



FACTORS ASSOCIATED WITH ADHERENCE TO MEDICATION AMONG HYPERTENSIVE PATIENTS SEEKING CARE IN A DISTRICT HOSPITAL, NORTHERN PROVINCE, RWANDA

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ABSTRACT

Globally, half of cardiovascular deaths are related to hypertension. Good adherence to anti-hypertensive medications is the most successful measure to control and prevent the now-increased hypertension crisis and its complications. Sub-Saharan Africa is burdened with lower adherence to anti-hypertensive medications. Identifying factors associated with adherence, aimed at drawing solutions to improve the wellbeing of populations. The objective of this study was to assess factors associated with adherence to hypertensive medications among hypertensive patients in a district hospital of Northern Province in Rwanda. The study was conducted under a cross-sectional descriptive study with analytical features on hypertensive patients. The systematic sampling method was used and the data was collected by the researcher and his assistant on 272 participants, data was analyzed using SPSS version 21.0: descriptive statistics bivariate and multivariate analysis were used. The significance level p -value ≤ 0.05 , and odds ratio and adjusted odds ratio with 95% confidence interval (CI) and significance of $p < 0.05$ were applied. Among 272 participants, 33 (12.1%) were Under 40 years, 90(33.1%) were 40-60 years, and 149(54.8%) were 60 years and above. There were 169 (62.1%) females and 103(37.9%) males. All 272 (100%) had health insurance. The self-reported adherence was 64.3%. Factors associated with adherence to hypertension medications were being female (AOR: 4.188, 95%CI [1.555-11.281], $p=0.005$); being diagnosed and be on treatment for 5 years and above (AOR: 33.35, 95%CI [5.016-221.2851], $p<0.001$); having good belief of medication (AOR: 16.867 95%CI [5.438-52.321], $p<0.001$), believing that it is important to take medication even when no symptoms (AOR: 24, 95%CI [4.831-119.281], $p<0.001$); and being once a smoker but stopped it after realizing health concerns (AOR: 9.348, 95%CI [2.594-33.686], $p=0.001$). To conclude, adherence was low, female sex, being on treatment for a long time, having good belief in medication and perceived susceptibility increased the chance of adherence to medications.

Key Words

Adherence, Adherence to medication, compliance, factors associated, ypertension, Risk factors, Ubudehe category.

INTRODUCTION

Globally, hypertension is among serious problems; literatures indicate that it is prevalent in almost all individuals age groups except for younger than 18 years old, with 22% in the age range of 18 years old and above [1]. It is stated that among 1.13 billion of people

diagnosed with hypertension, more than 60% are from the least developed countries. Among these cases, only one fifth of them are aware and only 42% are diagnosed and receiving treatment [2]. When uncontrolled, the persistent rise of the blood pressure can lead to different cardiovascular morbidities and mortality which includes stroke, heart diseases, vascular damage and death[3].

The global non adherence rate to hypertension treatment is 45%; African is one of the WHO regions with higher rate of non-adherence; 65.2% with Sub-Saharan region mostly burdened than other Africa regions [3]–[5]. In Rwanda, among the Non Communicable Diseases, hypertension accounts 15% of others and it is within the age categories from 18 and above [6]. The Northern Province where Gakenke District with its two district hospitals is located, has got high prevalence of hypertension with 18.6% [1].

In addition to that, stroke and other cardiovascular diseases are accounted to be one of the disease with high morbidity [1]. As mentioned above, to control the hypertension requires the adherence to Hypertension regimen in a strict way, and researcher wanted to identify factors that may be associated with that.

As many studies have reiterated that many factors affecting the adherence to medication exist, understanding them in details to know which type of factor and how it is affecting the adherence to antihypertensive medication will magnify and clear the ambiguity among health care providers, policy developers and implementers for they can be able to design effective interventions against different barriers to good adherence hence improving the patient outcome. Thus, the purpose of this study was to assess factors associated with the adherence to hypertension medications among patients with hypertension in Ruli district hospital, Rwanda. This study aimed at assess factors associated with adherence to hypertension medications among hypertensive patients in a district hospital.

METHODS AND MATERIALS

Research design

This study incorporated the cross-sectional analytical design on hypertensive patients being treated at Ruli hospital in Non Communicable diseases department.

Sample size and sampling

The sample size was 272 hypertensive patients being in the NCDs registry of Ruli Hospital. The sample was calculated using the Fisher et al formula [7]. $N = (Z^2 P (1-P))/d^2$ with $Z = 95\%$ confidence level normal standard deviation (1.96), $P =$ the expected prevalence of the target population (0.77) and d the acceptable degree of error (0.05). $N = (1.96^2 \times 0.77 (1-0.77))/0.05^2$. $N = 272$.

Data collection method

The data was collected using the questionnaire adopted from WHO STEP-wise approach to non communicable disease adopted to fit the study, the adherence scale of eight items belief about medications. Researcher himself attended each participants and was reading each question to patient while recording the response.

Data analysis

After data collection, each questionnaire filled underwent a daily checkup to anticipate errors or falsely recorded information. Data was entered using the Excel sheet then imported in IBM® Statistical Package of Social Sciences (SPSS) version 21 software in which data cleaning, text writing, and statistical analysis were conducted. Descriptive statistics were used in results presentation. Bivariate and multivariate Binary Logistic regression was performed. Variables whose p value is less than 0.05 were declared to be statistically significant predictors of adherence to hypertension medications. The association between the independent variables and the adherence to hypertension medications was described using the odds ratios (OR) with the 95% confidence Interval (CI) and the level of significance of p less than 0.05. Multivariable logistic regression analysis model was performed to get adjusted odds ratios (AOR) with 95% Confidence Interval (CI).

Ethical consideration

Before the commencement of the data collection, the researcher applied for the ethical approval from Mount Kenya University Institutional Research Review Committee (IRB). This ethical approval was presented to the administration of Ruli Hospital. The latter has approved the study and the data collection started from then. Before any participant provide information, they were given the full explanation of the aim and research and they had to sign the informed consent. All questionnaires used were kept in a closed cupboard which were accessed only by the researcher.

RESULTS

Sociodemographic factors

The table represent the sociodemographic factors of the respondent.

The socio demographic characteristics of the respondents in this study are age, sex, residence, education, religion, marital status, employment, social category, and possession of the health insurance.

Regarding the age, 12.1% were under 40 years old, 33.1% between 40 and 60 years and 54.8% were above 60 years. For sex, male were 37.9% while female were 62.1%. 23.2% were urban resident while 76.8% lived in rural area. 53.5% had no formal education and 46.7 % had a formal education, that is Primary education and above. The 71.7% of the study participants were catholic and 28.3% were protestant. There were 77.9% married, 9.2 % widows and 12.9% single participants. Regarding the occupation, 92.3% were unemployed which includes home keepers and those who do casual work when available, and 7.7 % full time employees in different institutions. Regarding their social categories, there were 43.4% in social category II and 56.6% in social category III. All of them 100% had the health insurance.

Table 1. Socio-demographic characteristics of the respondents.

Socio-demographic characteristic		Frequency	Percent (%)
Age	Under 40	33	12.1
	40-60	90	33.1
	Above 60	149	54.8
Sex	male	103	37.9
	female	169	62.1
Residence	urban	63	23.2
	rural	209	76.8
Education	no formal education	145	53.5
	Primary education and above	127	46.7
Religion	catholic	195	71.7
	protestant	77	28.3
Marital status	single	35	12.9
	married	212	77.9
	widow(er)	25	9.2
Employment	Unemployed	251	92.3
	Employed	21	7.7
Social category	cat 2	118	43.4
	cat 3	154	56.6
Health Insurance	Insurance	272	100
	No Insurance	0	0

Adherence to medication

The level of adherence was 63.4%, that is 175 respondents out of 272 were adherent to hypertension medications, whilst 35.6% i.e. 97 were non adherent.

Factors associated with adherence to hypertension medications

Table 2. Bivariate analysis of the factors associated with adherence to Hypertension medications

Variable	N	Adherence to medication		P value	
		Poor adherence	Good adherence		
Age	Under 40	33	27 (81.8)	6(18.2)	<0.001
	40-60	90	27(30)	63(70)	
	Above 60	149	43(28.9)	106(71.1)	
Sex	Male	103	51(49.5)	52(50.5)	<0.001
	Female	169	46(27.2)	123 (72.8)	
Residence	Urban	63	25(39.7)	38(60.3)	0.457
	Rural	209	72(34.4)	137(65.6)	
Education	No education	145	38(26.2)	107(73.8)	0.001
	Primary and above	127	59(46.5)	68(53.5%)	
Religion	Catholic	195	73(37.4)	122(62.6)	0.399
	Protestant	77	24 (31.2)	53(68.8)	
Marital status	Single	35	21(60)	14(40)	0.004
	Married	212	70(33)	142(67)	
Employment	Widower	25	6(24)	19(76)	0.816
	Unemployed	251	89(35.5)	162(64.5)	
Social categories	Employed	21	8(38.1)	13(61.9)	1
	Category I	118	42(35.6)	76(64.4)	
Time it takes to reach hospital	Category II	154	55(35.7)	99(64.3)	0.895
	Below 1 hr	176	62(35.2)	114(64.8)	
Taking other medications	1hr above	96	35(36.5)	61(63.5)	0.037
	No	169	52(30.8)	117(69.2)	
Number of Tablets	Yes	103	45(43.7)	58(56.3)	0.612
	One Tab	57	20 (35.1)	37(64.9)	
	Two Tabs	135	45(33.3)	90(66.7)	
Number of ATH Meds types	Three and more	80	32(40)	48(60)	0.979
	One	35	13(37.1)	22(62.9)	
	Two	122	43(35.2)	79(64.8)	
Time with Hypertension meds	Three and more	115	41(35.7)	74(64.4)	0.003
	Less than 5 yrs	176	74(42%)	102(58%)	
ATH Dose	More than 5 yrs	96	23(24%)	73(76%)	0.612
	BID	128	48(37.5)	80(62.5)	
	TID	144	49(34)	95(66)	
Important to take Meds even when no symptoms	No	107	47(43.9)	60(56.1)	0.027
	Yes	165	50(30.3)	115(69.7)	
Ever smoked	No	164	69(42.1)	95(57.9)	0.007
	Yes	108	28(25.9)	80(74.1)	
Currently Alcoholic	No	188	58(30.9)	130(69.1)	0.031
	Yes	52	25(48.1)	27(51.9)	
Moderate activity for 10' or more	No	104	26(25)	78(75)	0.004
	Yes	168	71(42.3)	97(57.7)	
Physical exercise	No	250	82(32.8)	168(67.2)	0.002
	Yes	22	15(68.2)	7(31.8)	
Fruit eating frequency	2 days or less	167	52(31.1)	115(68.9)	0.052

3 days or more 105 45(42.9) 60(57.1)

There was a statistical significance on association between the adherence to hypertension medication and the age ($p<0.001$), sex ($p<0.001$), education ($p=0.001$) and marital status ($p=0.004$). However there was no statistical significance on association between adherence to hypertension medication with residence ($p=0.457$), religion ($p=0.399$), employment ($p=0.816$) social categories ($p=1$) and the time it takes to reach the hospital ($p=0.895$).

However there was no significance on association between the non-adherence to medication and the employment ($p=0.369$) and the social category of participants ($p=0.34$) and **time** it takes to reach the health setting ($p=3.338$).

Taking other medication other than the ATH medication and those participants who reported that ‘it is important to take hypertension medication even when there is no symptom’ **were** found associated with adherence ($p=0.037$ and $p=0.027$ respectively).

Ever been a smoker but stopped it ($p=0.007$), currently drinking alcohol ($p=0.031$), moderate activity for 10 minutes or more ($p=0.004$), and doing physical exercises ($p=0.002$) were found associated with adherence to medication. While eating fruit was not associated with adherence to hypertension medication ($p=0.052$).

The Variables whose p values were significant were further analysed using multivariate logistic regression and the results are presented in the Table 3.

Table 3. Multivariate analysis of the factors associated to adherence to medications.

Variables	Categories	COR	AOR	95% CI		P value
				Lower	Upper	
Age	Below 40	Ref	Ref			
	40-60	10.50	4.596	0.839	25.162	0.079
	Above 60	11.09	2.954	0.317	27.562	0.342
Sex	Male	Ref	Ref			
	Female	2.62	4.188	1.555	11.281	0.005
Marital status	Single	Ref	Ref			
	Married	3.04	2.591	0.162	41.364	0.501
	Divorced	4.75	45.883	0.606	3475.001	0.083
Education	No formal education	2.44	1.431	0.345	5.943	0.622
	Formal education	Ref	Ref			
Taking other medication	No	1.74	1.828	0.775	4.310	0.168
	Yes	Ref	Ref			
Important to take medication even when no signs	No	Ref	Ref			
	Yes	1.8	24.006	4.831	119.281	<0.001
Belief about ATH medication	Good	4.29	16.867	5.438	52.321	<0.001
	Low	Ref	Ref			
Time with Hypertension meds	Less than 5 yrs	Ref	Ref			
	More than 5 yrs	2.3	33.359	5.016	221.851	<0.001
Ever smoked	yes	2.07	9.348	2.594	33.686	0.001
	No	Ref	Ref			
Currently drinking alcohol	Yes	Ref	Ref			
	No	2.07	0.383	0.096	1.527	0.174
Moderate activity lasting 10	Yes	0.45	0.528	0.151	1.842	0.317
	No	Ref	Ref			
Physical exercises	Yes	0.22	0.163	0.019	1.373	0.095

No Ref Ref

The multivariate logistic regression analysis revealed that female were more likely adherent than males (AOR: 4.188, 95% CI [1.555-11.281], $p=0.005$); Patients who have been diagnosed with hypertension and have been on medication for a period of 5 years or more were more likely to adhere to medication than those who were taking medication for a period less than 5 years (AOR: 33.35, 95%CI [5.016-221.2851], $p<0.001$). Participants who reported that 'it is important to take medication even when no symptoms' and those who had a good belief about medications were more likely to adhere than those who said no to the statement and also those who had low belief respectively (AOR: 24, 95%CI [4.831-119.281], $p<0.001$ and AOR:16.867 95%CI [5.438-52.321], $p<0.001$ respectively). People who were once smoker but quited it after realizing that they have Hypertension were more likely adherent than those who did not smoke (AOR: 9.348, 95%CI [2.594-33.686], $p=0.001$).

DISCUSSIONS

The findings of this study has revealed that the level of adherence is 64.34% Figure 4 1, this finding may be literally higher than what was found in 22 middle and lower income countries of Asia 50% [8] and that may be attributed to the fact that this study only recruited patients who are already in the NCDs registry being followed for Hypertension, these patients might have had the increased level of awareness as they are following the appointments.

In Africa, especially the sub-Saharan region, lower adherence to hypertension medication was obtained in a meta-analysis conducted by Abegaz and colleagues of 54.2% which highlight the burden that sub-Saharan region possess of low adherence to hypertensive medication than other side of the world[9]. This lower adherence rate has been attributed to many factors that hinder the quality of life such as insufficiency in health infrastructures, low education, and poor access to finance compared to the developed World, among others [10], [11].

Locally, such studies are scarce, but the accessed one by the researcher, a study that was conducted in four district hospitals in southern province of Rwanda has found the adherence rate of 77% [12] which is higher than the finding of this study. This difference might be explained by the way both studies were conducted; firstly, this study only recruited only patients who are being followed by the NCDs department of Ruli district hospital while the other study incorporated all hypertensive patients being treated at Gitwe, Kabgayi, Kabutare and Ruhango [12].

Secondly, the geographical location of southern province and Northern Province specifically Gakenke are different, all of Ruli district catchment areas do not have an easy public transport. Thirdly, the study setting used does not represent the whole country so the findings may not be generalized to the real situation of the country.

On the socio-demographic factors associated with adherence to the hypertension medication among hypertensive patients attending a district hospital, Northern Province, Rwanda; the age was not found to have an impact on the adherence rate despite previous studies conducted elsewhere in the world suggesting that younger people are less adherent compared to the old ones [10]–[13]. Although not conclusive, participants with the age of 60 years old and above were 2.9 times more likely to be adherent and people in the age range of 40-60 are 4.5 times more likely to be adherent; both than people younger than 40 years. That tendency was explained by the fact that younger people may not be as concerned by their health as old one, then ignore medical advices and recommendations prescribed [10], [13].

This study also revealed that females are more likely adherent compared to males (AOR: 4.188, 95% CI [1.555-11.281], $p=0.005$); similar findings also were obtained in a study conducted in Taiwan [14]. This may be explained by that males are the one who travel a lot and engage in activities that may prevent them to be back home on a regular basis so contributing to poor adherence than females. However, these findings are not similar with others, where it was found that female are non-adherent than men instead [15]. Despite that difference many other studies failed to establish an association with a statistical significance on that [11], [16], [17].

In this study, despite the COR suggesting that married (COR: 3.04) and divorced people (COR: 4.75) are more likely to be adherent than single ones, the adjusted odds ratios did not show any statistical significance (Married AOR: 2.591, 95%CI [0.162-41.364], $p=0.501$; divorced AOR: 45.883, 95%CI [0.606-3475], $p=0.083$). The findings are not in line with what was found elsewhere suggesting statistical significance, where it was attributed to the fact that people who have social support from their relatives and friends may be good adherent than their counterparts. [18]. Having been married could show the ability of the person to create a social network which result into social support, which contribute to good adherence [10].

Although previous studies have suggested that education can affect the adherence to hypertension medications, this study findings did not establish any association (AOR: 1.431 95%CI [0.345-5.943], $p=0.622$) despite the Crude Odd Ratio showing that non-educated participants were more likely to be adherent than people with formal education (COR:2.44). Different studies reiterated that non-adherence may be associated with poor literacy in some studies [15], [19]. This is contrary to what people may expect that if you are educated, you should have a good compliance to medication, however, that is not the case. Ezeala-Adikaibe and colleagues argued that educated people may resist to rely on the health care provider's advice whilst non educated people may have an undivided trust toward

the health care provider hence good adherence to the later [10]. However, some other studies failed to establish the association with the adherence to hypertension medication and the level of education [13], [20].

Regarding the medication related factors, it was revealed that being diagnosed for HTN and of course being on treatment for a period of 5 years and above was positively associated with adherence compared to being diagnosed and on treatment for a period of less than 5 years (AOR: 33.35, 95%CI [5.016-221.2851], $p<0.001$). This is similar with other studies that were conducted on the adherence to hypertension medication, which revealed that the more the long time on medication, patients get used to medications and the perceived susceptibility increase, hence their compliance to medication increases [10]. In addition to that, it is believed that the more the time pass, the more the chance of getting further knowledge on the condition, patient may have; HTN knowledge of patients who are diagnosed for HTN and are on treatment since then will keep increasing as the time pass, so this will increase their health awareness and hence adhere to medication [21].

This study also revealed that patients who were not taking other medications than HTN medications were likely adherent compared to people taking three tablets or more although not statistically significant (COR: 1.74; AOR: 1.828, (95%CI [0.775-4.310], $p=0.168$). this may be supported by the fact that if patient are taking other drugs this may increase the tables number and lead to body weakness and not feeling well, reading to poor compliance to medications [10], [22].

The patient who agreed on whether it is important to take medication even when no symptoms' and those who had a good belief about medications were more likely to adhere than those who said no to the statement and also those who had low belief respectively (AOR: 24, 95%CI [4.831-119.281], $p<0.001$ and AOR: 16.867 95%CI [5.438-52.321], $p<0.001$ respectively). That is similar with other studies; suggesting that having a good belief on medications is a sign of increased self-awareness and perceived susceptibility hence improve the adherence to medication [23].

On the lifestyle factors associated with adherence to medication as shown by the Table 4.7, this study has found that patient who have ever smoked have good adherence than those who did not smoke (AOR: 9.348, 95%CI [2.594-33.686], $p=0.001$). The findings seem to be different from other few studies that have suggested the association between adherence and smoking, suggesting that smoking is associated with poor adherence[18], [24]. Although the findings literally contradict the other past studies, it may be due to the fact all participants who responded to smokers, have all stopped after knowing their condition and there were no active smokers participants. We may assume that, since they all stopped smoking for their health concern, they were probably having good health belief and perceived susceptibility hence became more adherent.

However there was no established association between drinking alcohol (COR: 2.07, AOR: 0.383, 95%CI [0.096-1.527], $p=0.174$), moderate activities at work for 10 minutes or more (COR:0.45, AOR: 0.528, 95%CI [0.151-1.842], $p=0.317$) and regular physical exercises (COR: 0.22, AOR: 0.163, 95%CI [0.019-1.373], $p=0.095$) with the adherence to medication despite their Crude odds ratios from logistic regression suggesting its existence.

RECOMMENDATIONS

Based on the study findings, the following are proposed recommendations:

1. There is a need to emphasize on the health education on non-communicable diseases especially hypertension and adherence to medication among hypertensive patients.
2. There is a need of more effort to mainstream the benefits of compliance to medication especially hypertension medications so that there is no discrepancy of level of adherence in newly diagnosed and old cases and to ensure that patients have the good medication belief and health literacy

SUGGESTION FOR FURTHER STUDIES

Considering the study limitations which include the time vis à vis the study participants availability, the methodology used, and the study setting, that prevent the study findings from being generalized to the entire Rwandan population, given also the inconsistency of the results that was observed globally on the adherence to hypertension medication as mentioned in a study conducted in Philippines [19]; further studies on a large scale with a prospective study design would respond to the curiosity of the level of adherence to hypertension medication and factors that may be associated to it in the entire country and establish the causality as well

AUTHORS CONTRIBUTION

Abazimana Denys has designed the study, collected, analyzed, interpreted the data and wrote the manuscript. Dr. Rosemary Okova and Dr Michael Habtu supervised the whole process up to publication. They contributed the design of the study, the analysis and the

manuscript review while Mr. Sylevestre Ntirenganya contributed largely to the manuscript review and publication process.

DECLARATION OF CONFLICT OF INTEREST

The author declare no conflict of interest with regards to this research and the authorship of this article.

ACKNOWLEDGEMENT

The author appreciate the full support of the Ruli Hospital and the hypertensive clients in Ruli District Registry for their active participation to the success of this study.

REFERENCES

- [1] M. R. Nahimana *et al.*, “A population-based national estimate of the prevalence and risk factors associated with hypertension in Rwanda: Implications for prevention and control,” *BMC Public Health*, vol. 18, no. 1, pp. 1–11, 2018, doi: 10.1186/s12889-017-4536-9.
- [2] World Health Organization, *Improving hypertension control in 3 million people: country experiences of programme development and implementation*. 2020.
- [3] A. Akintunde and T. Akintunde, “Antihypertensive medications adherence among Nigerian hypertensive subjects in a specialist clinic compared to a general outpatient clinic,” *Ann. Med. Health Sci. Res.*, vol. 5, no. 3, p. 173, 2015, doi: 10.4103/2141-9248.157492.
- [4] V. N. Agbor, N. F. Takah, L. N. Aminde, L. Ndemnge, and A. ; Amindeln, “Prevalence and factors associated with medication adherence among patients with hypertension in sub-Saharan Africa: protocol for a systematic review and meta-analysis,” *BMJ Open*, vol. 8, p. 20715, 2018, doi: 10.1136/bmjopen-2017-020715.
- [5] N. M. Adidja, V. N. Agbor, J. A. Aminde, C. A. Ngwasiri, K. B. Ngu, and L. N. Aminde, “Non-adherence to antihypertensive pharmacotherapy in Buea, Cameroon: A cross-sectional community-based study,” *BMC Cardiovasc. Disord.*, vol. 18, no. 1, pp. 1–9, Jul. 2018, Accessed: Dec. 04, 2021. [Online]. Available: <https://bmccardiovascdisord.biomedcentral.com/articles/10.1186/s12872-018-0888-z>.
- [6] A. A. Baumann *et al.*, “Dissemination and Implementation Program in Hypertension in Rwanda Report on Initial Training and Evaluation,” 2019, doi: 10.1016/j.gheart.2019.06.001.
- [7] S. H. Jung, “Stratified Fisher’s exact test and its sample size calculation,” *Biometrical J.*, vol. 56, no. 1, pp. 129–140, Jan. 2014, doi: 10.1002/bimj.201300048.
- [8] S. Mahmood, Z. Jalal, M. A. Hadi, T. M. Khan, M. S. Haque, and K. U. Shah, “Prevalence of non-adherence to antihypertensive medication in Asia: a systematic review and meta-analysis,” *Int. J. Clin. Pharm.*, vol. 43, no. 3, pp. 486–501, Jun. 2021, doi: 10.1007/s11096-021-01236-z.
- [9] T. M. Abegaz, A. Shehab, E. A. Gebreyohannes, A. S. Bhagavathula, and A. A. Elnour, “Nonadherence to antihypertensive drugs: A systematic review and meta-analysis,” *Medicine (Baltimore)*, vol. 96, no. 4, 2017, doi: 10.1097/MD.0000000000005641.
- [10] B. Ezeala-Adikaibe *et al.*, “Factors Associated with Medication Adherence among hypertensive Patients in a Tertiary Health Center: A Cross-Sectional Study,” *Arch. Community Med. Public Heal.*, pp. 024–031, Mar. 2017, doi: 10.17352/2455-5479.000021.
- [11] P. Gupta *et al.*, “Risk Factors for Nonadherence to Antihypertensive Treatment,” *Hypertension*, vol. 69, no. 6, pp. 1113–1120, Jun. 2017, doi: 10.1161/HYPERTENSIONAHA.116.08729.
- [12] J. P. Sibomana, R. L. McNamara, and T. D. Walker, “Patient, clinician and logistic barriers to blood pressure control among adult hypertensives in rural district hospitals in Rwanda: A cross-sectional study,” *BMC Cardiovasc. Disord.*, vol. 19, no. 1, 2019, doi: 10.1186/s12872-019-1203-3.
- [13] C.-P. Chou, C.-Y. Chen, K.-S. Huang, S.-C. Lin, C.-F. Huang, and M. Koo, “Factors associated with nonadherence to antihypertensive medication among middle-aged adults with hypertension: findings from the Taiwan National Health Interview Survey,” *J. Int. Med. Res.*, vol. 48, no. 8, pp. 1–10, Aug. 2020, doi: 10.1177/0300060520936176.
- [14] S. M. Chang, I. C. Lu, Y. C. Chen, C. F. Hsuan, Y. J. Lin, and H. Y. Chuang, “Behavioral factors associated with medication

- nonadherence in patients with hypertension,” *Int. J. Environ. Res. Public Health*, vol. 18, no. 18, p. 9614, Sep. 2021, doi: 10.3390/IJERPH18189614/S1.
- [15] S. Kulkarni, R. Rao, J. D. H. Goodman, K. Connolly, and K. M. O’Shaughnessy, “Nonadherence to antihypertensive medications amongst patients with uncontrolled hypertension: A retrospective study,” *Medicine (Baltimore)*, vol. 100, no. 14, p. e24654, Apr. 2021, doi: 10.1097/MD.00000000000024654.
- [16] A. Biffi, F. Rea, T. Iannaccone, A. Filippelli, G. Mancina, and G. Corrao, “Sex differences in the adherence of antihypertensive drugs: A systematic review with meta-analyses,” *BMJ Open*, vol. 10, no. 7, Jul. 2020, doi: 10.1136/bmjopen-2019-036418.
- [17] T. R. Dego and E. M. Bobasa, “Adherence to anti-hypertensive medication and contributing factors among non-comorbid hypertensive patients in two hospitals of jimma town, south west ethiopia,” *Gulhane Med. J.*, vol. 58, no. 1, pp. 60–66, 2016, doi: 10.5455/gulhane.1286.
- [18] H. Abbas *et al.*, “Factors Associated with Antihypertensive Medication Non-Adherence: A Cross-Sectional Study Among Lebanese Hypertensive Adults,” *Patient Prefer. Adherence*, vol. 14, p. 663, 2020, doi: 10.2147/PPA.S238751.
- [19] M. M. Gutierrez and R. Sakulbumrungsil, “Factors associated with medication adherence of hypertensive patients in the Philippines: a systematic review,” *Clin. Hypertens.*, vol. 27, no. 1, pp. 1–15, Dec. 2021, doi: 10.1186/S40885-021-00176-0/FIGURES/2.
- [20] A. Getenet, M. Tesfa, A. Ferede, and Y. Molla, “Determinants of adherence to anti-hypertensive medications among adult hypertensive patients on follow-up in Hawassa Referral Hospital: A case–control study,” *JRSM Cardiovasc. Dis.*, vol. 8, p. 204800401989275, 2019, doi: 10.1177/2048004019892758.
- [21] F. M. Algabbani and A. M. Algabbani, “Treatment adherence among patients with hypertension: findings from a cross-sectional study,” *Clin. Hypertens.*, vol. 26, no. 1, pp. 1–9, Dec. 2020, doi: 10.1186/S40885-020-00151-1/TABLES/4.
- [22] D. F. Teshome, K. B. Bekele, Y. A. Habitu, and A. A. Gelagay, “Medication adherence and its associated factors among hypertensive patients attending the Debre Tabor General Hospital, Northwest Ethiopia,” *Integr. Blood Press. Control*, vol. 10, pp. 1–7, 2017, doi: 10.2147/IBPC.S128914.
- [23] R. M. Jamous, W. M. Sweileh, A. S. E.-D. A. Taha, and S. H. Zyoud, “Beliefs About Medicines and Self-reported Adherence Among Patients with Chronic Illness: A Study in Palestine,” *J. Fam. Med. Prim. Care*, vol. 3, no. 3, p. 224, 2014, doi: 10.4103/2249-4863.141615.
- [24] G. Mancina and E. Agabiti, *Drug Adherence in Hypertension and Cardiovascular Protection*. Springer, 2018.