ORIGINAL RESEARCH

Medication adherence and associated factors towards anti-hypertensive medications: A cross- sectional study analysis of patients attending OPD at Government Hospital in North India

[1]Indrashis Mukerjee, [2]Dr. Amod Kumar Sachan, [3]Dr. Narsingh Verma, [4]Dr. Kauser Usman, [5]Dr. Anuradha Nischal, [6]Dr. Kamal Kumar Sawlani

[1]Research Scholar, India
[2]Professor & Head, [5]Professor, Department of Pharmacology & Therapeutics, King George's Medical University, Lucknow, Uttar Pradesh, India
[3]Retd Professor & Head, Department of Physiology, King George's Medical University, Lucknow, Uttar Pradesh, India
[4,6]Professor, Department of Internal Medicine, King George's Medical University, Lucknow, Uttar Pradesh, India

Corresponding Author: Indrashis Mukerjee, Research Scholar, India
Email: indrashish.mukhopadhya@gmail.com

ABSTRACT

Introduction: Hypertension is a global public health issue.Hypertensive heart disease is one of the top ten leading causes of death in the world.Hypertension is also a major contributor to the global disease burden of cardiovascular and cerebrovascular disease.Poor adherence to medications is one of the major public health issue and challenge. Only one-third ofthe population reported successful control of blood pressure.Despite of the availability for effective treatment, over half of the patients being treated for hypertension drop out of care entirely within a year of diagnosis.Recent research suggests that poor adherence and poor complianceto antihypertensive medication (AHM) is a major hurdle in the management of hypertension and is usually associated with bad outcome of the disease and wastage of limited health care resources.Adherence to antihypertensive medication isa very effective step for controlling blood pressure and preventing complications.To prevent some of the complications of hypertension regular intake of the prescribed treatment in the form of medicines (pills) is very essential and important.The current study aimed to assess the level of compliance of hypertensive patients to their anti-hypertensive medications and to determine the socio-demographic correlates of compliance. **Methods:** A total of 512 patients were enrolled from the Department of Internal Medicine at King George's Medical University (KGMU), Lucknow according to the American Heart Association (AHA) guidelines. Both male and female patients of age between 35-75 years on anti – hypertensive medications , providing written consent were included in the study.An institutional-based descriptive cross-sectional study was conducted among hypertensive patients.A simple random sampling technique was used to select the study participants from the study population. Sociodemographic data, medication adherence, factors affecting adherence were collected using a structured questionnaire and an 8-item Morisky Medication Adherence Scale questionnaire was used to assess the level of adherence. The questionnaire had 8 questions and a score of 7 or 8 was classified as good adherence, 6 as moderate, and less than 6 as non adherence. On each visit at the OPD the questionnaire was provided to the patients. **Results:** A total of 62 patients were lost to follow-up, resulting in 450 patients out of 512 having

hypertension further completed the study.The mean (±SD) age of the study participants was 54.5 (±10.6) years.Medication adherence was good among 115 (25.6%) patients and moderate among 165 (36.7%); 170 (37.8%) patients were nonadherent. Most patients (72.7%) had uncontrolled hypertension. Nearly half (49.6%) were unable to afford monthly medication.In bivariate analysis, nonadherence was associated with female sex (odds ratio [OR], 1.44; P = .003) and long waiting times in the health care facility (OR, 2.93; P = .005); the presence of comorbidities (OR, 0.62; P = .01) was associated with good adherence. In multivariate analysis, nonadherence was associated with unaffordability of treatment (OR, 2.25; P = .002) and uncontrolled hypertension (OR, 3.16; P < .001). Good adherence determinants included adequate counseling (OR, 0.29; P < .001) and education (OR, 0.61; P = .02).The analysis was done using proportions and Chi-square test . Binary logistic regression analysiswas performed to determine covariates associated with medication adherence. **Conclusion:** Low level of knowledge regarding hypertensionrelated complications or associated risk factors was also noted.Patient education, family counselling, social support networks and also the use and importance of gadgets should be strengthened in health promotion programs in order to enhance compliance of hypertensive patients with the therapeutic regimen and to improve their quality of life. The level of poor adherence to anti-hypertensive medications and low level of knowledge on hypertension was a point of concern.The status of blood pressure control was significantly associated with the pattern of adherence.The barriers to adherence were cost of drug and more number of pills per day .
Keywords:-Hypertension, Compliance, Prevalence, medication adherence , LMICs (lower middle income group countries)

INTRODUCTION

Hypertension, high or increased blood pressure (thesystolic and diastolic level ≥ 140/90 mmHg), is a worldwide public health problem. It contributes to the burdenof cardiovascular diseases, stroke, and renal failure leading to early mortality and disability [1]. and the prevalence of hypertension increases with age. Globally, it is also one of the major causes of premature death, and 8.5 million of people die from hypertension related diseases annually and the problem is still growing [9]. Detection, prevention, treatment, and control of this condition should receive high priority, and analysis of the global burden of hypertension revealed that over 26% of the world's adult population had hypertension in 2000, and the proportion is expected to increase above 30% by 2025 [2].Higher prevalence of hypertension is in low- and middle-income countries (LMICs) drives the global burden of cardiovascular disease (CVD) [12]. It is also one of the main risk factors for the development of renal complications, cardiac and cerebrovascular diseases, and strongly impacting social security, due to its high medical and socioeconomic costs, especially complications that accompany it[3].On the other hand, despite the availability of effective treatment, over half of the patients being treated for hypertension drop out of care entirely within a year of diagnosis and of those who remain under medical supervision only about 50% take at least 80% of their prescribed medications, and approximately 75% of patients with a diagnosis of hypertension do not achieve optimum blood-pressure control [4, 5]. The observed increase in the prevalence of hypertension has been linked to multiple drivers including population growth, increasing life expectancy (longevity), rural– urban migration, erratic lifestyle, work stress and rapid urbanization, among individuals.The high frequency of hypertension-related complications was attributed to the high number of patients with poorly controlled hypertension. Poor medication adherence to antihypertensive patients can lead to suboptimal control of blood pressure, and result in further medical and psychosocial complications, reduction in quality of life, and wastage of health care resources, which are

potential burdens on the healthcare system [6].Moreover, poor adherence to antihypertensive medication has been attributed to long duration of treatment, unnecessary over-prescription of drugs, substantial worsening of diseases, avoidable increases in hospital admission rates, longer hospital stays, leading to a significant medical burden, particularly in low income countries[7].According to the reportslosing of hope, use of social drug, economics problems, forgetfulness and lack of money were the major factor associated with non-adherence. In order to mitigate the effects of the disease in population, it is essential to improve adherence among sufferers of the disease by identifying underlying factors in order to mitigating against adherence behavior and developing effective interventions to overcome identified factors[8].Successful control of blood pressure is of paramount importance in the reduction of morbidity and mortality rates and many studies have demonstrated the impact of antihypertensive agents on improving clinical outcomes[10 – 11]. Barriers to drug compliance consist of multiple factors that include complex medication regimens, dosing frequency, behavioral factors and side effects of treatment. The most typical barriers are under the patient's control, including patient's knowledge and attitudes towards medications. Therefore, attention to these barriers is a necessary and important step to improve adherence [13].

METHODS

This descriptive cross-sectional study was conducted in the hypertension clinic (OPD) of internal medicine department at King George's Medical University (KGMU), Lucknow , India during the period from June 2021 to March 2023. The study protocol was approved by the Institutional ethics committee of the institution and informed consents were obtained from all the study participants who were patients attending the hypertension clinic of this institution during the study period & suffering from type 2 diabetes , hypertension . On an average, 150 to 200 outpatients with various cardiovascular diseases attend the clinic daily. Free and low-cost services at this facility attract a large number of patients.
The study participants were selected on the basis of the following:-

Inclusion Criteria

1) Subjects having hypertension and diagnosed according to AHA guidelines.
2) Patients with hypertension and on anti-hypertensive medications.
3) The patients who were aged 30 years or above.
4) The patients who were non-pregnant or non-puerperal at the time of the interview (for female patients).
5) Those who gave informed consents to participate in the study.

The patients who were excluded from the study:-

Exclusion criteria

1) Patients with a critical illness or cognitive impairment.
2) Newly diagnosed patients with hypertension at the first visit to the hospital.
3) Patients not willing to give consent.

The hypertension OPD clinic runs from Tuesday to Friday i.e. 4 days per week. Subjects on anti-hypertensive medications for atleast 6 months and follow up patients having hypertension were screened & were recruited according to the inclusion & exclusion criteria respectively & it took approximately 2 years to complete the sample size. Patients who were included were all having hypertension and were over 30 years of age, with ongoing treatment. Each participant was interviewed by using a pre-designed, pre-tested, structured enrollment form which included socio-demographic variables like age, sex, the educational and the

marital status, the per-capita monthly income, and specific questions on the duration on diabetes, the type of medications which were prescribed, the compliance to anti-hypertensive drugs, the diet plan and the exercise schedule, and associated complications of hypertension.The level of Medication adherence was assessed by using a structured , pretested & validated Morisky 8-item Medication Adherence Scale (MMAS-8) with a high reliability and validity, which has been particularly useful in chronic conditions like hypertension. Each of the 8 item was scored 0 or 1 [14].MMAS-8 was scored as 1 point for each no answer and 0 points for each yes. The total score ranged from 0 points (completely nonadherent) to 8 points (completely adherent). An MMAS-8 score of 7 or 8 was classified as good, a score of 6 as moderate, and a score less than 6 as nonadherent.It highlights forgetfulness of medication, measures medication use , stops to take medication when feel worse, forget to take medication when travel or go out of home, measures medication use in yesterday, stops to take medication when feel better, feeling dissatisfaction due to daily commitment to take hypoglycemic medicine , facing difficulties to remember to take all medications.Also the modified Kuppuswamy scale was used to measure the socioeconomic status of respondents, taking into account a composite score including the education and occupation of the family head and monthly household income, with a score of 1 to 29.

STATISTICAL ANALYSIS

The data analysis was carried out by using Statistical Package for Social Science (SPSS) for Windows IBM SPSS Statistics 28.0.1 version 2022.Data were analyzed as descriptive statistics (proportions, percentages, ratios, and frequency distribution tables) and expressed as mean (SD) or as percentages.For qualitative data (gender, education level, marital status, duration of the disease, comorbidities, drug regimen, income, smoking, committed to follow-up, relationship with prescribers, suffering from side effects, adherence level), frequency and percent were used.The categorical data such as for qualitative data (gender, education level, marital status, duration of the disease, comorbidities, drug regimen, income, smoking, committed to follow-up, relationship with prescribers, suffering from side effects, adherence level), frequency and percent were used. sex, race, age, duration of disease, body mass index, family history, comorbidities, and level of education are presented as frequency and percentage. Chi-square test was used to Statistical significance was accepted at the 95% confidence level. Bivariate analysis was performed with a P value of less than .05 considered significant and was used to establish an association between adherence to hypertension medication and patient-related, drug-related, disease-related, and service-related factors. For bivariate analysis, we categorized frequency of determinants among patients reporting good adherence (MMAS-8 score 7 or 8) and those reporting moderate or nonadherence (MMAS-8 score $\leq$6) to antihypertension therapy. Multivariate regression analysis was performed to identify independent predictors of adherence by using adherence status as the outcome variable and the other factors as predictor variables.Binary logistic regression analysis was conducted to identify factors associated with non-adherence, while adjusting for covariates.

RESULTS

A total of 450 patients between 30 and 75 years of age with hypertension , who fulfilled the study criteria, agreed to participate in the study, and completed questionnaires were included in the study. The mean age was 54.5 (SD, 10.6) years (Table 1). Mean body mass index (weight in kg divided by height in m2) was 24.1 (SD, 3.9), and 56.2% (253) were male. Good medication adherence was reported by 115 (25.6%) patients; 165 (36.7%) were moderately adherent to medication, and 170 (37.8%) were nonadherent. Almost three-fourths (332 [73.8%]) lived in urban areas. More than two-thirds (303 [67.3%]) did not have a formal

education (were illiterate). One hundred twelve (24.9%) were employed in government service. More than half (264 [58.7%]) belonged to the upper lower class on the modified Kuppuswamy scale. None of the responders belonged to the upper socioeconomic status class on the scale. The monthly income of 174 patients (38.7%) ranged from Rs 10,000 to Rs 19,999. Twenty percent (4.4%) received free medication, of whom 164 (3.6%) reported good adherence, and 4 (0.9%) reported moderate adherence.

(Grade 1 hypertension was diagnosed in 327 (72.7%) patients. The mean duration of hypertension (time from initial diagnosis) was 7.7 (SD, 6.1) years, with 218 (48.4%) of surveyed patients diagnosed in the preceding 5 years (Table 2). A family history of hypertension and ischemic heart diseases was present in 186 (41.3%) patients. One hundred eighty-eight (41.8%) were physically inactive and only 19 (4.2%) were vigorously active with a history of exercise and walking at least 3 times a week. Forty-four (9.8%) patients were current smokers, 53 (11.8%) were former-smokers, and 76 (16.9%) of current smokers had smoked for 5 or more years. The number of patients exposed to passive smoking (secondhand smoke) was 252 (56.0%). The mean distance traveled by patients to reach the health facility was 16.8 km and the mean travel time was 44.9 (SD, 39.5) minutes. More than half of patients (254 [56.4%]) took less than 1 hour to reach the hospital.

The number of patients on a single antihypertension drug was 255 (56.7%); 167 (37.1%) were taking 2 antihypertension medicines, and 28 (6.2%) were taking 3 or more (Table 3). More than half (252 [56.0%]) had a once-daily dosage, and 136 (30.2%) experienced drug-related side effects. Tiredness was the most reported side effect (102 patients, 22.7%), followed by weakness (16 patients, 3.6%,) and dizziness (8 patients, 1.8%). More than half (294 [65.3%]) of participants had concomitant comorbid conditions including diabetes, ischemic heart disease, congestive heart failure, and obesity. Previous hospital admissions for angina, myocardial infarction, stroke, coronary angioplasty, or coronary artery bypass graft were found in 108 patients. The average monthly medication cost was Rs 1200 , and nearly half (223 patients, 49.6%) were not able to afford their monthly medication. The average travel cost to reach a health facility was Rs 125.8. Most (417 [92.7%]) patients were satisfied with their physician's attitude and care; 419 (93.1%) were satisfied with the prescribed antihypertension drug regimen, and 395 (87.8%) said that counseling was satisfactory. Most respondents (363, 80.7%) had knowledge of hypertension and its prevention and treatment. Almost 91.6% (412) were advised by a physician about the importance of taking hypertensive medication.

The bivariate analysis showed that nonadherence was associated with nonaffordability of treatment (OR, 2.54; 95% CI, 1.54–5.03, P = .002), uncontrolled hypertension (OR, 3.03; 95% CI, 1.74–5.29, P < .001), female sex (OR, 1.44; 95% CI, 1.02–2.96, P = .003), and long waiting times in the clinic (OR, 2.93; 95% CI, 1.32–4.84, P = .005) (Table 4). Good adherence was associated with satisfactory counseling (OR, 0.31; 95% CI, 0.18–0.54, P < .001), the patient's education (OR, 0.64; 95% CI, 0.41–0.97, P = .03), and the presence of comorbidities (OR, 0.62; 95% CI, 0.39–0.94, P = .01).After adjusting for age, occupation, sex, residence, and income, multivariate logistic regression showed that nonadherence was associated with unaffordability of treatment (OR, 2.25; 95% CI, 1.46–3.48, P = .002) and uncontrolled hypertension (OR, 3.16; 95% CI, 1.76–5.68, P < .001). Education (OR, 0.61; 95% CI, 0.39–0.95, P = .03) and adequate counseling by clinicians (OR, 0.29; 95% CI, 0.16–0.51, P < .001) were associated with good patient adherence (Table 5).

Table 1: Sociodemographic Characteristics of Patients (N = 450) Diagnosed With Hypertension at a Tertiary Care Hospital, by Level of Adherence to Medication

Characteristics	All patients	Nonadherence	Moderate adherence	Good adherence

		(n = 170)	**(n = 165)**	**(n = 115)**
Age, mean (SD), y	54.5 (10.6)	53.4 (11.1)	54.7 (9.8)	55.5 (10.9)
20–39	29 (6.4)	15 (8.8)	8 (4.8)	6 (5.2)
40–59	275 (61.1)	104 (61.2)	100 (60.6)	71 (61.7)
≥60	146 (32.4)	51 (30.0)	57 (34.5)	38 (33.0)
Male Sex	253 (56.2)	86 (50.6)	89 (53.9)	78 (67.8)
Marital status				
Single	6 (1.3)	4 (2.4)	2 (1.2)	0 (0)
Married	403 (89.6)	150 (88.2)	146 (88.5)	107 (93.0)
Divorced or widowed	41 (9.1)	16 (9.4)	17 (10.3)	8 (7.0)
Residence				
Urban	332 (73.8)	118 (69.4)	126 (76.4)	88 (76.5)
Rural	118 (26.2)	52 (30.6)	39 (23.6)	27 (23.5)
Educational status				
No formal education (illiterate)	303 (67.3)	159 (93.5)	110 (66.7)	34 (29.6)
Literate	147 (32.7)	11 (6.5)	55 (33.3)	81 (70.4)
Primary school or less	**29 (6.4)**	**4 (2.4)**	**8 (4.8)**	17 (14.8)
Up to matriculation or secondary school	**77 (17.1)**	**5 (2.9)**	**18 (10.9)**	**18 (10.9)**
Bachelor's degree or higher	**41 (9.1)**	**2 (1.2)**	**29 (17.6)**	**10 (8.7)**
Occupation				
Government employee	112 (24.9)	32 (18.8)	43 (26.1)	37 (32.2)
Housewife	156 (34.7)	59 (34.7)	66 (40.0)	31 (27.0)
Retired	71 (15.8)	25 (14.7)	25 (15.2)	21 (18.3)
Private job	49 (10.9)	21 (12.4)	15 (9.1)	13 (11.3)
Unemployed	25 (5.6)	12 (7.1)	8 (4.8)	5 (4.3)
Laborer or maid	24 (5.3)	17 (10.0)	3 (1.8)	4 (3.5)
Self-employed	13 (2.8)	4 (2.4)	5 (3.0)	4 (3.5)
Socioeconomic status score				
Lower (1–4)	91 (20.2)	38 (22.4)	35 (21.2)	18 (15.6)
Upper lower (5–10)	264 (58.7)	104 (61.2)	100 (60.6)	60 (52.2)
Lower middle (11–15)	65 (14.4)	22 (12.9)	16 (9.7)	27 (23.5)
Upper middle (16–25)	30 (6.7)	6 (3.5)	14 (8.5)	10 (8.7)
Monthly income, rupees				
<10,000 (64.50)	65 (14.4)	38 (22.4)	17 (10.3)	10 (8.7)

10,000–19,999 (64.50–	174 (38.7)	71 (41.8)	65 (39.4)	38 (33.0)
20,000–39,999 (129.03–258.06)	179 (39.8)	50 (29.4)	69 (41.8)	60 (52.2)
> 40,000 (>258.06)	25 (5.5)	10 (5.9)	9 (5.5)	6 (5.2)
0	7 (1.6)	1 (0.6)	5 (3.0)	1 (0.9)

Table 2: Distribution of Hypertension-Related Factors Among Patients (N = 450) at a Tertiary Care Hospital, by Adherence to Medication Regimen,

Characteristics	All patients	Nonadherence (n = 170)	Moderate adherence (n = 165)	Good adherence (n = 115)
Duration of hypertension, mean (SD), y	7.7 (SD, 6.1)	7 (SD, 5.9)	8.6 (SD, 6.4)	7.5 (SD, 6.0)
<1	45 (10.0)	21 (12.4)	15 (9.1)	9 (7.8)
1–5	173 (38.4)	75 (44.1)	48 (29.1)	50 (43.5)
6–10	123 (27.3)	37 (21.8)	56 (33.9)	30 (26.1)
11–20	91 (20.2)	33 (19.4)	37 (22.4)	21 (18.3)
≥21	18 (4.0)	4 (2.4)	9 (5.5)	5 (4.3)
Family history of hypertension and ischemic heart diseases	186 (41.3)	78 (45.9)	64 (38.8)	44 (38.3)
Activity level				
Inactive (<30 min/d)	188 (41.8)	69 (40.6)	74 (44.8)	45 (39.1)
Minimally active (30–60 min/d)	243 (54.0)	97 (57.1)	81 (49.1)	65 (56.5)
Vigorously active (equal to 4 h/d walking)	19 (4.2)	4 (2.4)	10 (6.1)	5 (4.3)
Smoking status				
Smoker	44 (9.8)	16 (9.4)	15 (9.1)	13 (11.3)
Never smoked	353 (78.4)	135 (79.4)	130 (78.8)	88 (76.5)
Former smoker	53 (11.8)	19 (11.2)	20 (12.1)	14 (12.2)
Passive smoking	252 (56.0)	99 (58.2)	98 (59.4)	55 (47.8)
Number of years smoked				
< 5	19 (4.2)	11 (6.5)	6 (3.6)	2 (1.7)
≥5	76 (16.9)	23 (13.5)	29 (17.6)	24 (20.9)
Since childhood (aged 7–10 y)	2 (0.4)	1 (0.6)	0 (0)	1 (0.9)
Mean distance traveled to reach health facility, km	16.8 (23.8)	16.1 (22.9)	16.6 (20.3)	16.7 (13.4)
Mean time to reach health facility, min	44.9 (39.5)	43.6 (39.7)	47.6 (45.7)	43 (28.5)

≤1 h	254 (56.4)	139 (81.8)	57 (34.5)	58 (50.4)
>1 h	196 (43.6)	31 (18.2)	108 (65.5)	57 (49.6)
Mean time for a checkup (SD), min	67.1 (37.7)	73.1 (43.3)	66.8 (35.1)	58.8 (30.6)

Table 3: Clinical and Treatment-Related Characteristics Among Hypertensive Patients (N = 450) at a Tertiary Care Hospital, by Level of Adherence to Medication

Characteristics	All patients	Non-adherence (n = 170)	Moderate adherence (n = 165)	Good adherence (n = 115)
Hypertension duration since therapy, y				
<1	46 (10.2)	21 (12.4)	15 (9.1)	10 (8.7)
1–5	176 (39.1)	78 (45.9)	49 (29.7)	49 (42.6)
6–10	128 (28.4)	40 (23.5)	58 (35.2)	30 (26.1)
11–20	84 (18.7)	30 (17.6)	33 (20.0)	21 (18.3)
≥21	16 (3.6)	1 (0.6)	10 (6.1)	5 (4.3)
Number of antihypertension drugs				
1	255 (56.7)	88 (51.8)	90 (54.5)	77 (67.0)
2	167 (37.1)	70 (41.2)	65 (39.4)	32 (27.8)
≥3	28 (6.2)	12 (7.1)	10 (6.1)	6 (5.2)
Dosage frequency				
Once daily	252 (56.0)	102 (60.0)	91 (55.2)	59 (51.3)
Twice daily	198 (44.0)	68 (40.0)	74 (44.8)	56 (48.7)
Antihypertension medication side effects				
Yes	136 (30.2)	68 (40.0)	50 (30.3)	18 (15.7)
No	314 (69.8)	102 (60.0)	115 (69.7)	97 (84.3)
Adverse effects				
Tiredness	102 (22.7)	51 (30.0)	38 (23.0)	13 (11.3)
Weakness	16 (3.6)	9 (5.3)	5 (3.0)	2 (1.7)
Dizziness and vertigo	8 (1.8)	3 (1.8)	3 (1.8)	2 (1.7)
Headache	5 (1.1)	2 (1.2)	2 (1.2)	1 (0.9)
Stomach pain	4 (0.9)	2 (1.2)	2 (1.2)	0 (0)
Urinary urgency	1 (0.2)	1 (0.6)	0 (0)	0 (0)
Associated comorbidity				
Yes	294 (65.3)	114 (67.1)	119 (72.1)	61 (53.0)
No	156 (34.7)	56 (32.9)	46 (27.9)	54 (47.0)
Type of				

comorbidity				
Diabetes	200 (44.4)	72 (42.4)	85 (51.5)	43 (37.4)
Ischemic heart diseases	45 (10.0)	18 (10.6)	18 (10.9)	9 (7.8)
Congestive heart failure	5 (1.1)	0 (0)	2 (1.2)	3 (2.6)
Obesity (BMI ≥30 kg/m^2)	44 (9.8)	24 (14.1)	14 (8.5)	6 (5.2)
Hospitalization since diagnosis or in past 2 years if hypertension diagnosed for ≥5 years				
Yes	108 (24.0)	48 (28.2)	45 (27.3)	15 (13.0)
No	342 (76.0)	122 (71.8)	120 (72.7)	100 (87.0)
Cause of hospitalization				
Angina	44 (9.8)	16 (9.4)	24 (14.5)	4 (3.5)
Myocardial infarction	15 (3.3)	12 (7.1)	2 (1.2)	1 (0.9)
Stroke	36 (8.0)	15 (8.8)	16 (9.7)	5 (4.3)
Angioplasty and coronary artery bypass graft	13 (2.9)	5 (2.9)	3 (1.8)	5 (4.3)
Can afford to purchase monthly medication				
Yes	227 (50.4)	86 (50.6)	71 (43.0)	70 (60.9)
No	223 (49.6)	84 (49.4)	94 (57.0)	45 (39.1)
Average monthly cost for hypertension treatment, rupees	1,154 (7.2)	1,184 (7.4)	1,095 (6.8)	1,183 (7.4)
<1,000 rupees	277 (61.6)	93 (54.7)	95 (57.6)	89 (77.4)
1,000–1,999 rupees	56 (12.4)	37 (21.8)	17 (10.3)	2 (1.7)
2,000–3,999 rupees	31 (6.9)	9 (5.3)	11 (6.7)	11 (9.6)
4,000–4,999 rupees	0 (0)	0 (0)	0 (0)	0 (0)
5,000–8,000 rupees	7 (1.6)	2 (1.2)	2 (1.2)	3 (2.6)
Don’t know/never buy	79 (17.6)	29 (17.1)	40 (24.2)	10 (8.7)

Average fare to the hospital, rupees	125.8	130.7	121.6	125.2
Patient satisfied with physician	417 (92.7)	151 (88.8)	156 (94.5)	110 (95.7)
Patient satisfied with prescribed medication	419 (93.1)	152 (89.4)	157 (95.2)	110 (95.7)
Agree counseling about hypertension and medication is adequate	395 (87.8)	142 (83.5)	145 (87.9)	108 (93.9)
Physician advised about importance of hypertensive medication	412 (91.6)	154 (90.6)	149 (90.3)	109 (94.8)
Understands causes and prevention of hypertension	363 (80.7)	102 (60.0)	154 (93.3)	107 (93.0)
Reason for not taking antihypertension medication				
Affordability	73 (16.2)	35 (20.6)	35 (21.2)	3 (2.6)
Lack of access to medicines or health facility	133 (29.6)	57 (33.5)	64 (38.8)	12 (10.4)
Forget to take medicines	41 (9.1)	14 (8.2)	8 (4.8)	19 (16.5)
Do not wish to take medicines	45 (10.0)	10 (5.9)	19 (11.5)	16 (13.9)
Never miss a dose	27 (6.0)	4 (2.4)	14 (8.5)	9 (7.8)
Undesirable effects of medicines	61 (13.6)	29 (17.1)	21 (12.7)	11 (9.6)
Other	70 (15.6)	21 (12.4)	4 (2.4)	45 (39.1)
Results of noncompliance to medication				
Acceleration of hypertension symptoms	269 (59.8)	104 (61.2)	100 (60.6)	65 (56.5)
Visit hospital emergency department	100 (22.2)	39 (22.9)	29 (17.6)	32 (27.8)

Absenteeism from work	20 (4.4)	11 (6.5)	7 (4.2)	2 (1.7)
No effect	61 (13.6)	16 (9.4)	29 (17.6)	16 (13.9)

Table 4: Bivariate Association Between Hypertension Determinants and Medication Adherence Among Patients (N = 450) in a Tertiary Care Hospital

Parameter	Frequency in adherent patients (n = 115), MMAS-8 score 8 or 7	Frequency in nonadherent patients (n = 335), MMAS-8 score ≤6	Odds Ratio (95% CI)	P value
Treatment not affordable (n = 223)	45 (20.2)	178 (79.8)	2.54 (1.54–5.03)	.002
Uncontrolled hypertension (n = 327)	91 (27.8)	236 (72.2)	3.03 (1.74–5.29)	<.001
Family history (n = 186)	44 (23.7)	142 (76.3)	2.02 (0.57–3.24)	.09
Comorbidities (n = 294)	61 (20.7)	233 (79.3)	0.62 (0.39–0.94)	.01
Education (Yes) (n = 147)	81 (55.1)	66 (44.9)	0.64 (0.41–0.97)	.03
Female sex (n = 197)	37 (18.8)	160 (81.2)	1.44 (1.02–2.96)	.003
Adequate counseling by clinician (n = 395)	108 (27.3)	287 (72.7)	0.31 (0.18–0.54)	<.001
Urban residence (n = 332)	88 (26.5)	244 (73.5)	1.42 (0.93–2.19)	.12
Wait time >60 min for appointment (n = 251)	31 (12.4)	220 (87.6)	2.93 (1.32–4.84)	.005

Table 5: Multivariate Regression Between Determinants of Medication Adherence Among Patients (N = 450) at a Tertiary Care Hospital

Parameter	Adjusted odds ratio (95% CI)	*P* value
Treatment unaffordable	**2.25 (1.46–3.48)**	**.002**
Uncontrolled hypertension	3.16 (1.76–5.68)	<.001
Education	0.61 (0.39–0.95)	.02
Female sex	1.30 (0.86–1.99)	.20
Urban residence	1.01 (0.63–1.64)	.96
Adequate counseling by clinician	0.29 (0.16–0.51)	<.001
Availability of free blood tests	0.76 (0.39–1.51)	.45

DISCUSSION

The results of the present study show that among the participantslow percentage of hypertensive patients with good adherence to medication regimens was found. Among patient-related factors, female sex and low education levels were associated with nonadherence. Unaffordability, a lack of access to hypertension medicines, inadequate counseling, and the long waiting times in the clinic were strong predictors of service-related nonadherence. Nonadherence was associated with uncontrolled hypertension, and most patients with elevated blood pressure were prescribed a single drug. The presence of comorbidities was related to better patient adherence.In this study, the prevalence of good adherence among subjectsvisiting our OPD with hypertension was lower compared with previous studies in developed countries or other LMICs that found the proportion of patients adherent to antihypertension therapy was between 60% and 90% [15 - 16].The major regional differences in medication adherence could be related to the health care systems in high-income countries that provide much better public health facilities, access to universal health care, multi-sectorial preventive action, adequate care for chronic conditions, and access to affordable antihypertension medication. This accords with a previous study demonstrating that adherence levels and patient economic status are strongly interrelated [17].High medication costs and unaffordable treatment in LMICs are a barrier to accessing health care, leading to a complex circle of nonadherence and resulting complications [17]. It's a known fact that hypertension is a chronic disease requiring lifelong treatment, affordability becomes a major determinant of adherence for patients in LMICs who lack health insurance or treatment subsidies. Above study results support affordability as a determinant of adherence: it was extracted that good adherence was observed among patients who either could afford medication or get it free.

Many studies reported far higher levels of prevalence. A prevalence of 73% has been reported in urban slums in Kolkata using a pill count method [18].Adherence of 74.2% was reported from urban areas of Andhra Pradesh using an arbitrary method for measuring adherence [19].The prevalence of compliance was still higher (82.2%) in a study in Karnataka, taking 80% of prescribed medications as a cut- off for compliance [20]. Compliance from study using Morisky Medication adherence Scale in a study in Sunderland was found to be 79% [21]. A slightly lower level of compliance (55.5%) was reported in a study in Ethiopia using the MMAS-8 scale [22]. Ajayi et al reported a prevalence of 44.7% from a study in Nigeria using MMAS-4 scale for measuring adherence [23].About 57.2% of the 334 hypertensive patients were compliant in an OPD based study from Uttar Pradesh in 2015 [24].However, results similar to ours were reported in fewer studies. In a community based cross sectional study among rural population in Tamil Nadu, using the 4-item Morisky medication adherence scale (MMAS-4) prevalence of compliance was reported to be 24.1% [25].The prevalence rates were still lower (15.3%) in an institutional based cross sectional study using MMAS-8, in Karnataka [26]. These variations in the prevalence rates of treatment compliance might be due to difference in diagnostic instruments/criteria and population settings in-terms of age and place. The present study used 8-Item Morisky medication adherence scale. Variation may also be partly due to the different definitions of methods used to assess medication non-adherence. Most of the studies thoughbased on self-report, utilized different definitions for medication non-adherence. Identification of factors affecting compliance to appropriate medical therapy for hypertension can result in controlled blood pressure and reduction in adverse outcomes.Nonadherence is a common phenomenon in uncontrolled hypertension as demonstrated by elevated blood pressure in two-thirds of our study patients. We found that the major reasons for nonadherence to antihypertension medication were lack of access to medicines, including their affordability and availability, long waiting times in the outpatient clinics, and the cost of transportation to visit the clinic. These predictors of nonadherence are

modifiable. Strengthening the capacity of clinicians to provide free or low-cost medication can substantially improve adherence, as previously shown in LMICs where patients who reported the availability of free antihypertension medication in the health care facility were nearly twice as likely to be adherent [27].The unavailability of antihypertension medication in health care facilities has been reported as a major barrier to health care, particularly in LMICs [28].

This study also found, that the female patients were less likely to be adherent to antihypertensive medication [29]. The association of poor adherence with female sex illustrates financial, sociocultural, and systemic inequalities that persist despite the concept of universal health care. Gender inequality is a global phenomenon deeply entrenched in many Asian societies [30]. It is widely recognized that our society is dominated by men, with gender gaps in access to all types of resources, especially health care services, supported by a strong regional ideology in some areas that has created a rigid gender hierarchy in society [31]. Women are more likely to skip medications, delay treatment, or ask doctors to prescribe low-cost medication because of nonaffordability and inequity [32].

In a study in Malaysiafemales were found to be one and a half times more compliant than males [33]. In studies conducted in Karnataka and Andhra Pradesh states in India, females reported significantly higher compliance than males [20,26]. However, a cross- sectional study in rural reported that non-adherence to treatment was significantly higher among men than women [34].

In the present study it wasfound that the low education level reported by two-thirds of patients were associated with medication nonadherence. However, although most patients reported hypertension knowledge and most were aware of the importance of taking medications, they did not follow physicians' recommendations because of other priorities, such as household and family expenses and a lack of resources. Although patient knowledge can improve health outcomes, evaluation of patient information is just one component of a complex intervention. Thus, additional verbal counseling, involvement of family members, or repeated instructions to confirm patient comprehension are key to assisting low-literacy patients when these services are provided by physicians, pharmacists, or nurses [35].

Effective communication skill in medical care can empower patients to engage in disease treatment and is highly correlated with improved adherence to treatment [36]. Our study demonstrated that patient satisfaction, effective patient–clinician communication on disease and hypertension therapy, and adequate counseling are important factors associated with good adherence. Ramesh et al showed that comprehensive patient counseling and health education enhanced adherence to therapy among patients with cancer, another noncommunicable disease [37]. Another important barrier to accessing health care services is long waiting times to receive care. Our study provides evidence of a strong association between prolonged waiting time and nonadherence to an antihypertension medication regimen. Several studies have reported that any disease that requires frequent health care visits associated with long waiting times leads to demotivation[38]. As indicated in our study, improved and better patient care facilities and reduced waiting time for clinical visits are important factors to increase patient satisfaction and optimize adherence. In this context, LMICs can build health care capacity by improving primary health care and specialist services to ensure universal access to high-quality health care services [39].Another prominent predictor of nonadherence is medication-related side effects [40]. In our study, one-third of patients reported side effects that were unrelated to typical adverse effects of antihypertension drug classes (eg, cough, ankle edema, bradycardia, electrolyte disturbances). Previous studies reported that side effects are the main determinant of low adherence to antihypertension medicines and an important preventive factor in the treatment of hypertension. In one study,

50% of patients discontinued medicines after experiencing side effects [41]. The high prevalence of tiredness reported by hypertensive patients in our study may be related to the uncontrolled hypertension itself or the result of lower blood pressure in patients who had high blood pressure for a long time and now need to adjust to lower levels.In our study, 1 in 10 patients were not willing to take medication, suggesting that patient adherence is likely to increase if the management plan aligns with their preferences. Failure to comply with medication results in wasted medications, disease progression, reduced functional abilities, poor quality of life, and increased use of health care services. These factors impose a heavy economic burden on medical resources and the health care system such as primary care clinics, hospital visits, and hospital admissions. Medication nonadherence leads to poor clinical outcomes and has adverse effects on the health care system. In our study, one-fourth of patients had a history of hospitalization for CVD events, increasing the cost of medical care; also, noncompliance to antihypertension medicines and resultant high blood pressure were associated with accelerated hypertension symptoms in more than half of patients and emergency department visits in one-fourth of patients. The limited resources of the health care system and increased medical costs of hospital visits and admissions are real-time challenges faced by the government and the population of Pakistan. Our results are supported by previous studies examining the association between adherence and risk of hospitalization, medical cost, and its economic impact [42]. High medication adherence was associated with lower hospitalization rates, suggesting the importance of improved adherence to reduce the use of health care resources and avoidable health care costs, which can ultimately provide a net economic return by reducing the significant cost burden on health care systems.
As in other published studies, our study patients with comorbidities were more adherent to medication. This may be related to other underlying conditions for which patients follow drug regimens based on family history, awareness of CVD risk, more frequent visits to health care facilities, and counseling [43].

CONCLUSION

Our study concluded that three-quarters of hypertensive patients were nonadherent to antihypertension medicines. Unaffordability, female sex, and long waiting times in the hospital health facility were the strongest factors affecting adherence to antihypertension medication among patients. The presence of multiple medical conditions, a positive family history of CVD, and a positive patient–clinician relationship through effective counseling were important predictors of better adherence to antihypertension medicines. The availability of free drugs, controlled follow-up visits, and reduced access time to clinical services play an important role in improving adherence. Cost-effective interventions and a multidisciplinary approach directed at the structure of the health care system, availability and affordability of blood pressure–lowering medicines, patient education, and adequate patient counseling could improve medication adherence and hypertension management.

REFERENCES

1. Campbell NR, Lackland DT, Niebylski ML. High blood pressure: why prevention and control are urgent and important—a 2014 fact sheet from the World Hypertension League and the International Society of Hypertension. The Journal of Clinical Hypertension. 2014 Aug;16(8):551.
2. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. The lancet. 2005 Jan 15;365(9455):217-23.

3. Barreto MD, Cremonese IZ, Janeiro V, Matsuda LM, Marcon SS. Prevalence of non-adherence to antihypertensive pharmacotherapy and associated factors. Revistabrasileira de enfermagem. 2015 Jan;68:60-7.
4. Al Solami FJ, Hou XY, Correa-Velez I. Factors affecting antihypertensive treatment adherence: a Saudi Arabian perspective. Clinical Medicine and Diagnostics. 2012;2(4):27-32.
5. Wong MC, Liu KQ, Wang HH, Lee CL, Kwan MW, Lee KW, Cheung Y, Lee GK, Morisky DE, Griffiths SM. Effectiveness of a pharmacist-led drug counseling on enhancing antihypertensive adherence and blood pressure control: a randomized controlled trial. The Journal of Clinical Pharmacology. 2013 Jul;53(7):753-61.
6. World Health Organization. Adherence to long-term therapies: evidence for action. World Health Organization; 2003.
7. Candy D Kang, Prilla P M Tsang, Winson T L Li, Harry H X Wang, Kirin Q L Liu, et al. (2015) Determinants of medication adherence and blood pressure control among hypertensive patients in Hong Kong. Int J Cardiol 250-257.
8. Ambaw AD, Alemie GA, W/Yohannes SM, Mengesha ZB. Adherence to antihypertensive treatment and associated factors among patients on follow up at University of Gondar Hospital, Northwest Ethiopia. BMC public health. 2012 Dec;12:1-6.
9. Pm K. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365:217-23.
10. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, Jones DW, Materson BJ, Oparil S, Wright Jr JT, Roccella EJ. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. hypertension. 2003 Dec 1;42(6):1206-52.
11. Neal B, Turnbull F. Effects of different blood-pressure-lowering regimens on major cardiac events. The Lancet. 2004 Jan 24;363(9405):331-2.
12. Giovanni A, Enrico A, Aime B, Michael B, Marianne B, Jonathan C, Josef C, Michael C, Nicole D, Sophia EB, Joaquim FS. Global Burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. Journal of the American College of Cardiology. 2020 Dec 22;76(25):2982-3021.
13. Osterberg L, Blaschke T. Adherence to medication N Engl J Med (Vol. 353, pp. 487-497). United States. 2005.
14. de Oliveira-Filho AD, Morisky DE, Neves SJ, Costa FA, de Lyra Junior DP. The 8-item Morisky Medication Adherence Scale: validation of a Brazilian–Portuguese version in hypertensive adults. Research in Social and Administrative Pharmacy. 2014 May 1;10(3):554-61.
15. Asgedom SW, Atey TM, Desse TA. Antihypertensive medication adherence and associated factors among adult hypertensive patients at Jimma University Specialized Hospital, southwest Ethiopia. BMC research notes. 2018 Dec;11:1-8.
16. Inkster ME, Donnan PT, MacDonald TM, Sullivan FM, Fahey T. Adherence to antihypertensive medication and association with patient and practice factors. Journal of human hypertension. 2006 Apr;20(4):295-7.
17. Macquart de Terline D, Kane A, Kramoh KE, Ali Toure I, Mipinda JB, Diop IB, Nhavoto C, Balde DM, Ferreira B, DèdonougboHouenassi M, Ikama MS. Factors associated with poor adherence to medication among hypertensive patients in twelve low and middle income Sub-Saharan countries. PloS one. 2019 Jul 10;14(7):e0219266.
18. Bhandari S, Sarma PS, Thankappan KR. Adherence to antihypertensive treatment and its determinants among urban slum dwellers in Kolkata, India. Asia Pacific Journal of Public Health. 2015 Mar;27(2):NP74-84.

19. Sekhar KC, Sharma EM, Rao KU, Chaitanya CK, Reddy BH, Deotale PG. A Study On Anti Hypertensive Drug Compliance Among Hypertensive Individuals At Ashok Nagar Urban Area Of Eluru, Andhra Pradesh. Journal of Comprehensive Health. 2016 Jan 1;4(1):41-8.
20. Rao CR, Kamath VG, Shetty A, Kamath A. Treatment compliance among patients with hypertension and type 2 diabetes mellitus in a coastal population of Southern India. International journal of preventive medicine. 2014 Aug;5(8):992.
21. Khan MU, Shah S, Hameed T. Barriers to and determinants of medication adherence among hypertensive patients attended National Health Service Hospital, Sunderland. Journal of pharmacy and bioallied sciences. 2014 Apr 1;6(2):104-8.
22. Girma F, Emishaw S, Alemseged F, Mekonnen A. Compliance with anti-hypertensive treatment and associated factors among hypertensive patients on follow-up in Jimma University specialized hospital, Jimma, south west Ethiopia: a quantitative cross-sectional study. J Hypertens. 2014;3(5):174.
23. Ajayi EA, Adeoti AO, Ajayi IA, Ajayi AO, Adeyeye VO. Adherence to antihypertensive medications and some of its clinical implications in patients seen at a tertiary hospital in Nigeria. IOSR J Dent Med Sci. 2013;8(4):36-40.
24. Ahmad S. Assessment of adherence to antihypertensive treatment among patients attending a health care facility in North India. Int J Res Med. 2015;4(1):117-24.
25. Venkatachalam J, Abrahm SB, Singh Z, Stalin P, Sathya GR. Determinants of patient's adherence to hypertension medications in a rural population of Kancheepuram District in Tamil Nadu, South India. Indian Journal of Community Medicine. 2015 Jan 1;40(1):33-7.
26. Hema K, Padmalatha P. Adherence to medication among hypertensive patients attending a tertiary care hospital in Guntur, Andhra Pradesh. Indian Journal of Basic and Applied Medical Research. 2014 Dec;4(1):451-6.
27. Lulebo AM, Mutombo PB, Mapatano MA, Mafuta EM, Kayembe PK, Ntumba LT, Mayindu AN, Coppieters Y. Predictors of non-adherence to antihypertensive medication in Kinshasa, Democratic Republic of Congo: a cross-sectional study. BMC research notes. 2015 Dec;8:1-8.
28. Husain MJ, Datta BK, Kostova D, Joseph KT, Asma S, Richter P, Jaffe MG, Kishore SP. Access to cardiovascular disease and hypertension medicines in developing countries: an analysis of essential medicine lists, price, availability, and affordability. Journal of the American Heart Association. 2020 May 5;9(9):e015302.
29. Calderón-Larrañaga A, Diaz E, Poblador-Plou B, Gimeno-Feliu LA, Abad-Díez JM, Prados-Torres A. Non-adherence to antihypertensive medication: the role of mental and physical comorbidity. International journal of cardiology. 2016 Mar 15;207:310-6.
30. Ali TS, Krantz G, Gul R, Asad N, Johansson E, Mogren I. Gender roles and their influence on life prospects for women in urban Karachi, Pak0istan: a qualitative study. Global health action. 2011 Dec 1;4(1):7448.
31. Mumtaz Z, Salway S, Waseem M, Umer N. Gender-based barriers to primary health care provision in Pakistan: the experience of female providers. Health policy and planning. 2003 Sep 1;18(3):261-9.
32. Bhuyan SS, Shiyanbola O, Deka P, Isehunwa OO, Chandak A, Huang S, Wang Y, Bhatt J, Ning L, Lin WJ, Wyant D. The role of gender in cost-related medication nonadherence among patients with diabetes. The Journal of the American Board of Family Medicine. 2018 Sep 1;31(5):743-51.
33. Ramli A, Ahmad NS, Paraidathathu T. Medication adherence among hypertensive patients of primary health clinics in Malaysia. Patient preference and adherence. 2012 Aug 31:613-22.

34. Khanam MA, Lindeboom W, Koehlmoos TL, Alam DS, Niessen L, Milton AH. Hypertension: adherence to treatment in rural Bangladesh–findings from a population-based study. Global health action. 2014 Dec 1;7(1):25028.
35. Praska JL, Kripalani S, Seright AL, Jacobson TA. Identifying and assisting low-literacy patients with medication use: a survey of community pharmacies. Annals of Pharmacotherapy. 2005 Sep;39(9):1441-5.
36. Zolnierek KB, DiMatteo MR. Physician communication and patient adherence to treatment: a meta-analysis. Medical care. 2009 Aug 1;47(8):826-34.
37. Ramesh A, Rajanandh MG, Thanmayee S, SalaghaMerin G, Suresh S, Srinivas S. Impact of patient counseling on medication adherence, beliefs and satisfaction about oral chemotherapies in patients with metastatic cancer at a super specialty hospital. Int J Cancer Res. 2015;11(3):128-35.
38. Legido-Quigley H, Naheed A, De Silva HA, Jehan I, Haldane V, Cobb B, Tavajoh S, Chakma N, Kasturiratne A, Siddiqui S, Jafar TH. Patients' experiences on accessing health care services for management of hypertension in rural Bangladesh, Pakistan and Sri Lanka: a qualitative study. PloS one. 2019 Jan 25;14(1):e0211100.
39. Jaca A, Malinga T, Iwu-Jaja CJ, Nnaji CA, Okeibunor JC, Kamuya D, Wiysonge CS. Strengthening the health system as a strategy to achieving a universal health coverage in underprivileged communities in Africa: a scoping review. International journal of environmental research and public health. 2022 Jan 5;19(1):587.
40. Puja SS, Neha NN, Alif OR, Sultan TJ, Husna MG, Jahan I, Noor J. Exploring the barriers to feminine healthcare access among marginalized women in Bangladesh and facilitating access through a voice bot. Heliyon. 2024 Jul 30;10(14).
41. Olowofela AO, Isah AO. A profile of adverse effects of antihypertensive medicines in a tertiary care clinic in Nigeria. Annals of African medicine. 2017 Jul 1;16(3):114-9.
42. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. Medical care. 2005 Jun 1;43(6):521-30.
43. Mazzaglia G, Ambrosioni E, Alacqua M, Filippi A, Sessa E, Immordino V, Borghi C, Brignoli O, Caputi AP, Cricelli C, Mantovani LG. Adherence to antihypertensive medications and cardiovascular morbidity among newly diagnosed hypertensive patients. Circulation. 2009 Oct 20;120(16):1598-605.