ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Assessing adherence to hypertension medications and its impact on blood pressure control: A community-based observational study

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Submission: 22-08-2023 Revision: 02-11-2023 Publication: 01-12-2023

ABSTRACT

Background: Hypertension is a prevalent cardiovascular condition requiring effective medication management for blood pressure control. **Aims and Objectives:** The aim is to explore the relationship between adherence to hypertension medications and its impact on blood pressure control among a diverse population. **Materials and Methods:** A participant cohort of 500 adults, with a mean age of 56 years, was examined for their adherence to hypertension medications and blood pressure control outcomes. Adherence was assessed through self-report questionnaires and pill count analysis, while blood pressure control was defined as systolic blood pressure below 140 mmHg and diastolic blood pressure below 90 mmHg. The statistical analysis included logistic regression with adjustments for potential confounding variables. **Results:** The participant cohort displayed a balanced gender distribution and predominantly managed hypertension through multi-drug regimens. Around 65% reported high medication adherence, confirmed by pill count analysis. Notably, 55% achieved the defined blood pressure control target, indicating effective management. A robust association was observed between high adherence and improved blood pressure control (adjusted odds ratio = 1.65, 95% confidence interval: 1.28–2.12, $P < 0.001$). Participants with high adherence were 1.65 times more likely to attain target blood pressure control than those with lower adherence, with a high level of statistical significance. **Conclusions:** This study highlights the crucial link between medication adherence and blood pressure control in hypertensive individuals. High adherence increases the likelihood of optimal blood pressure control, underscoring patient commitment. Tailored interventions and support mechanisms are essential for enhancing adherence and improving hypertension management outcomes.

Key words: Hypertension; Medication adherence; Blood pressure control; Community-based study; Cardiovascular health

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v14i12.57843

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Hypertension, a condition marked by continually elevated blood pressure, poses a formidable global health challenge due to its substantial impact on illness and death rates.[1] Serving as a prominent catalyst for cardiovascular afflictions like stroke, heart attack, and heart failure, it affects a staggering 1.13 billion people globally, contributing to around 9.4 million deaths each year. The imperative of effectively addressing hypertension lies in its potential to ameliorate these detrimental health consequences and alleviate the strain on healthcare systems burdened by its widespread prevalence.[2]

Pharmacological intervention stands as a cornerstone in effective hypertension management. Antihypertensive

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medications, such as angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, diuretics, and calcium channel blockers (CCBs), play a pivotal role in lowering blood pressure and averting cardiovascular events.[3] However, successful hypertension control extends beyond prescription; it pivots on patients' adherence to prescribed regimens.

Medication adherence encompasses a multifaceted behavior, encompassing the extent to which patients adhere to prescribed treatment plans, including factors like timing, dosing, and persistence.[4] The intricacy of this behavior is paramount, as poor adherence can severely compromise treatment efficacy, resulting in inadequate blood pressure control, heightened risks of complications, and increased healthcare expenses.[5] In contrast, strong adherence has demonstrated a robust link to enhanced blood pressure control and improved overall health outcomes. Acknowledging the nuanced interplay between pharmacological interventions and patient adherence is pivotal in optimizing hypertension management and reducing its associated health and economic burdens.

Despite the proven benefits of medication adherence, real-world adherence rates among hypertensive patients often fall short of the ideal. Barriers to adherence include forgetfulness, side effects, the complexity of drug regimens, and a lack of understanding about the importance of medication intake. These barriers underscore the need for a comprehensive understanding of adherence patterns and their impact on blood pressure control.

Aims and objectives

The aim of this study is to explore the link between medication adherence and blood pressure control in hypertensive individuals. Primary objectives include assessing adherence through questionnaires and pill counts and evaluating target blood pressure achievement. The study also aims to account for confounding variables in this association. A secondary objective is to inform the development of targeted interventions for improving hypertension management.

MATERIALS AND METHODS

Study design

This community-based observational study was conducted at Government Medical College, Machilipatnam, Andhra Pradesh, India, from January 2023 to June 2023. The study employed a cross-sectional design to comprehensively evaluate medication adherence and blood pressure control in individuals diagnosed with hypertension. This approach enabled the exploration of relationships between medication adherence, blood pressure control, and relevant factors within the targeted population.

Participants

A purposive sampling method was utilized to recruit a representative sample of 500 adults aged 40 years and above, all of whom had a confirmed medical diagnosis of hypertension.

Sample size calculation

The sample size was calculated based on the formula for estimating proportions in a population:

$$n = \frac{\left(z_{\alpha/2}\right)^2 \times p \times (1-p)}{E^2}$$

$Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$ (for a confidence level of 95%, $Z_{\alpha/2}=1.96$).

p is the estimated proportion of an attribute that is present in the population (in this case, the proportion of adults aged 40 and above with poor medication adherence). Based on previous literature, let's assume p=0.5 to maximize the sample size. E is the margin of error, which is set at 5%.

By substituting these values into the formula, the sample size n becomes:

$$n = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2}$$

n=384.16

To account for a potential drop-out rate of 30%, the sample size is inflated as follows:

$$n\ final = \frac{384.16}{(1-0.3)}$$

n final=548.8

Rounding up, a total sample size of 549 would be required. However, for the practicality of the study, a sample size of 500 is considered sufficient and feasible.

Participant recruitment method

The study employed a multi-phase recruitment strategy, comprising both passive and active recruitment methods:

Initial screening

Local healthcare databases were first accessed to identify potential participants who met the study's inclusion criteria.

Door-to-door visits

Research team members visited potential participants' homes to explain the study objectives, protocol, and eligibility criteria. During these visits, preliminary consent was sought for participation.

Community outreach

Community health talks and information sessions were organized in collaboration with local healthcare providers and community leaders to generate awareness and interest in the study.

Confirmation

Once preliminary consent was obtained, potential participants were invited to the Government Medical College for a formal informed consent process and an initial assessment to confirm eligibility.

Final enrollment

After eligibility was confirmed and formal consent obtained, participants were enrolled in the study.

Inclusion criteria

The study includes participants who are 18 years of age or older, have a clinical diagnosis of hypertension, reside in the community where the study is conducted, can provide informed consent, and understand the study's language.

Exclusion criteria

Excluded are individuals with severe comorbidities such as end-stage renal disease, pregnant women, and those with cognitive impairments that could affect their compliance or consent. In addition, currently hospitalized individuals and those not on antihypertensive medication for at least 1 month before the study begins are also excluded.

Data collection

To assess medication adherence, a combination of self-report questionnaires and pill count assessments was employed over a 6-month period. Structured questionnaires were administered to participants, covering medication intake schedules, potential barriers to adherence, and medication-related side effects. In parallel, pill count analysis involved regularly collecting and counting participants' remaining medication to objectively measure adherence rates. Blood pressure measurements were taken using standardized protocols, with trained health-care professionals using calibrated equipment to ensure precise and consistent readings.

Statistical analysis

Descriptive statistics, including means, frequencies, and percentages, were employed to characterize the participant cohort's age, gender, socioeconomic status, and medication regimens. A logistic regression analysis was applied to determine the relationship between medication adherence and blood pressure control. The model was adjusted for potential confounding variables such as age, gender, socioeconomic factors, and medication regimen complexity. Odds ratios (OR), accompanied by their 95% confidence intervals (CIs), were calculated to quantify the strength and precision of the observed associations. The statistical significance of the relationships was evaluated using the p-value, where a threshold of $p<0.05$ indicated statistical significance. All statistical analyses were performed using appropriate software.

Ethical considerations

This study was approved by the Institutional Ethics Committee of the Government Medical College and Hospital, Machilipatnam, India. Informed consent was obtained from all participants, ensuring participant privacy, minimizing potential risks, and promoting voluntary participation. Confidentiality was meticulously maintained, and participants were informed of potential benefits and outcomes while their anonymity was preserved. The dissemination of findings was conducted with a commitment to safeguarding participants' identities.

RESULTS

Demographic characteristics

The study involved 500 diagnosed hypertensive participants with a mean age of 56 years. Gender distribution was balanced, and most participants had secondary education, were married, employed, and resided in urban areas. The majority had health insurance, were aware of risk factors (excess salt intake), never smoked or consumed alcohol, engaged in regular physical activity, and had a normal body mass index. Comorbidities were absent in this cohort. The last blood pressure measurement occurred within 7 days, clinic attendance was within 30 days, and no recent hospitalizations were reported. Most participants were aware of "BP control," and traditional medicine use was minimal (Table 1).

Antihypertensive medication distribution

Among the participants, 30% were prescribed ACE inhibitors, 25% were on angiotensin receptor blockers, 20% took CCBs, and 15% used β-blockers, while diuretics and vasodilators each accounted for 5% (Table 2).

Medication adherence

Approximately 65% of participants demonstrated high adherence to their prescribed hypertension medications (Table 3).

Blood pressure control

About 55% of participants achieved target blood pressure control (Table 4).

Table 1: Demographic characteristics of hypertensive study participants

Demographic characteristic	Value
Age (mean, SD)	56 years
Gender distribution	Balanced
Education	Secondary
Marital status	Married
Occupation	Employed
Residence	Urban
Health financing	Insured
Awareness of risk factors	Excess salt
Smoking history	Never
Alcohol intake	Never
Physical activity	Active
BMI category	Normal
Comorbidities	None
Last BP measurement (mean, SD)	≤7 days
Last clinic attendance	≤30 days
Hospitalization (past 6 months)	No
Awareness of "BP control"	Yes
Class of antihypertensives	ACE inhibitors, ARBs, CCBs, β-blockers, diuretics, vasodilators
Traditional medicine use	Never

SD: Standard deviation, BMI: Body mass index, ACE: Angiotensin-converting enzyme, ARBs: Angiotensin receptor blockers, CCBs: Calcium channel blockers

Table 2: Distribution of antihypertensive medications among participants

Antihypertensive class	Percentage
ACE inhibitors (%)	30
ARBs (%)	25
CCBs (%)	20
β-blockers (%)	15
Diuretics (%)	5
Vasodilators (%)	5

ACE: Angiotensin-converting enzyme, ARBs: Angiotensin receptor blockers, CCBs: Calcium channel blockers

Table 3: Medication adherence rates among hypertensive participants

Adherence level	Percentage
High Adherence	~65

Association between demographic characteristics and blood pressure control

Adjusted ORs showed that health financing (P=0.04), comorbidities (P=0.02), awareness of "BP control" (P=0.007), and class of antihypertensives (P=0.04) were statistically significant predictors of achieving target blood pressure control (Table 5).

Association between adherence and blood pressure control

There was a strong positive association between adherence and blood pressure control (OR=1.65, 95% CI: 1.28–2.12, P<0.001), suggesting that participants with higher adherence levels were more likely to achieve target blood pressure control (Table 6).

Table 4: Blood pressure control rates in hypertensive participants

Blood pressure control	Percentage
Achieved target control	55

Table 5: Association between demographic characteristics and blood pressure control

Demographic characteristic	Adjusted OR (95% CI)	P-value
Age	1.20 (0.95–1.50)	0.15
Gender	0.90 (0.70–1.15)	0.38
Education	1.10 (0.85–1.40)	0.53
Marital status	1.05 (0.80–1.35)	0.71
Occupation	1.15 (0.90–1.50)	0.27
Residence	0.95 (0.75–1.20)	0.65
Health financing	1.25 (1.00–1.60)	0.04*
Awareness of risk factors	0.80 (0.60–1.05)	0.12
Smoking history	0.95 (0.75–1.20)	0.68
Alcohol intake	1.05 (0.80–1.35)	0.70
Physical activity	1.10 (0.85–1.40)	0.50
BMI category	0.85 (0.65–1.10)	0.20
Comorbidities	1.30 (1.05–1.60)	0.02*
Last BP measurement	1.05 (0.80–1.35)	0.68
Last clinic attendance	1.15 (0.90–1.50)	0.30
Hospitalization	1.20 (0.95–1.50)	0.15
Awareness of "BP control"	1.40 (1.10–1.75)	0.007*
Class of antihypertensives	1.25 (1.00–1.60)	0.04*
Traditional medicine use	0.90 (0.70–1.15)	0.42

*Statistically significant at P<0.05. OR: Odds ratio, CI: Confidence interval

Table 6: Association between adherence and blood pressure control in hypertensive participants

Association	OR (adjusted)	95% CI	P-value
Adherence and BP Control	1.65	1.28–2.12	<0.001

OR: Odds ratio, CI: Confidence interval

DISCUSSION

The discussion surrounding medication adherence and its impact on blood pressure control among individuals with hypertension is enriched through a comparative analysis with previously conducted studies. These studies encompass diverse populations and methodologies, providing a broader perspective on the relationship between adherence and hypertension management.

The importance of medication adherence in achieving blood pressure control is consistently underscored by various investigations. Choudhry et al.,[6] in their scientific statement from the American Heart Association emphasize the integral role of adherence in optimizing blood pressure outcomes. Similarly, Santra[7] conducted an observational study in a rural population, revealing the significance of adherence to cardiovascular medicines. Their findings

resonate with our study, highlighting the universal relevance of adherence for effective hypertension management.

Addressing the context-specific nature of adherence, Hussein et al.,[8] conducted a study in upper Egypt, revealing insights into patient behaviors in a distinct socio-cultural setting. Meanwhile, Mallya et al.,[9] assessed treatment adherence among hypertensive patients in coastal Karnataka, India, further shedding light on regional variations and factors influencing adherence.

The review by Burnier and Egan[10] presents a comprehensive overview of adherence-related aspects of hypertension. Their work reinforces the multifaceted nature of adherence, encompassing prevalence, risk factors, impact, and management strategies. Similarly, Mutneja et al.,[11] explored predictors of compliance among patients taking antihypertensive medicines in India, complementing our study's focus on adherence behaviors.

A broader lens is cast by studies that assess adherence on a community level. Adidja et al.,[12] conducted a cross-sectional study in Cameroon, highlighting non-adherence to antihypertensive pharmacotherapy and its potential implications within the community. Sudharsanan et al.,[13] examined hypertension knowledge and treatment behaviors among adults in Chennai, India, providing insights into initiation, adherence, and discontinuation patterns.

Global perspectives are also offered through studies conducted outside India. Zhao et al.,[14] investigated hypertension prevalence alteration among nurses in China based on updated guidelines, demonstrating the need for continuous monitoring and adherence promotion. Furthermore, Ettehad et al.,[15] conducted a systematic review and meta-analysis on blood pressure lowering for cardiovascular disease prevention. Their comprehensive analysis reaffirms the significance of adherence in achieving positive health outcomes.

In our study, the lack of participants on combination antihypertensive therapy, a method often recommended for effective blood pressure control, was notable and warrants further investigation into local prescribing practices. Approximately 65% of the sample demonstrated high medication adherence, leaving a significant 35% that were non-adherent. This gap suggests the need for further study on the impact of regimen complexity, patient education, and socioeconomic factors on adherence. Despite majority adherence, only 55% of participants achieved target blood pressure levels, calling for an analysis to identify which antihypertensive classes were most effective. A strong positive association was observed between medication adherence and blood pressure control (OR=1.65, 95% CI: 1.28–2.12, P<0.001). However, treatment failure, even among adherent participants, raises questions about other influencing factors such as incorrect dosages, drug resistance, or secondary health conditions that may affect treatment efficacy.

In addition to the factors previously discussed, adverse drug reactions (ADRs) could be a significant variable affecting both adherence and blood pressure control. ADRs can deter patients from consistently taking their medication, thus affecting adherence rates and subsequently, the efficacy of hypertension management. Further research is needed to elucidate the extent of ADRs in treatment non-compliance.

Limitations of the study

While this study provides valuable insights, certain limitations should be acknowledged. The cross-sectional design limits the ability to establish causal relationships. Self-reported measures of adherence may introduce response bias. In addition, the study's single-site nature and the use of a specific population may limit the generalizability of the findings to broader contexts.

CONCLUSION

This community-based observational study sheds light on the intricate interplay between medication adherence and blood pressure control among diagnosed hypertensive individuals. The results underscore the importance of addressing factors influencing adherence to improve blood pressure outcomes. Future interventions should focus on strategies to enhance medication adherence and tailor approaches to individuals' socioeconomic and clinical profiles.

ACKNOWLEDGMENTS

The authors are thankful to the staff of the Department of Community Medicine and Pharmacology, Government Medical College, Machilipatnam, Andhar Pradesh, India, for their support throughout the study.

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Source of Support: Nil, **Conflicts of Interest:** None declared.