

## Blood Pressure Control and Antihypertensive Pharmacotherapy Patterns in Hypertensive Cases in Erbil City

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### Funding information

Self-funded

### Conflict of interest

None declared by authors

Received : July,2022

Published: September, 2022

DOI: [10.5281/zenodo.7088974](https://doi.org/10.5281/zenodo.7088974)

### Abstract

**Background:** Hypertension is a common public health problem in Kurdistan region/Iraq. Different antihypertensive treatment agents and patterns are used aiming in blood pressure control, despite the advances in pharmacotherapies and increased awareness, blood pressure control is still unsatisfactory.

**Aim of study:** To determine the rate of blood pressure control in hypertensive patients on medications, concentrating on pharmacological patterns along with determining the importance of compliance.

**Patients & methods:** An observational cross sectional study conducted in Outpatient Clinics in Erbil city-Kurdistan region/Iraq through duration period of six months from January to 30th of June 2022 on a sample of two hundred and thirty known hypertensive adult patients was selected after eligibility to inclusion exclusion criteria. The diagnosis of hypertension was done by physician according to and international guidelines. The controlled blood pressure was defined when it is less than 140/90mmHg and for patients with type 2 diabetes mellitus the target is less than 130/80mmHg.

**Results:** Among hypertensive patients, 56.1% had controlled and 43.9% had uncontrolled hypertension. The common antihypertensive pharmacotherapy used were angiotensin receptor blockers (51.3%) and calcium channel blockers (51.3%); followed by diuretics beta-blockers (32.2%). The mean blood pressure of hypertensive patients was (138.9/81 mmHg); was a significant association between calcium channel blockers use and controlled pressure ( $p=0.03$ ). A significant association was observed between fixed combination treatment and controlled blood pressure ( $p=0.008$ ).

**Conclusions:** In our study, more than half of have their BP controlled and the blood pressure control was better in patients taking channel blockers with fixed-dose combination

**Keywords:** Hypertension, Blood pressure control, Antihypertensive

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## 1. INTRODUCTION

The hypertension is a most common non-communicable disease affecting wide spectrum of population all over the world. The hypertension is categorized as the most prevalent chronic medical disease featured by a long-standing elevated arterial blood pressure (1). The hypertension was diagnosed for approximately 33.2% of United States population (2) and in about 24.5% of Chinese population (3), while the prevalence of hypertension was considerable among Asian population (4). In Iraq, the prevalence of hypertension was (24.9%) (5). However, it was found that about 90% of Iraqi diabetic patients were hypertensive (6). The hypertension is recently defined as systolic blood pressure value of 130mmHg or more and/or diastolic blood pressure value of more than 80 mmHg (7). However, the blood pressure threshold is classified according to age, gender and clinical co-morbidities (8). This blood pressure threshold of hypertension had been changed in last decades. However, there is a clinical assent that persistent blood pressure values of 140/90mmHg or more need pharmacotherapy with therapy goal of 130/80mmHg or less. Elevating blood pressure is responsible of higher mortality and morbidity rates. The aim of hypertension control is prevent target organ damage that include cerebrovascular accidents, myocardial infarction, heart failure and renal failure (9). The hypertension is commonly idiopathic or known as essential hypertension. The most common risk factor for developing essential hypertension is the high salt intake (10). It was also reported that genetic predisposition in some population affected the salt intake and response which in turn lead to essential hypertension (11,12). It was found that salt response is present in about 50-60% of hypertensive patients which led to development of essential hypertension (13). Different mechanisms were reported in pathogenesis of essential hypertension which all concentrating on increasing of salt absorption that cause volume extension, renin-angiotensin-aldosterone system response impairment and higher activation of sympathetic nervous system which all cause increasing in arterial peripheral resistance and high blood pressure afterload leading to hypertension development (14,15). The management of hypertension is divided into non-pharmacological and pharmacological therapy. The non-pharmacological therapy included lifestyle modification,

weight reduction, smoking cessation and physical activity. The pharmacological therapy included angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs), beta-blockers (BBs) and diuretics. These therapies are prescribed in regard to age, race and presence of co-morbidities like heart failure, ventricular dysfunction, renal failure, stroke and diabetes mellitus in addition to cost of therapy (16,17). For population with black race, the diuretics (thiazide) or (CCBs) alone or in combination were helpful in controlling blood pressure. In adult hypertensive patients with renal disorders with or without diabetes mellitus, the ACEIs or ARBs alone or in combination were helpful in management regardless of age and race (18,19). Many guidelines were published regarding management of hypertension which are clinically evidence-based guidelines and helping the clinicians all over the world in management decision, lowering selection variances, lead to management completion and evaluating quality of health care (20,21). The Eighth Joint National Committee (JNC-8) is the most common used guideline in management of hypertension that presented many important facts in detection, evaluation and treatment of hypertension. This guideline also reported the patients' adherence to treatment plans and clinician's adherence to guidelines are important indicators in blood pressure control (21). Additionally, it was shown that implementing life style modifications in combination with pharmacotherapy is important in achieving therapy target of hypertension. Despite that, it was shown that the behavior of clinicians is not affected by clinical practice guidelines and the patterns of management need regular monitoring and evaluation (22). Although high hypertension prevalence among Iraqi adults (23), little researches were implemented to evaluate patterns and outcome of hypertension treatment in this country. However, one study revealed that only 48.2% of diabetic controlled hypertension (6). The problem of uncontrolled hypertension in Iraq represented a major public health problem that need urgent policies and strategies which are unfortunately unavailable (24). In Iraqi, the blood pressure control in general was suboptimal (25).

## 2. METHODOLOGY

The present study was an observational cross sectional study conducted in Outpatient Clinics in Erbil city-Kurdistan region/Iraq from first of January to 30th of June 2022. Hypertensive patients presented to Outpatient Clinics for monitoring or consultation were the study population. The inclusion criteria were adults (age  $\geq 18$  years) patients with hypertension on antihypertensive treatment for duration of more than six months. Exclusion criteria were younger age patients, newly diagnosed hypertension (less than one year), taking antihypertensive treatment in duration of six months and less, hypertensive patients co-morbid with heart failure and reduced ejection fraction, patients with cognitive decline and patients not receiving antihypertensive treatment. The ethical considerations were implemented according to Helsinki Declaration. Regarding ethical approval of Health Authorities; an ethical approval was taken from Kurdistan Board Ethical Committee, agreement of hospital authorities, oral informed consent, completing management of patients and helping them in control of blood pressure. A sample of two hundred and thirty hypertensive patients was selected after eligibility to inclusion and exclusion criteria.

The required sample size for the study was calculated using the standard equation for cross-sectional studies (26) as followed:

$$N = \frac{Z^2 * PQ}{d^2}$$

Where N is sample size

Z : is the standard normal variate at 5% type I error (P. value  $\leq 0.05$ ), the Z value = 1.96.

P: is the expected prevalence in the population based on earlier studies. The Q value equal to (1-P). The “d” referred to the absolute allowed error or precision, in medical studies it is set to 0.05. The level of confidence was 95%, with adjustment for finite population.

Application of the aforementioned equation revealed a sample size of 230 hypertensive patients.

Data of the patients were collected by direct interview with patients and fulfilled in a prepared structured questionnaire. The questionnaire was designed by the researchers. The questionnaire included the following information: general characteristics of hypertensive patients (age, gender and body mass index), socioeconomic characteristics of hypertensive patients (marital status, educational level, occupation, private car, private house and monthly income), risk factors for hypertension (physical activity, smoking, alcohol consumption, diabetes mellitus and family history of hypertension), hypertension characteristics (duration of hypertension and blood pressure measurement) and treatment characteristics of hypertensive patients (types of antihypertensive, patterns, dose model and compliance to treatment). The diagnosis of hypertension was done by physician according to national and international guidelines (2,6,8,9). The controlled Bp was defined when its less than 140/90 mmHg and less than 130/80 for patients with diabetes (10). Weight was recorded to the nearest 0.1 kg. Height was measured with participants standing upright with the head in Frankfort plane and was recorded to the nearest 0.5 cm. Then, BMI was calculated by dividing weight in kg to height in m<sup>2</sup>, and patients were categorized into underweight (BMI <18.5), normal (BMI 18.5–24.9), overweight (BMI 25–29.9), and obese (BMI ≥30). Physical activity is defined by doing exercise for 150 minutes per week or more than 30 minutes for more than 5 days. Other data collected included education level from illiterate up to higher degree education levels, socioeconomic status is of vital importance is evaluated by asking about monthly income, others including Comorbidities, duration of HTN, family History if HTN, and Compliance is asked by direct questioning.

Blood pressure (BP) was measured using mercury sphygmomanometer, BP was taken from the patient after the patient rested for 5 minutes, BP is checked twice with 1-2 minutes interval in between with average of the 2 readings is calculated.

Data were analyzed statistically by Statistical Package of Social Sciences software version 22. The chi-square and Fishers exact tests were applied for analyzing categorical variables. Level of significance (p value) was regarded statistically significant if it was 0.05 or less.

### 3. RESULTS

This study included 230 adult hypertensive patients presented with mean age of (58.9 years) and range of 19-90 years; however, 48 patients (20.9%) aged below 50 years, 26.5% at 50-59 years, and the remaining 121 patients (52.6%) aged 60-90 years. Females were relatively dominant than males among the studied groups, 54.3% vs. 45.7%, respectively. The mean body mass index (BMI) of hypertensive patients was (25.7 Kg/m<sup>2</sup>), overweight patients contributed for 50.9% while 12.6% patients were obese. (Table 1). Majority (93%) of hypertensive patients were married and 61.8% of low educational level (36.1% illiterate and 25.7% primary level). Housewives represented 49.1% of the studied group, 22.6% were public servants and 13.9% were self-employed, retired patients and unemployed represented only 8.7% and 4.3%, respectively. Among the studied group, 68.3% had monthly income of 500000-1500000 Iraqi Dinars (IQD), 77.8% owned a private car, while 82.2% owned a private house (Table 2). Physical activity was reported in 36.1% of hypertensive patients, smoker patients were 59 (25.7%), and alcohol consumption was reported by 4.8% of patients. History of diabetes mellitus was found in 33% and family history of hypertension was reported in 63.9% of patients. Mean duration of hypertension in studied patients was (9.1 years) and the duration was less than 5 years in 30% of patients, 5-10 years in 43.5% and it was more than 10 years in 26.5% of patients. (Table 3). The mean blood pressure of patients was (138.9/81 mmHg); hypertension was controlled in 56.1% of the patients while it was uncontrolled in the remaining 43.9% of patients. (Figure 1). Regarding the treatment, 14.3% of patients used angiotensin-converting enzyme inhibitors (ACEIs), 51.3% take angiotensin receptor blockers (ARBs). 40.4% used diuretics, 51.3% take calcium channel blockers (CCBs), 32.2% beta blockers (BB) and only 3% of patients used other treatments like methyldopa or alpha-blockers. From other point of view, 37.4% used single medication (monotherapy), while 62.6% used combination therapy, either double or triple medications. Free combination used by 23.5%, while fixed combination used by 39.1% of hypertensive patients. The compliance to treatment was observed in 83.9% of hypertensive patients. (Table 4). No significant differences were observed between hypertensive patients controlled or uncontrolled BP regarding age ( $p=0.49$ ), gender ( $p=0.17$ ) and BMI ( $p=0.4$ ). (Table 5). No significant differences had been

found between hypertensive patients with controlled and uncontrolled BP regarding their socioeconomic characteristics , in all comparisons, P. value > 0.05, (Table 6). A highly significant association was found between physical inactivity and uncontrolled blood pressure ( $p < 0.001$ ). No significant differences had been observed between hypertensive patients with controlled BP and those with uncontrolled BP regarding smoking ( $p = 0.37$ ), alcohol consumption ( $p = 0.46$ ), family history of hypertension ( $p = 0.07$ ) and duration of hypertension ( $p = 0.33$ ). A significant association was observed between accompanying HT with DM and uncontrolled blood pressure ( $p = 0.007$ ). (Table 7). There was a significant association between CCB treatment and controlled blood pressure ( $p = 0.03$ ). A significant association was observed between fixed combination treatment and controlled blood pressure ( $p = 0.004$ ). A highly significant association was found between compliance to treatment and controlled blood pressure ( $p < 0.001$ ). No significant differences were observed between hypertensive patients with controlled BP and hypertensive patients with uncontrolled BP regarding ACEI ( $p = 0.43$ ), ARBs ( $p = 0.62$ ), diuretics ( $p = 0.11$ ), BB ( $p = 0.66$ ), others ( $p = 0.4$ ), monotherapy ( $p = 0.15$ ), combination therapy ( $p = 0.75$ ) and free combination ( $p = 0.3$ ). (Table 8).

**Table 1. General characteristics of hypertensive patients (N=230)**

Variable	No.	%	
Age (year)	<40	14	6.1
	40-49	34	14.8
	50-59	61	26.5
	60-69	74	32.2
	70-79	39	17.0
	≥80	8	3.4
Mean age(SD)	58.9 (11.9)	-	-
Gender	Male	105	45.7
	Female	125	54.3
BMI category	Normal	84	36.5
	Overweight	117	50.9
	Obese	29	12.6
Mean BMI(SD) kg/m <sup>2</sup>	25.7 (3.8)	-	-

SD: standard deviation of mean, BMI: body mass index

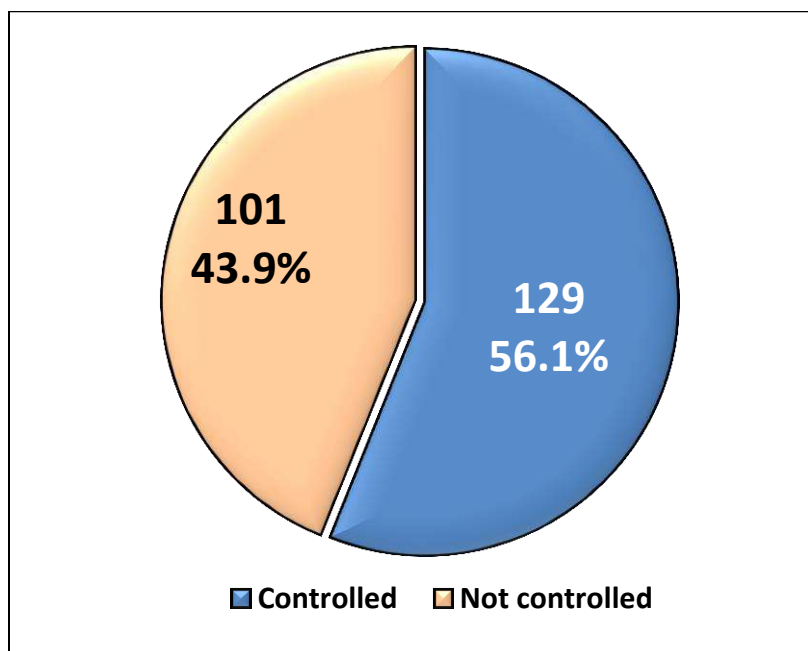
**Table 2. Socioeconomic characteristics of hypertensive patients(N=230).**

Variable		No.	%
Marital status	Single	13	5.7
	Married	214	93.0
	Divorced	3	1.3
Educational level	Illiterate	83	36.1
	Primary	59	25.7
	Intermediate	22	9.6
	High school	16	7.0
	Institute	19	8.3
	College	26	11.3
	Higher education	5	2.2
Occupation	Housewife	113	49.1
	Student	3	1.3
	Public servant	52	22.6
	Self-employed	32	13.9
	Retired	20	8.7
	Unemployed	10	4.3
Monthly income (x 1000 IQD)	<500	58	25.2
	500 -1500	157	68.3
	>1500	15	6.5
Own private car	Yes	179	77.8
	No	51	22.2
Own private house	Yes	189	82.2
	No	41	17.8



**Table 3: Risk factors and duration of hypertension (N=230)**

Variable		No.	%
Physical activity	Yes	83	36.1
	No	147	63.9
Smoking	Yes	59	25.7
	No	171	74.3
Alcohol consumption	Yes	11	4.8
	No	219	95.2
Diabetes mellitus	Yes	76	33.0
	No	154	67.0
Family history of hypertension	Yes	147	63.9
	No	83	36.1
Duration of hypertension	<5	69	30.0
	5 - 10	100	43.5
	>10	61	26.5
	Mean (SD)	9.1 (7.2)	-



**Figure 1. Blood pressure control of hypertensive patients.**

**Table 4. Treatment received by hypertensive patients (N=230)**

Treatment	No.	%	
ACEI	33	14.3	
ARBs	118	51.3	
Diuretics	93	40.4	
CCBs	118	51.3	
BBs	74	32.2	
Others	7	3.0	
Mono-therapy	86	37.4	
Combined therapy	Double	94	40.9
	Triple	50	21.7
	Total	144	62.6
Free combination	54	23.5	
Fixed combination	90	39.1	
Compliant patients	193	83.9	

**ACEI:** Angiotensin-Converting Enzyme Inhibitors; **ARBs:** Angiotensin Receptor Blockers.

**CCBs:** Calcium Channel Blockers; **BBs:** Beta-blockers

**Table 5. Relationship between patients' general characteristics and blood pressure control.**

Variable		Blood pressure				P. value
		Controlled (n=129)		Not controlled (n=101)		
		No.	%	No.	%	
Age (year)	<40	8	6.2	6	5.9	0.49 <sup>NS</sup>
	40-49	18	14	16	15.9	
	50-59	32	24.8	29	28.7	
	60-69	44	34.1	30	29.7	
	70-79	20	15.5	19	18.8	
	≥80	7	5.4	1	1.0	
Gender	Male	64	49.6	41	40.6	0.17 <sup>NS</sup>
	Female	65	50.4	60	59.4	
BMI category	Normal	52	40.3	32	31.7	0.4 <sup>NS</sup>
	Overweight	62	48.1	55	54.5	
	Obese	15	11.6	14	13.9	

NS: not significant

**Table 6. Relationship between patients' socioeconomic characteristics and blood pressure control.**

Variable		Blood pressure				P. value
		Controlled (n=129)		Not controlled (n=101)		
		No.	%	No.	%	
Marital status	Single	7	5.4	6	5.9	0.92 <sup>NS</sup>
	Married	120	93	94	93.1	
	Divorced	2	1.6	1	1.0	
Educational level	Illiterate	44	34.1	39	38.6	0.77 <sup>NS</sup>
	Primary	32	24.8	27	26.7	
	Intermediate	15	11.6	7	6.9	
	High school	10	7.8	6	5.9	
	Institute	10	7.8	9	8.9	
	College	14	10.9	12	11.9	
	PHD	4	3.1	1	1.0	
Occupation	Housewife	58	45	55	54.5	0.17 <sup>NS</sup>
	Student	2	1.6	1	1.0	
	Public servant	28	21.7	24	23.8	
	Self-employed	24	18.6	8	7.9	
	Retired	13	10.1	7	6.9	
	Unemployed	4	3.1	6	5.9	
Private car	Yes	106	82.2	73	72.3	0.07 <sup>NS</sup>
	No	23	17.8	28	27.7	
Private house	Yes	106	82.2	83	82.2	0.99 <sup>NS</sup>
	No	23	17.8	18	17.8	
Monthly income (x 1000 IQD)	<500	28	21.7	30	29.7	0.18 <sup>NS</sup>
	500 -1500	90	69.8	67	66.3	
	>1500	11	8.5	4	4.0	

NS: not significant

**Table 7. Relationship between hypertension risk factors and blood pressure control.**

Variable		Blood pressure				P. value
		Controlled (n=129)		Not controlled (n=101)		
		No.	%	No.	%	
Physical activity	Yes	60	46.5	23	22.8	<b>&lt;0.001<sup>S</sup></b>
	No	69	53.5	78	77.2	
Smoking	Yes	36	27.9	23	22.8	0.37 <sup>NS</sup>
	No	93	72.1	78	77.2	
Alcohol consumption	Yes	5	3.9	6	5.9	0.46 <sup>NS</sup>
	No	124	96.1	95	94.1	
Diabetes mellitus	Yes	33	25.6	43	42.6	<b>0.007<sup>S</sup></b>
	No	96	74.4	58	57.4	
Family history of hypertension	Yes	76	58.9	71	70.3	0.07 <sup>NS</sup>
	No	53	41.1	30	29.7	
Duration of hypertension (year)	<5	38	29.5	31	30.7	0.33 <sup>NS</sup>
	5 - 10	61	47.3	39	38.6	
	>10	30	23.3	31	30.7	

S: Significant; NS: Not significant.

**Table 8. Relationship between treatment characteristics and blood pressure control.**

Variable		Blood pressure				P. value
		Controlled (n=129)		Not controlled (n=101)		
		No.	%	No.	%	
ACEI	Yes	21	16.3	12	11.9	0.43 <sup>NS</sup>
	No	108	83.7	89	88.1	
ARBs	Yes	68	52.7	50	49.5	0.62 <sup>NS</sup>
	No	61	47.3	51	50.5	
Diuretics	Yes	58	45	35	34.7	0.11 <sup>NS</sup>
	No	71	55	66	65.3	
CCB	Yes	74	57.4	44	43.6	<b>0.03<sup>S</sup></b>
	No	55	42.6	57	56.4	
BB	Yes	40	31	34	33.7	0.66 <sup>NS</sup>
	No	89	69	67	66.3	
Others	Yes	5	3.9	2	2	0.4 <sup>NS</sup>
	No	124	96.1	99	98	
Monotherapy	Yes	43	33.3	43	42.6	0.15 <sup>NS</sup>
	No	86	66.7	58	57.4	
Combination therapy	Double	57	66.3	37	63.8	0.75 <sup>NS</sup>
	Triple	29	33.7	21	36.2	
Free combination	Yes	27	20.9	27	26.7	0.3 <sup>NS</sup>
	No	102	79.1	74	73.3	
Fixed combination	Yes	61	47.3	29	28.7	<b>0.004<sup>S</sup></b>
	No	68	52.7	72	71.3	
Compliance	Yes	126	97.7	67	66.3	<b>&lt;0.001<sup>S</sup></b>
	No	3	2.3	34	33.7	

#### 4. DISCUSSION

Optimal treatment of hypertension is important in preventing stroke, myocardial infarction, heart failure and death. Blood pressure control is achieved through compliance to recommended national and international guidelines which lead to lowering morbidity and mortality rates in addition to cost benefits. Evaluating antihypertensive patterns and outcome is essential in blood pressure control (27)

The present study showed that common antihypertensive pharmacotherapy used were angiotensin receptor blockers (51.3%) and calcium channel blockers (51.3%); followed by diuretics (40.4%) and beta-blockers (32.2%). These findings are close to results of different systematic review and randomized controlled studies that explore the higher efficacy of angiotensin receptor blockers and calcium channel blockers in controlling blood pressure among hypertensive patients (28,29). Inconsistently, Yürüyen et al. (30) study in Turkey revealed that the diuretics were the common antihypertensive used by adults especially in elderly age population. Current study showed that beta blockers were used by 32.2% of hypertensive patients. This finding is close to results of Nassr and Forsyth study in Iraq (25), which reported that beta blockers were used by 29.3% of hypertensive patients. In our study, monotherapy for hypertension was applied in 37.4% of hypertensive patients, while combination therapy was applied by 62.6% of them. This finding is consistent with many randomized controlled studies that reported earlier control of blood pressure after use of combination antihypertensive therapy as compared to monotherapy (31–33). Our study showed that free combination was used by 23.5% of hypertensive patients, while fixed combination was used by 39.1% of patients. A study conducted in Germany by Bramlage et al.(34) reported that fixed dose of antihypertensive therapy improved the persistence and adherence. In our study, the compliance to treatment was observed in 83.9% of hypertensive patients, this compliance rate is better than the rate of (43.3%) reported by Hawrami and Abdulla study (35) in Sulaimani city (Kurdistan region-Iraq) which included 309 hypertensive patients. On the other hand, Tilea et al. (36) study in Romania reported that 69.8% of hypertensive patients had high compliance to treatment .

The current study found that mean blood pressure of hypertensive patients was (138.9/81 mmHg); 56.1% of patients had controlled and 43.9% had uncontrolled hypertension. This control rate is better than that reported by Nassr and Forsyth study (25) in Iraq, who found a control rate of (38.7%).

Additionally, during 2017-2018, a cross sectional study carried out in USA by Muntner et al. (37) documented a blood pressure control rate among American population of 43.7%.

In the present study, there was a significant association between calcium channel blockers use and controlled blood pressure ( $p=0.03$ ). This finding consistent with the results of previous literatures such as Chen and Yang systematic review and meta-analysis study in China (38) moreover, in a meta-analysis in India Chakraborty et al. (39) documented higher efficacy of calcium channel blockers in controlling blood pressure among hypertensive patients. These findings regarding calcium channel blockers efficacy are similar to results of Almeshhadani et al. (40) study in Erbil city (Kurdistan region/Iraq) which reported that calcium channel blockers were effective in controlling blood pressure of Kurdish hypertensive patients. Our study also showed a significant association between fixed combination treatment and controlled blood pressure ( $p=0.008$ ). Consistently, DiPette et al. (41) study reported that earlier and wider use of fixed-dose combination therapy is a practical, safe and effective strategy in management of hypertension. The current study found a highly significant association between compliance to treatment and controlled blood pressure ( $p<0.001$ ). This finding is similar to reports of Choudhry et al.(42) study in USA which documented a direct link between medications adherence and blood pressure control among hypertensive patients.

The present study showed a highly significant association between physical inactivity and uncontrolled blood pressure ( $p=0.003$ ). Similarly, Hegde and Solomon (43) from USA stated that physical activity is required in controlling blood pressure and preventing cardiovascular complications. Our study found a significant association between accompanying HT with DM and uncontrolled blood pressure ( $p=0.007$ ). This finding is consistent with results of Li et al.(44) study in China which reported that iabetes mellitus is common co-morbidity lead to uncontrolled blood pressure among hypertensive patients.



## 5. CONCLUSIONS

This study concluded that the blood pressure control rate among hypertensive patients in Erbil city was 56.1%. The common antihypertensive medications taken was angiotensin receptor blockers and Calcium channel blockers with common fixed combination therapy. The blood pressure control is better in patients taking Calcium channel blockers with fixed-dose combination. Blood pressure control was affected by adherence to medication, physical activity and co-morbidity by diabetes mellitus. Emphasis on adherence to treatment mainly in fixed-dose combination pattern is the main recommendation of current study.

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**Ethical Clearance:**

All ethical issues approved by the authors from the local authorities. Patients enrollment and data collection were in accordance with the World Medical Association (WMA), [declaratiron of Helsinki](#) - Ethical Principles for Medical Research Involving Human Subjects, 2013

**Acknowledgement**

*Great thanks to all medical and health staff working in Erbil Cardiac center and Rizgari Teaching hospital for their efforts and help to complete my research.*

**Citation:** Fathi M K, Habeeb M A. Blood Pressure Control and Antihypertensive Pharmacotherapy Patterns in Hypertensive Cases in Erbil City. AJMS 2022; 8 (4): 218-38