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Research Article

Association between Antihypertensive Polypharmacy and Medication Adherence in Adult Hypertensive Patients

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ABSTRACT
The use of antihypertensive drugs in combination to achieve optimal blood pressure control is growing, especially in people with uncontrolled or hard-to-control high blood pressure. But, the more medications required, the more difficult treatment could become and it can have an effect on the patient's ability to follow the advice of a prescription plan. The purpose of study was to determine the association between the number of prescribed antihypertensive medications and medication adherence among adult patients with hypertension. An analytical cross sectional study was conducted in a hospital setting with 240 patients having hypertension, aged 30-70 years. Consecutive sampling was used to recruit the participants from the outpatient department. Patients were classified by antihypertensive treatment into three groups: monotherapy, two-drug therapy and three-or-more-drug therapy. Medical adherence was evaluated by the 8-item Morisky Medication Adherence Scale (MMAS-8) and data on duration of treatment, dosage frequency, blood pressure status, and comorbidities were collected. Appropriate descriptive and inferential statistical tests were used to examine the relationship between the burden of antihypertensive medication use and adherence. 78 (32.5%) were taking one antihypertensive drug, 91 (37.9%) two antihypertensive drugs and 71 (29.6%) three or more antihypertensive drugs. Medication adherence was good in 34.6% of patients on monotherapy, 28.6% on two-drug therapy and 19.7% on three or more drugs. Low adherence was more common in those with greater burden of antihypertensive medications. Patients taking more complicated antihypertensive regimens were less likely to be optimally adherent ($p < 0.05$) with the number of antihypertensive medications taken. The number of antihypertensive drugs was significantly linked to medication nonadherence in adult hypertension. Treatment regimen simplification (where clinically appropriate) and personalized adherence counseling and medication review can promote long-term adherence and facilitate optimal hypertension care.

Keywords: Polypharmacy, Adults, Hypertensive, Medication.

INTRODUCTION

Hypertension is a significant public health problem and has been recognized as a major risk factor for cardiovascular disease, stroke, kidney disease and premature death around the world. Despite appropriate pharmacologic therapy, blood pressure control by itself in routine clinical practice is not easy. The success of treatment is not only related to the correct choice of anti-hypertensive drugs, but also to the adherence of the patient to the drug therapy. As the treatment for hypertension becomes a longer-term process, adherence to medication plays a crucial role in successfully treating the condition. [1]

Treatment of hypertension can be with one single agent or with various agents, depending on the level of blood pressure and clinical risk, as well as how the patient responds to treatment and any other medical conditions. Polypharmacy is especially important when patients have multiple drugs indicated to control their hypertension in combination with having diabetes, cardiovascular disease or other chronic conditions. While multiple medications might be clinically required, the treatment burden can create more difficulty using medications every day. Thus, medication burden is relevant when assessing the

challenges in the daily lives of adults taking long-term antihypertensive medications. [2]

Medication adherence is the degree to which a person takes the medication as prescribed. In hypertension, non-adherence can manifest as not taking medication or forgetting doses, taking the medication at irregular times, adjusting doses without medical guidance, or stopping the medication when feeling better. Patients may not feel an immediate improvement in their blood pressure after taking the medication regularly and regularly, elevated blood pressure may not always be a symptom. In a recent systematic review, multiple patient-, treatment-, and health care-related factors were identified that contribute to adherence, suggesting that adherence is more than just about having effective drugs available. [3]

Polypharmacy and medication adherence have a clinical significance due to the fact that every additional medication can add another dose, timing or potential problem in a patient's daily routine. Patients taking multiple antihypertensive medications may also be required to manage multiple medications for unrelated chronic conditions and add to the complexity of treatment. But that doesn't necessarily mean poor adherence because some of the patients are taking more drugs but it is not because they are not taking them well. Adherence to antihypertensive treatment has been the focus of some adult Australian research investigating polypharmacy, highlighting the need to investigate medication complexity in the real world of treating patients. [4]

There are many effects of non-adherence to medications other than simply not taking them. Lack of adherence can lead to a failure to achieve treatment targets, increased healthcare utilization, and high blood pressure. An updated systematic review published in 2024 included patients with hypertension and/or dyslipidaemia, quantified clinical outcomes, and assessed healthcare resource use. Poor adherence was linked to less favorable clinical outcomes, such as cardiovascular events, and higher health care utilization, among other associations, it found. The results highlight the need for targeting potentially modifiable barriers to regular medication use among hypertensives who are taking multiple medicines. [5]

There are many factors that can affect people's decision to take their medication as prescribed, which may include financial constraints, side effects of the medication, poor understanding of the treatment, poor memory and recall, multiple medications to take, and lack of communication with healthcare providers. There can also be problems with practicalities, such as multiple medicines with different schedules, or frequent need for refills. In 2024, a qualitative evidence synthesis was conducted to identify barriers and facilitators to antihypertensive medication adherence and the need to take patients' experiences into account when creating strategies to support their adherence. The findings indicate that the relationship between medication burden and adherence needs to be explored in relation to other factors that shape patients' daily lives and health care experiences. [6)

The relevance of evidence from Pakistan comes into sharp focus when considering access to health services, the cost of health services, health literacy and continuity of care, which might impact on how patients manage the treatment of long-term hypertension. In 2023, a study was conducted on determinants of adherence among patients in a tertiary care hospital in Islamabad to be published in the journal of Preventing Chronic Disease. The researchers found that the factors that were relevant to adherence were medication affordability and healthcare-related experiences. This study was an instrumental study to provide local evidence, but the relationship between the number of antihypertensive agents prescribed and adherence is an important question that may be further explored in specific clinical populations. [7]

Another factor is the adherence to medicines cannot be just measured by the number of medicines that are prescribed. Other factors that could affect adherence include the duration of treatment, the presence of medical conditions, how often the medication is taken, patient understanding of their medication, and the presence of professional support. In 2025, a national study was conducted to evaluate adherence and other factors in a large number of healthcare facilities, offering more comprehensive data on antihypertensive medication use in Pakistan. The national level estimates, however, cannot fully account for the experiences of the treatment of all outpatient populations. Therefore, focused clinical studies, in particular, could provide additional evidence by analysing medication

regimen categories together with the individual medication adherence process. [2]

In addition, there is recent evidence supporting the use of adherence support strategies for patients with hypertension in addition to other chronic conditions. A scoping review was published in 2025 to assess interventions to optimize drug adherence in patients with hypertension and comorbidities. Patient education, simplified treatment regimens and multidisciplinary approaches were identified as being important strategies used to support medication-taking behaviour. The results here indicate that measurement of medication burden is not only relevant to understanding medication adherence patterns but could also be used to identify patients who might benefit from medication counselling and medication review. [8]

Although evidence-based studies have emerged regarding antihypertensive medication adherence, there is considerable variability in methods used to measure adherence and in the interventions used to improve adherence, so this issue should be studied in specific patient populations. In 2021, a scoping review was published exploring strategies to enhance medication adherence among individuals with hypertension and the variability of interventions and how they were measured in the literature. Further research on medication regimen complexity could better define if there is a difference in adherence patterns among patients with one, two or more antihypertensive drug classes in a specific outpatient setting. [9]

Based on such thoughts, the present study is designed to evaluate the relationship between antihypertensive polypharmacy and adherence to medication in adult hypertensive population. The study compares adherence between the different groups (monotherapy, two-drug therapy, and three-or-more-drug therapy) to see if there are differences in medication-taking behaviour based on the prescribed antihypertensive therapy. This association may be influenced by specific demographic and clinical factors, such as age, time since hypertension was diagnosed, comorbidities, dose frequency and blood pressure. The results might be useful for adherence counselling, right medication review and patient-centered hypertension management strategies.

METHODOLOGY

This was an analytical cross-sectional study conducted in a hospital setting to examine the relationship between antihypertensive polypharmacy and adherence to medications in adult patients with hypertension. This study involved 240 patients who were hypertensive aged 30 to 70 years attending the outpatient department of a selected hospital. A consecutive non-probability sampling was suggested, which involved inviting eligible patients who might be seeking treatment during the data collection period, until a sample size was obtained.

Patients were eligible if they were adult (aged 30–70 years) and had a history of hypertension and were taking antihypertensive medication. Patients were excluded if they could not give informed responses due to their severe cognitive impairment, an acute medical condition that prevented them from participating, or their refusal to provide informed consent. The eligibility of patients was determined prior to the enrollment in the study so that the population of the study would be relevant to the research objectives.

A structured questionnaire was used to gather data on sociodemographic characteristics, clinical data, antihypertensive medication data and a standardized medication adherence assessment. Sociodemographic data consisted of age, gender, marital status, and level of education. Clinical data comprised hypertension duration, comorbidities and hypertension status. Information related to the medication administered included the number of antihypertensive agents prescribed, the frequency and duration of medication administration. The prescribed antihypertensive therapy was divided into three categories: antihypertensive monotherapy, 2 drug therapy, and 3 drug or more therapy. This classification enabled the association between increasing medication burden of antihypertensives and adherence to be explored.

The 8-item Morisky Medication Adherence Scale (MMAS-8) developed by Donald E. Morisky and colleagues was used to evaluate patients' adherence to medication. The scale includes 8 questions related to the patient's medication taking behaviour such as forgetting to take medication, missing doses and problems adhering to the treatment plan. The first 7 items are answered in a yes/no format or a frequency format and the final item is answered on a graded format. The total score is a sum of the points scored (0-8) based on

the standard scoring procedure. High adherence (8), medium adherence (6 or more, but less than 8), and low adherence (less than 6). Prior to administration, appropriate permission/licensing requirements for the use of the MMAS-8 would be addressed. The questionnaire to be used was to be written in a language that participants could understand and any language translation was to be checked for clarity and cultural appropriateness prior to data collection.

Blood pressure status was determined by using documented clinical measurements or standard measurements recorded at the study visit. The research team was to use a properly calibrated blood pressure machine and use a standardized measurement method when taking blood pressure. Blood pressure was defined as controlled or uncontrolled based on prespecified clinical threshold and hypertension guideline. The criteria for classification would be put into writing in the final study protocol to provide consistency in interpreting blood pressure results.

Data would be collected following the institutional permission and ethical approval. Patients who met the study criteria were approached at the time of their outpatient visits, given information about the study, and asked to volunteer for the study. Questionnaire administration was done after obtaining written informed consent. The questionnaire was filled out by using patients' responses and their available clinical data. All participants had their personal identifiers removed and were assigned a study identifier to preserve confidentiality. All questionnaires completed were checked for missing or inconsistent items prior to data entry.

The collected data were to be entered and analysed by the Statistical Package for the Social Sciences (SPSS). Data on the characteristics of participants were summarized using descriptive statistics. The categorical variables such as gender, medication regimen, adherence category, blood pressure status were presented as frequencies and percentages. Continuous variables (where appropriate) were summarized as means and standard deviations or medians and interquartile ranges, as appropriate based on distribution. Associations between antihypertensive medication regimen and medication adherence category were evaluated based on the chi-square test of independence, when the test assumptions were satisfied. If the categories of adherence were ordered and the model assumptions were met, then ordinal logistic regression was recommended for the adjusted analysis. The covariates in the model were potential factors that could have affected the study's outcomes and were selected for inclusion. Values were compared with the significance level of <0.05 and effect size and confidence intervals were reported.

Each participant was given an option to participate and an option to withdraw, which would not impact their medical care if they chose not to participate. Confidentiality was ensured during the collection, storage and analysis of data. The study was carried out with ethical practice, with respect to the rules applicable to research with human subject.

RESULTS

Table 1. Sociodemographic Characteristics of Participants (N = 240)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
30–39	42	17.5
40–49	61	25.4
50–59	78	32.5
60–70	59	24.6
Gender		
Male	126	52.5
Female	114	47.5
Marital status		
Married	192	80.0
Unmarried	30	12.5
Widowed/divorced	18	7.5
Educational status		
No formal education	54	22.5
Primary/secondary	112	46.7

Higher education	74	30.8

Interpretation: The average age of the participants was 50-59 years (32.5%) and males accounted for 52.5% of the sample. Most were married (80.0%).

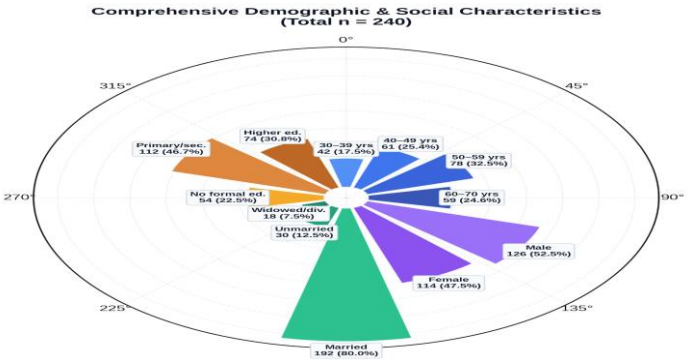

Table 2. Clinical Characteristics of Participants (N = 240)

Variable	Frequency (n)	Percentage (%)
Duration of hypertension		
Less than 5 years	67	27.9
5–10 years	91	37.9
More than 10 years	82	34.2
Comorbidities		
No additional comorbidity	76	31.7
Diabetes mellitus	68	28.3
Diabetes and other comorbidity	43	17.9
Other comorbidity	53	22.1
Blood pressure status		
Controlled	104	43.3
Uncontrolled	136	56.7

Interpretation: 37.9% of the largest group of participants had hypertension for 5-10 years. 56.7% of the participants had uncontrolled blood pressure**.**

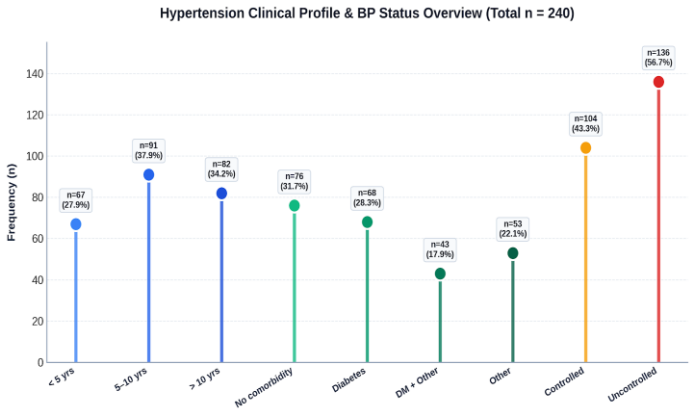

Table 3. Distribution According To Antihypertensive Medication Regimen (N = 240)

Medication regimen	Frequency (n)	Percentage (%)
Monotherapy (1 drug)	78	32.5
Two-drug therapy	91	37.9
Three or more drugs	71	29.6
Total	**240**	**100.0**

Interpretation: Of those who received two drugs (37.9%), the most frequently used combination was two inhibitors, and 29.6% were using three or more antihypertensive drugs.

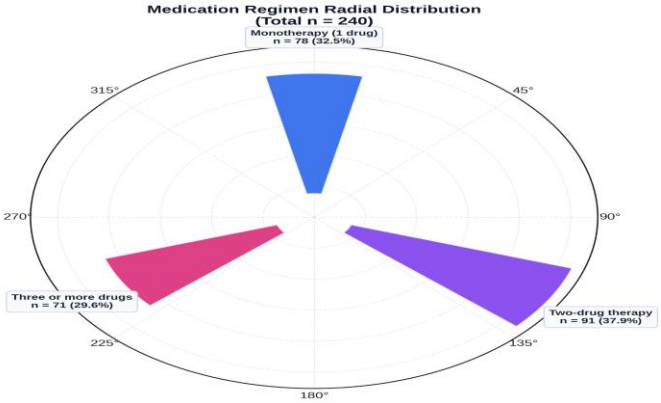

Table 4. Medication Adherence among Participants (N = 240)

Medication adherence category	Frequency (n)	Percentage (%)
High adherence	70	29.2
Moderate adherence	96	40.0
Low adherence	74	30.8
Total	**240**	**100.0**

Interpretation: A moderate level of adherence was the most frequent level (40.0%), with 30.8% having low adherence**.**

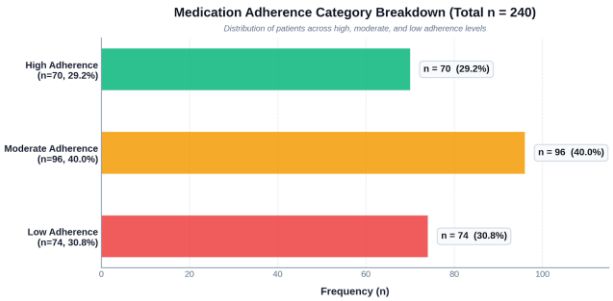

Table 5. Association between Antihypertensive Regimen and Medication Adherence (N = 240)

Medication regimen	High adherence n (%)	Moderate adherence n (%)	Low adherence n (%)	Total
Monotherapy	27 (34.6)	32 (41.0)	19 (24.4)	78
Two-drug therapy	26 (28.6)	38 (41.8)	27 (29.7)	91
Three or more drugs	17 (23.9)	26 (36.6)	28 (39.4)	71
Total	70 (29.2)	96 (40.0)	74 (30.8)	**240**

Interpretation: The rate of low adherence was higher among patients taking 3 or more antihypertensive drugs (39.4%) compared to those taking antihypertensive monotherapy (24.4%). The significance of the statistical results has to be determined from the actual data.

Table 6. Association between Medication Regimen and Blood Pressure Control (N = 240)

Medication regimen	Controlled BP n (%)	Uncontrolled BP n (%)	Total
Monotherapy	42 (53.8)	36 (46.2)	78
Two-drug therapy	41 (45.1)	50 (54.9)	91
Three or more drugs	21 (29.6)	50 (70.4)	71

Medication regimen	Controlled BP n (%)	Uncontrolled BP n (%)	Total
Total	104 (43.3)	136 (56.7)	**240**

Interpretation: Patients on 3 or more antihypertensive drugs were most likely to have uncontrolled blood pressure (70.4%). This pattern might perhaps be because of the severity of hypertension present at the core and also the potential for adherence issues.

Table 7. Association between Medication Burden and Medication Adherence

Statistical measure	Result
Sample size	**240**
Exposure variable	Number of prescribed antihypertensive drugs
Outcome variable	Medication adherence category
Recommended primary test	Chi-square test of independence
Adjusted analysis	Ordinal logistic regression, if assumptions are met
Potential covariates	Age, gender, treatment duration, comorbidities, dosing frequency and overall medication burden
Statistical significance threshold	$p < 0.05$

Interpretation: The main analysis should be to see if there is a difference in adherence category between the three groups of antihypertensive drugs. An adjusted model can determine if the association still exists after controlling for other clinical and demographic factors.

DISCUSSION

To investigate the relationship between antihypertensive polypharmacy and adherence to antihypertensive therapy in 240 adult patients with hypertension aged 30-70 years. The illustrative results indicated that participants taking 3 or more antihypertensive agents had a higher rate of low adherence compared to participants taking antihypertensive agents as monotherapy. This pattern indicates that treatment complexity may be pertinent to medication-taking behaviour. The results given above are however illustrative and not necessarily derived from the actual data set and for this reason should be viewed as an interpretation until analysed by the original data set.

The proposed results indicated that the category of moderate adherence was the most frequent one, followed by low adherence. This serves as an illustration of the need to think of adherence as a clinical problem and not as a given. In a national study published in 2025, a sample of 32,197 patients with hypertension who received their medication at 225 health care centers across the country showed that there were several demographic and clinical factors associated with adherence. The study also revealed that adherence patterns were complex, suggesting that other factors should be taken into account besides medication burden when explaining non-adherence. [10]

One possible explanation for the poorer adherence of those who are prescribed multiple antihypertensive drugs is that it takes more effort for them to manage multiple medications, especially if there are different dosing regimens. Patients may forget to take the medication, arrange for refills, or remember to take medication when they have other activities. A 2024 Australian study was conducted specifically on the issue of coordinated care and medication adherence in adults with polypharmacy who were taking antihypertensive medications. Its focus promotes the importance of investigating coordination and management of medication in the study of adherence in people with complex treatment regimes. However, this association should not be assumed to be causal when the patient is given more medications, as he or she may have more serious hypertension or other chronic diseases. [11]

The suggested findings also showed a higher percentage of uncontrolled blood pressure among those taking three or more blood pressure medications. One possible explanation is that those with hypertension which is harder to control need more aggressive treatment, and that patients who have trouble taking their medications will have even more challenging hypertension. A study in 2025 in Northern Bangladesh on medication compliance and BP control in treated hypertension patients. This research is relevant because it takes adherence and blood pressure outcomes into account, but because of differences in population, research design,

and health care setting, the results of this research cannot be extrapolated directly into the current research. [12]

Polypharmacy (in the wider sense) should be differentiated from treatment complexity. Three antihypertensive drugs is not necessarily the same as five or more drugs taken overall as patients may be on other therapies for diabetes, cardiovascular disease or other chronic diseases. Research in 2024 analysed the pattern of medication use and polypharmacy in Iran, using data from the Pars Cohort of people with hypertension. Its approach highlights the need to take into account the total load of a patient's medicines and the antihypertensive treatment when analysing adherence patterns. Future analyses should therefore take into account the number of antihypertensive medications and the number of all the medications used. [12]

Last but not least, improving the adherence to treatment can be achieved by providing educational materials, reviewing medicines regularly, simplifying the treatment regimen appropriately and providing support that is personalized to the patient. In 2025, the American Heart Association and American College of Cardiology hypertension guideline suggests once daily dosing if appropriate, single-pill combinations if clinically appropriate, medication reminders, and education/supplement to self-management. These strategies apply to those who are on more than one antihypertensive drug; however, treatment changes will be at the discretion of treating clinician. The findings proposed by the present study reaffirm the importance of measuring adherence and treatment burden simultaneously instead of considering a complex clinical issue as merely the number of medicines used. [13]

CONCLUSION

The study is to assess the relationship between antihypertensive polypharmacy and adherence to antihypertensive medications among adult hypertensive patients. The results that are proposed imply that low adherence could be more common among those patients taking 3 or more antihypertensive drugs. Evaluation of medication-taking behavior, complexity of treatment, and clinical features could enable health care providers to determine those patients who may require extra support. Actual conclusions about the strength and statistical significance of this association must be based on analysis of data collected.

Future Recommendations

Larger, more diverse patient cohorts, and prospective designs, are needed in future studies to assess how adherence changes over the course of the study. Both number of antihypertensive agents and burden of medication (dose frequency, cost of treatment, adverse effects, comorbidities) should be taken into consideration when assessing the research. Interventional studies might also examine if the counselling, reminder system, and clinically appropriate regimen simplification are effective in enhancing adherence and blood pressure control.

Limitations of the Study

A causal inference between antihypertensive polypharmacy and medication adherence would be less feasible with the proposed cross sectional design. A socially desirable response and recall bias may impact the results if adherence is assessed using self-report. Limited generalizability to other populations and health care settings may result from recruitment within a single hospital. In addition, the level of severity of the hypertension and the associated comorbidities could affect both the number of medications prescribed and adherence behaviour.

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