



Factors Affecting Medication Adherence among Nepalese Hypertensives in a Rural Area

Sudim Sharma¹, Natkamol Chansatitporn², Ann Jirapongsuwan³, Lava Timsina⁴

¹ Master of Public Health Program (International Program), Faculty of Public Health, Mahidol University, 420/1 Ratchawithi Road, Ratchathewi District, Bangkok 10400, Thailand.

² Department of Biostatistics, Faculty of Public Health, Mahidol University, Bangkok, Thailand.

³ Department of Public Health Nursing, Faculty of Public Health, Mahidol University, Bangkok, Thailand.

⁴ Department of Surgery, Center for Outcome Research in Surgery, Indiana University School of Medicine, 545 Barnhill Dr., EH 103, Indianapolis, IN 46202, USA.

Correspondence: Natkamol Chansatitporn, 420/1 Ratchawithi Road, Ratchathewi District, Bangkok 10400, Thailand, natkamol.cha@mahidol.ac.th

Received: April 21 2023; Revised: June 28 2023; Accepted: July 11 2023

Abstract

Maintaining drug adherence has become a challenge for both the hypertensives and the health system for a variety of reasons. There is a lack of understanding about the several factors that may lead to medication non-adherence, especially among rural hypertensives. The purpose of this study was to assess the status of medication adherence and to identify the factors influencing medication adherence among Nepalese rural hypertensives. This community-based cross-sectional study was conducted among 405 rural hypertensives from Lamahi Municipality, Dang District of Nepal through a simple random sampling. The sample size for this study was determined using the formula: $Z^2 pq/d^2$. The standard 9-items Hill-Bone medication scale (HB-MAS) questionnaire was used to assess the status of medication adherence. The questionnaires used in this study are based on rigorous literature review and were tested for the validity and reliability. Data was collected using a face-to-face interview and was analyzed using descriptive (frequency and proportion), bivariate (chi-square) and multiple logistic regression. Study indicated that only 56.5% hypertensives are adherent to antihypertensive medication. Ethnicity [adjusted odds ratio (AOR) = 0.24; 95% CI: 0.09 - 0.65, $p < 0.005$], knowledge [AOR = 13.80; 95% CI: 4.95 - 38.48, $p < 0.001$], attitude [AOR = 15.08; 95% CI: 5.21 - 43.63, $p < 0.001$], availability of medication and services [AOR = 2.84; 95% CI: 1.24 - 6.49, $p < 0.013$], and accommodation of

hypertension-related services [AOR = 14.15; 95% CI: 2.21 – 90.57, p 0.005] are the factors associated with medication adherence. Targeting tailored interventions for specific ethnic groups, enhancing knowledge, and building trust among the hypertensives regarding the medication, ensuring availability of the antihypertensive medication, and strengthening current health service provision for antihypertensive medication and services closer to the communities might improve medication adherence among the rural hypertensives in Nepal.

Keywords: Medication adherence, Hypertension, Community based, Rural, Patient-related factors

What was Known

- Medication adherence is a personal or behavioral trait that depends on several factors
- Adherence to antihypertensive medication is crucial to keeping blood pressure under control

What's New and Next

- Strengthening hypertension related services could enhance medication adherence
- Tackling health-service related barriers could better medication adherence among rural hypertensives

Introduction

With the gradual paradigm shift from communicable disease to non-communicable disease, hypertension has become a serious public health problem with rising unmet needs for its prevention and treatment^{1,2}. Globally, an estimated 1.28 billion adults have hypertension, out of which most hypertensives belong to low-income countries with only less than 42% being diagnosed and treated for hypertension³.

Regular monitoring and taking medication precisely are the key to hypertension management with its lifelong benefits. However, nearly half of the hypertensives do not adhere to the required dose of medication and among them above 50% faces difficulty in maintaining their blood pressure^{1,2}. In a low-income country like Nepal, maintaining good adherence to antihypertensive medications remains one of the significant challenges to the health system. In the year 2019 World Health Organization (WHO) hypertension factsheet claimed that there are

currently 4.7 million people living with hypertension in Nepal⁴ and the medication adherence status is only around 52%–62% among those hypertensives^{5,7}. However, this level of adherence is remarkably less when compared to the necessary adherence rates of 80% or higher for suboptimal therapeutic effectiveness¹ in chronic disease like hypertension.

The Nepalese health system, which is largely dominated by the for-profit and insufficiently regulated private health sector⁸, has several structural impediments that limit access to healthcare⁹, especially for rural hypertensives. As a result, only 59% of people have access to health service, and 55% endure financial hardship in order to pay for their healthcare¹⁰. Early federalization efforts showed promise for improving Nepal's health system and expanding access to healthcare. However, in terms of equitable and affordable access, a significant gap still lingers⁹. In such, people in rural areas with limited resources¹¹ and lack of awareness are most vulnerable to the increased burden of hypertension. This burden is further compounded by people's restricted access and cost⁶ to the life-long therapy required for hypertension control. This has resulted in several complications as well as an increased risk of poor cardiovascular outcomes. Furthermore, a shortage of competent human resources¹⁰, lack of essential medicines needed for hypertension^{12,13}, lack of family support¹⁴, inadequate access to treatment, lack of insurance coverage, socio-economic and health system-related obstacles exist in Nepal, exacerbating the low adherence among rural hypertensives¹¹. Besides, the onset of hypertension is significantly influenced by family history. According to studies, those who have a history of hypertension in their families are more likely to experience the condition themselves. There have been conflicting reports regarding the adherence behavior of patients with a family history, including whether or not they are compliant with their medication^{15,18}. According to the literature, having a family history of hypertension may indirectly increase awareness of the condition and reinforce drug compliance¹⁹. Closely, understanding the impact of family history of hypertension in terms of adherence behavior is crucial for prevention of further complications. Therefore, a pressing need exists for a community-based need assessment to comprehend the factors influencing adherence to antihypertensive medication, which are often considered complicated and multidimensional^{20,21}.

To assess the status of medication adherence and the factors that influence it, PRECEDE phase of the PRECEDE-PROCEED model²² has been applied to this study. This comprehensive model has taken the lead in enticing policy makers and practitioners to consider

health and individual behaviors within the larger ecosystem of health determinants and to enhance those conditions. Therefore, we carefully integrated sociodemographic factors into the PRECEDE phase of the model to collectively study predisposing factors (knowledge, attitude, co-morbidities), enabling factors (accessibility, availability, affordability, acceptability, accommodation of Services, health insurance), and reinforcing factors (family history of hypertension, family support, types of healthcare center) and their relationship with medication adherence.

Materials and Methods

1. Study area

This study was conducted in the 9 sub-division wards of Lamahi Municipality, Dang district of Nepal.

2. Study design and sample size

A community based cross-sectional study was conducted among the hypertensive patients who were under medication residing in the Lamahi Municipality, Dang District of Nepal. The estimated sample size was based on Cochran²³, and was determined using the following formula:

$$n = \frac{Z^2 pq}{d^2}$$

Considering the previous prevalence of medication adherence as 62.1%⁵, the margin of error set to 0.05%, and 95% as confidence interval, a total sample size (n) of 362 was calculated. To overcome the non-response rate, 10% was added to the total sample size. Hence, the desired sample size was 398. However, we recruited 405 respondents. Hypertensive patients over 18 years of age who were diagnosed by the physician, currently under medication for at least six months were included in this study. In addition, we ensured to include those who were able to take the medication without assistance and those who provided consent to participate in the study.

3. Sampling method

To assess the status of medication adherence in Lamahi Municipality, all 9 wards were selected using a simple random sampling technique. Selection of study sample was done using following steps; Step 1: Female Community Health Volunteers (FCHVs) from each ward were oriented to identify hypertensives from their catchment areas and hence mobilized to create an inventory of these cases with the addresses of the hypertensives. Step 2: The research team then validated those cases through the recorded medical and medication history. Step 3: The research team, with the help of the FCHVs, sorted out the cases by the wards in the municipality. Step 4: Based on the total number of hypertensives in each ward, 45 eligible respondents were selected from every ward using a simple random sampling for the nine wards. One eligible respondent was selected from each household. In case any household had multiple eligible hypertensive cases, one subject was selected randomly using a lottery method.

4. Data collection and instrument

We obtained official permission to conduct the research from the Lamahi Municipal office. Written informed consent was obtained from the respondents. The data were collected from July to August 2022. Instruments used in this study are based on rigorous literature reviews which were later cross-checked for content validity. 5 public health professionals were appointed and trained by principal investigator and were later mobilized for data collection.

5. Outcome variable

Medication adherence was the outcome variable. We used standard 9-items Hill-Bone Medication Adherence Scale (HB-MAS)^{24,25} to assess the level of medication adherence. License to use the standard HB-MAS scale was obtained. The Scale had a four-point Likert -type response format for each question. Each response carried a score: all the time = 1, most of the time = 2, some of the time =3 and none of the time=4. The total scores were added for each patient. The total score for each patient ranged from 9 (minimum) to 36 (maximum). Lower scores would reflect poorer adherence to medication therapy. In this study, eighty percent of the maximum possible score^{1,2,24,25} was used for the cut-off point as: Good $\geq 80\%$ of ($\geq 28 - 36$) and Poor $< 80\%$ (< 28).

6. Studied variable

Altogether 18 independent variables were studied to learn about their association with the outcome variable. These variables were systematically grouped into 4 categories applying the PRECEDE phase of PRECEDE-PROCEED framework²².

- i. Socio-demographic factors: This included age, sex, education, ethnicity, occupation, and family income. For analysis each variable was categorized into groups.
- ii. Predisposing factors: Comprised 10 items for knowledge on medication adherence-based questionnaire with 6 positive and 4 negative statements and was categorized into two groups based on their cut offs scores as: good/fair knowledge (≥ 18) and poor knowledge (< 18). Similarly, for attitude towards medication adherence a 10 items questionnaire with 5 positive and 5 negative statements was used and was further categorized as positive attitude (≥ 22) and negative attitude (< 22). The scoring system for the 10 items knowledge statements were: Correct=3, Don't Know=2, Incorrect=1 for correct statement and reverse system was used for incorrect statement. Similarly for the 10 items attitude statements the scoring system was Agree=3, Uncertain=2 and Disagree=1 for positive statement and reverse system was used for negative statement. Knowledge and attitude scores were categorized according to Benjamin Bloom's cut off point²⁶. Each negative statement for Knowledge and attitude was further re-coded and analyzed accordingly. Co-morbidities were categorized as present or absent.
- iii. Enabling factors: Included 4 items questionnaire related to access to care (5As); accessibility, availability, affordability, acceptability, accommodation²⁷, and health insurance. Cut-off scores were good/fair (≥ 7.2) and poor (< 7.1) for 5A's and health insurance was categorized as insured and not insured.
- iv. Reinforcing factors: Included 3 items questionnaire related to family history of hypertension (yes or no), family support (yes or no) and types of health care to get antihypertensive medication (government or private).

7. Reliability and validity

For content validity, the structured questionnaire was checked by 3 experts from a similar field and was later approved by the research committee before data collection. The questionnaires were pretested among 30 hypertensive patients in adjoining Pyuthan district of Nepal. For internal consistency, the Cronbach's Alpha Coefficient 0.80 was achieved for 10 items knowledge and 0.74 for 10 items attitude questionnaires respectively. Whereas Cronbach's Alpha of greater than 0.77 was achieved for all 4 items 5A's (accessibility, availability, affordability, acceptability, accommodation of services) related questionnaires. In addition, Cronbach's Alpha Coefficient 0.92 was achieved for standard 9 items Hill Bone medication adherence scale.

8. Data processing and analysis

Data was analyzed using the SPSS version 25. Frequency, percentage, mean, median, and standard deviation were used for descriptive statistics. For inferential statistics we applied the chi-square test or when at least one of the expected cells count in the crosstabulation was less than 5, we applied Fisher's exact test to perform required statistical output. Bivariate analysis was performed to assess the relationship between various factors and medication adherence. Multiple logistic regression analysis was performed to determine the predictive factors for medication adherence. Factors that were associated to medication adherence at a higher level of significance ($p \leq 0.20$) in the bivariate analysis were considered as a potential predictor for multivariable logistic regression model.

Result

Table 1 portrays the socio-demographic and background characteristics of the participants after dividing them into adherent (good adherent) and nonadherent (poor adherent) groups. A total of 405 hypertensive patients were approached. Of which 56.5% were male and 43.5% were female with a mean age of 64.1 ± 13.46 years. A greater proportion of respondents (67.4%) attained secondary and high school education. Almost half of the respondents were from Brahmin/Chhetri (45.7%) ethnicity and one-fourth were from Tharu (25.4%) ethnic background. Most of the respondent's primary occupation were agriculture/labor (42.3%). Additionally, 53.8% respondents had a good/fair knowledge on medication adherence and 52.3% had a positive attitude towards medication adherence. The clinical characteristics of the respondents showed that 47.9% were currently living with co-morbid conditions like diabetes, heart diseases, kidney disease, liver disease and other chronic conditions. The result showed

that only 25.4% of the hypertensives had good/fair access to medication. Around half (49.6%) of the respondents had good/fair availability of medication and services. Whereas a greater proportion (90.9%) of respondents had good/fair affordability towards medication and services. Similarly, acceptability, and accommodation towards medication and services was found to be 97%, 89.6% respectively. Only 24% respondents were insured among which 23.3% were insured under the government insurance scheme and least (0.7%) were insured under the private insurance scheme. 17% of the respondents had a prior family history of hypertension. Higher proportion of respondents received a family support for medication (84.2%) and around three-fourth quarter (75.8%) of the respondents have chosen private health care center to get their anti-hypertensive medication over government healthcare center (24.2%).

Table 1 Characteristics of the respondents related to the medication adherence (n=405)

| Variables | Participant n (%) | Adherence | |
|---------------------------|----------------------|---------------|---------------|
| | | Good n (%) | Poor n (%) |
| Socio-Demographic Factors | | | |
| Age (years) | | | |
| 30 – 49 | 70 (17.3) | 34 (48.6) | 36 (51.4) |
| 50 – 69 | 190 (46.9) | 108 (56.8) | 82 (43.2) |
| 70 and above | 145 (35.8) | 87 (60.0) | 58 (40.0) |
| Mean ± SD 64.1 ± 13.46 | | | |
| Sex | | | |
| Male | 229 (56.5) | 137 (59.9) | 92 (40.1) |
| Female | 176 (43.5) | 92 (52.2) | 84 (47.8) |
| Education | | | |
| Illiterate | 36 (8.9) | 1 (2.8) | 35 (97.2) |
| Primary | 66 (16.3) | 15 (22.7) | 51 (77.3) |
| Secondary and high school | 273 (67.4) | 184 (67.4) | 89 (32.6) |

| | | | |
|--------------------------------------|------------|------------|------------|
| Graduate and above | 30 (7.4) | 29 (96.7) | 1 (3.3) |
| Ethnicity | | | |
| Brahmin/Chhetri | 185 (45.7) | 122 (65.9) | 63 (34.1) |
| Tharu | 103 (25.4) | 25 (24.2) | 78 (75.8) |
| Others (Janajati, Madhesi and Dalit) | 117 (28.9) | 82 (70.1) | 35 (29.9) |
| Occupation | | | |
| Not employed | 163 (40.2) | 75 (46.0) | 88 (54) |
| Agriculture and Labor | 171 (42.3) | 108 (63.2) | 63 (36.8) |
| Business and Service | 71 (17.5) | 46 (64.8) | 25 (35.2) |
| Monthly family Income (USD) | | | |
| <75 USD | 104 (25.7) | 52 (50.0) | 52 (50.0) |
| 75\$ – 150 USD | 181 (44.7) | 96 (53.0) | 85 (47.0) |
| 150 USD and above | 120 (29.6) | 81 (67.5) | 39 (32.5) |
| Predisposing Factors | | | |
| Knowledge | | | |
| Good/Fair | 218 (53.8) | 205 (94.1) | 13 (5.9) |
| Poor | 187 (46.2) | 24 (12.8) | 163 (87.2) |
| Attitude | | | |
| Positive | 214 (52.8) | 201 (93.9) | 13 (6.1) |
| Negative | 191 (47.2) | 28 (14.7) | 163 (85.3) |
| Co-morbidities | | | |
| Having co-morbidity | 194 (47.9) | 101 (53.1) | 93 (47.9) |

| | | | |
|-------------------------------------|------------|------------|------------|
| Not having co-morbidity | 211 (52.1) | 128 (60.7) | 83 (39.3) |
| Enabling Factors | | | |
| Accessibility | | | |
| Good/Fair | 103 (25.4) | 58 (56.3) | 45 (43.7) |
| Poor | 302 (74.6) | 171 (56.6) | 131 (43.4) |
| Availability | | | |
| Good/Fair | 201 (49.6) | 136 (67.7) | 65 (32.3) |
| Poor | 204 (50.4) | 93 (45.6) | 111 (54.4) |
| Affordability | | | |
| Good/Fair | 368 (90.9) | 213 (57.9) | 155 (42.1) |
| Poor | 37 (9.1) | 16 (43.2) | 21 (56.8) |
| Acceptability | | | |
| Good/Fair | 393 (97) | 225 (57.2) | 168 (42.8) |
| Poor | 12 (3) | 4 (33.3) | 8 (66.7) |
| Accommodation of services | | | |
| Good/Fair | 363 (89.6) | 226 (62.3) | 137 (37.7) |
| Poor | 42 (10.4) | 3 (7.1) | 39 (92.9) |
| Health Insurance | | | |
| Insured (government/private scheme) | 97 (24) | 59 (60.8) | 38 (39.2) |
| Not Insured | 308 (76) | 170 (55.2) | 138 (44.8) |
| Reinforcing factors | | | |

Family history of hypertension

| | | | |
|-----|------------|------------|------------|
| Yes | 69 (17.0) | 39 (56.5) | 30 (43.5) |
| No | 336 (83.0) | 190 (56.5) | 146 (43.5) |

Family Support

| | | | |
|-----|------------|------------|------------|
| Yes | 341 (84.2) | 188 (55.1) | 153 (44.9) |
| No | 64 (15.8) | 41 (64.1) | 23 (35.9) |

Types of healthcare to get medication

| | | | |
|--------------------------------|------------|------------|------------|
| Government healthcare facility | 98 (24.2) | 44 (44.9) | 54 (55.1) |
| Private healthcare facility | 307 (75.8) | 185 (60.3) | 122 (39.7) |

SD = Standard deviation, 1 USD \approx 132 Nepalese Rupees

Figure 1 portrays the adherence status of the respondents. Based on the (HB-MAS), 56.50% are good adherent and 43.50% are poorly adherent to anti-hypertensive medication.

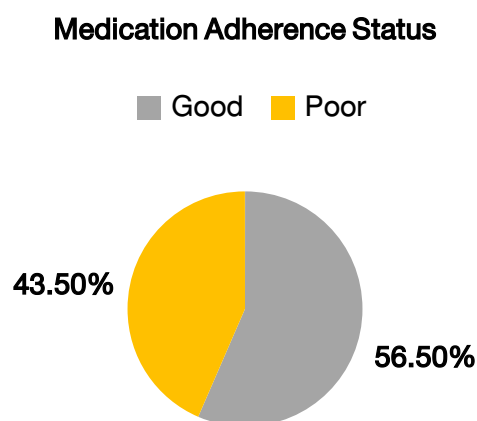


Figure 1 Status of Medication Adherence: Good vs Poor

The final model with adjusted odds ratio (AOR) for the various predictors, after controlling the list of covariates (education, occupation, family income, and types of healthcare center to get medication) is shown in

Table 2. The results indicates that the respondents from Tharu ethnic group had 80% significantly lower odds of adherence to hypertension medication as compared to those from Brahmin/Chhetri ethnicity [AOR=0.2, 95%CI: 0.0-0.6, p 0.005]. Whereas the odds of being adherent to medication is 13 times higher among the respondents having a good/fair knowledge about medication when compared to respondents with poor knowledge [AOR=13.8, 95%CI: 4.9-38.4, p <0.001]. Regarding attitude, the odds of being adherent is 15 times higher among the hypertensives who have the positive attitude towards medication adherence when compared to the respondents with negative attitude [AOR= 15, 95%CI: 5.2-43.6, p <0.001]. Similarly, respondents who had a good/fair availability for antihypertensive medication are 2.8 times more adherent to the medication compared to those having poor availability of antihypertensive medication [AOR=2.8, 95%CI: 1.2-6.4, p 0.013]. Lastly, the odds of being adherent to the medication was 14 times higher among the respondents who had good/fair accommodation to the antihypertensive medication and services as compared to the ones with poor accommodation [AOR=14.1, 95%CI: 2.2 - 90.5, p 0.005].

Table 2 Significant predictors of medication adherence

| Variables | Bivariate | | Multivariate | |
|--------------------------------------|-----------------------|--------|--------------------|--------|
| | OR (95% CI) | p | AOR (95% CI) | p |
| Ethnicity | | | | |
| Brahmin and Chhetri ^{ref} | 1 | | 1 | |
| Tharu | 0.16 (0.09,0.28) | <0.001 | 0.24 (0.09,0.65) | 0.005 |
| Others (Janajati, Dalit and Madhesi) | 1.21 (0.73,1.99) | 0.454 | 1.15 (0.45,2.90) | 0.764 |
| Knowledge | | | | |
| Poor ^{ref} | 1 | | 1 | |
| Good/Fair | 107.09 (52.88,216.88) | <0.001 | 13.80 (4.95,38.48) | <0.001 |
| Attitude | | | | |
| Negative ^{ref} | 1 | | 1 | |
| Positive | 90.00 (45.10,179.35) | <0.001 | 15.08 (5.21,43.63) | <0.001 |
| Availability | | | | |

| | | | | |
|---------------------|--------------------|--------|-----------------------|-------|
| Poor ^{ref} | 1 | | 1 | |
| Good/Fair | 2.49 (1.66,3.74) | <0.001 | 2.84 (1.24,6.49) | 0.013 |
| Accommodation | | | | |
| Poor ^{ref} | 1 | | 1 | |
| Good/Fair | 21.44 (6.50,70.72) | <0.001 | 14.15 (2.21,90.57) | 0.005 |

OR, Odds ratio; AOR, adjusted odds ratio; CI, Confidence interval; ref, Reference category

Discussion

This study assessed the level of medication adherence and its association with various factors. The result showed that ethnicity, knowledge, attitude, availability, and accommodation are significant predictors of medication adherence. The overall adherence was only 56.5%. The finding of this study is aligned with the aggregate percentage of adherence status reported in a systematic review performed in developing countries including Nepal⁶. However, the finding is greater than what was reported in Saudi Arabia²⁸ and China²⁹ and lower than that of Nepal⁵, Pakistan³⁰, and Sunderland study³¹. This might be due to differences in sociodemographic characteristics, health service access and delivery, variance in sample size and the tools used to measure the medication adherence.

Ethnicity was found to be a significant factor associated with medication adherence. The result of this study indicates that Tharu, an indigenous marginalized ethnic group are less likely to adhere to the medication when compared to the privileged Brahmin/Chettri ethnic groups. The ethnic related studies covering the wider aspect of non-communicable disease, hypertension and particularly for adherence to the anti-hypertensive medication are limited in Nepal. Although we noted that ethnic minorities are usually less adherent when compared to the privileged ones^{32,34}, there is a need for more research to closely understand ethnic traits that influences medication adherence. Using culturally appropriate local remedies (traditional medicine) often considered cheap and widely available³⁵ instead of modern allopathic medicine, social-political, structural and health inequalities³⁶ could be the reasons for non-adherence among Tharu ethnic groups in Nepal. Further possible explanation could be resistance to change³⁷, low education attainment, poor economic status, and other health service-related barriers³⁸ contributing to poor adherence. Therefore, targeting systematic interventions for specific ethnic groups could enhance good adherence.

We found that the more informed the patient is about their status of hypertension and the medication, the better their adherence status. This was also backed by the prior study³⁹. The majority of patients were found to be nonadherent to their prescribed medications who have a poor understanding of their drug regimen⁴⁰, and those who get less information on medication use⁴¹. It has also been demonstrated that enhancing patient knowledge, both about their disease and about the drugs they take, leads to improved drug adherence. Involving patients in their care through patient counseling and as well as maintaining good doctor patient relationships⁴² to share knowledge regarding the medication could greatly enhance adherence to medication⁴³.

Though an attitude is a theoretical concept, it greatly impacts the patient's behavior towards medication adherence. The current study suggests that the negative attitude towards medication is a significant risk factor for poor adherence which is congruent with the previous study conducted in Hongkong⁴⁴. Similar findings were observed in a recent Stepwise approach to NCD surveillance (STEPS) survey done by WHO in Nepal, where the majority of people (55.4%) have a negative attitude toward antihypertensive medicine⁴⁵. Whereas, the study in Indonesia³⁹ showed that greater proportion (90.9%) of the participants have negative attitude regarding antihypertensive medication. The same study³⁹ further discusses the importance of how adherence can be increased when the patient truly understands the disease. Reasonably, a patient will demonstrate a certain behavior in the form of an action. Hence modifying attitude could greatly contribute to having a fair judgment towards medication and lifestyle modification, ultimately leading to greater adherence towards medication. In addition, understanding key causative factors is necessary when delivering better behavior change strategies and interventions to resolve non-adherence among the hypertensives⁴⁶.

In this study half (50.4%) of the patients reported poor availability of antihypertensive medication, and this has impacted medication adherence. Previous studies have found a comparable outcome in terms of availability of antihypertensive drug and medication adherence^{42,47}. As per the WHO standard, antihypertensive medication should be made timely available with an adequacy and proper dose at an affordable cost to assure the healthcare needs of the people. Making it the national priority, the government of Nepal has emphasized NCD prevention and treatment by including hypertensive medication on the list of essential medicines⁴⁸. Meaning that, the government will provide these medicines ensuring ample

supply at the government owned healthcare centers. However, a large proportion of the people are compelled to visit private healthcare centers to receive antihypertensive medication and services⁴⁵ because of lack of availability of medication in the government healthcare centers. It is not surprising to see this result as there is a remarkable mismatch in procurement of antihypertensive medicines, their demand and adequate supply of antihypertensive medication particularly in the government owned health sector^{12,13,42,47}. It is therefore truly important for policy makers to further strengthen the existing supply chain mechanism, regularly monitor the stock out of essential medicines and ensure regular supply prioritizing the rural nooks of Nepal.

In the current study, poor accommodation was found to be the predictive factor for non-adherence of antihypertensive medication. Accommodation-related factors such as inconvenient opening hours of the healthcare center, long wait times were the limiting factors in maintaining good adherence as discussed in the previous studies^{37,49,50}. A quality and functional health system should not have patients wait a long time for treatment and counselling. Nevertheless, oftentimes the hypertensives especially in low resource setting has to deal with the healthcare related hassle and delay to receive services and medications³⁸ which has ultimately led to non-adherence. Therefore, it is crucial to prioritize healthcare needs of the hypertensives by reducing the wait times. It has been demonstrated in other chronic illnesses that shorter wait periods may have enhanced the patient experience, leading to greater patient involvement in their own treatment⁵¹.

As a cross sectional study, we were unable to establish temporal and causal relationships between different variables and medication adherence. As this study was conducted in one municipality it might limit the generalizability of the findings. To our understanding, this is one of the few community-based studies in Nepal which has assessed the status of medication adherence particularly among rural hypertensive patients and the factors that influence medication adherence. Medication adherence was assessed using the nine-item Hill Bone Medication Adherence Scale, a validated instrument. The license was obtained and translated to use in the Nepali version. With an adequate sample size, the data was collected by trained health professionals with the standardized questionnaire adopted from Nepal Demographic Health Survey, WHO STEPS Survey and various other literatures. This study is

noble in terms of acquiring municipal status of medication adherence among the hypertensives within a short period of time.

Conclusion

In conclusion, only 56.5% percentage of hypertensives are adherent to antihypertensive medication. This study indicates that culturally appropriate interventions for hypertensives within the marginalized Tharu ethnic group is essential. Similarly, healthcare professionals should be forthcoming, educating patients about the advantages of antihypertensive medicines, and encouraging hypertensives through motivational counseling regarding medication adherence. Our study indicates a significant mismatch between the demand for and availability of antihypertensive medication, necessitating regular stock-out monitoring and strengthening of the current supply chain mechanism. Moreover, ensuring regular supply of antihypertensive medicines in rural nooks of Nepal is of utmost importance. Future research in a more diverse community setting is advised.

Ethical Approval Statement

The study obtained ethical approval from the Human Research Committee, Faculty of Public Health, Mahidol University, Thailand (ref. ID MUPH 2022-063). In addition, this study has also obtained the Ethical Clearance and permission to conduct the study from Nepal Health Research Council, Kathmandu, Nepal (NHRC) (ref. ID 4352). An informed written consent was obtained from all the study participants. Confidentiality and anonymity were maintained throughout the study.

Author Contributions

SS designed the study and formulated the content of the tools and questionnaire with guidance from NC, AJ, LT. SS conducted the study under the supervision of NC, AJ, LT, and SS carried out pretest, reliability testing and the statistical analysis of data, following advice from NC. SS re-analyzed the data and wrote the manuscript. SS produced the original abstract, and NC, AJ and LT helped to revise it. All authors read and approved the manuscript prior to submission for publication.

Acknowledgements

The authors would like to express their gratitude to research team and female community health volunteers for their unwavering support to conduct this study. In addition, the authors would like to thank Lamahi municipality office at Lamahi, Dang District, Nepal for their administrative support.

Source of Funding

The work presented in this article was self-funded.

Conflicts of Interest

None

References

1. Burnier M, Egan BM. Adherence in hypertension: A review of prevalence, risk factors, impact, and management. *Circulation Research*. 2019 Mar 29;124(7):1124-40. DOI: 10.1161/CIRCRESAHA.118.313220
2. Burnier M, Wuerzner G, Struijker-Boudier H, Urquhart J. Measuring, analyzing, and managing drug adherence in resistant hypertension. *Hypertension*. 2013 Aug; 62(2): 218-25. DOI: 10.1161/HYPERTENSIONAHA.113.00687
3. World Health Organization. Hypertension Factsheet. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>, access 18 October, 2022
4. World Health Organization. Nepal hypertension factsheet. 2019. Available from: https://cdn.who.int/media/docs/default-source/country-profiles/hypertension/npl_en.pdf?sfvrsn=2c2ad0ce_9&download=true, accessed 8 January, 2022
5. Shrestha P, Wattanakitkriearat D, Pongthavornkamol K. Factors influencing medication adherence in Nepalese patients with essential hypertension. *Nursing Science Journal of Thailand*. 2019 Sep 23; 37(3): 18-31.
6. Dhar L, Earnest J, Ali M. A systematic review of factors influencing medication adherence to hypertension treatment in developing countries. *Open J Epidemiol*. 2017; 7(03): 211-50. DOI:10.4236/ojepi.2017.73018
7. Roka T, Ghimire M. Medication adherence among hypertensive patients attending a tertiary care hospital in Nepal. *J Nepal Health Res Counc*. 2019; 17(4): 521-7. DOI: 10.33314/jnhrc.v17i4.2337

8. Khanal GN, Bharadwaj B, Upadhyay N, Bhattarai T, Dahal M, Khatri RB. Evaluation of the national health insurance program of Nepal: are political promises translated into actions?. *Health Res. Policy Syst.* 2023 Dec; 21(1): 1-26. DOI: 10.1186/s12961-022-00952-w
9. Thapa R, Bam K, Tiwari P, Sinha TK, Dahal S. Implementing federalism in the health system of Nepal: opportunities and challenges. *Int J Health Policy Manag.* 2019 Apr; 8(4): 195. DOI: 10.15171/ijhpm.2018.121
10. World Health Organization. Regional Office for South-East Asia. Monitoring progress on universal health coverage and the health-related sustainable development goals in the WHO South-East Asia Region: 2019 update. 2019. Available from: <https://apps.who.int/iris/handle/10665/326828>
11. Garha M. Health care in Nepal: An observational perspective. *J Nurs Educ Pract.* 2017; 7(1): 114-7. DOI: 10.5430/jnep.v7n1p114
12. Mendis S, Fukino K, Cameron A, Laing R, Filipe Jr A, Khatib O, et al. The availability and affordability of selected essential medicines for chronic diseases in six low-and middle-income countries. *Bull World Health Organ.* 2007 Apr; 85(4):279-88. DOI: 10.2471/blt.06.033647
13. Ewen M, Zweekhorst M, Regeer B, Laing R. Baseline assessment of WHO's target for both availability and affordability of essential medicines to treat non-communicable diseases. *PloS One.* 2017 Feb 7; 12(2): e0171284. DOI: 10.1371/journal.pone.0171284
14. Khadka S, Maharjan A, Bhardwaj M, Jha A, Bajracharya M, Lamichhane B. Adherence to anti-hypertensive medications among patients in selected health facilities of Nepal. *J Nepal Health Res Counc.* 2021 Apr 23; 19(1): 83-6. DOI: 10.33314/jnhrc.v19i1.1395
15. Shakya R, Shrestha S, Gautam R, Rai L, Maharjan S, Satyal GK, et al. Perceived illness and treatment adherence to hypertension among patients attending a tertiary hospital in Kathmandu, Nepal. *Patient Prefer Adherence.* 2020 Nov 20: 2287-300. DOI: 10.2147/PPA.S270786
16. Shrestha TM, Bhusal L, Raut S, Ghimire R, Shrestha P. Factors associated with non-adherence to antihypertensive medication among hypertensive patients in community. *Journal of Karnali Academy of Health Sciences.* 2019 Jun 6; 2(1). DOI: 10.2147/PPA.S238751
17. Hassanein M. Adherence to antihypertensive fixed-dose combination among Egyptian patients presenting with essential hypertension. *Egypt Heart J.* 2020 Dec; 72(1): 1-9. DOI: 10.1186/s43044-020-00044-6

18. Alsofyani MA, Aloufi AO, Al-Qhtani NS, Bamansour SO, Almathkori RS. Factors related to treatment adherence among hypertensive patients: A cross-sectional study in primary healthcare centers in Taif city. *J Family Community Med.* 2022 Sep 1; 29(3):181-8. DOI: 10.4103/jfcm.jfcm_153_22
19. Haga SB, Orlando LA. Expanding family health history to include family medication history. *J Pers Med* 2023 Feb 25; 13(3): 410. DOI: 10.3390/jpm13030410
20. Zhang Y, Li X, Mao L, Zhang M, Li K, Zheng Y, Cui W, et al. Factors affecting medication adherence in community-managed patients with hypertension based on the principal component analysis: Evidence from Xinjiang, China. *Patient Prefer Adherence.* 2018 May 11: 803-12. DOI: 10.2147/PPA.S158662
21. Shaw R, Bosworth HB. Baseline medication adherence and blood pressure in a 24-month longitudinal hypertension study. *J Clin Nurs.* 2012 May; 21(9-10): 1401-6. DOI: 10.1111/j.1365-2702.2011.03859.x
22. Green LW, Kreuter MW. *Health program planning: an educational and ecological approach.* 4 New York; 2005.
23. Lwanga SK, Lemeshow S, World Health Organization. *Sample size determination in health studies: A practical manual.* World Health Organization; 1991.
24. Kim MT, Hill MN, Bone LR, Levine DM. Development and testing of the hill-bone compliance to high blood pressure therapy scale. *Prog Cardiovasc Nurs.* 2000 Jun; 15(3): 90-6. DOI: 10.1111/j.1751-7117.2000.tb00211.x
25. Lambert EV, Steyn K, Stender S, Everage N, Fourie JM, Hill M. Cross-cultural validation of the hill-bone compliance to high blood pressure therapy scale in a South African, primary healthcare setting. *Ethnicity & Disease.* 2006; 16(1): 286-91.
26. Krathwohl DR. A revision of Bloom's taxonomy: An overview. *Theory into practice.* 2002 Nov 1; 41(4): 212-8. DOI: 10.1207/s15430421tip4104_2
27. McLaughlin CG, Wyszewianski L. Access to care: remembering old lessons. *Health services research.* 2002 Dec 1; 37(6): 1441-3. DOI: 10.1111/1475-6773.12171
28. Algabbani FM, Algabbani AM. Treatment adherence among patients with hypertension: findings from a cross-sectional study. *Clinical hypertension.* 2020 Dec; 26(1): 1-9. DOI: 10.1186/s40885-020-00151-1

29. Shi S, Shen Z, Duan Y, Ding S, Zhong Z. Association between medication literacy and medication adherence among patients with hypertension. *Front Pharmacol*. 2019 Jul 19; 10: 822. DOI: 10.3389/fphar.2019.00822
30. Hashmi SK, Afridi MB, Abbas K, Sajwani RA, Saleheen D, Frossard PM, et al. Factors associated with adherence to anti-hypertensive treatment in Pakistan. *PLOS ONE*. 2007 Mar 14; 2(3): e280. DOI: 10.1371/journal.pone.0000280
31. Khan MU, Shah S, Hameed T. Barriers to and determinants of medication adherence among hypertensive patients attended National Health Service Hospital, Sunderland. *J Pharm Bioallied Sci*. 2014 Apr 1; 6(2): 104. DOI: 10.4103/0975-7406.129175
32. Safford MM, Halanych JH, Lewis CE, Levine D, Houser S, Howard G. Understanding racial disparities in hypertension control. *Ethnicity & disease*. 2007 Jul 1; 17(3): 421-6. DOI: 10.1007/s11886-022-01826-x
33. Dong X, Tsang CC, Wan JY, Shih YC, Chisholm-Burns MA, Dagogo-Jack S, et al. Exploring racial and ethnic disparities in medication adherence among medicare comprehensive medication review recipients. *Explor Res Clin Soc Pharm*. 2021 Sep 1; 3: 100041. DOI: 10.1016/j.rcsop.2021.100041
34. Liu Q, Quan H, Chen G, Qian H, Khan N. Antihypertensive medication adherence and mortality according to ethnicity: A cohort study. *Can J Cardiol*. 2014 Aug 1; 30(8): 925-31. DOI: 10.1016/j.cjca.2014.04.017
35. Edward A, Campbell B, Manase F, Appel LJ. Patient and healthcare provider perspectives on adherence with antihypertensive medications: An exploratory qualitative study in Tanzania. *BMC Health Serv Res*. 2021 Dec; 21(1): 1-2. DOI: 10.2147/PPA.S328785
36. Thresia CU, Srinivas PN, Mohindra KS, Jagadeesan CK. The health of Indigenous populations in South Asia: A critical review in a critical time. *Int J Health Serv*. 2022 Jan; 52(1): 61-72. DOI: 10.1177/0020731420946588
37. Odusola AO, Hendriks M, Schultsz C, Bolarinwa OA, Akande T, Osibogun A, et al. Perceptions of inhibitors and facilitators for adhering to hypertension treatment among insured patients in rural Nigeria: a qualitative study. *BMC Health Serv Res*. 2014 Dec; 14(1): 1-6. DOI: 10.1186/s12913-014-0624-z
38. Lubaki JP, Mabuza L, Malete N, Ndimande JV, Maduna P. Reasons for non-compliance among patients with hypertension at Vanga Hospital, Bandundu Province, Democratic Republic of Congo: A qualitative study. *Afr J Prim Health Care Fam Med*. 2009 Jan 1; 1(1): 1-5. DOI: 10.4102/phcfm.v1i1.68

39. Wahyuni AS, Mukhtar Z, Pakpahan DJ, Guhtama MA, Diansyah R, Situmorang NZ, et al. Adherence to consuming medication for hypertension patients at primary health care in medan city. *Open Access Maced J Med Sci.* 2019 Oct 10;7 (20): 3483. DOI: 10.3889/oamjms.2019.683
40. Kumar Praveen N, Halesh L. Antihypertensive treatment: A study on correlates of non adherence in a tertiary care facility. *Int J Biol Med Res.* 2010; 1(4): 248-52.
41. Hareri HA, Gedefaw M, Simeng B. Assessment of prevalence and associated factors of adherence to anti-hypertensive agents among adults on follow up in Adama Referral hospital, East Shoa, Ethiopia-cross sectional study. *Int J Curr Microbiol Appl Sci.* 2014; 3(1): 760-0.
42. Rampamba EM, Meyer JC, Helberg E, Godman B. Medicines availability among hypertensive patients in primary health care facilities in a rural province in South Africa: Findings and implications. *J Res Pharm Pract.* 2020 Oct; 9(4): 181. DOI: 10.4103/jrpp.JRPP_20_49
43. Ramli A, Ahmad NS, Paraidathathu T. Medication adherence among hypertensive patients of primary health clinics in Malaysia. *Patient Prefer Adherence.* 2012 Aug 31: 613-22. DOI: 10.2147/PPA.S34704
44. Kang CD, Tsang PP, Li WT, Wang HH, Liu KQ, Griffiths SM, et al. Determinants of medication adherence and blood pressure control among hypertensive patients in Hong Kong: a cross-sectional study. *Int J Cardiol.* 2015 Mar 1; 182: 250-7. DOI: 10.1016/j.ijcard.2014.12.064
45. Dhimal M, Bista B, Bhattarai S, Dixit LP, Hyder MK, Agrawal N, et al. Report of non communicable disease risk factors: STEPS survey Nepal 2019. Kathmandu: Nepal Health Research Council. 2020.
46. Akuiyibo S, Anyanti J, Amoo B, Aizobu D, Idogho O. Effects of behaviour change communication on hypertension and diabetes related knowledge, attitude and practices in Imo and Kaduna States: A quasi-experimental study. *BMC Public Health.* 2022 Apr 11; 22(1): 715. DOI: 10.1186/s12889-022-13139-3
47. Attaei MW, Khatib R, McKee M, Lear S, Dagenais G, Igumbor EU, et al. Availability and affordability of blood pressure-lowering medicines and the effect on blood pressure control in high-income, middle-income, and low-income countries: An analysis of the PURE study data. *Lancet Public Health.* 2017 Sep 1; 2(9): e411-9. DOI: 10.1016/S2468-2667(17)30141-X

48. Ministry of Health and Population. Department of Drug Administration. National List of Essential Medicines Nepal Sixth Revision. Nepal: 2011. Available from:
<https://www.dda.gov.np/content/essential-drug-list>
49. Choudhry NK, Kronish IM, Vongpatanasin W, Ferdinand KC, Pavlik VN, Egan BM, et al. Medication adherence and blood pressure control: a scientific statement from the American Heart Association. *Hypertension*. 2022 Jan; 79(1): e1-4. DOI: 10.1161/HYP.000000000000203
50. Edward A, Campbell B, Manase F, Appel LJ. Patient and healthcare provider perspectives on adherence with antihypertensive medications: An exploratory qualitative study in Tanzania. *BMC Health Serv Res*. 2021 Dec; 21(1): 1-2.
51. Robinson JH, Callister LC, Berry JA, Dearing KA. Patient-centered care and adherence: Definitions and applications to improve outcomes. *J Am Acad Nurse Pract*. 2008 Dec; 20(12): 600-7. DOI: 10.1111/j.1745-7599.2008.00360.x