



# HYPERTENSION RELATED BONE DISORDERS: A PROSPECTIVE OBSERVATIONAL STUDY

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## **ABSTRACT:**

*Background:* Hypertension and osteoarthritis/osteoporosis are the most commonly observed co- morbidities in elderly population. A few studies have shown the association between hypertension and bone disorders.

*Aim:* The study aims to evaluate the relationship between hypertension and bone disorders and study the drug effects of anti-hypertensive agents on bone.

*Method:* This prospective cross-sectional study was done in Star Hospitals for six months in Orthopaedics department. A minimum of 120 active cases of osteoarthritis were collected, and survey was done through a questionnaire in 120 patients who had hypertension. This data was noted in patient profile form which includes age, gender, diagnosis, lab reports and past medication history. All the parameters were followed and the analysis involves SPSS software version 22, MS Excel.

*Result:* This study identifies hypertension as one of the risk factors for osteoporosis and osteoarthritis. Diuretic and Beta-blocker based combination therapy has a better outcome in slowing the disease progression.

*Conclusion:* There is an association between hypertension and osteoporosis/osteoarthritis. Anti-hypertensive therapy influences the bone proliferation.

**Keywords:** *Hypertension, Osteoporosis, Osteoarthritis, Bone proliferation.*

## **INTRODUCTION:**

Blood pressure that is higher than usual is referred to as high blood pressure or hypertension. High blood pressure may be diagnosed if blood pressure readings are frequently above normal. Recently, it has been found that hypertension and bone disorders share a common pathophysiology and are inter-linked. [1]

Based upon this assumption, we have conducted a research to analyze the relationship between hypertension (HTN) and osteoarthritis (OA), a condition that affects the elderly more frequently and causes severe joint pain concurrently, due to the deterioration and inflammation of the articular cartilage. OA is known to be the main cause of disability, with restriction of activity and pain, leading to a low quality of life and a higher rate of hospitalization. At the same time after the age of 35 years, both men and women are at a risk of developing osteoporosis and usually have a low bone mineral density.[2]

In this study we have tried to explore the relationship between hypertension, osteoporosis and osteoarthritis in middle aged individuals. The prevalence rate of essential hypertension (EH) and osteoporosis (OP) increases every year, and these have become two of the most common diseases in the world.[3]

Numerous studies have indicated that age, gender, smoking, drinking coffee, coronary heart disease, diabetes, essential hypertension and decreased estrogens level are risk factors for osteoporosis. Hypertension is one of the common diseases found in the clinic. Research results have shown that hypertension and osteoporosis are a common occurrence. Both hypertension and osteoporosis are age-related diseases and result from the interaction of genetic and environmental factors. However, there is still a controversy concerning whether a correlation exists between hypertension and osteoporosis. Several studies have indicated that hypertension is negatively correlated with bone mineral density. Cappuccio F P and his

colleague conducted a prospective study of 3676 women, and they found that high blood pressure in elderly white women is associated with increased bone loss at the femoral neck. This association may reflect greater calcium losses associated with high blood pressure, which may contribute to the risk of hip fractures.[4]

A meta analysis by Li et al. of more than 1.4 million subjects indicate that osteoporotic fractures are 33% higher among those with hypertension than without and that this is true in both Asia and Europe. [5] Like osteoporosis, hypertension becomes increasingly prevalent with aging, such that by age 70, 70% of the population is hypertensive. Hypertension is also less prevalent in females before menopause but becomes more frequent thereafter, again mimicking a pattern observed in osteoporosis. [6]

Therefore, in this study we have tried to explore the relationship between hypertension and bone disorders i.e., osteoporosis and osteoarthritis, in middle age population of 35-55 years (women) and 35-65 years (men). We have also tried to explore the effect of various anti-hypertensive drugs on bone.

## **LITERATURE REVIEW**

1. In a study, "Is hypertension associated with arthritis: The United States national health and nutrition examination survey 1999-2018" conducted by "Xiaopeng Liang, Oscar Hou in Chou, Ching Lung Cheung, Bernard M. Y. Cheung" in the journal, *Annals of Medicine*, vol 54, stated that, the study showed a robust association between hypertension and arthritis using 20 years of nationally representative data from NHANES. In conclusion, the analysis from the nationally representative survey showed a strong association between hypertension and arthritis. In particular, RA and OA were significantly associated with hypertension. This suggested that clinicians should screen for hypertension among people with arthritis of all ages and intervene early.

2. In a study, "Elevated Systemic Blood Pressure is Associated with increased prevalent Knee Osteoarthritis and Knee Pain: Data from the Osteoarthritis Initiative", conducted by, "Grace H. Lo, Timothy E. McAlindon, Jeffrey N. Katz, Jeffrey B. Driban, Lori Lyn Price, Charles Eaton, Nancy Petersen, Christie Ballantyne and Maria E. Suarez-Almazor", in the *American college of Rheumatology*, abstract 242, this is the first epidemiological study to show elevated systemic blood pressure is associated with increased prevalence of knee OA and greater levels of knee pain. The associations were weakened when adjusting for age, sex, and BMI, but were still significant. These findings suggest a new promising avenue for research on disease modification as well as symptom control in OA.

3. In a study "Association between Hypertension and the Prevalence of Low Back Pain and Osteoarthritis in Koreans: A Cross-Sectional Study", conducted by, "Young-Hyeon Bae, Joon-Shik Shin, Jinho Lee, ME-riong Kim, Ki Byung Park, Jae-Heung Cho, In-Hyuk Ha", September 22, 2025, in the journal, *PLOS ONE*, This study demonstrated an inverse relationship between high blood pressure and LBP and osteoarthritis prevalence. Anti-hypertensive medication intake attenuated this relationship through pain sensitivity modulation, and lower pain sensitivity was found in shorter duration of hypertension, i.e. more acute onset of hypertension. Hypertension showed an inverse relationship with LBP and osteoarthritis prevalence, which may be ascribed to hypertension-associated hypalgesia, and anti hypertensive medication intake and longer hypertension duration attenuated this association.

4. In a study "Association between hypertension and osteoarthritis : A systematic review and meta-analysis of observational studies", conducted by, "Kenneth Lo, Manting Au, Junguo Ni, and Chunyi Wen", in the

journal of orthopaedic translation, 2021 Jun 12, this study revealed the associations of the anatomic location and type of OA with its vascular comorbidity.i.e. Hypertension.

Blood pressure has been reported to link with OA for years ago, however, its contribution to OA is still unclear and conflicted in different reports. This review indicated an intimate relationship between hypertension and structural damages of knee OA, rather than simply chronic joint pain, especially in women. A BMI-independent association between hypertension and radio graphic knee OA existed with potential sex variation,which warrants further investigations into the underlying genetic, hormonal and environmental factors.

5. In a study, “Association between Hypertension and Osteoarthritis”, conducted by, “E.Taskina, E.Strebkova, L.Alekseeva, N.Kashevarova, K.Telysheb, S.Anikin, E.Sharapova,D.Kudinsky,A.Lila”, in BMJ journals, vol 80, AH in patients with knee OA is affected by a variety of variables, both related to traditional CVD factors and to OA itself, and the correlations found are approximately equal in strength. The results obtained require further study, and it is possible that preventive measures aimed at reducing the traditional risk factors of diseases of the circulatory system, or correcting existing CVD, will contribute to a more favourable course of OA.

### **AIMS & OBJECTIVES:**

**AIM:**This study aims to evaluate the association between bone disorders and hypertension by using various parameters that contribute to bone degeneration and also to assess the effect of anti-hypertensive agents on bone health.

### **OBJECTIVES:**

- To study the prevalence of bone degeneration in hypertensive patients.
- To analyze the incidence of joint pains in hypertensive patients.
- To evaluate the effect of anti-hypertensive agents and compare their efficacy in preventing bone degeneration.

### **METHODOLOGY**

**Study site:** This study is being conducted in Star Hospitals, Hyderabad.

**Study design and subjects:** A prospective study is conducted over a period of 6 months in orthopaedics department.

**Study duration:** 6 months.

**Sample size:** 320

**Method of study:**A cross-sectional study was conducted in a group of middle-aged patients. The data was taken from the inpatient area of orthopaedics department. A sample patient profile form was prepared and the necessary data was collected. Also a survey form was prepared for the assessment of

joint pains in hypertensive patients. The survey was done in hypertensive patients admitted in various other departments as per the inclusion criteria. Around 120 active cases have been collected in the inpatient department through the patient profile form and survey was done in 200 patients. The data has been recorded in an excel sheet for analysis.

## **SOURCE OF DATA**

All essential data has been gathered from patient data collection forms of inpatient department, and survey questionnaire circulated to various departments in the hospital.

## **SELECTION CRITERIA**

### **❖ Inclusion criteria:**

- Patients of both the genders.
- Patients of age

Male: 35-65 years

Female : 35-55 years

- Patients diagnosed with hypertension for more than 2 years.
- Patients having SBP >125mmHg and DBP >85mmHg
- Non-alcoholic
- Non-smoker
- Patient not having CAD, cancer, endocrine or immune disorders, severe liver, kidney or haematopoietic diseases.

### **❖ Exclusion criteria:**

- Pregnant or lactating women.
- Patients taking medications for bone disorders.
- Post-menopausal women.
- Patients having diabetes, RA, other malignant disorders.

## **RESULTS**

- Most of the individuals having symptoms of OA and osteoporosis had hypertension as a comorbidity.
- The patients using combination of beta-blockers and diuretics had a higher bone mineral density and slower disease progression than compared to the individuals taking other antihypertensive drugs.

Table 1 : Gender distribution of patients admitted in hospital with respect to hypertension

Hypertension	Gender		Total	P value
	Male	Female		
Yes	29	72	101	0.2425
No	3	16	19	
Grand Total	32	88	120	

Significant difference was not found

Figure 1:

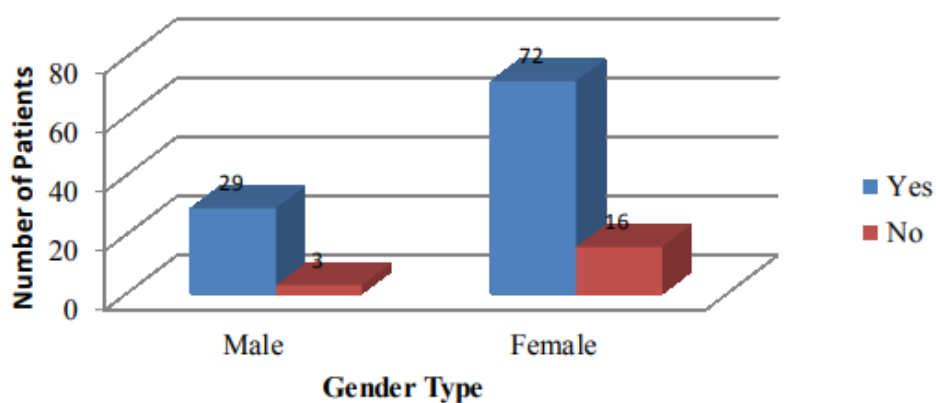


Figure 2:

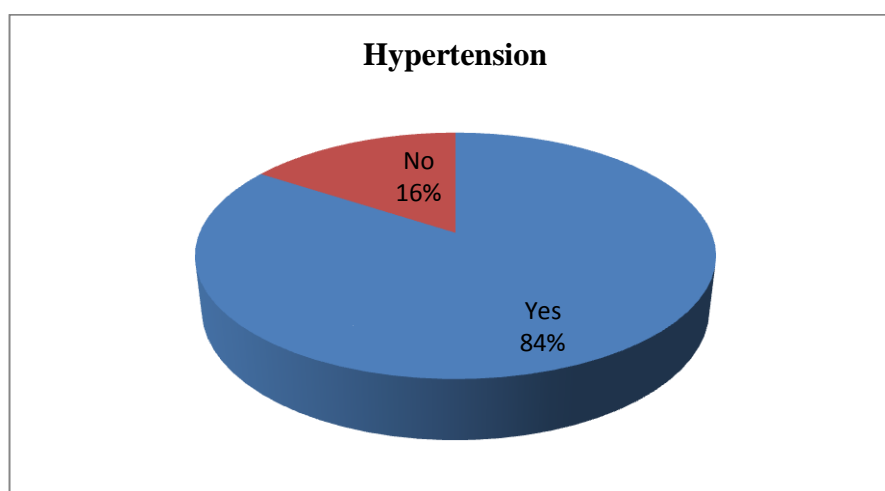


Table 2: Type of Knee affected in patients admitted in hospital with respect to duration of hypertension

Hypertension duration	Knee affected			Total
	Right Knee	Left Knee	Both	
No hypertension	8	8	2	18
0.1-5 Years	5	12	41	58
5.1 -10 Years	6	5	21	32
10.1 - 20 Years	1	2	9	12
Grand Total	20	27	73	120

$\chi^2$  test =24.718, P value =0.00038

**Figure 3:**

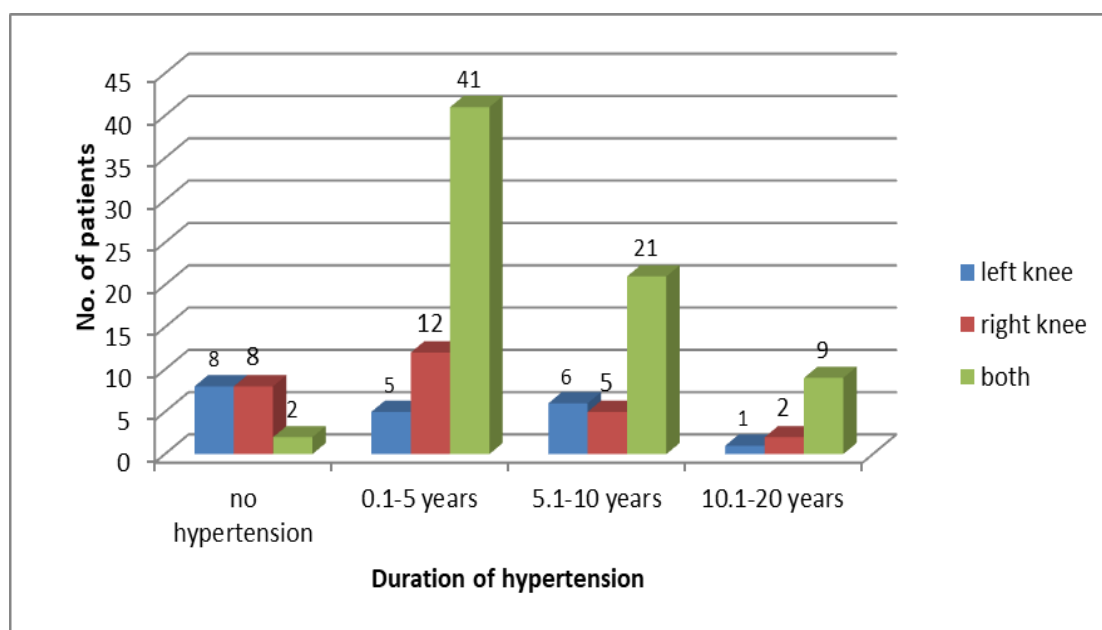


Figure 4

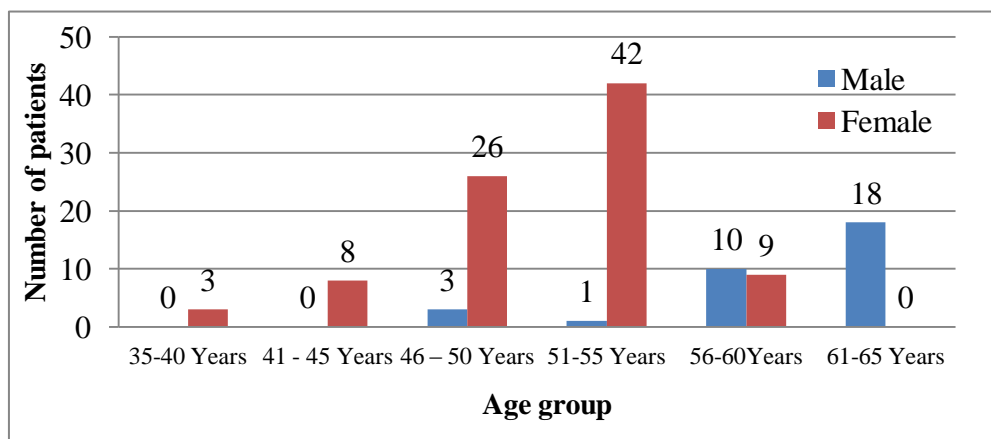


Table 3: T Score (Femur) in patients admitted in hospital with respect to hypertension drug class

Hypertension drug class	T Score (Femur)		Total	P value
	Low Bone Density	Normal Bone Density		
ACE/CCB+BB	1	0	1	<0.0001*
ACE+CCB	3	0	3	
ARB	29	0	29	
ARB+CCB	8	4	12	
ARB+DU	0	16	16	
ARB+DU/CCB	0	1	1	
BB	8	0	8	
BB+ARB	1	9	10	
BB+CCB	8	2	10	
BB+CCB/ACE	0	4	4	
CCB	4	0	4	
CCB/BB+ARB	1	3	4	
no medication	7	11	18	
Grand Total	70	50	120	

\*Significant difference was found



Table 4 : T Score (Femur) in patients admitted in hospital with respect to hypertension drug class

Hypertension drug class	T Score (Femur)		Total	P value
	Low Bone Density	Normal Bone Density		
ACE/CCB+BB	1	0	1	<0.0001*
ACE+CCB	3	0	3	
ARB	29	0	29	
ARB+CCB	8	4	12	
ARB+DU	0	16	16	
ARB+DU/CCB	0	1	1	
BB	8	0	8	
BB+ARB	1	9	10	
BB+CCB	8	2	10	
BB+CCB/ACE	0	4	4	
CCB	4	0	4	
CCB/BB+ARB	1	3	4	
no medication	7	11	18	
Grand Total	70	50	120	

\*Significant difference was found

Table 5: X ray inference with respect to drug class

Drug class	X-ray Inference							Total	P value
	advanced bone degeneration of both knees	moderate OA of both knees	moderate OA of left knee	moderate OA of right knee	severe OA of both knees	severe OA of left knee	severe OA of right knee		
ACE/CCB+BB	0	0	0	1	0	0	0	1	<0.0001*
ACE+CCB	0	0	0	0	3	0	0	3	
ARB	28	0	0	0	1	0	0	29	
ARB+CCB	3	0	0	1	8	0	0	12	
ARB+DU	1	4	6	2	3	0	0	16	
ARB+DU/CCB	0	0	1	0	0	0	0	1	
BB	2	0	0	0	5	1	0	8	
BB+ARB	0	2	3	3	2	0	0	10	
BB+CCB	1	1	3	3	1	1	0	10	
BB+CCB/ACE	1	0	2	0	0	0	1	4	
CCB	2	0	0	0	2	0	0	4	
CCB/BB+ARB	0	0	2	1	1	0	0	4	
no medication	0	2	5	7	0	3	1	18	
Total	38	9	22	18	26	5	2	120	

\*Significant difference was found

**Table 6: NRS result with respect to drug class (active cases admitted in hospital)**

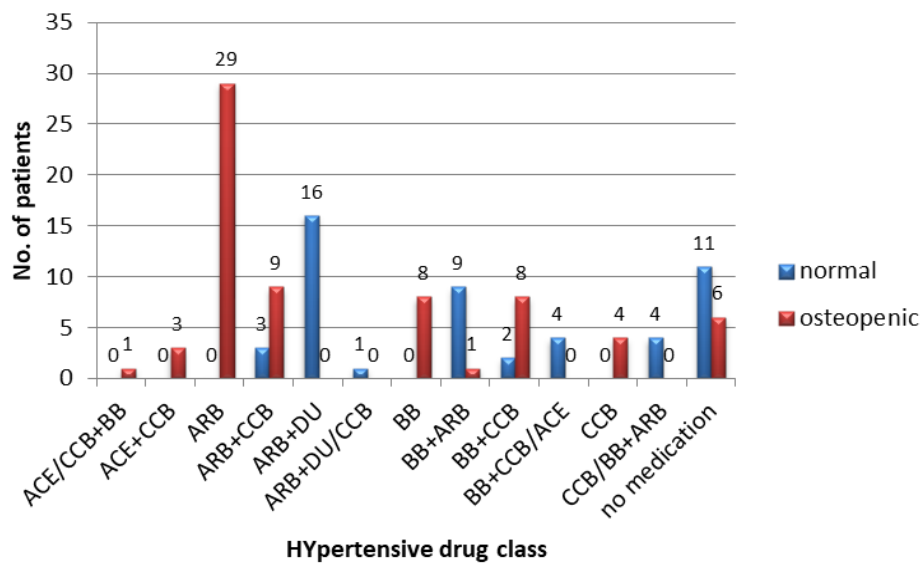
Drug Class	NRS result			Total	P value
	Mild	Moderate	Severe		
ACE+CCB	0	1	0	1	<0.0001*
ARB	0	18	1	19	
ARB+BB	6	1	0	7	
ARB+BB/DU	1	0	0	1	
ARB+CCB	0	2	2	4	
sARB+DU	16	0	0	16	
BB	0	37	3	40	
BB+ARB	2	0	0	2	
BB+CCB	8	1	0	9	
BB+CCB/ACE	1	1	0	2	
CCB	0	0	11	11	
CCB+DU	8	0	0	8	
Total	42	61	17	120	

\*Significant difference was found

**Table 7: Osteoporosis in patients admitted with respect to hypertension drug class**

Hypertension drug class	Osteoporosis status			Total
	Normal	Osteopenic	No record	
ACE/CCB+BB	0	1	0	1
ACE+CCB	0	3	0	3
ARB	0	29	0	29
ARB+CCB	3	9	0	12
ARB+DU	16	0	0	16
ARB+DU/CCB	1	0	0	1
BB	0	8	0	8
BB+ARB	9	1	0	10
BB+CCB	2	8	0	10
BB+CCB/ACE	4	0	0	4
CCB	0	4	0	4
CCB/BB+ARB	4	0	0	4
no medication	11	6	1	18
Grand Total	50	69	1	120

Figure 5:



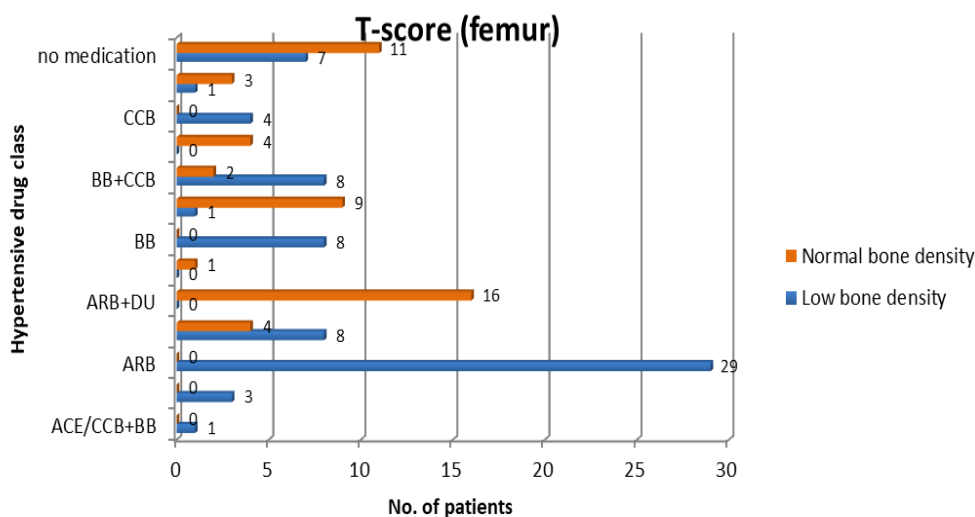
It is seen that 69 out of 120 patients are osteopenic. On comparing the different anti-hypertensive drugs used, it is found that 29 osteopenic patients are taking ARBs.

**Table 8 : T Score (Femur) in patients with respect to anti-hypertensive drug class**

Hypertension drug class	T Score (Femur)		Total
	Low Bone Density	Normal Bone Density	
ACE/CCB+BB	1	0	1
ACE+CCB	3	0	3
ARB	29	0	29
ARB+CCB	8	4	12
ARB+DU	0	16	16
ARB+DU/CCB	0	1	1
BB	8	0	8
BB+ARB	1	9	10
BB+CCB	8	2	10
BB+CCB/ACE	0	4	4
CCB	4	0	4
CCB/BB+ARB	1	3	4
no medication	7	11	18
<b>Grand Total</b>	<b>70</b>	<b>50</b>	<b>120</b>

P value <0.0001, Significant difference was found.

**Figure 6:**

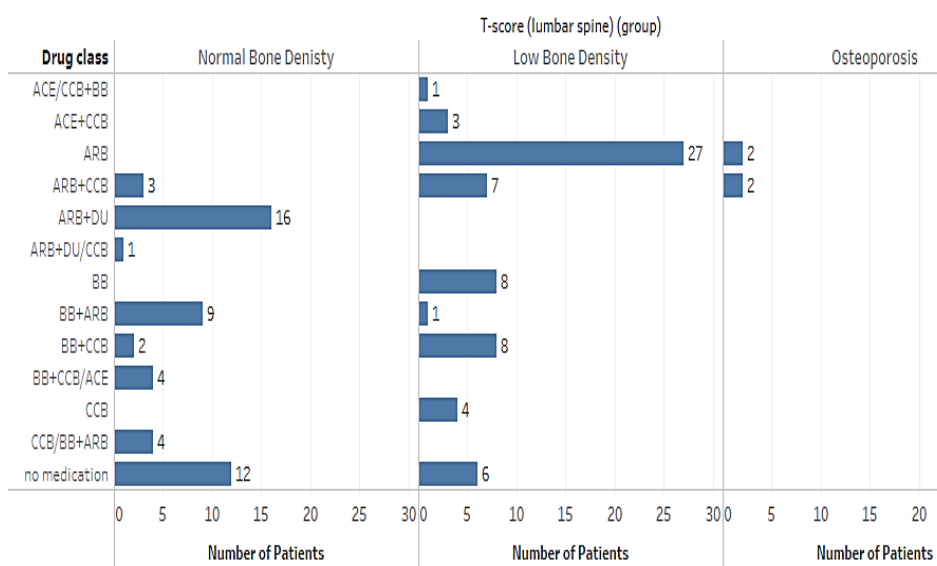


It is seen that low bone density is usually caused in patients using Angiotensin Receptor Blockers, and normal bone density is seen in patients using a combination of ARBs and Diuretics. This can be noticed from the above graph.

**Table 9 : T Score (Lumbar) in patients with respect to hypertension drug class**

Hypertension drug class	T Score (Lumbar)			Total
	Normal Bone Density	Low Bone Density	Osteoporosis	
ACE/CCB+BB	0	1	0	1
ACE+CCB	0	3	0	3
ARB	0	27	2	29
ARB+CCB	3	7	2	12
ARB+DU	16	0	0	16
ARB+DU/CCB	1	0	0	1
BB	0	8	0	8
BB+ARB	9	1	0	10
BB+CCB	2	8	0	10
BB+CCB/ACE	4	0	0	4
CCB	0	4	0	4
CCB/BB+ARB	4	0	0	4
no medication	12	6	0	18
<b>Grand Total</b>	<b>51</b>	<b>65</b>	<b>4</b>	<b>120</b>

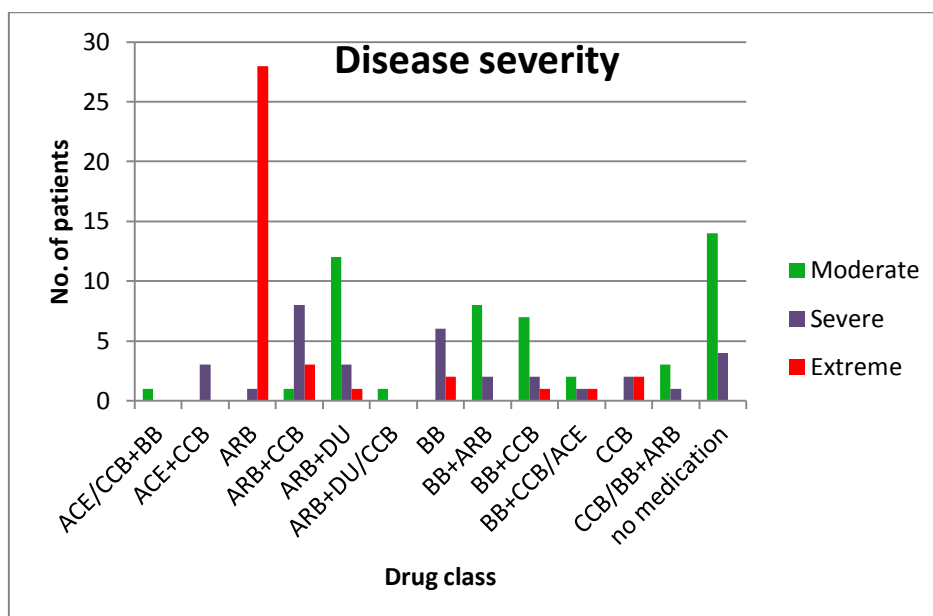
**Figure 7:**



**Table 10: Disease severity with respect to drug class**

Drug Class	Rating			Total
	extreme	moderate	severe	
ACE/CCB+BB	0	1	0	1
ACE+CCB	0	0	3	3
ARB	28	0	1	29
ARB+CCB	3	1	8	12
ARB+DU	1	12	3	16
ARB+DU/CCB	0	1	0	1
BB	2	0	6	8
BB+ARB	0	8	2	10
BB+CCB	1	7	2	10
BB+CCB/ACE	1	2	1	4
CCB	2	0	2	4
CCB/BB+ARB	0	3	1	4
no medication	0	14	4	18
<b>Total</b>	<b>38</b>	<b>49</b>	<b>33</b>	<b>120</b>

**Figure 8:**



It can be observed from the above graph that in patients taking ARBs, the disease severity is extreme.

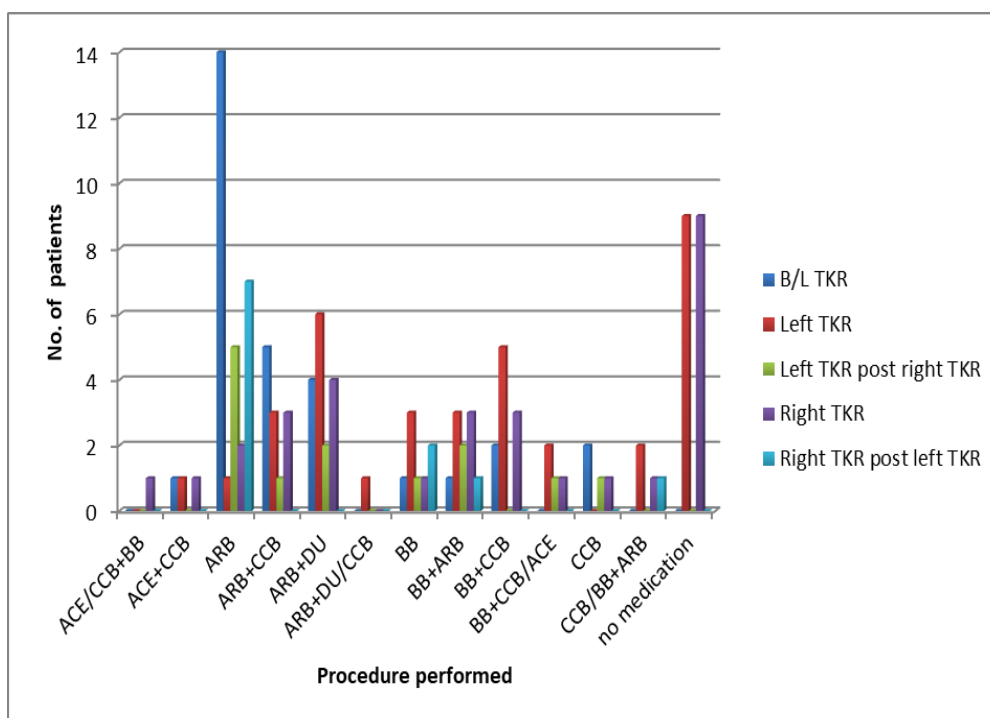
**Table 11: Procedure performed in the patients**

Drug class	Procedure performed					Total
	B/L tkr	left tkr	left tkr post Rt tkr	right tkr	right tkr post Lt tkr	
ACE/CCB+BB	0	0	0	1	0	1
ACE+CCB	1	1	0	1	0	3
ARB	14	1	5	2	7	29
ARB+CCB	5	3	1	3	0	12
ARB+DU	4	6	2	4	0	16
ARB+DU/CCB	0	1	0	0	0	1
BB	1	3	1	1	2	8
BB+ARB	1	3	2	3	1	10
BB+CCB	2	5	0	3	0	10
BB+CCB/ACE	0	2	1	1	0	4
CCB	2	0	1	1	0	4
CCB/BB+ARB	0	2	0	1	1	4
no medication	0	9	0	9	0	18
<b>Total</b>	<b>30</b>	<b>36</b>	<b>13</b>	<b>30</b>	<b>11</b>	<b>120</b>

The above table represents the different drug classes of anti-hypertensive drugs with respect to knee replacement procedure performed in patients.



**Figure 9 :**



### Statistical Analysis of Survey Report

**Table 12 : Frequency distribution of patients on the basis of diet**

Diet Type	Frequency	Percentage (%)
Veg.	18	15%
Mixed	102	85%
Grand Total	120	100

85% of patients are noted to take mixed diet, while 15% are vegetarians.

**Table 13 : Frequency distribution of Smoking or Alcohol habits among patients**

Smoking /Alcohol Habit	Frequency	Percentage (%)
Smoking and Alcohol both	3	2.5%
Only Smoking	2	1.7%
Only Alcohol	22	18.3%
None	93	77.5%
Grand Total	120	100

**Table 14 : Frequency distribution of Physical activity among patients**

Physical activity	Frequency	Percentage (%)
Yes	27	22.5%
No	93	77.5%
Grand Total	120	100

78% of patients are noted to do physical activity, majority of which do walking (59%). Others practice physical activities like Yoga (15%), Gym (19%), etc.

**Table 15 : Frequency distribution of Physical activity type among patients**

Physical activity type	Frequency	Percentage (%)
Gym	5	18.5%
Walking	16	59.3%
Yoga	4	14.8%
Other type	2	7.4%
Grand Total	27	100

**Table 16 : Duration of hypertension in admitted patients**

Duration of hypertension	Frequency	Percentage (%)
No hypertension	0	0%
0.1-5 Years	78	65%
5.1 -10 Years	30	25%
10.1 - 20 Years	11	9.2%
20.1-25 Years	1	0.8%
Grand Total	120	100

Figure 10 :

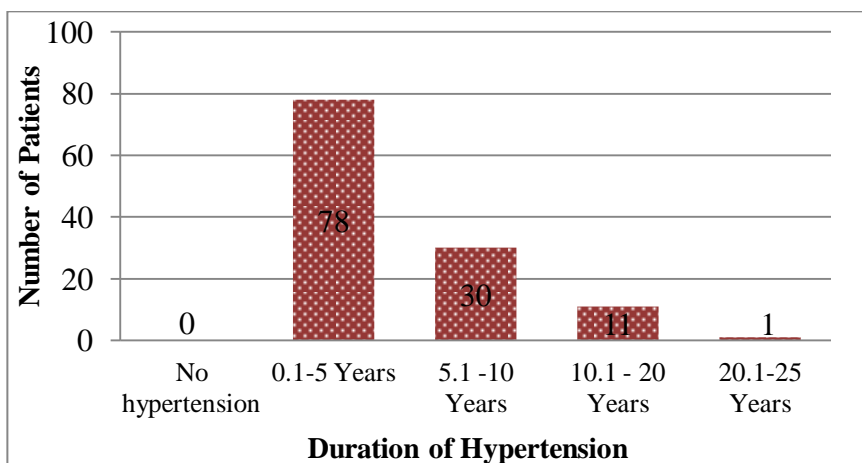


Table 17 :Distribution of pain score in admitted patients

Pain score	Frequency	Percentage (%)
0-5	27	22.5%
6-10	60	50%
11-15	28	23.3%
16-20	5	4.2%
Grand Total	120	100

50% of patients have a pain score of 6-10, 23% have a pain score of 11-15, 22% have a pain score of 0-5% and 4% have a pain score of 0-5.

Table 18 : Pain score with respect to anti-hypertensive drugs

Drug Class	Pain Score				Total
	0 to 5	06 to 10	11 to 15	16 to 20	
ACE+CCB	1	0	0	0	1
ARB	1	14	4	0	19
ARB+BB	7	0	0	0	7
ARB+BB/DU	0	1	0	0	1
ARB+CCB	0	1	3	0	4

ARB+DU	11	4	1	0	16
BB	1	25	14	0	40
BB+ARB	2	0	0	0	2
BB+CCB	2	6	1	0	9
BB+CCB/ACE	1	1	0	0	2
CCB	0	1	5	5	11
CCB+DU	1	7	0	0	8
Total	27	60	28	5	120

Figure 11:

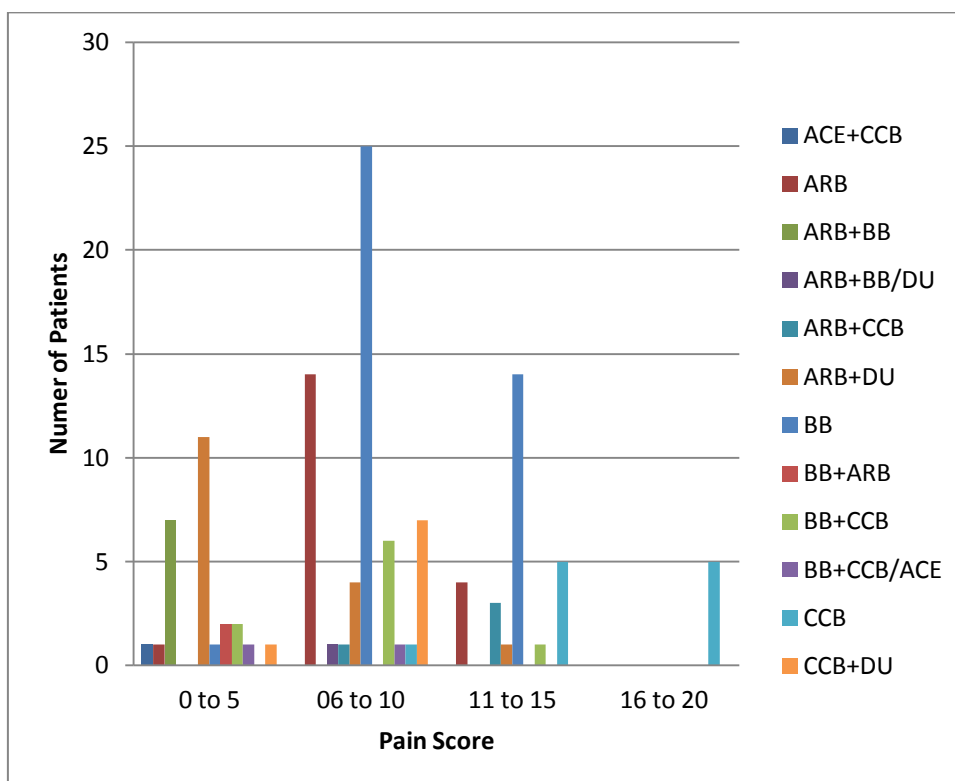
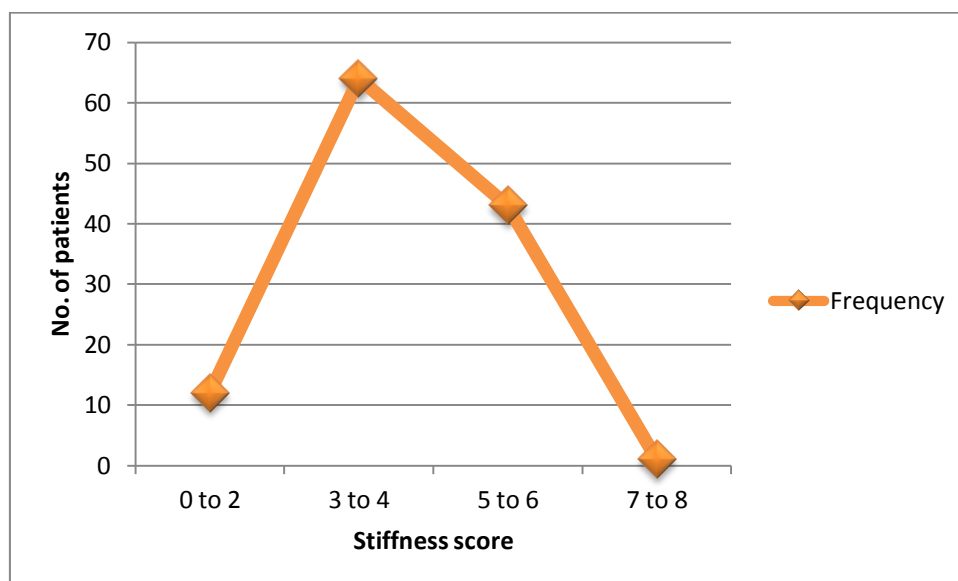


Table 19: Distribution of patients with respect to stiffness score

Stiffness score	Frequency	Percentage (%)
0-2	12	10%
3-4	64	53.3%
5-6	43	35.8%
7-8	1	0.8%
Grand Total	120	100

**Figure 12:**



Majority of patients have a stiffness score of 3-4 (53.3%), followed by a stiffness score of 5-6 in 36% of patients.

**Table 20 : Distribution of physical function score in admitted patients**

Physical function Score	Frequency	Percentage (%)
0-25	42	35%
26-50	76	63.3%
51-68	2	1.7%
Grand Total	120	100

**Table 21 : Distribution of Total WOMAC score in admitted patients**

Total womac score	Frequency	Percentage (%)
0-25	25	20.8%
26-50	69	57.5%
51-75	26	21.7%
76-96	0	0
Grand Total	120	100

WOMAC scale is an index for measuring physical function, pain and stiffness in patients with osteoarthritis.

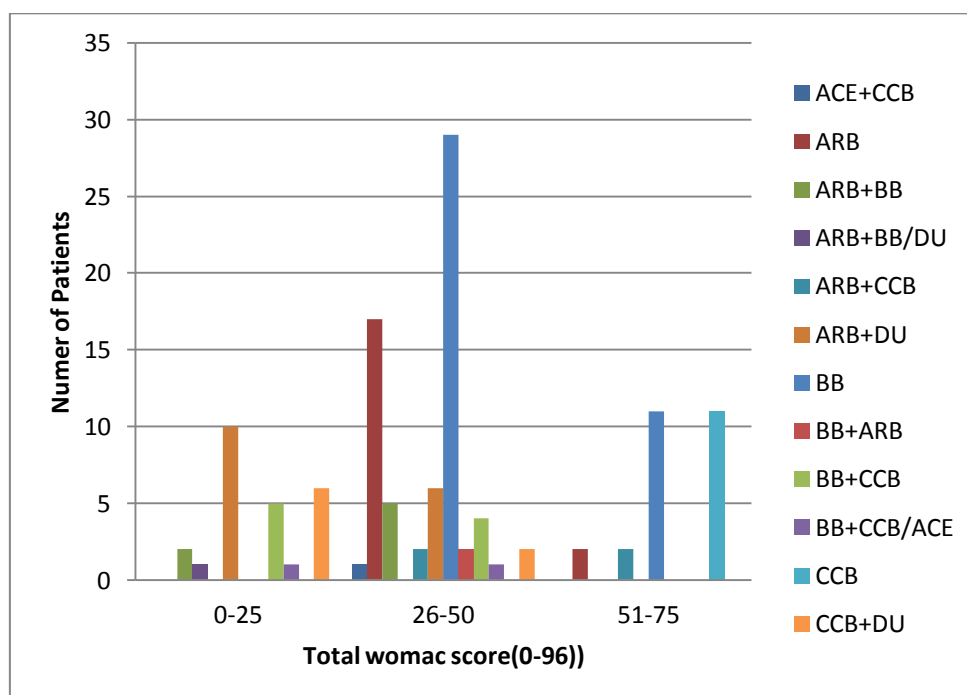
Total WOMAC score is measured from 0-96.

It is observed that drugs used in combination have a lesser womac score, compared to individual therapy.

**Table 22 : Total Womac score with respect to anti-hypertensive drugs**

Drug Class	Total womac score(0-96) (group)			Total
	0-25	26-50	51-75	
ACE+CCB	0	1	0	1
ARB	0	17	2	19
ARB+BB	2	5	0	7
ARB+BB/DU	1	0	0	1
ARB+CCB	0	2	2	4
ARB+DU	10	6	0	16
BB	0	29	11	40
BB+ARB	0	2	0	2
BB+CCB	5	4	0	9
BB+CCB/ACE	1	1	0	2
CCB	0	0	11	11
CCB+DU	6	2	0	8
<b>Total</b>	<b>25</b>	<b>69</b>	<b>26</b>	<b>120</b>

**Figure 13 :**



**Table 23: Distribution of NRS Grade in patients**

Pain score	NRS Grade	Frequency	Percentage (%)
0-3	Mild	42	35%
3.01-6.0	Moderate	61	50.8%
6.01-10	Severe	17	14.2%
Grand Total		120	100

Numerical Rating Scale (NRS) is a scale for measurement of pain. Higher the score more is the pain.

It is seen that 51% of patients have moderate pain, while 35% have mild pain and 14% have severe pain. Combination therapy of ARBs and Diuretics has relatively less pain score, compared to individual drugs, which show high pain score.

**Table 24: Association of Duration of Hypertension with NRS Result**

Duration (years)	NRS			P value
	Mild	Moderate	Severe	
1-3	8	40	6	0.1295
4-6	7	26	2	
7-9	3	7	1	
10-12	6	4	3	
13-15	0	4	0	
>15	0	2	1	

Significant difference was not found

Figure 14 : Association of Duration of Hypertension with NRS Result

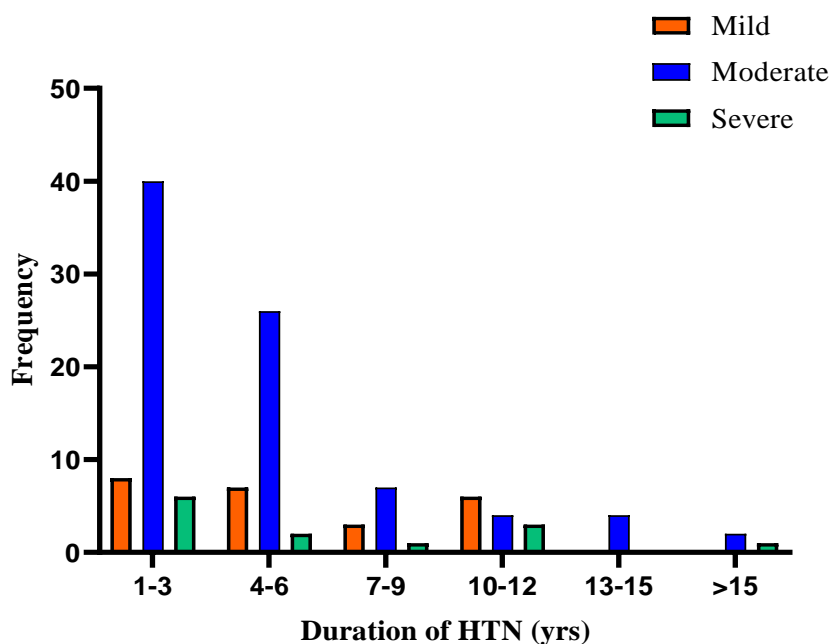


Table 25 : NRS result with respect to anti-hypertensive drugs

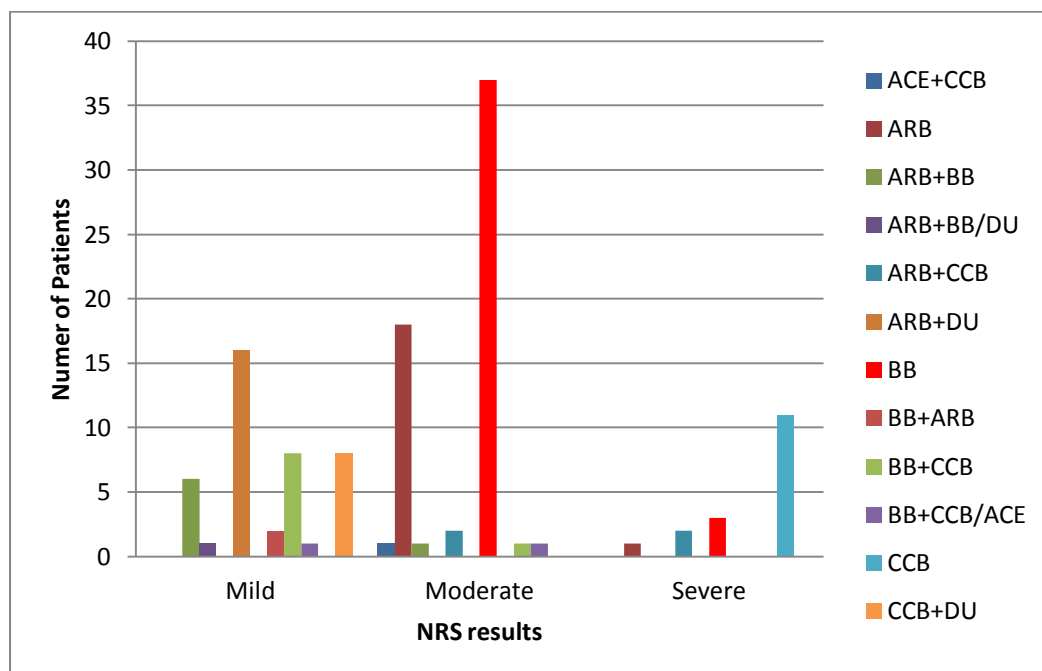
Drug Class	NRS result			Total
	Mild	Moderate	Severe	
ACE+CCB	0	1	0	1
ARB	0	18	1	19
ARB+BB	6	1	0	7
ARB+BB/DU	1	0	0	1
ARB+CCB	0	2	2	4
ARB+DU	16	0	0	16
BB	0	37	3	40
BB+ARB	2	0	0	2
BB+CCB	8	1	0	9
BB+CCB/ACE	1	1	0	2
CCB	0	0	11	11
CCB+DU	8	0	0	8
Total	42	61	17	120

P value=<0.0001. Significant difference was found.

The above table represents pain rating based on NRS scale with respect to different anti-hypertensive drug classes



Figure 15 : Pain rating with respect to drug class



## DISCUSSION

This study was carried out at Star Hospital, Hyderabad. Patients of both sexes, males within 35-65 years and females within 35-55 years of age were included in this study. Details including patient's demographics, history of hypertension, past medical history, diagnosis, and management were collected from the patient's case reports through suitable data collection forms.

- 2 A total of 120 cases have been collected from the inpatient department of orthopaedics and the data is analyzed using SPSS software version-22.
- 3 According to our study 84.2% patients had hypertension as co-morbidity, and 15.8% patients do not have hypertension. Both of them were diagnosed with either osteoarthritis/ low bone density.
- 4 Females were high in number (n=72), compared to males (n=29), having  $X^2$ test= 1.266 and p-value= 0.242, with this we conclude that after getting diagnosed with hypertension, females are at greater risk for developing bone disorders.
- 5 Majority of the females were found in the age range between 51-55 years, and males were predominant in 61-65 years (p-value=0.8565).
- 6 Around 48.3% of patients had hypertension since 1-5 years, and 26.7% of patients had hypertension since 5-10 years.
- 7 About 70% patients who were on anti-hypertensive drugs had a normal systolic blood pressure value and 98.3% patients had a normal Diastolic blood pressure value.
- 8 Among patients having hypertension, some were taking individual drug therapy (most of patients were on ARB) and some were given combination therapy (13% of patients were on ARB+Diuretics) (p-value<0.0001).

- 9 All patients have osteoarthritis (n=120), and a few were osteopenic (n=57.5%).
- 10 The erythrocyte sedimentation rate was elevated in around 57% of patients.
- 11 T-score evaluation showed that 58.3% of patients have osteopenia in femur, and 54.2% of patients had osteopenia in lumbar spine and 3.3% patients have osteoporosis in lumbar spine.
- 12 Patients who were not having hypertension were affected from osteoarthritis of either left or right knee. Majority of the hypertensive patients were affected from osteoarthritis of both the knees. With this we conclude that the hypertensive patients had greater progression of disease ( $X^2$ test=24.718, p-value=0.0001).
- 13 Hypertensive patients who were on combination therapy of ARB+DU had normal bone mineral density (n=50). And most of the patients receiving BB+ARB/BB+CCB+ACEi/CCB+BB+ARB had normal BMD. Patients who were on ARB alone, BB alone, CCB alone, BB+CCB were osteopenic (n=69).
- 14 The patients who were on individual drug therapy with BB or ARB or CCB had an extreme bone degeneration of both the knees when compared to patients who were on combination therapy of DU or BB.

To assess the above results we have conducted a survey and found that most of the individuals had a mixed diet (n=102), and 77.5% of people were non-smoker and non-alcoholic, only 22.5% people do physical exercises like gym, jogging, yoga etc. Hypertensive patients were interviewed for the presence or absence of pain and we found that all the individuals had frequent joint pains and fatigue. Pain scoring, stiffness scoring and physical function scoring was done and total womac score was calculated for 120 people. The total womac was evaluated using NRS scale. As per the scale we found that around 50.8% patients with hypertension have moderate pain in joints (pain score: 3.01-6.0), and 14.2% patients with hypertension have sever joint pains (pain score: 6.01-10). Patients who were taking diuretics combination therapy had mild pain scoring and up to some extent BB combination.

## **CONCLUSION:**

In our study 120 active cases were collected and survey was conducted in 120 patients. Our study showed that bone disorders are more common in hypertensive patients. After comparing the disease pattern in hypertensive and non-hypertensive individuals we have concluded that bone disorder becomes much more severe and progressive until it is diagnosed, in hypertensive patients. This means that there is some link between pathophysiological mechanism of hypertension and osteoarthritis/Osteoporosis. Due to increasing age or due to the underlying deficiency of calcium, hypertensive women are at more risk of developing osteoarthritis/Osteoporosis. Almost all the individuals who have hypertension, experience frequent joint pains ranging from mild to moderate or sometimes severe, depending upon the duration of hypertension and drug they have been taking for HTN. These individuals have a high womac and NRS score. We have also found the possible effect of antihypertensive drugs on bone health. Individuals who were taking a combination therapy with diuretics had a normal BMD, optimum womac score and less disease severity than compared to those who are on individual drug therapy. Also, the individuals taking beta-blockers combination therapy showed a positive effect. The disease was extreme with individual drugs like ARB or BB or CCB etc. With this we conclude that diuretics may have a positive effect on bone degeneration and its combination therapy could be a good choice for patients who are at high risk of developing bone disorder. The effect with CCB and its combination with Beta-blockers remain controversial. However, there is a need to study this association in relation to genetic markers with a large population size.

## **INFORMED CONSENT**

Informed consent was obtained from all individual participants included in the study.

## **ETHICAL APPROVAL:**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional ethics committee of Star Hospitals, Hyderabad, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors. Observational study was conducted on the human subjects.

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