Medical Science

Level of antihypertensive medication adherence and knowledge about the disease in Saudi Arabia

Authors' Affiliation:
[1]Assistant professor, consultant of cardiology, Cardiology department, Imam Mohammad Ibn Saud Islamic University (IMSIU), Saudi Arabia
[2]College of Medicine, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia

[*]**Corresponding author**
College of Medicine, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh,
Saudi Arabia
Email: aamalhumaidan95@sm.imamu.edu.sa

Mohammad Rediny Alshammri[1], **Abdulmalk Almadhi**[2], **Abdullah Bin Shulhub**[2], **Renad Alsahli**[2], **Almaha Alhumaidan**[2*]

ABSTRACT

Introduction: The adherence level to antihypertensive medication is a neglected topic in academic research in Saudi Arabia; however, there are a number of international studies that shed light on the level of patient adherence to medication. *Aim:* This study aimed to determine patients' knowledge and medication adherence among hypertensive patients. *Patients and methods:* This is a cross-sectional study conducted among hypertensive patients in Saudi Arabia. An Arabic translation for a self-administered questionnaire was distributed among patients with hypertension (HTN). *Results:* 698 hypertensive patients took part in the study (59.2% females, 40.8% males). The incidence of patients with hypertensive complications was 39.4%. The mean knowledge score was 47.9% (SD 21.4) while the overall mean adherence score was 75.4 (SD 16.5). Factors associated with increased score of knowledge and adherence were age group >45 years, female gender, being unemployed, earning more than 10,000 SAR monthly, being a non-smoker, diagnosed with HTN for 5 years or more, and regular doctor visits. *Conclusion:* The patient's compliance with HTN medication is good, but the understanding of their own disease is poor.

Keywords: Hypertension, adherence, knowledge, HK-LS, HB-HBP, HTN

1. INTRODUCTION

Hypertension is the most prevalent cardiovascular disease in the world, and according to the World Health Organization (WHO), it affects 1.28 billion adults aged 30-79 around the globe (WHO, 2021). In Saudi Arabia, non-communicable diseases account for (73%) of mortality, and cardiovascular disease is responsible for (37%) of the mortalities (WHO, 2019). Less than half (42%) of adults with hypertension are diagnosed and treated, and approximately only 1 in 5 adults (21%) have their hypertension under control (WHO, 2021). With this, a challenge emerges for healthcare practitioners, as many studies have showed an overall poor adherence to antihypertensive

DISCOVERY
SCIENTIFIC SOCIETY

medications (Zhou et al., 2021; Vrijens et al., 2017). The poor adherence rates for pharmacological therapy against hypertension poses a serious threat to health, as it's known that hypertension is a well-recognized risk factor for stroke and cardiovascular morbidity and mortality as well as many other complications that can affect nearly every organ in the human body (Strandgaard, 1996; Kjeldsen, 2018).

According to the burden of disease study, hypertension is the leading factor for disability-adjusted life year's worldwide (Lim et al., 2012). With its importance, the adherence level to antihypertensive medication is a neglected topic in the academic research In Saudi Arabia, but there is quite several global and international studies that shed light on the level of patient's adherence to medication and the impact of knowledge on adherence (Laila & Nidal, 2017).

In this study, we aim to determine the level of medication adherence and the impact of knowledge on adherence, as well as the role of demographics in medication adherence, using both the Hill-Bone High Blood Pressure (HB-HBP) scale and Hypertension Knowledge-Level Scale (HK-LS).

2. MATERIAL AND METHODS

This is a cross-sectional descriptive comparative study aiming to determine patients' knowledge and medication adherence among hypertensive patients. A validated Arabic questionnaire was obtained (Laila & Nidal, 2017). The questionnaire focuses on providing basic demographic information in addition to two scales. The first scale is the Hill-Bone Compliance to High Blood Pressure Therapy (HBC) which assesses the level of adherence to HTR. The second scale is the Hypertension Knowledge-Level (HK-L) Scale which assesses individuals' level of knowledge of hypertension. The inclusion criteria were participants of at least 18 years of age and current residents of Saudi Arabia. Participants who are younger than 18, not permanent residents or didn't complete the questionnaire were excluded. Written informed consent was obtained from all participants. The study was conducted on hypertensive patients in Riyadh, Saudi Arabia, over a period of 4 months starting from January 2022 until April 2022. Population sample sizes were calculated using EPI (Epidemiological Information Package) INFO version 7.2. According to the software, the required sample size is at least 385 participants, the margin of error is ±5%, the confidence level is 95%, and the expected frequency is 50%. Community-based sampling procedures are not possible due to COVID-19 precautions. Therefore, the questionnaires were distributed to five regions of Saudi Arabia (Central, Eastern, Southern, Northern and Western regions) through social media platforms.

Hill-Bone High Blood Pressure (HB-HBP) scale

There are two Hill-Bone Scales. The original scale is the Hill-Bone Compliance to High Blood Pressure Therapy Scale (HB-HBP) is a 14-item scale that assesses patient behaviors for three important behavioral domains of high blood pressure treatment, this scale consists of three subscales: (1) reduced-sodium intake, (2) appointment keeping, and (3) medication taking. Each item is a four-point Likert type scale (1 = all of the time, 2 = most of the time, 3 = some of the time, 4 = none of the time. The maximum and minimum scores are 56 and 14 respectively for all items. The maximum scores for medication adherence, sodium intake and appointment keeping subscales are 36, 12, and 8, respectively (Hopkins et al., 2021). Moreover, this brief questionnaire provides a simple method for clinicians in various settings to assess patients' self-reported adherence and to plan appropriate interventions. Consent to use the questionnaire was obtained through the original Hill-Bone website (Kim et al., 2000; 2007; Lambert et al., 2006).

Hypertension Knowledge-Level Scale (HK-LS)

The Hypertension Knowledge-Level (HK-L) Scale was utilized to determine individuals' knowledge level of hypertension. It consists of a 22- item self-report scale that measures six sub-dimensions of hypertension knowledge (definition, management, medication compliance, lifestyle, diet, and complications). Moreover, it was generated based on content, face, and construct validity, internal consistency, test-retest reliability, and discriminative validity procedures (Raja et al., 2021). Patients responded with "correct," "incorrect," or "don't know" for each item; the maximum viable score is 22. The total score can be demonstrated as marks out of 100, in which a higher mark indicates a greater level of knowledge (Baliz et al., 2012).

Statistical analysis

The Hypertension Knowledge-Level (HK-L) Scale was utilized to assess individuals' level of knowledge of hypertension. To assess individuals' knowledge level of hypertension, we used the Hypertension Knowledge-Level (HK-L) Scale, this tool has good levels of face, content, and construct validity, as well as high internal consistency reliability (Baliz et al., 2012). The total score was converted to 100%, with a higher mark indicating a higher level of knowledge (Baliz et al., 2012). To determine the level of

knowledge we used the Polish version of the Hypertension Knowledge-Level Scale (HK-LS). According to the asymmetrical answer distribution (Jankowska et al., 2016), the group was divided into two subgroups depending on the score: ≤55% score points – low level of knowledge on hypertension and >55% score point's high level of knowledge on hypertension.

Categorical variables were presented as numbers and percentages (%) while continuous variables were summarized as mean and standard deviation. The total scores of the knowledge and medication adherence were compared to the socio-demographic and clinical characteristics of the patients by using Mann Whitney Z-test. Normality tests were conducted using Shapiro Wilk, Kolmogorov and Smirnov tests. The knowledge and adherence scores follow the abnormal distribution. Thus, non-parametric tests were applied. Pearson correlation coefficient was also carried out to determine the correlation between the HK-LS dimensions and the total score of HB-HBP. Two-tailed analyses with $p<0.05$ or $p<0.01$ were used as the cutoff for statistical significance or highly statistical significance. All data analyses were performed using the statistical package for social sciences, version 26 (SPSS, Armonk, NY: IBM Corp, USA).

3. RESULTS

A total of 698 hypertensive patients were recruited. Table 1 described the socio-demographic characteristics of the patients. The most common age group was 46 – 60 years old (35.4%) with nearly 60% being females. Patients who were living in the Northern region constituted 29.8% and patients who were married were 62.8%. With respect to education, half of them (50%) were bachelor's degrees and 41.8% were employed. With respect to monthly income, 36.7% were earning less than 5,000 SAR a month. The proportion of patients who were following educational medical programs and accounts on television or social media programs was 65.6%. The majorities were non-smokers (73.5%) and only 8% were smoking for more than 10 years.

Table 1 Socio-demographic characteristics of hypertensive patients [(n=698)]

Study Data	N (%)
Age group	
18 – 25 years	188 (26.9%)
26 – 45 years	179 (25.6%)
46 – 60 years	247 (35.4%)
>60 years	84 (12.0%)
Gender	
Male	285 (40.8%)
Female	413 (59.2%)
Residence region	
Central Region	142 (20.3%)
Eastern Region	173 (24.8%)
Southern Region	44 (06.3%)
Northern Region	208 (29.8%)
Western Region	131 (18.8%)
Marital status	
Single	220 (31.5%)
Married	438 (62.8%)
Divorced	40 (05.7%)
Educational level	
High school	207 (29.7%)
Diploma	68 (09.7%)
Bachelor's degree	349 (50.0%)
Postgraduate education	74 (10.6%)
Occupation	
Student	157 (22.5%)
Employed	292 (41.8%)
Unemployed	119 (17.0%)
Retired	130 (18.6%)

Monthly income (SAR)	
<5,000	256 (36.7%)
5,000 – 10,000	162 (23.2%)
10,0001 – 20,000	183 (26.2%)
>20,000	97 (13.9%)
Following educational medical programs and accounts on television or social media programs	
Yes	458 (65.6%)
No	240 (34.4%)
Smoking status	
Non-smoker	513 (73.5%)
Ex-smoker	79 (11.3%)
Smoking for less than 5 years	30 (04.3%)
Smoking for 5 to 10 years	20 (02.9%)
Smoking for more than 10 years	56 (08.0%)

Regarding the clinical characteristics of hypertensive patients (Table 2), nearly two-thirds (64.9%) had HTN duration of fewer than 5 years while 67.6% were using HTN medication for a similar duration. Approximately 62.3% of them were taking medication once per day. The proportion of patients who were having a regular exercise for at least 3 times a week was 47.7%. A family history of HTN was found among 66.2%. The most commonly known source of medication was primary health centers or government hospitals (51.3%). The prevalence of patients who experienced complications due to HTN was 39.4%.

Table 2 Clinical characteristics of the hypertensive patients [(n=698)]

Variables	N (%)
Duration of hypertension	
<5 years	453 (64.9%)
≥5 years	245 (35.1%)
Duration of medication use for hypertension	
<5 years	472 (67.6%)
≥5 years	226 (32.4%)
Number of medications per day	
One	435 (62.3%)
Two	206 (29.5%)
Three or more	57 (08.2%)
Regular exercise at least 3 times a week	
Yes	333 (47.7%)
No	365 (52.3%)
Family history of hypertension	
Yes	462 (66.2%)
No	236 (33.8%)
Regular doctor visit	
Yes	458 (65.6%)
No	240 (34.4%)
Medication source	
Health insurance	179 (25.6%)
Primary health centers or government hospitals	358 (51.3%)
Personal expenses	161 (23.1%)
Experienced complications due to hypertension	
Yes	275 (39.4%)
No	423 (60.6%)

The descriptive statistics of HK-LS and HB-HBP were given in Table 3. Regarding HK-LS dimensions, the mean values of complication score, lifestyle score, medical treatment score, diet score, drug compliance score, and definition score were 3.31. 2.29, 1.66, 1.29, 1.11, and 0.89, respectively, and the total knowledge mean percentage score was 47.9 (SD 21.4%). Regarding HB-HBP, the mean values of reducing sodium intake score, appointment keeping score, and medication-taking score were 8.58, 5.83, and 27.8, respectively whereas the overall mean medication percentage score was 75.4 (SD 16.5).

Table 3 Descriptive statistics of Hypertension Knowledge level scale (HK-LS) and Hill-Bone HBP Compliance to High Blood Pressure Therapy Scale (HB-HBP) (n=698)

HK-LS dimensions	Mean ± SD
Complications score	3.31 ± 1.93
Lifestyle score	2.29 ± 1.36
Medical treatment score	1.66 ± 1.01
Diet score	1.29 ± 0.83
Drug compliance score	1.11 ± 0.89
Definition score	0.89 ± 0.82
% Total knowledge score	47.9 ± 21.4
HB-HBP subscales	
Reducing sodium intake score	8.58 ± 2.26
Appointment keeping score	5.83 ± 1.48
Medication taking score	27.8 ± 6.84
% Total medication adherence score	75.4 ± 16.5

Figure 1 showed the histogram of the percentage of total HK-LS score. It can be observed there was an asymmetrical answer distribution as seen in the figure. Using a 55% score as a cutoff point in determining the level of knowledge, we found that 58.9% of the patients were considered a low level of knowledge, and 41.1% were classified as having a high knowledge level. In Figure 2, the level of adherence to HTN was poor, moderate, and good among 35.5%, 18.2% and 46.3%, respectively.
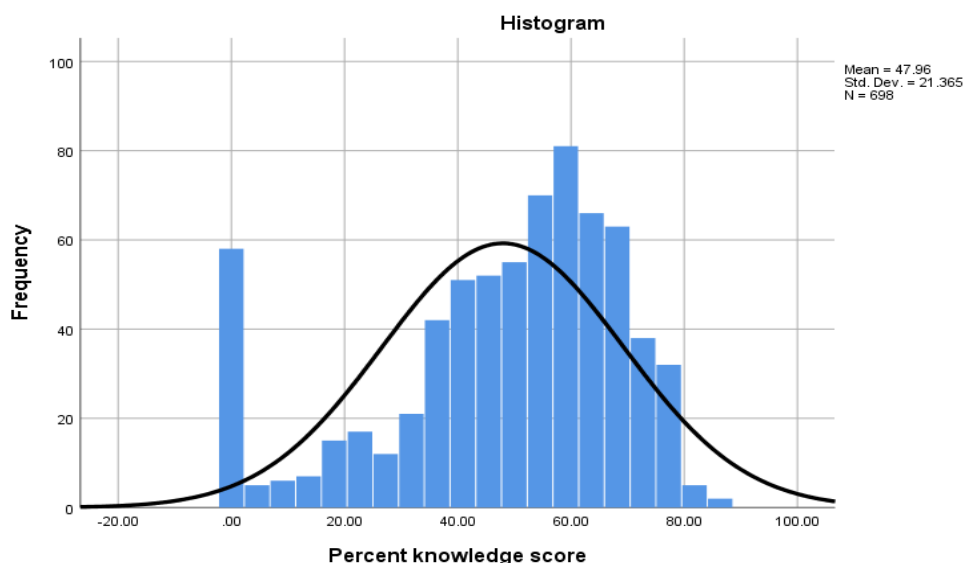

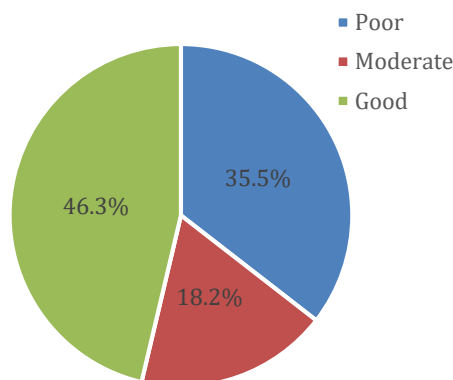**Figure 1** Histogram of hypertension knowledge score

Figure 2 Level of Adherence to hypertension medication

We also measured the correlation between the overall score of HB-HBP and the HK-LS dimensions. It can be observed that there was a positive correlation between the HB-HBP score according to lifestyle score (r=0.172), diet score (r=0.269), complication score (r=0.230), and the total knowledge score (r=0.224) (Table 4). Indicating that the increase in the overall score of HBP-HBP is correlated with the increase in the score of the overall knowledge along with 3 knowledge domains such as lifestyle score, diet score, and complications score.

Table 4 Correlation (Pearson-r) between HK-LS dimension scores and total HB-HBP score [(n=698)]

HK-LS dimensions	% Total HB-HBP score	
	R-value	P-value
Definition score	0.073	0.054
Medical treatment score	0.056	0.136
Drug compliance score	0.041	0.282
Lifestyle score	0.172	<0.001
Diet score	0.269	<0.001
Complications score	0.230	<0.001
% Total knowledge score	0.224	<0.001

When measuring the differences in the scores of the knowledge and medication adherence in relation to the socio-demographic and clinical characteristics of the patients with HTN, it was found that higher knowledge score was more associated with increasing age (Z=3.758; p<0.001), female gender (Z=2.410; p=0.016), being married (Z=5.357; p<0.001), being more educated (Z=3.097; p=0.002), higher monthly income (Z=4.666; p<0.001), following educational medical programs (Z=2.742; p=0.006), being a non-smoker (Z=2.210; p=0.034), having diagnosed with HTN for 5 years or more (Z=2.556; p=0.011), taking HTN medication for 5 years or more (Z=2.258; p=0.024), family history of HTN (Z=3.717; p<0.001) and regular visit with the doctor (Z=2.281; p=0.023). On the other hand, a higher adherence score was more associated with increasing age (Z=6.677; p<0.001), gender female (Z=2.351; p=0.019), being married (Z=6.933; p<0.001), being unemployed (Z=6.021; p<0.001), earning more than 10,000 SAR per month (Z=4.428; p<0.001), being a non-smoker (Z=3.753; p<0.001), having diagnosed with HTN for 5 years or more (Z=5.036; p<0.001), taking HTN medication for 5 years or more (Z=4.970; p<0.001), regular doctor visit (Z=5.332; p<0.001) and experience complications due to HTN (Z=2.460; p=0.014) (Table 5).

Table 5 Differences in the scores of the knowledge and medication adherence in relation to the Socio-demographic and clinical characteristics of the hypertensive patients [(n=609)]

Factor	Knowledge Score (100) Mean ± SD	Z-test; P-value [§]	Adherence Score (100) Mean ± SD	Z-test; P-value [§]
Age group				
≤45 years	45.7 ± 21.1	3.758;	71.2 ± 17.5	6.677;
>45 years	50.5 ± 21.4	<0.001	80.0 ± 13.9	<0.001
Gender				
Male	45.3 ± 22.7	2.410;	73.9 ± 15.8	2.351;
Female	49.8 ± 20.2	0.016	76.4 ± 16.9	0.019
Marital status				
Unmarried	42.9 ± 21.6	5.357;	69.7 ± 17.2	6.933;
Married	50.9 ± 20.7	<0.001	78.8 ± 15.1	<0.001
Educational level				
Diploma or below	44.7 ± 22.5	3.097;	74.6 ± 16.8	1.034;
Bachelor or higher	50.1 ± 20.4	0.002	75.9 ± 16.3	0.301
Occupation				
Employed/Student	47.2 ± 21.4	1.661;	72.6 ± 16.8	6.021;
Unemployed	49.4 ± 21.2	0.097	80.4 ± 14.8	<0.001
Monthly income (SAR)				
≤10,000	44.8 ± 22.3	4.666;	73.2 ± 16.7	4.428;
>10,000	52.7 ± 18.9	<0.001	78.7 ± 15.6	<0.001
Following educational medical programs				
Yes	49.8 ± 20.1	2.742;	75.3 ± 16.9	0.044;
No	44.4 ± 23.2	0.006	75.7 ± 15.6	0.965
Smoking status				
Smoker/Ex-smoker	44.8 ± 22.8	2.120; 0.034	71.9 ± 15.7	3.753; <0.001
Non-smoker	49.1 ± 20.7		76.7 ± 16.6	
Duration of hypertension				
<5 years	47.1 ± 20.3	2.556;	73.2 ± 16.7	5.036;
≥5 years	49.5 ± 23.1	0.011	79.6 ± 15.4	<0.001
Duration of medication use for hypertension				
<5 years	47.3 ± 20.3	2.258;	73.4 ± 16.4	4.970;
≥5 years	49.3 ± 23.3	0.024	79.6 ± 15.9	<0.001
Regular exercise at least 3 times a week				
Yes	47.9 ± 21.6	0.119;	74.6 ± 16.7	1.185;
No	48.0 ± 21.2	0.905	76.1 ± 16.3	0.236
Family history of hypertension				
Yes	50.4 ± 19.6	3.717;	75.6 ± 16.6	0.560;
No	43.2 ± 23.7	<0.001	75.0 ± 16.3	0.575
Regular doctor visit				
Yes	49.0 ± 21.4	2.281;	77.4 ± 17.1	5.332;
No	45.9 ± 21.3	0.023	71.7 ± 14.6	<0.001
Experienced complications due to hypertension				
Yes	47.3 ± 22.9	0.019; 0.985	73.7 ± 16.6	2.460; 0.014
No	48.4 ± 20.3		76.6 ± 16.3	

[§] P-value has been calculated using Mann Whitney Z-test.

4. DISCUSSION

The present study attempted to evaluate the level of knowledge and adherence of hypertensive patients toward therapeutic regimens. The knowledge of the patients' regarding hypertension was inadequate. Nearly 60 percent appeared to have a low knowledge level and the rest (41.1%) were considered as high knowledge. According to HK-LS criteria, the overall mean knowledge score was 47.9 (SD 21.4) with the smallest proportion of correct answers was found in the HTN definition domain (mean: 0.89), followed by the drug compliance domain (mean: 1.11) while the highest proportion was found in complications domain (mean: 3.31) and lifestyle domain (mean: 2.29). Consistent with these findings, Jankowska et al., (2016), reported that, out of 233 patients diagnosed with arterial hypertension (AH), 63% of them had a low level of knowledge regarding their disease with the lowest number of correct answers given for items related to non-pharmaceutical treatment, diet, HTN definition, and drug compliance.

Similarly, Alzahrani et al., (2019), also documented a poor knowledge of hypertensive patients toward the disease with 58.1% of the exhibited unsatisfactory knowledge. Contrary to these reports, a study conducted in Sri Lanka (Pirasath et al., 2017), showed that 69.9% of the patients with hypertension demonstrated adequate knowledge, however, 40.5% were unaware of the status of their disease. This has been concurred by Paczkowska et al., (2021) who reported that while most patients have sufficient general knowledge about HTN, however, 77% were unaware of their systolic blood pressure at the time of diagnosis and 75% exhibited the same at the last visit to their physician. The lack of knowledge about the disease could play a big factor in the treatment outcome of the disease. Thus, healthcare professionals should exert efforts to fill the gaps in patients' lack of information about their disease.

According to our data, there have been multiple predictors of increased knowledge being identified including older age group, gender female, being married, being more educated, higher income, following educational medical programs, being a non-smoker, 5 years or more HTN duration, and treatment medication, a family history of HTN, and regular doctor visit. In Poland (Paczkowska et al., 2021), a study finds that the level of education and the place of receiving medical care were significantly associated with the extent of knowledge about HTN, and a good knowledge level was concomitant with having controlled blood pressure, a number of antihypertensive drugs used, frequency of hospitalization as well as with medication adherence and healthy lifestyle behavior while age, BMI, place of residence as well as the duration of the disease did not significantly influence patient's level of knowledge. The recognition of the knowledge factors being established here could help our healthcare practitioners in filling the knowledge gaps. Educating patients who perceived their knowledge as inadequate would achieve better patient satisfaction and therapeutic adherence and ultimately improved quality of life.

Regarding medication adherence, according to the HB-HBP scale, the overall mean adherence score was 75.4 (SD 16.5) with 46.3% classified as good adherence, 18.2% were moderate and 35.5% were classified as poor adherence. Higher adherence to HTN medication had also been reported by Al-Dakeh and Eshah (2017). Based on their accounts, 82.8% reported having good adherence to medication (HB-HBP mean score: 87.3) which was higher than our report. Contrary to these reports, several papers documented poor medication adherence (Pirasath et al., 2017; Gavrilova et al., 2019; Verulava & Mikiashvii, 2021). Poor knowledge about the disease, complex therapy, dissatisfaction with healthcare service, high cost, daily routine that prevents from taking medication continuously at the proper time, and forgetfulness had been cited as the most common reasons for poor compliance (Barreto et al., 2014; Verulava & Mikiashvii, 2021).

While there were several predictors of increased knowledge, this was also mirrored with adherence. Multiple factors for increased adherence had been noted including gender female, being married, being unemployed, a higher monthly income, being a non-smoker, longer duration of HTN as well as its treatment, regular follow up, and experienced complications due to HTN. These findings are almost similar to that of Al-Dakeh and Eshah (2017), which reported that adherence scores were significantly higher among women, with less education, unemployed patients, those with comorbidities, those with a negative family history of HTN, and those who visited their physicians regularly. They also noted that good adherence to HTN was predicted by greater knowledge about HTN and regularly visiting a physician. Similarly, in a paper published by Gavrilova et al., (2019), they found out that older patients tend to be more adherent than the younger patients and they have learned that the longer a patient was known to suffer from HTN, the better adherent he or she is. These assumptions were supported by our study as we found older age groups, as well as longer duration of HTN, were predicted to increase their adherence to HTN medication.

Conversely, a study suggests that increased knowledge is associated with increased medication adherence (Jankowska et al., 2016). This is also true in our study as we discovered that the adherence score was positively correlated with the overall knowledge score as well as with knowledge domains including lifestyle score, diet score, and complication score. Contradicting these findings, Saleem et al., (2019), documented that the correlation between the knowledge score and the total adherence score was inverse, and

suggesting that the increase in the score of knowledge will negatively affect the adherence score. They further concluded that the patients were unsure of the benefits of continuous medication use which results in patients' non-adherence to regimens.

5. CONCLUSION

Although the patient's adherence to HTN medication was adequate, however, their understanding of their disease was deficient. Better knowledge and adherence were demonstrated by female patients who were married with a better income and who regularly visited their doctor. Healthcare providers had a vital role to make sure that hypertensive patients understood their disease and were aware of the importance of adherence to pharmacology. More research is needed to determine the level of knowledge and adherence to medication among hypertensive patients in our region.

Authors' Contributions

All authors participated in the research and/or preparation of the manuscript. AbdulmalkAlmadhi and AlmahaAlhumaidan participated in the study design and collected and processed the samples. Abdullah Bin Shulhubwrote the first draft of the manuscript. Mohammad Alshammri and RenadAlsahli performed the statistical analyses. The final manuscript was read and approved by all authors.

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study.

Ethics Approval

All of the research process steps were written in this study. Ethical approval number of the article is 184\2022 (Date: 15\2\2022), was provided by the Ethics Committee of Imam Mohammad Ibn Saud Islamic University Institutional Review Board.

Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Al-daken LI, Eshah NF. Self-reported adherence to therapeutic regimens among patients with hypertension. Clin Exp Hypertens 2017; 39:3, 264-270 doi: 10.1080/10641963.2016.1247164

2. Al-Daken LI, Eshah NF. Self-reported adherence to therapeutic regimens among patients with hypertension. Clin Exp Hypertens 2017; 3;39(3):264-70 doi: 10.1080/10641963.2016.1247164

3. Alzahrani S, Alosaimi ME, Alamri AA, Alotaibi M, Almatar EA, Almanea BA, Aljabar SA, Alomar AS, Alzahrani AH, Al-Hindi ME, Al-Shams AA, Alamri SS, Alkhoudair AN, Alnofaily MM. Association between Knowledge and Drug Adherence in Patients with Hypertension in Saudi Arabia. Arch Pharm Pract 2019; 10(3): 71-6

4. Barreto MD, Reiners AA, Marcon SS. Knowledge about hypertension and factors associated with the non-adherence to drug therapy. Rev Lat Am Enfermagem 2014; 22:491-898 doi:10.1590/0104-1169.3447.2442

5. Erkoc SB, Isikli B, Metintas S, Kalyoncu C. Hypertension Knowledge-Level Scale (HK-LS): a study on development, validity and reliability. Int J Environ Res Public Health 2012; 9(3): 1018–1029 doi:10.3390/ijerph9031018

6. Gavrilova A, Bandere D, Rutkovska I, Šmits D, Mauriņa B, Poplavska E, Urtāne I. Knowledge about disease, medication therapy, and related medication adherence

levels among patients with hypertension. Medicina 2019; 55(11): 715 doi:10.3390/medicina55110715

7. Jankowska-Polańska B, Uchmanowicz I, Dudek K, Mazur G. Relationship between patients' knowledge and medication adherence among patients with hypertension. Patient Prefer Adher 2016; 10: 2437–2447 doi:10.2147/PPA.S117269

8. Kim EY, Han HR, Jeong S, Kim KB, Park H, Kang E, Shin HS, Kim MT. Does knowledge matter?: intentional medication nonadherence among middle-aged Korean Americans with high blood pressure. J Cardiovasc Nurs 2007; 22(5):397-404 doi: 10.1097/01.JCN.0000287038.23186.bd.

9. 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; 15(3):90-96 doi:10.1111/j.1751-7117.2000.tb00211.x

10. Kjeldsen SE. Hypertension and cardiovascular risk: General aspects. Pharmacol Res 2018; 129: 95–99 doi:10.1016/j.phrs.2017.11.003

11. 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. Ethn Dis 2006; 16(1):286-91

12. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, Amann M, Anderson HR, Andrews KG, Aryee M, Atkinson C, Bacchus LJ, Bahalim AN, Balakrishnan K, Balmes J, Barker-Collo S, Baxter A, Bell ML, Blore JD, Blyth F, Memish ZA. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012; 380(9859): 2224–2260 doi:10.1016/S0140-6736(12)61766-8

13. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet 2021; 398(10304): 957–980 doi: 10.1016/S0140-6736(21)01330-1

14. Paczkowska A, Hoffmann K, Kus K, Kopciuch D, Zaprutko T, Ratajczak P, Michalak M, Nowakowska E, Bryl W. Impact of patient knowledge on hypertension treatment adherence and efficacy: A single-centre study in Poland. Int J Med Sci 2021; 18(3):852 doi:10.7150/ijms.48139

15. Pirasath S, Kumanan T, Guruparan M. A study on knowledge, awareness, and medication adherence in patients with hypertension from a tertiary care centre from northern Sri Lanka. Int J Hypertens 2017; 9656450 doi: 10.1155/2017/9656450

16. Raja W, Ayub T, Jeelani A, Khan SMS. Adherence to antihypertensive therapy and its determinants among patients attending primary care hospitals of Kashmir, India. J Fam Med Prim Care 2021; 10(11): 4153–4159 doi:10.4103/jfmpc.jfmpc_668_21

17. Strandgaard S. Hypertension and stroke. Int J Hypertens 1996; 14(3): S23–S27 doi:10.1097/00004872-199610003-00005

18. Tan CS, Hassali MA, Neoh CF, Saleem F. A qualitative exploration of hypertensive patients' perception towards quality use of medication and hypertension management at the community level. Pharm Pract 2017; 15(4): 1074 doi: 10.18549/PharmPract.2017.04.1074

19. Verulava T, Mikiashvili G. Knowledge, awareness, attitude and medication compliance in patients with hypertension. Arter Hypertens 2021; 25(3):119-26 doi: 10.5603/AH.a2021.0021

20. Vrijens, B, Antoniou, S, Burnier M, de la Sierra A, Volpe M. Current Situation of Medication Adherence in Hypertension. Front pharmacol 2017; 8: 100 doi:10.3389/fphar.2017.00100