# Study on knowledge, awareness and medication adherence among hypertensive patients in Saudi Arabia

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## ABSTRACT

**Introduction: Hypertension, high blood pressure, is a prevalent non-communicable condition worldwide. Blood pressure control remains a challenge worldwide due to poor adherence to blood pressure treatments. Although hypertension is a predominant health burden in Saudi Arabia, affecting a significant percentage of adults.**

**Objectives: To evaluate knowledge, awareness, and medication adherence among patients with hypertension in Saudi Arabia.**

**Methods: A cross-sectional online survey study was conducted in Saudi Arabia in July 2024 to examine knowledge, awareness and medication adherence among hypertensive patients in Saudi Arabia. Logistic regression analysis was used to identify predictors of hypertension knowledge.**

**Results: A total of 391 patients were involved in this study. The mean adherence score for the patients was 7.5 (SD: 1.9); which reflects high adherence to hypertension medications. The most commonly reported reasons for non-adherence to hypertension medications were forgetfulness (24.0%; n= 94), adverse drug reactions (18.4%; n= 72), and worry about taking medicine ore are about concern about side effects of medicine (12.0%; n= 47). Binary logistic regression analysis identified that there is no statistically significant difference in patients' adherence to hypertension medications based on their sociodemographic characteristics (p>0.05).**

**Conclusion: In the current study, there was a high level of knowledge about their disease and adherence to medications noted in patients with hypertension. The three most commonly stated reasons for not adhering were not remembering to take the medication and side effects from medicine. Future research needs to focus on interventions that address forgetfulness and more tailored ways to reduce adverse drug reactions. Such practices oriented toward reminder systems, improvement in patient education, and support for mental health could therefore improve adherence toward hypertension medications by addressing some very key barriers elicited in this study.**

**Keywords: Adherence; Awareness; Hypertension; Knowledge; Saudi Arabia**

## INTRODUCTION

Hypertension, high blood pressure, is a prevalent non-communicable condition worldwide, influencing about 1.3 billion adults (30 to 79 years old) [1], and is one of the main risk factors for multiple severe health conditions, including chronic kidney disease, coronary artery disease, and stroke [2,3]. Numerous studies have referred to it as a silent killer to emphasize its severity [4]. Many risk factors can contribute to hypertension, including unmodifiable risk factors, such as age and family history, and modifiable risk factors, such as comorbidities (like kidney disease and diabetes), obesity, alcohol consumption, smoking, physical inactivity, and unhealthy diet [1,5]. Globally, the high prevalence of hypertension is attributed to many of these factors, including excessive salt intake, consumption of alcohol, obesity, sedentary lifestyle, urbanization, and aging [6]. In Saudi Arabia, obesity, unhealthy diets, and lifestyle changes result in increased hypertension prevalence [7], with approximately 25% of adults having hypertension. Furthermore, it is considered one of the principal reasons for adult mortality and morbidity in Saudi Arabia [8-10].

Uncontrolled hypertension can result in numerous life-threatening and severe complications, including brain, kidney, and heart disorders, which typically leave patients disabled [11,12]. One of the most frequent causes of hypertension treatment failure is non-adhering to hypertension treatment [13]. Studies have proven the effectiveness of pharmacological and non-pharmacological treatment in achieving excellent blood pressure control [14], which is associated with long-term health effects [15,16]. Thus, to achieve excellent blood control, it is crucial to adhere to hypertension treatment (pharmacological and non-pharmacological) [17-19].

Blood pressure control remains a challenge worldwide due to poor adherence to blood pressure treatments [20]. Considering that hypertension can progress and raise mortality and morbidity, non-adherence to hypertension treatment results in a considerable financial strain on the healthcare system and patients [21]. Hence, increasing financial strains and unfavorable health consequences could be avoided by enhancing patients' adherence to treatment [22]. Although hypertension is a predominant health burden in Saudi Arabia, affecting a significant percentage of adults [23], studies on hypertension medication adherence and knowledge are still deficient in Saudi Arabia [24], which may increase the load on the healthcare system in the region [7,25]. Therefore, our study aimed to evaluate knowledge, awareness, and medication adherence among patients with hypertension in Saudi Arabia.

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## METHOIDS

### Study design

A cross-sectional online survey study was conducted in Saudi Arabia in July 2024 to examine knowledge, awareness and medication adherence among hypertensive patients in Saudi Arabia.

### Sampling strategy and study population

Eligible participants were identified through the convenient sampling technique, and afterwards, the eligible individuals were invited to take part in this study. Invitations for participation in this study were extended to as many people as possible through the use of social media platforms such as Facebook, WhatsApp, Twitter, and Instagram. Each participant gave informed consent on a purely voluntary basis and was informed that completing the survey is considered as written consent. At the start of the survey, the aims and objectives of the study were clearly explained in detail to the subjects. Inclusion criteria included those participants with a diagnosed condition of hypertension who were at least 18 years old and currently resident in Saudi Arabia. Participants aged below 18 years or unable to read or understand Arabic were excluded.

### Study tool

This study utilized previously developed questionnaire tool by Pirasath et al [26]. The original questionnaire tool comprised of 12-items that examined participants' knowledge of hypertension. For each correct answer the participants were given a score of one, with a maximum attainable score of 12, the higher the higher the level of knowledge. A score of >10, 6–10 and <6 is considered as high, moderate and low level of knowledge and awareness, respectively. Besides, patients' adherence was examined using a previously developed tool which consisted of eight- items of yes/no format [26,27]. The score for the scale range within low (<6), medium (6 to <8) and high (8) adherence. Higher scores indicate poor adherence. All patients who answered yes for at least one question were considered as nonadherent. Furthermore, we examined reasons for non-adherence to antihypertensive medications. In addition, this questionnaire tool asked the participants about their demographic characteristics including gender, age, education level, employment status, monthly income, and smoking status.

### Ethical approval

This research was approved by the Institutional Review Board at Al-Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia (Project number: 669/2024).

### Statistical analysis

All statistical analyses were done using SPSS, version 29. Descriptive statistics were used to describe the demographic features of participants in the study. Continuous data for normally distributed variables were presented as mean ± SD. The categorical data were presented as percentages, with frequencies. Odds ratio and 95% confidence intervals for the predictors that are more likely to result in knowledge about hypertension were determined using logistic regression. The cut-off for logistic regression was based on the mean knowledge score of the study participants.

## RESULTS

Table 1 below presents Patients' demographic characteristics. A total of 391 patients were involved in this study. The majority of them were males (70.8%; n= 277). More than half of them (59.1%; n= 231) were aged 41-60 years and have bachelor degree (63.4%; n= 241). Around 38.0% of them were working in the governmental sector. Around one-third the patients (32.0%; n= 125) reported that their monthly income category was above 15000 SAR. The majority of the patients (78.0%; n= 305) reported that they are non-smokers.

**Table 1.** Patients demographic characteristics

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Males | 277 | 70.8% |
| **Age categories** | | |
| 18-20 years | 4 | 1.0% |
| 21-40 years | 80 | 20.5% |
| 41-60 years | 231 | 59.1% |
| 61-80 years | 71 | 18.2% |
| 81 years and older | 5 | 1.3% |
| **Education level** (n= 380) | | |
| Primary school or lower | 6 | 1.6% |
| Intermediary school | 7 | 1.8% |
| Secondary school | 16 | 4.2% |
| Diploma | 110 | 28.9% |
| Bachelor degree | 241 | 63.4% |
| **Employment status** | | |
| Unemployed | 96 | 24.6% |
| Governmental sector employee | 148 | 37.9% |
| Private sector employee | 57 | 14.6% |
| Others | 90 | 23.0% |
| **Monthly income categories** | | |
| Less than 5000 SAR | 91 | 23.3% |
| 5001-10000 SAR | 75 | 19.2% |
| 10001-15000 SAR | 100 | 25.6% |
| 15001 SAR and above | 125 | 32.0% |
| **Smoking status** | | |
| Non-smoker | 305 | 78.0% |
| 1-5 times a day | 22 | 5.6% |
| 6-10 times a day | 19 | 4.9% |
| More than 10 times a day | 45 | 11.5% |

### Patients' knowledge of hypertension

Overall, the percentage of right answers for hypertension knowledge questions were high and ranged between 85.7% (n= 335) and 100.0% (n= 391). All patients correctly identified that more salt consumption increases blood pressure. The least correctly identified question was that eating fatty foods is a risk factor for hypertension (85.7%; n= 335), Table 2.

**Table 2. Percentage of patients with correct answer**

| Number | Question | Frequency (percentage) |
|---|---|---|
| 1 | The normal values of blood pressure as 120/80mmHg? | 380 (97.2%) |
| 2 | Blood pressure >140/90mmg is called hypertension? | 372 (95.1%) |
| 3 | Hypertension which can progress along with the age? | 332 (84.9%) |
| 4 | Both men and women have equal chance of developing hypertension? | 262 (67.0%) |
| 5 | Hypertension is a treatable condition? | 287 (73.4%) |
| 6 | Members of family have risk developing of hypertension if family history of hypertension is present? | 359 (91.8%) |

| | | |
|---|---|---|
| 7 | Older persons have greater risk of having hypertension? | 362 (92.6%) |
| 8 | Smoking is a risk factor for hypertension? | 355 (90.8%) |
| 9 | Eating fatty foods is a risk factor for hypertension? | 335 (85.7%) |
| 10 | Overweight is a risk factor for hypertension? | 372 (95.1%) |
| 11 | Regular physical exercise has lowering the chance of developing hypertension? | 379 (96.9%) |
| 12 | More salt consumption increases blood pressure? | 391 (100.0%) |

## Patients' awareness of hypertension

Table 3 below presents patients' answers for awareness of hypertension questions. The vast majority of the patients were aware that they are diagnosed with hypertension (95.9%; n= 375). Around 40.0% (n= 155) of the patients reported that their blood pressure measurement was 150-160 / 90-95 mmHg when they were diagnosed. The majority of the patients (74.9%; n= 293) reported that their blood pressure reading should be 120-130 / 75-80 mmHg. The vast majority of the patients confirmed that control of blood pressure reduces the complications (99.0%; n= 387) and uncontrolled hypertension can lead to your organ damage (95.1%; n= 372). Around 34.0% (n= 133) of the patients reported that blood pressure reading at their most recent visit was 130-140 / 80-85 mmHg; of which 57.5% (n= 225) believe that this reading is normal.

Around 58.3% (n= 228) regard high blood pressure to be a very serious concern to their personal health. As much as 89.8% (n= 351) of all those responding definitely believe that taking medicines is very important to have the blood pressure under control. To the statement "High blood pressure can be cured", 45.3% (n= 177) believed it to be true. The majority 94.1% (n= 368) of all those responding do agree that changing lifestyle can definitely lower blood pressure. Finally, 67.3% (n= 263) of the patients feel that their blood pressure is better than it was over the last 12 months.

**Table 3.** Patients' awareness of hypertension

| Number | Question | Frequency (percentage) |
|---|---|---|
| 1 | Do you know that you have hypertension? | 375 (95.9%) |
| 2 | Do you know the blood pressure values when you diagnosed as hypertension? | |
| | 120-130 / 75-80 | 19 (4.9%) |
| | 130-140 / 80-85 | 48 (12.3%) |
| | 140-150 / 85-90 | 116 (29.7%) |
| | 150-160 / 90-95 | 155 (39.6%) |
| | I don't know | 53 (13.6%) |
| 3 | Do you know what your personal blood pressure reading should be? | |
| | 120-130 / 75-80 | 293 (74.9%) |
| | 130-140 / 80-85 | 48 (12.3%) |
| | 140-150 / 85-90 | 5 (1.3%) |
| | 150-160 / 90-95 | 6 (1.5%) |
| | I don't know | 39 (10.0%) |
| 4 | Control of blood pressure reduces the complications? (Yes) | 387 (99.0%) |
| 5 | Uncontrolled hypertension can lead to your organ damage? (Yes) | 372 (95.1%) |
| 6 | Do you know your blood pressure level at your most recent visit? | |
| | 120-130 / 75-80 | 132 (33.8%) |
| | 130-140 / 80-85 | 133 (34.0%) |
| | 140-150 / 85-90 | 61 (15.6%) |
| | 150-160 / 90-95 | 34 (8.7%) |
| | I don't know | 31 (7.9%) |
| 7 | What did you think this blood pressure level was? | |
| | Normal | 225 (57.5%) |
| | High | 146 (37.3%) |
| | Low | 11 (2.8%) |
| | I don't know | 9 (2.3%) |
| 8 | How serious of a personal health concern has high blood pressure been? | |
| | Very serious | 228 (58.3%) |
| | Serious | 128 (32.7%) |
| | No serious | 35 (9.0%) |
| 9 | How important do you think taking medicine is to keeping blood pressure under control? | |
| | Very important | 351 (89.8%) |
| | Important | 40 (10.2%) |
| | Not important | 0 (0.0%) |
| 10 | Do you think that high blood pressure (hypertension) is something you can cure? | |
| | Yes | 177 (45.3%) |
| | No | 109 (27.9%) |
| | I don't know | 105 (26.9%) |
| 11 | Can changing lifestyle help to lower your blood pressure? | |
| | Yes | 368 (94.1%) |
| | No | 8 (2.0%) |
| | I don't know | 15 (3.8%) |
| 12 | Do you think your blood pressure has improved over the last 12 months? | |
| | Yes | 263 (67.3%) |
| | No | 69 (17.6%) |
| | I don't know | 59 (15.1%) |

## Patients' drug adherence of hypertension medications

The mean adherence score for the patients was 7.5 (SD: 1.9); which reflects high adherence to hypertension medications. More than half of the patients (52.7%; n= 206) reported that they have never had difficulty remembering to take all their medications. The most commonly agreed upon statement the demonstrates patients' adherence was that they took their medicine yesterday (91.8%; n= 359). The least commonly agreed upon statement the demonstrates patients' adherence was that they forget to take medication while leaving out of home (79.3%; n= 310), Table 4.

**Table 4.** Patients adherence to hypertension medications

| Number | Question | Frequency (percentage answer no) |
|---|---|---|
| 1 | Do you sometimes forget to take your drugs? | 273 (69.8%) |
| 2 | Did you forget to take your drugs over last two weeks? | 338 (86.4%) |
| 3 | Do you stop medication own-self after feeling of discomfort with drugs/adverse effects? | 348 (89.0%) |
| 4 | Do you forget to take medication while leaving out of home? | 310 (79.3%) |

| | | |
|---|---|---|
| 5 | Did you take your medicine yesterday? (Yes) | 359 (91.8%) |
| 6 | Do you stop your drugs own-self with thinking good blood pressure control? | 338 (86.4%) |
| 7 | Do you feel any discomfort to take drugs daily? | Frequency (percentage) |
| 8 | How often do you have difficulty remembering to take all your medicine? | |
| | Rarely | 124 (31.7%) |
| | Once a while | 30 (7.7%) |
| | Sometimes | 31 (7.9%) |
| | Never | 206 (52.7%) |

Around 45.0% of the patients (n= 176) were found to have high level of adherence based on their adherence score (a score of 8 and above). Besides, around 30.7% (n= 120) of the patients were found to have poor adherence level, Table 5.

**Table 5.** Classification of patients' adherence to hypertension medications

| Number | Adherence category | Frequency (percentage) |
|---|---|---|
| 1 | Poor adherence (less than 6) | 120 (30.7%) |
| 2 | Medium adherence (6-8) | 95 (24.3%) |
| 3 | High adherence (above 8) | 176 (45.0%) |

### Reasons for non-adherence to hypertension medications

The most commonly reported reasons for non-adherence to hypertension medications were forgetfulness (24.0%; n= 94), adverse drug reactions (18.4%; n= 72), and worry about taking medicine ore are about concern about side effects of medicine (12.0%; n= 47), Table 6.

**Table 6.** Reasons for non-adherence to hypertension medications

| Number | Question | Frequency (percentage) |
|---|---|---|
| 1 | Forgetfulness | 94 (24.0%) |
| 2 | Adverse drug reactions | 72 (18.4%) |
| 3 | Worry about taking medicine ore are about concern about side effects of medicine | 47 (12.0%) |
| 4 | Poor knowledge of disease and ignorance of long term treatment | 41 (10.5%) |
| 5 | Too many medications to take | 36 (9.2%) |
| 6 | Religious beliefs and cultural practices | 33 (8.4%) |
| 7 | Interruptions of daily routine | 31 (7.9%) |
| 8 | Was way on weekend/vacation | 19 (4.9%) |
| 9 | Patient does not believe health depends on medicine | 18 (4.6%) |
| 10 | Drug out of supply | 17 (4.3%) |
| 11 | Expenses (Doctors, transportation, medicine, and hospitalization) | 17 (4.3%) |
| 12 | Poor communication with physician/ insufficient patient information/education | 16 (4.1%) |
| 13 | Taking medications wrong time | 15 (3.8%) |

### Predictors of high adherence for hypertension medications

Binary logistic regression analysis identified that there is no statistically significant difference in patients' adherence to hypertension medications based on their sociodemographic characteristics (p>0.05), Table 7.

**Table 7.** Predictors of high adherence for hypertension medications

| Variable | Odds ratio (95% confidence interval) | P-value |
|---|---|---|
| **Gender** | | |
| Females (Reference group) | 1.00 | |
| Males | 1.31 (0.84-2.04) | 0.235 |
| **Age categories** | | |
| 18-20 years (Reference group) | 1.00 | |
| 21-40 years | 1.44 (0.14-14.57) | 0.755 |
| 41-60 years | 3.03 (0.31-29.52) | 0.341 |
| 61-80 years | 2.20 (0.22-22.15) | 0.505 |
| 81 years and older | 4.50 (0.25-80.57) | 0.307 |
| **Education level** | | |
| Primary school or lower (Reference group) | 1.00 | |
| Intermediary school | 0.83 (0.04-17.00) | 0.906 |
| Secondary school | 5.00 (0.47-52.96) | 0.181 |
| Diploma | 4.32 (0.49-38.21) | 0.188 |
| Bachelor degree | 4.13 (0.48-35.87) | 0.199 |
| **Employment status** | | |
| Unemployed (Reference group) | 1.00 | |
| Governmental sector employee | 1.38 (0.82-2.31) | 0.224 |
| Private sector employee | 0.91 (0.47-1.77) | 0.775 |
| Others | 0.94 (0.52-1.68) | 0.825 |
| **Monthly income categories** | | |
| Less than 5000 SAR (Reference group) | 1.00 | |
| 5001-10000 SAR | 0.76 (0.40-1.45) | 0.408 |
| 10001-15000 SAR | 1.59 (0.90-2.83) | 0.114 |
| 15001 SAR and above | 1.60 (0.93-2.77) | 0.091 |
| **Smoking status** | | |
| Non-smoker (Reference group) | 1.00 | |
| 1-5 times a day | 1.62 (0.68-3.85) | 0.280 |
| 6-10 times a day | 1.50 (0.59-3.79) | 0.395 |
| More than 10 times a day | 1.54 (0.82-2.88) | 0.179 |

SAR: Saudi Arabia riyal

## DISCUSSION

This study presents detailed information on the awareness, knowledge, and medication adherence among hypertension patients in Saudi Arabia. Patients with hypertension usually have difficulty fully comprehending their disorder due to changes in lifestyle, non-drug therapy, adverse drug reaction concerns, the coexistence of other medical disorders, and limited knowledge [28-30]. Understanding knowledge and information can influence patient adherence to treatment [31]. Moreover, inadequate adherence to blood pressure-lowering medications is associated with poor blood pressure control, mortality, and morbidity [32]. Enhancing awareness and knowledge of hypertension, earlier detection, appropriate management, and treatment significantly decrease the death rate resulting from cardiovascular disorders [33-36].

In our study, the percentage of accurate answers for hypertension knowledge questions was high, ranging between 85.7% (n= 335) and 100.0% (n= 391). All patients correctly identified that more salt consumption increases blood pressure. The least correctly identified question was that eating fatty foods is a risk factor for hypertension (85.7%; n= 335). The vast majority of the patients were aware that they were diagnosed with hypertension (95.9%; n= 375). The vast majority of the patients confirmed that control of blood pressure reduces complications (99.0%; n= 387), and uncontrolled hypertension

can lead to organ damage (95.1%; n= 372). Moreover, most patients (74.9%; n= 293) reported that their blood pressure reading should be 120-130 / 75-80 mmHg. These findings highlight high levels of awareness and knowledge among our participants about hypertension diagnosis, suitable diet, complications, and the goal of blood pressure. Still, enhancing levels of awareness and knowledge about the risks of eating fatty foods and the goal of blood pressure could improve their understanding and aid in improving their health outcomes. A prior study indicates that enhancing hypertension-related knowledge and awareness may assist in decreasing mortality rates [37].

Compared to previous studies among hypertensive patients in Saudi Arabia, our participants have higher levels of hypertension knowledge and awareness. For instance, in the Qassim region, 58.4% of participants had an average (moderate) level of hypertension knowledge [38], and 58.1% of participants from seven cities in Saudi Arabia had poor hypertension knowledge [31]. In the Jazan region, a prior study demonstrated insufficient hypertension management knowledge among most patients, where the least knowledge was related to complications, drug adherence, hypertension definition, medical treatment, and diet [39]. Similarly, in Jeddah, in King Abdulaziz University Hospital, 62% of patients had poor levels of hypertension knowledge and only 12% had good knowledge about medication adherence, hypertension definition, diet, and non-pharmaceutical therapy [40].

On a global scale, studies have shown a variety of hypertension knowledge levels. In a tertiary care center in Northern Sri Lanka, most of the hypertensive patients (69.9%) had sufficient hypertension knowledge, while only 48.2% of the hypertensive patients understood hypertension-related organ damage [27]. Likewise, in a tertiary care center in Eastern Sri Lanka, most hypertension patients had moderate to high knowledge about hypertension [26]. In Georgia, most patients had adequate overall hypertension knowledge, while their awareness regarding certain hypertension-associated factors was less [41]. Hypertension patients in Greece were reported to have good hypertension knowledge [42]. Most hypertension patients in North Indian hospitals [43] and 54.7% in a single-center study in Poland [44] had good hypertension knowledge. Furthermore, in a tertiary care setting in Pakistan, hypertension knowledge was moderate, while lifestyle change therapy was misperceived [45]. Still, other prior studies in India [46], Pakistan [47], and Poland reported insufficient hypertension knowledge among most hypertension patients [48].

Our study showed higher levels of awareness and knowledge about hypertension compared to previous studies among hypertensive patients in Saudi Arabia and other countries. These could be attributed to several factors, including educational level; most patients in our study had a high academic level. Consistent with these, previous research in Eastern Sri Lanka has documented significant associations between education levels and awareness and knowledge about hypertension [26]. Therefore, enforcing practical educational programs and interventions can improve hypertension-related understanding and knowledge in Saudi Arabia and other countries.

Our study found that around 58.3% (n= 228) regard high blood pressure as a very serious concern to their health. These concerning findings indicate about 41.7% of participants underestimate the seriousness of hypertension, considering that hypertension is one of the primary risk factors for multiple severe health conditions and is associated with increased mortality risk [2,3,49]. Besides, as much as 89.8% (n= 351) of all those responding believe that taking medicines is very important to control blood pressure. Most respondents (94.1% (n= 368)) agree that changing lifestyle can lower blood pressure. These positive findings are consistent with hypertension guidelines and recommendations, indicating high awareness about hypertension treatment among our participants. As for the statement "High blood pressure can be cured", 45.3% (n= 177) believed it to be true. Likewise, most hypertension patients in India believe that hypertension is curable [46]. These emphasize that misconceptions about hypertension treatment are common. Hypertension treatment leads to controlling blood pressure, not curing it [50]. Therefore, it is imperative to address misconceptions through patient consulting and education.

In our study, the mean adherence score for the patients was 7.5 (SD: 1.9), which reflects high adherence to hypertension medications. More than half of the patients (52.7%; n= 206) reported never having difficulty remembering to take all their medications. Besides, around 45.0% of the patients (n= 176) were found to have a high level of adherence based on their adherence score. These results are considered positive because medication adherence is essential for effective control of hypertension.

Prior studies in Saudi Arabia found comparable results; 66.7% of participants from seven cities in Saudi Arabia had moderate medication adherence levels, while 7.6% had good levels [31]. Aligned with our findings, 51.3% of participants in the Qassim region [38] and 42.2% of patients in the Riyadh region [51] had high adherence levels, and participants in the Hail region had sufficient adherence levels [52]. However, only 36.3% of participants who attended primary centers in the Abha region had high medication adherence levels [53].

At international levels, levels of adherence vary even more. For example, most patients in Sweden (87.3%) [54] and tertiary care centers in Eastern Sri Lanka (58.8%) [26] had good medication adherence levels. These are higher than the adherence levels we observed. On the other hand, adherence levels were low or moderately low in multiple prior studies, specifically among patients in Georgia [41], Greece [42], and India [46], in a tertiary care setting in Pakistan [45], and a tertiary care center in Northern Sri Lanka [27].

These differences in adherence to hypertension treatment underscore the need for and importance of designing interventions based on the different challenges, barriers, and constraints that each population group may face. Evidence from previous research proves that low adherence to hypertension treatment is challenged, prevalent, and associated with treatment failure [55-57]. Thus, improving patients' education, responsible communication with healthcare professionals, and handling worries about side effects could raise adherence levels among patients with low adherence rates. Such strategies could also result in effective treatment for hypertension.

Our study demonstrates that the most commonly reported reasons for non-adherence to hypertension medications were forgetfulness (24.0%; n= 94), adverse drug reactions (18.4%; n= 72), and worry about taking medicine ore are about concern about side effects of medicine (12.0%; n= 47). Constant with our findings, forgetfulness was reported as the primary reason for hypertension medication non-adherence among hypertension patients from Ghana [58], Cameroon [59], North India [43], and tertiary care centers in Pakistan [45], Eastern Sri Lanka [26], and Northern Sri Lanka [27]. These emphasize forgetfulness as a global challenge to adherence to hypertension medications. Consequently, it is necessary to address the challenge of forgetfulness via a targeted approach, such as using an alarm for medication reminders, which has been shown to enhance medication adherence [60-62].

Regarding findings of non-adherence due to adverse drug reactions and concern about side effects of medicine, that could be because hypertension patients frequently face multiple drug intolerance syndrome [63]. Previous studies have also found that among the main

factors leading to non-adherence to treatment in patients with hypertension are side effects of medications [59], in addition to financial constraints and multiple daily doses of medications [26,59]. There is a need to handle these adherence barriers. Studies have shown the effectiveness of many interventions in improving patient adherence, such as enhancing patient education and counseling to reduce medication misconceptions [64,65].

In our study, binary logistic regression analysis identified that there is no statistically significant difference in patients' adherence to hypertension medications based on their sociodemographic characteristics ($p>0.05$). These findings contrast with findings from previous studies. For instance, in Abha, sociodemographic factors (including marriage, living in rural areas, income, and age) were significantly associated with poor adherence to hypertension medications [53]. Similarly, sociodemographic factors were associated with non-adherence to hypertension medications among patients in Sweden [54]. Additionally, other studies found differences in patients' adherence to hypertension medications based on clinical situations and awareness about the disorder. In Qassim and Riyadh, better adherence was associated with hypertension awareness [38,51]. Besides, in Riyadh, patients with comorbidities were reported to be at higher non-adherence risk [51]. Regardless of the significant association between non-adherence and specific clinical and sociodemographic characteristics, these characteristics are inadequate to predict adherence levels accurately [66]. Finally, the only practical clinical strategy for measuring adherence statuses is to evaluate it directly via patient consultations or utilize resources like records from the pharmacy [67,68].

This study has limitations. The cross-sectional online survey study design restricted the generalisability of the study findings and the ability to examine causality among the study variables. We are unable to estimate the number of participants who were invited to participate in the study as we used an online survey, therefore, we are unable to estimate the response rate for the study. The generalisability of our study findings might have been affected due to the use of online survey (for example the majority of the participants were males). Therefore, our study findings should be interpreted carefully.

## CONCLUSION

**In this study, hypertension patients demonstrated high level of knowledge of their disease and adherence to their medications. The most common reasons for non-adherence were forgetfulness, adverse drug reactions, and worry about taking medicine ore are about concern about side effects of medicine. Future research needs to focus on interventions that address forgetfulness and more tailored ways to reduce adverse drug reactions. Practices oriented toward reminder systems, patient education improvement, and mental health support, therefore, have the potential to improve adherence toward hypertension medications by addressing some of the most important barriers elucidated from this study.**

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