



## **Age-Related Prescribing Patterns of Antihypertensive Medications**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author NJA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MAM and ZSA managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Introduction:** Hypertension is the most common modifiable risk factor for cardiovascular diseases, renal failure, and stroke. Previous studies showed that prescription patterns of antihypertensive drugs varied by gender.

**Aim:** This is a retrospective study that was conducted to describe the difference in prescribing antihypertensive drugs according to patients' age.

**Methodology:** In this study, the electronic prescriptions of hypertensive patients that were dispensed from the outpatient pharmacy of a public hospital in Alkharj were revised.

**Results:** Generally, older patients are using antihypertensive drugs more than younger adults and their usage pattern of antihypertensive drugs is different according to age.

**Conclusion:** It is important to know the age-related prescribing patterns of antihypertensive drugs and to know the efficacy and safety of these agents in different patients in order to develop an evidence-based and age-appropriate antihypertensive pharmacotherapy.

**Keywords:** Age-related; antihypertensive; prescribing; pattern.

## 1. INTRODUCTION

Hypertension is the most common modifiable risk factor for cardiovascular diseases, renal failure, and stroke [1]. Clinical evidence suggests that lowering blood pressure with antihypertensive medications decreases the risk of stroke, end-stage renal diseases, heart failure, revascularization procedures, and myocardial infarction in hypertensive patients [2].

The increasing prevalence of hypertension has been attributed to population growth, behavioral risk factors (such as unhealthy diet, excess use of alcohol, sedentary lifestyle, and obesity), exposure to persistent stress, and aging [3]. Around 9.4 million deaths occur globally every year because of hypertension [3], with it being responsible for approximately 50% of deaths due to heart disease and stroke [4].

There are several pharmacological classes of antihypertensive drugs that are used to treat hypertension including beta-blockers, angiotensin-converting enzyme inhibitors, angiotensin II receptor antagonists, diuretics, centrally acting agents, renin inhibitors, alpha-adrenergic receptor blockers, direct-acting vasodilators, and calcium channel blockers [5].

Previous studies have identified increased use of antihypertensive drugs to coincide with increased control over blood pressure both in older and younger populations and also with decreased cardiovascular mortality, myocardial infarction, and stroke rates [6-8].

Advancing age is characterized by impairment of numerous regulatory processes that provide functional integration between cells and organs. Moreover, numerous pharmacokinetic and pharmacodynamic changes occur with advancing age [9]. The pharmacokinetic changes include an increase in the volume of distribution of lipid-soluble drugs and as a result this leads to the prolongation of elimination half-life [9]. Moreover, pharmacokinetic changes include a reduction in renal and hepatic clearance [9]. The pharmacodynamic changes involve altered sensitivity to many classes of drugs such as cardiovascular drugs [9].

Al Khaja *et al* reported that significant age- and gender-related differences in prescribing patterns were seen at a primary health care centers in

Bahrain [10]. Gu *et al.* reported that there were differences in antihypertensive drug use patterns between older and younger patient groups [11]. Additionally, a previous study reported that prescription patterns varied by gender, clinical facilities, and age [12]. Therefore, this study aimed to describe the difference in antihypertensive medications prescribing patterns according to age.

## 2. METHODOLOGY

This is a retrospective study that was conducted to describe the patterns in prescribing antihypertensive drugs according to patients' age. In this study, the electronic prescriptions of hypertensive patients that were dispensed from the outpatient pharmacy of a King Khalid Hospital in Al-Kharj were reviewed.

Inclusion criteria included all hypertensive prescriptions for patients diagnosed with hypertension from January to December 2018 and dispensed by outpatient pharmacy. Prescriptions of patients who had other diseases and didn't have hypertension were excluded. Moreover, the prescriptions that were dispensed by other setting such as inpatient were excluded.

Excel software was used to analyze the data and after that, the data were represented as frequencies and percentages.

The data in the present study included the age of patients, the prescribed antihypertensive classes, and the difference of prescribing antihypertensive drugs according to age.

## 3. RESULTS AND DISCUSSION

Among the 1838 patients receiving antihypertensive medications, the age of the majority of these patients was more than 49 years old (71.70%) (Table 1).

Borzecki *et al.* reported that patients more than 50 years accounted for 90.7% of hypertensive patients [13]. Similarly, Gu *et al.* reported that the percentage of hypertensive patients aged 50 to 59 years was high and that the average age of the hypertensive populations were 59.6 years [14].

The most commonly prescribed antihypertensive class was calcium channel blockers (CCBs) (27.86%) followed by diuretics (21.16%) (Table 2).

In contrast to the results of the present study, Kim *et al* reported that Angiotensin receptors blockers were the most frequently prescribed drug (51.6%) [15]. Liu and Wang reported that calcium channel blockers and beta-blockers were the most frequently prescribed antihypertensive drugs [12]. Wallenius *et al.* reported that prescribing diuretics and beta blocking agents depended on the patient's age but ACE inhibitors and calcium channel blockers were prescribed with no relation to age. Furthermore, Wallenius *et al.* reported that the prescribing of diuretics increased with age and that the use of beta-blocking agents increased until 65 years and then decreased [16].

Patients more than 39 years old used mainly CCBs; more than 89% of patients more than 39 years old use one of the CCBs medications. Regarding diuretics, more than 80% of the patients were more than 49 years old used (Table 3).

In the present study adult, less than 30 years use BBs mainly. Kim *et al.* reported that patients who are less than 20 years of age use ACEIs and BBs more frequently [15]. In contrast to the present study, Pittrow *et al.* reported that ACEIs

were the most prescribed antihypertensive class for the patient more than 60 years of age and that beta-blockers were the most prescribed for patients less than 60 years of age [17].

Liu and Wang stated that patients aged over 55 years were treated with CCBs more often than younger patients, with beta-blockers, ACE inhibitors, and ARBs being more frequently prescribed among younger patients [12].

The most commonly prescribed antihypertensive drug was amlodipine (25.30%) followed by bisoprolol (13.98%) (Table 4). Antihypertensive drugs were prescribed mainly for patients more than 39 years old; for example, 90.53% of amlodipine prescriptions and 90.66% of bisoprolol prescriptions were for patients more than 39 years old (Table 5).

In the present study, amlodipine was the most prescribed calcium channel blockers, bisoprolol was the most commonly prescribed beta-blockers, furosemide was the most commonly prescribed diuretics, Lisinopril was the most commonly prescribed ACE inhibitors and valsartan was the most commonly prescribed Angiotensin receptors blockers.

**Table 1. Age of patients**

Age, years	Number	Percentage
Less than 30	53	2.88%
30-39	121	6.58%
40-49	346	18.82%
50-59	470	25.57%
60-69	459	24.97%
70 or more	389	21.16%

**Table 2. The prescribed antihypertensive classes in the outpatient setting in 2018**

Antihypertensive class	n (%)
Calcium channel blockers (CCBs)	512 (27.86%)
Diuretics	389 (21.16%)
Angiotensin-converting enzyme inhibitors (ACEIs)	370 (20.13%)
Beta-blockers (BBs)	343 (18.66%)
Angiotensin receptors blockers (ARBs)	202 (10.99%)
Others	22 (1.20%)

**Table 3. The difference in prescribing different antihypertensive classes according to age**

Medication	Less than 30	30-39	40-49	50-59	60-69	70 or more
CCBs	16 (3.12)	37 (7.23)	110 (21.48)	131 (25.59)	114 (22.27)	104 (20.31)
BBs	11 (3.21)	27 (7.87)	72 (20.99)	79 (23.03)	88 (25.66)	66 (19.24)
Diuretics	11 (2.82)	10 (2.57)	56 (14.40)	101 (25.96)	105 (27.00)	106 (27.25)
ACEIs	8 (2.16)	24 (6.48)	60 (16.22)	99 (26.76)	96 (25.95)	83 (22.43)
ARBs	5 (2.48)	10 (4.95)	44(21.78)	58 (28.71)	56 (27.72)	29 (14.36)
Others	2 (9.09)	13 (59.09)	4 (18.18)	2 (9.09)	0 (0.00)	1(4.55)

**Table 4. The prescribed antihypertensive drugs in the outpatient setting in 2018**

Medication	n (%)
Amlodipine	465 (25.30%)
Bisoprolol	257 (13.98%)
Furosemide	180 (9.79%)
Lisinopril	147 (8.00%)
Captopril	135 (7.34%)
Indapamide	105 (5.71%)
Telmisartan	75 (4.08%)
Enalapril	67 (3.64)
Valsartan	64 (3.48%)
Hydrochlorothiazide	56 (3.16%)
Spironolactone	48 (2.61%)
Olmesartan	37 (2.01%)
Metoprolol	36 (1.96%)
Nifedipine	35 (1.90%)
Perindopril	21 (1.14%)
Atenolol	18 (0.98%)
Methyldopa	17 (0.92%)
Propranolol	16 (0.87%)
Carvedilol	16 (0.87%)
Irbesartan	16 (0.87%)
Losartan	10 (0.54%)
Diltiazem	7 (0.38%)
Hydralazine	5 (0.27%)
Verapamil	5 (0.27%)
Total	1838

**Table 5. The difference in prescribing different antihypertensive drugs according to age**

Medication	Less than 30	30-39	40-49	50-59	60-69	70 or more
Amlodipine	11(2.37)	33 (7.10)	107 (23.01)	123 (26.45)	101(21.72)	90 (19.35)
Bisoprolol	7 (2.72)	170(6.61)	59 (22.96)	65 (25.29)	67 (26.07)	42 (16.34)
Furosemide	6 (3.33)	3 (1.66)	22 (12.22)	46 (25.56)	48 (26.67)	55 (30.56)
Lisinopril	3 (2.04)	9 (6.12)	27 (18.37)	39 (26.53)	41(27.89)	28 (19.05)
Captopril	3 (2.22)	8 (5.92)	25 (18.52)	43 (31.85)	29 (21.48)	27 (20.00)
Indapamide	1 (0.95)	2 (1.90)	22 (20.95)	30 (28.57)	29 (27.62)	21 (20.00)
Telmisartan	3 (4.00)	5 (6.67)	15 (20.00)	26 (34.67)	13 (17.33)	13 (17.33)
Enalapril	1 (1.50)	4 (5.97)	4 (5.97)	14 (20.90)	23 (34.33)	21 (31.35)
Valsartan	1 (1.55)	2 (3.13)	10 (15.63)	15 (23.44)	25 (39.06)	11 (17.19)
Hydroch lorothiazide	2 (3.57)	4 (7.14)	8 (14.29)	12 (21.43)	17 (30.36)	13 (23.21)
Spironolactone	2 (4.17)	1 (2.08)	4 (8.33)	13 (27.08)	11 (22.92)	17 (35.42)
Olmesartan	1 (2.70)	3 (8.11)	7 (18.92)	14 (37.84)	10 (27.03)	2 (5.40)
Metoprolol	0 (0.00)	0 (0.00)	8 (22.22)	8 (22.22)	8 (22.22)	12 (33.33)
Nifedipine	5 (14.29)	3 (8.57)	1 (2.86)	4 (11.43)	13 (37.14)	9 (25.71)
Perindopril	1 (4.76)	3 (14.29)	4 (19.04)	3 (14.29)	3 (14.29)	7 (33.33)
Atenolol	0 (0.00)	3 (16.67)	2 (11.11)	3 (16.67)	3 (16.67)	7 (38.88)
Methyldopa	2 (11.76)	11 (64.71)	4 (23.53)	0 (0.00)	0 (0.00)	0 (0.00)
Propranolol	3 (18.75)	5 (31.25)	2 (12.5)	2 (12.5)	3 (18.75)	1(6.25)
Carvedilol	1 (6.25)	2 (12.5)	1 (6.25)	1 (6.25)	7 (43.75)	4 (25.00)
Irbesartan	0 (0.00)	0 (0.00)	8 (50.00)	2 (12.50)	4 (25.00)	2 (12.50)
Losartan	0 (0.00)	0 (0.00)	4 (40.00)	1 (10.00)	4 (40.00)	1 (10.00)
Diltiazem	0 (0.00)	0 (0.00)	1 (14.28)	1 (14.28)	0(0.00)	5 (71.43)
Hydralazine	0 (0.00)	2 (40.00)	0 (0.00)	2 (40.00)	0 (0.00)	1 (20.00)
Verapamil	0 (0.00)	1 (20.00)	1 (20.00)	3 (60.00)	0 (0.00)	0 (0.00)
Total	53 (2.88)	121 (6.58)	346 (18.83)	470 (25.57)	459 (24.97)	389 (21.16)

Gu et al. stated that diuretics (predominantly thiazide diuretics) were the most commonly prescribed antihypertensive drug class and that beta-blockers and angiotensin receptor blocker were among the most commonly prescribed antihypertensive agents [11]. In contradiction to the present results, Al Khaja et al. reported that beta-blockers were the most frequently prescribed antihypertensive and that atenolol was mainly used, for diuretics indapamide was mainly used, for ACE inhibitors captopril was mainly used and for calcium channel blockers nifedipine was mainly used [10].

#### 4. CONCLUSION

It can be concluded that older patients are using antihypertensive drugs more than younger adults and that there is a difference in usage pattern of antihypertensive drugs according to age.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

This study was approved by the IRB ethical committees with IRB log No: 2019-0153E.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Go AS, Mozaffarian D, Roger VL. Heart disease and stroke statistics—2014 update. *Circulation*. 2013;129(3):e28–292.
2. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J et al. Evidence-Based guideline for the management of high blood pressure in adults. *JAMA*. 2014;311(5):507-520.
3. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H et al. 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. *The Lancet*. 2012;380(9859):2224-2260.
4. World Health Organization. Causes of Death 2008; Accessed 11 OCT 2012. Available: [http://www.who.int/healthinfo/global\\_burden\\_disease/cod\\_2008\\_sources\\_methods.pdf](http://www.who.int/healthinfo/global_burden_disease/cod_2008_sources_methods.pdf).
5. Laurent S. Antihypertensive drugs. *Pharmacol Res*. 2017;124:116-125.
6. Gu Q, Burt VL, Dillon CF, Yoon S. Trends in antihypertensive medication use and blood pressure control among United States adults with hypertension: The national health and nutrition examination survey, 2001 to 2010. *Circulation*. 2012;126(17):2105–2114.
7. Guo F, He D, Zhang W, Walton RG. Trends in prevalence, awareness, management, and control of hypertension among United States adults, 1999 to 2010. *J Am Coll Cardiol*. 2012;60(7):599–606.
8. Egan BM, Zhao Y, Axon RN. US trends in prevalence, awareness, treatment, and control of hypertension, 1988-2008. *JAMA*. 2010;303(20):2043-2050.
9. Mangoni AA, Jackson SH. Age-related changes in pharmacokinetics and pharmacodynamics: Basic principles and practical applications. *Br J Clin Pharmacol*. 2004;57(1):6-14.
10. Jassim al Khaja KA, Sequeira RP, Abdul Wahab AWM, Mathur VS. Antihypertensive drug prescription trends at the primary health care centres in Bahrain. *Pharmacoepidemiol Drug Saf*. 2001; 10(3):219-227.
11. Gu A, Yue Y, Argulian E. Age differences in treatment and control of hypertension in us physician offices, 2003-2010: A serial cross-sectional study. *Am J Med*. 2016; 129(1):50-58.
12. Liu P, Wang J. Antihypertensive medication prescription patterns and time trends for newly-diagnosed uncomplicated hypertension patients in Taiwan. *BMC Health Serv Res*. 2008;8:133.
13. Borzecki AM, Glickman ME, Kader B, Berlowitz DR. The effect of age on hypertension control and management. *Am J Hypertens*. 2006;19(5):520-527.
14. Gu Q, Paulose-Ram R, Dillon C, Burt V. Antihypertensive medication use among US adults with hypertension. *Circulation*. 2006;113(2):213-221.

15. Kim SH, Shin DW, Kim S, Han K, Park SH, Kim YH et al. Prescribing patterns of antihypertensives for treatment-naïve patients in South Korea: From korean NHISS claim data. *Int J Hypertens*. 2019; 2019:4735876.
16. Wallenius S, Peura S, Klaukka T, Enlund H. Who is using antihypertensive drugs?: A prescription analysis from Finland. *Scand J Prim Health Care*. 1996;14(1):54-61.
17. Pittrow D, Kirch W, Bramlage P, Lehnert H, Höfler M, Unger T et al. Patterns of antihypertensive drug utilization in primary care. *Eur J Clin Pharmacol*. 2004;60(2): 135-142.

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