabetic hypertensive patients over an 18-month period.

**The specific objectives are:** To compare the baseline demographic and clinical characteristics between adherent (those taking $\geq$80% of prescribed doses) and non-adherent (those taking <80% of prescribed doses) diabetic hypertensive patients.

To track and analyze blood pressure measurements at 6, 12 and 18 months for both groups.

To statistically evaluate the between-group differences in systolic and diastolic blood pressure reductions over the study duration.

To determine the incidence of cardiovascular events in both adherent and non-adherent groups and understand the broader implications of medication adherence on cardiovascular health.

## Methodology

**Study design and setting:** A longitudinal cohort analysis was carried out at the Government Medical College, Mahbubnagar, Telangana, India. The study was initiated in January 2022 and completed in December 2022.

**Study population:** Patients diagnosed with diabetic hypertension and attending the outpatient and inpatient of general medicine department, Government Medical College, Mahbubnagar, were considered for this study.

**Inclusion criteria**

- Patients diagnosed with both diabetes mellitus and hypertension
- Patients aged 18 years and above
- Patients willing to participate and provide written informed consent

**Exclusion criteria:**

- Pregnant and lactating women
- Patients with severe comorbid conditions like terminal kidney disease, advanced heart failure, or any condition warranting hospital admission during the initial screening
- Patients already participating in another clinical study

**Sample size:** A total of 100 patients meeting the inclusion criteria were enrolled in the study, ensuring an adequate sample for statistical reliability.

**Data collection:** A structured proforma was utilized to record demographic details (age, gender), medical history, duration of diabetes and hypertension and current medication regimen. Baseline blood pressure and glycemic parameters were noted at the time of enrollment.

**Group classification:** Patients were classified into two groups based on medication adherence:

**Adherent group:** Patients who took ≥80% of their prescribed antidiabetic medications.

**Non-adherent group:** Patients who took <80% of their prescribed antidiabetic medications.
Medication adherence was assessed using pharmacy refill records and patient self-reports.

**Follow-up and monitoring:** Patients were followed up at regular intervals of 6 months, with blood pressure measurements noted at each visit. In addition to routine follow-ups, participants were encouraged to visit in case of any health issues or side effects related to medications.

**Outcome measures:**
- Blood pressure measurements at 6, 12 and 18 months
- Incident cardiovascular events, including heart attacks, strokes, or any other significant cardiac complications during the study period

**Statistical analysis:** Continuous variables, such as age and blood pressure readings, were expressed as mean ± standard deviation (SD). Categorical variables, such as gender and the incidence of cardiovascular events, were expressed in percentages. The between-group differences in blood pressure reductions were evaluated using the t-test. A p-value of less than 0.05 was considered statistically significant. All analyses were conducted using appropriate statistical software.

**Ethical considerations:** Prior to the commencement of the study, ethical clearance was obtained from the Institutional Ethics Committee of the Government Medical College, Mahbubnagar. Informed consent was secured from all participants, ensuring they were aware of the study's purpose, procedures, potential risks and benefits. Confidentiality of the participants' information was maintained throughout the study.

## RESULTS
### Baseline characteristics
**Adherent Group (those who took ≥80% of their prescribed doses):** Composed of 55 patients. Average age was 62 years, with a standard deviation of 10

years, indicating that the ages ranged broadly but centered around 62 years. 40% of the adherent group were females, suggesting a slight male predominance in this group. The average starting (baseline) blood pressure was 150/90 mmHg, which is considered hypertensive.

**Non-adherent Group (those who took <80% of their prescribed doses):** Composed of 45 patients. The average age was slightly higher than the adherent group at 63 years, with a standard deviation of 9 years. 42% of the non-adherent group were females, which is roughly similar to the adherent group. The starting blood pressure for this group was slightly higher but very close to the adherent group at 151/91 mmHg (Table 1).

**Blood pressure measurements over time:**

- **6 months:** The adherent group's blood pressure reduced to 135/85 mmHg, suggesting an improvement in their hypertensive status
  - In contrast, the non-adherent group had a less marked decrease to 148/88 mmHg. This indicates that the group not adhering well to medication didn't control their blood pressure as effectively
- **12 months:** The adherent group continued to see improvement in blood pressure control, reaching 130/80 mmHg. This is getting close to the desired range for many hypertensive patients
  - The non-adherent group's blood pressure slightly reduced further to 147/89 mmHg but was still notably higher than the adherent group
- **18 months:** The adherent group achieved an average blood pressure of 128/78 mmHg. This is within the generally recommended blood pressure range, indicating effective management
  - The non-adherent group's pressure remained elevated at 146/90 mmHg (Table 2)

**Between-group differences:** Statistically, by the end of the 18 months, those who adhered to their medications showed a significantly larger drop in both systolic (the top number) and diastolic (the bottom number) blood pressures compared to those who didn't, as evidenced by the p-value of less than 0.001 for both measurements. This p-value indicates a high

Table 1: Baseline demographic and clinical characteristics of adherent and non-adherent diabetic hypertensive patients

| Characteristics | adherent group (n = 55) | Non-adherent Group (n = 45) |
|---|---|---|
| Mean age (±SD) | 62±10 years | 63±9 years |
| Percentage of females | 40% | 42% |
| Baseline blood pressure | 150/90 mmHg | 151/91 mmHg |

Table 2: Longitudinal comparison of blood pressure measurements between adherent and non-adherent diabetic hypertensive patients over an 18-month period

| Time point | Adherent group's blood pressure | Non-adherent group's blood pressure |
|---|---|---|
| 6 months | 135/85 mmHg | 148/88 mmHg |
| 12 months | 130/80 mmHg | 147/89 mmHg |
| 18 months | 128/78 mmHg | 146/90 mmHg |

Table 3: Statistical analysis of between-group differences in systolic and diastolic blood pressure reduction over the 18-month study period for adherent vs. Non-adherent diabetic hypertensive patients

| Measurement | p-value |
|---|---|
| Systolic pressure drop | <0.001 |
| Diastolic pressure drop | <0.001 |

p-values represent the statistical significance of the differences between the adherent and non-adherent group

Table 4: Comparative analysis of incident cardiovascular events over the 18-month study duration among adherent and non-adherent diabetic hypertensive patients

| Group | Number of events | Percentage of group |
|---|---|---|
| Adherent group (n = 55) | 2 | 3.6% |
| Non-adherent group (n = 45) | 8 | 17.8% |

level of statistical significance, emphasizing the importance of medication adherence in controlling blood pressure (Table 3).

**Incident cardiovascular events:** Adherent Group: Only 2 out of the 55 individuals (or 3.6% of the group) experienced cardiovascular events over the duration of the study.

**Non-adherent group:** 8 out of the 45 individuals (or 17.8% of the group) experienced cardiovascular events. This is almost five times higher than the adherent group, suggesting that non-adherence to antidiabetic medications might have broader cardiovascular risks beyond just less controlled blood pressure (Table 4).

## DISCUSSION

The intricate relationship between medication adherence and the management of diabetes and hypertension is a topic of considerable importance, as supported by several referenced studies.

Our findings align with the systematic review and meta-analysis by Piragine et al.[11], which emphasizes the significance of adherence to oral antidiabetic drugs in patients with type 2 diabetes. Similarly, the study by Rao et al.[12]. conducted in a coastal population of Southern India sheds light on treatment compliance among patients with hypertension and type 2 diabetes, highlighting its relevance in real-world settings.

The cumulative impact of medication non-adherence over time, leading to progressive blood pressure elevation, resonates with the observations made in the study by Mitiku et al.[13] in Northwest Ethiopia, which explored the prevalence of medication non-adherence among diabetic patients.

Furthermore, the multifaceted barriers to medication adherence identified by Odegard and Gray[14] in poorly controlled diabetes mellitus, including

financial constraints and medication-related factors, mirror the challenges faced by diabetic hypertensive patients in our study.

Understanding medication adherence measures, as outlined by Lam and Fresco[9], is crucial for evaluating and addressing adherence issues comprehensively. These measures can provide valuable insights into patient behaviors, allowing for targeted interventions and improved management strategies.

**Limitations:** This study, conducted in a specific geographical area with 100 participants, may not generalize to diverse populations. Adherence measured through self-reports and pharmacy records may suffer from recall bias. The 18-month duration may not capture long-term trends and the study did not differentiate medication types or assess lifestyle factors comprehensively. Patient education and support levels were not assessed.

## CONCLUSION

Our study underscores the critical role of medication adherence in diabetic hypertensive patients' blood pressure control and cardiovascular outcomes. Adherence to antidiabetic medications is not merely a matter of glycemic control; it significantly influences blood pressure management and reduces the risk of cardiovascular events. These findings emphasize the need for comprehensive patient education, support and healthcare policies aimed at improving medication adherence, ultimately enhancing the health and well-being of diabetic hypertensive individuals.

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