

Analysis of Cost and Prescribing Patterns of Anti-Hypertensive Drugs

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Abstract: Objective: The present study was conducted to analyze the current prescription pattern and cost analysis of antihypertensive drugs in hypertensive patients in a tertiary care hospital.

Materials and Methods: A retrospective cross-sectional study was conducted in tertiary care hospital, Kadapa, A.P., and India for six months and utilized 600 prescriptions for the analysis. The data analyzed from the prescription included patients demographics, stage of hypertension according to JNC VII guidelines, type of drug therapy, class of anti-hypertensive, and cost effectiveness of therapy. Drug Percentage cost variation calculated, using the Minimum and Maximum cost of individual drug. The average maximum and minimum costs were calculated and compared with average range of blood pressure. Statistical analysis was performed by using unpaired t-test.

Result: In this study it was observed that Telmisartan was prescribed for maximum number of male and female subjects. In case of FDC, maximum number of male and female subjects were prescribed with Telmisartan + Hydrochlorothiazide. Average maximum cost of drugs is Rs.80.00 and minimum cost is Rs.33.00. Average B.P range for maximum cost drugs is 142/89 and minimum cost drugs is 141/91.

Conclusion: There is an extremely significant difference in maximum and minimum cost of anti-hypertensive drugs but B.P range remains same for both. Hence minimum cost drugs can be prescribed instead of maximum cost drugs to provide cost-effective treatment.

Key words: FDC, Unpaired t-test, % cost variation, Telmisartan, Hydrochlorothiazide.

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I. Introduction

Hypertension is a condition which involves increased force of blood flow on lateral walls of arteries and veins. It is a major risk factor for most of the cardiovascular diseases like coronary heart disease, stroke, congestive heart failure, impaired renal function. It is a treatable condition which can be treated with continuous treatment by anti-hypertensive drugs. The most commonly used anti-hypertensive drugs are: Diuretics, Beta blockers, Angiotensin converting enzyme inhibitors, Angiotensin receptor blockers, Calcium channel blockers. As prevalence of hypertension increased there is also an increase in investment of treatment and this shows impact on our health economics. Physicians prescribe drugs from many pharmacological agents to treat hypertension. Clinical pharmacist play an important role in managing cost by providing information to the physicians for prescribing cost effective drugs when it is appropriate. Evidence based therapy with safety and efficacy and low cost must be selected. By this we can reduce economic burden and quality of patient care can be enhanced. Now, the present study is mainly to analyze the cost and prescribing patterns of anti-hypertensive drugs among various physicians.

II. Material And Methods

This retrospective comparative study was carried out on patients of Department of general Medicine at tertiary care hospital, Kadapa, A.P., and India for six months and utilized 600 prescriptions.

Study Design: a retrospective observational study.

Study Location: This was a tertiary care teaching hospital based study done in Department of General Medicine and casualty, at Kadapa, Andhra Pradesh, India.

Study Duration: 6 months

Sample size: 600 patients.

Inclusion criteria:

- Both male and female patients with hypertension.
- Patients aged \geq 18 years

- Both IP and OP patients who come for regular follow-up.
- Patients who are willing to participate in the study.

Exclusion criteria:

- Patients who are not willing to participate in the study.
- Pregnant and lactating women.
- Herbal preparations available in the market were excluded.
- Drugs which are manufactured by only one company were excluded.
- No Co-morbid condition.

Materials of the study:

- Data record form. (DRF)
- Current index of medical specialties (CIMS).
- Biomedical literatures.

III. Procedure methodology

Both OP and IP patients will be included in the study and their demographic details will be collected through personal interview. The details of the therapy will be collected from prescription and by medication chart review. The costs of the drugs of different brands will be collected from CIMS. The cost of 10 tablets will be collected for each brand. The maximum price and minimum price for each drug will be observed. Percentage variation of cost will be calculated by using the following formula.

$$\text{Maximum cost} - \text{minimum cost} \times 100 \div \text{minimum cost}$$

The average maximum and minimum costs were calculated and compared with average range of blood pressure. The present study comes under cost-minimization analysis which is one of the important pharmacoeconomic method.

IV. Statistical analysis

For this study, Unpaired T-test is used to perform the statistical analysis of the data. It tests the null hypothesis that the population means related to two independent, random samples from an approximately normal distribution are equal. In this study, it was performed using Graph Pad Prism.

V. Result

For this study, data of 600 subjects was collected who are on treatment with anti-hypertensive drugs. The data included age, gender, range of BP, class of drug, brand name and generic names of drug and their cost per 10 tablets. Descriptive analysis of the collected data was conducted along with the statistical analysis and the results were shown in the form of following tables and graphs.

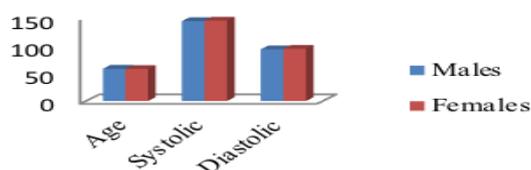
6.1 .Average age and range of BP of the study population:

The age of both males and females were observed and calculated average of age of subjects. Average age of males with hypertension was found to be 58yrs and average age of females on anti-hypertensive therapy was found to be 57yrs. Average systolic and diastolic pressures of males was found to be 144 and 93 mm of Hg respectively. Average systolic and diastolic pressures of females was found to be 145 and 94 mm of Hg respectively. There is no significant difference in average age and ranges of BP between males and females. This result is shown in Table no: 6.1 and Fig.No:6.1.

Table no: 6.1. Average age and B.P range

Gender	Age	Systolic	Diastolic
Males	58.28	144.08	93.34
Females	57.85	145.04	94.31

Fig. no: 6.1 Average age and B.P range



6.2. Age distribution of study population:

Based on the ages of the total study population, the subjects were separated according to the range of their ages. From this it was observed that highest number of male subjects with hypertension were at the range of 50-59 years of age with the percentage of 18.17% and female subjects with hypertension were more at the age of 40-49 years with the percentage of 11.50%. This data was shown in the form of tables and graphs in Table no:6.2 and Fig.no:6.2.

Fig. no: 6.2 Age distribution of study population

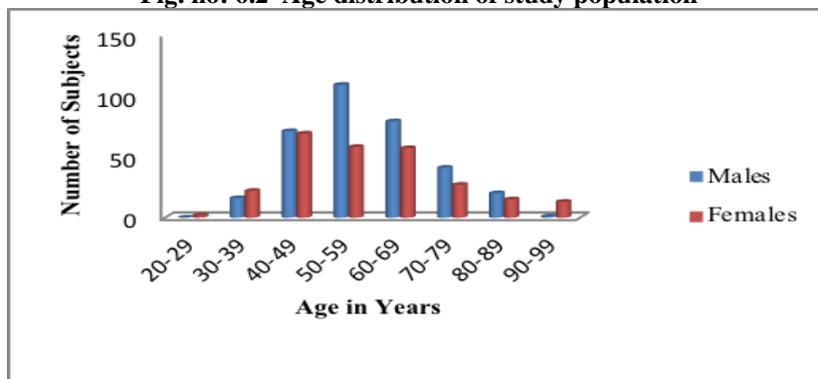


Table no:6.2 Age distribution of population

Age Distribution	Males	Percentage	Females	Percentage
20-29	0	0	2	0.33
30-39	16	2.67	22	3.67
40-49	71	11.83	69	11.50
50-59	109	18.17	58	9.67
60-69	79	13.17	57	9.50
70-79	41	6.83	27	4.50
80-89	20	3.33	15	2.50
90-99	1	0.17	13	2.17
Total	337	56.17	263	43.83

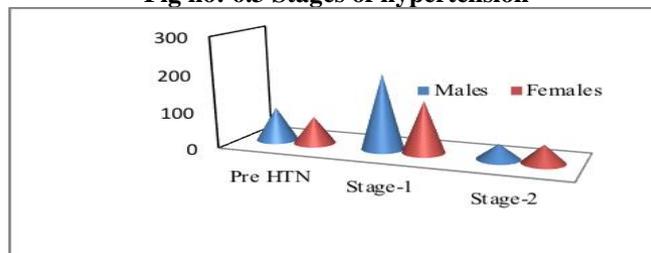
6.3. Average of study population at various stages of Hypertension:

There are various stages of hypertension namely Pre-hypertension, Stage 1 hypertension and Stage 2 hypertension. From this study, it was found that out of 600 subjects maximum numbers of male subjects were with Stage 1 hypertension with percentage of 34% and maximum number of female subjects were with stage-1 hypertension with percentage of 23%. The data was shown in Table no:6.3 and Fig.no:6.3.

Table no: 6.3 Stages of hypertension

Type of Hypertension	Males	Percentage	Females	Percentage
Pre HTN	92	15.33	74	12.33
Stage-1	204	34.00	140	23.33
Stage-2	41	6.83	49	8.17
Average	337	56.17	263	43.83

Fig no: 6.3 Stages of hypertension



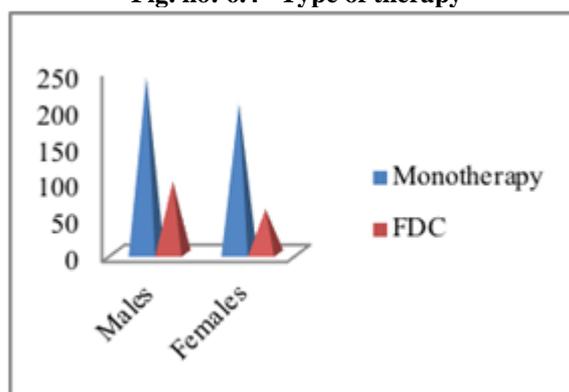
6.4. Type of therapy:

There are two types of anti-hypertensive therapy included in the study namely monotherapy and fixed drug combination. The total number of male subjects under monotherapy were 239 which is of 39.83% and subjects under FDC were 98 which is of 16.33%. The total number of female subjects under monotherapy were 203 which is of 33.83% and subjects under FDC were 60 which is of 10%. This data was shown in Table no: 6.4 and Fig no: 6.4.

Table no: 6.4 Type of therapy

Type of therapy	Males	Percentage	Females	Percentage
Monotherapy	239	39.83	203	33.83
FDC	98	16.33	60	10.00

Fig. no: 6.4 Type of therapy



6.5. Name of drug:

There are various anti-hypertensive drugs that are being used for therapy of hypertension. In this study it was observed that Telmisartan was prescribed for maximum number of male subjects for about 80 subjects which is of 13.33%. The maximum number of female subjects of about 48 subjects were prescribed with the same Telmisartan which is of 8%. The data is given for all drugs in Table no:6.5.1.

Table no: 6.5.1 Name of the drug (Monotherapy)

Drug	Male	Percentage	Female	Percentage
Amlodipine	21	3.5	9	1.5
Amiodarone	2	0.33	0	0
Atenolol	15	2.5	25	4.17
Azilsartan	0	0	2	0.33
Bisoprolol	8	1.33	9	1.5
Carvedilol	12	2	6	1
Clindipine	9	1.5	5	0.83
Furosemide	3	0.5	2	0.33
Lisinopril	3	0.5	1	0.17
Losartan	15	2.5	12	2
Metoprolol	18	3	21	3.5
Nifedipine	3	0.5	3	0.5
Nebivolol	0	0	1	0.17
Olmisartan	8	1.33	11	1.83
Propranolol	22	3.67	36	6
Prazosin	0	0	3	0.5
Ramipril	13	2.17	8	1.33
Telmisartan	80	13.33	48	8
Torsemide	7	1.17	1	0.17

In case of FDC, both males and females, maximum were prescribed with Telmisartan + Hydrochlorothiazide.

Table no: 6.5.2 Name of the drug (FDC)

DRUG	MALE	%	FEMALE	%
Amlodipine + Atenolol	13	2.17	7	1.17
Amlodipine+hydrochlorothiazide	1	0.17	2	0.33
Amlodipine+Metoprolol succinate	3	0.5	1	0.17
Amlodipine+furosemide	1	0.17	0	0
Bisoprolol+ Amlodipine	3	0.5	2	0.33
Telmisartan+ Chlorthalidone	6	1	9	1.5
Furosemide+ Spiranolactone	10	1.67	3	0.5
Losartan+Hydrochlorothiazide	1	0.17	1	0.17
Telmisartan+ Metoprolol	9	1.5	1	0.17
Olmesartan+Amlodipine	2	0.33	1	0.17
Olmesartan+Hydrochlorothiazide	5	0.83	5	0.83
Olmesartan+clindipine+chlorthalidone	1	0.17	0	0
Olmesartan+Metoprolol	1	0.17	0	0
Telmisartan+Hydrochlorothiazide	19	3.17	18	3
Telmisartan+Amlodipine	18	3	7	1.167
Torsemide+ Spiranolactone	5	0.83	0	0
Amiloride+Furosemide	0	0	1	0.167
Propranolol+hydrochlorothiazide	0	0	1	0.167
Ramipril+metoprolol succinate	0	0	1	0.167

6.6. Class of drug:

From the collected data it was observed that male subjects were mostly prescribed with ARB's and female subjects were prescribed highly with Beta blockers. The information was given in Table no:6.6.1. In case of combination therapy, maximum male subjects were with ARB's+Diuretics and females also with the same class. This is shown in Table no: 6.6.2.

Table no: 6.6.1 Class of drug (Monotherapy)

CLASS OF DRUG	MALE	PERCENTAGE	FEMALE	PPERCENTAGE
ACE inhibitors	16	2.67	9	1.5
Alpha-blockers	0	0	2	0.33
ARB's	104	17.33	73	12.17
Beta-blockers	76	12.67	98	16.3
CCB's	33	5.5	17	2.83
Diuretics	11	1.83	3	0.5

Table no: 6.6.2 Class of drug (FDC)

CLASS OF DRUG	MALE	%	FEMALE	%
ACE's+Beta-blockers	0	0	1	0.00
ARB's+CCB's	20	3.33	8	0.56
ARB's+Beta-blockers	10	1.67	1	0.28
ARB's+CCB's+Diuretics	1	0.167	0	0.03
ARB's+Diuretics	31	5.17	34	0.86
CCB's+Beta-blockers	18	3	10	0.50
Beta-blockers+Diuretics	0	0	1	0.00
CCB's+Diuretics	2	0.33	2	0.06
Diuretics+Diuretics	15	2.5	4	0.42

6.7. Percentage cost variation of drugs:

Percentage cost variation was calculated by using the formula. In case of monotherapy highest percentage variation was observed for Metoprolol and in case of FDC it was observed for Amlodipine +Atenolol. The data was shown in Table no:6.7.1, Table no:6.7.2. Average systolic and diastolic pressures were compared and there is no significant difference observed. It was shown in Fig no:6.7.3 and Table no:6.7.3.

Table no: 6.7.1 percentage cost variation

NAME OF THE DRUG	MAX COST	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	MIN COST	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE	% cost variation
Amlodipine	67.5	140	90	11.61	146	98	481.40
Amiodarone	60	148	90	55.5	140	80	8.11
Atenolol	80	140	80	17.77	141	90	350.20
Azilsartan	59	140	90	59	150	100	0.00
Bisoprolol	54.43	145	95	22.5	150	95	141.91
Carvedilol	68.5	145	93	18.5	140	94	270.27
Clindipine	69.92	142	95	39.93	150	100	75.11
Furosemide	61.75	138	90	33.3	132	90	85.44
Lisinopril	79.2	140	90	43.12	130	90	83.67
Losartan	46.6	148	90	15.5	143	83	200.65
Metaprolol	158.9	166	90	19.5	135	90	714.87
Nifedipine	55.2	140	93	16	140	90	245.00
Nebivilol	50.5	150	80	50.5	150	80	0.00
Olmesartan	210	130	80	45	140	100	366.67
Propranolol	45.25	135	88	11.23	135	88	278.01
Prazosin	104	140	95	104	140	95	0.00
Ramipril	82.35	128	84	25.5	136	88	222.94
Telmisartan	128.7	160	100	19.06	137	90	575.24
Torsemide	42.9	130	90	35.4	150	90	21.19
Average	80.24	142.31	89.69	33.84	141.39	91.12	

Table No: 6.7.3 Average ranges of BP for maximum and minimum cost drugs

	Cost	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE
Max	80.24737	142.3684	89.63158
Min	33.83789	141.3158	91.10526

Fig. no: 6.7.3

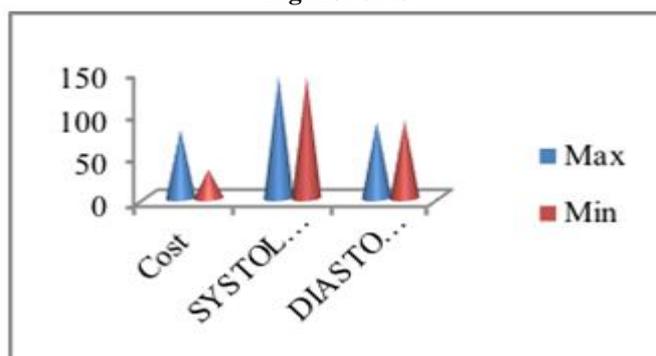


Fig. No: 6.7.2 Range of BP for minimum cost drugs

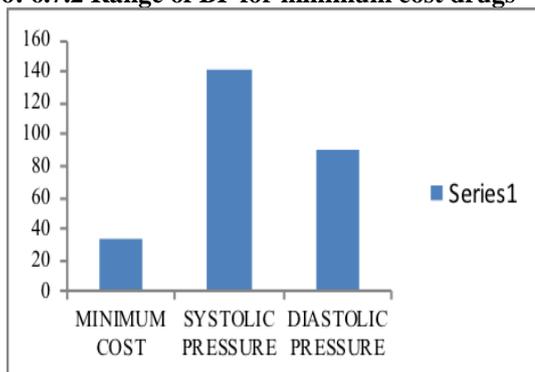
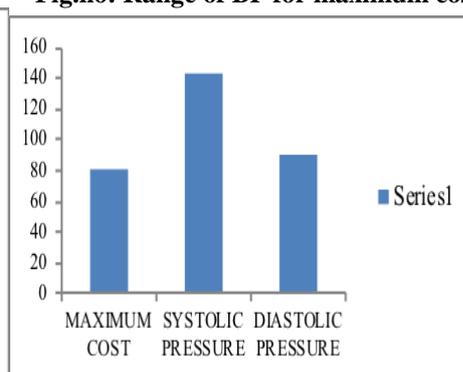


Fig.no: Range of BP for maximum cost drugs



6.8. Statistical analysis:

Unpaired T-test was done by using graph pad prism and the results were shown in Fig no: 6.8.1, 6.8.2, 6.8.3 and Tables no:6.8.1, 6.8.2, 6.8.3.

Fig. No:6.8.1 Maximum and Minimum cost of drugs

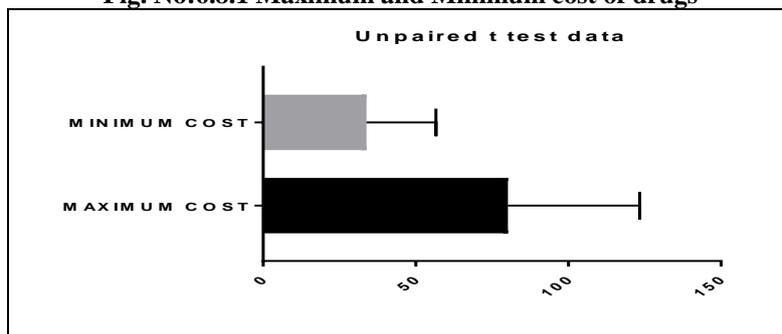


Fig. No: 6.8.2 Average systole pressure for maximum and minimum cost drugs

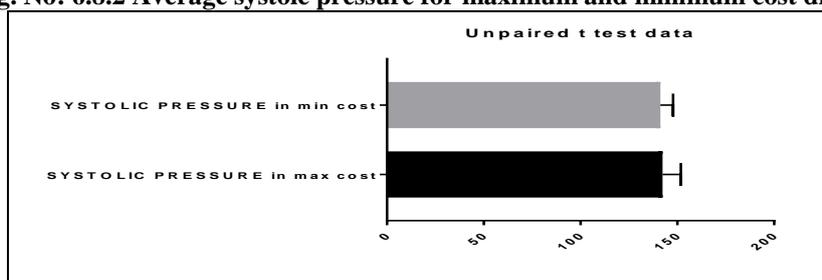


Fig. No: 6.8.3 Average diastole pressure for maximum and minimum cost drugs

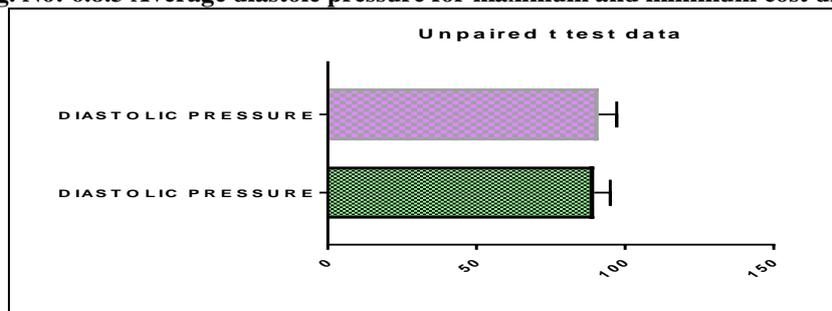


Table No: 6.8.1 Maximum and Minimum cost of drugs

NAME OF THE DRUG	MAXIMUM COST	MINIMUM COST
Amlodipine	67.5	11.61
Amiodarone	60	55.5
Atenolol	80	17.77
Azilsartan	59	59
Bisoprolol	54.43	22.5
Carvedilol	68.5	18.5
Clindipine	69.92	39.93
Furosemide	61.75	33.3
Lisinopril	79.2	43.12
Losartan	46.6	15.5
Metoprolol	158.9	19.5
Nifedipine	55.2	16
Nebivilol	50.5	50.5
Olmesartan	210	45
Propranolol	45.25	11.23
Prazosin	104	104
Ramipril	82.35	25.5
Telmisartan	128.7	19.06
Torsemide	42.9	35.4
Average	80.22	33.84

P summary *** Extremely Significant Difference

P value – 0.0002

P value summary - ***

95% confidence interval

Mean ± SEM of column A – 80.25 ± 9.894, n=19

Mean ± SEM of column B – 33.84 ± 5.223, n=19

Table No: 6.8.2 Average systole pressure for maximum and minimum cost drugs

Systolic Pressure in Max Cost	Systolic Pressure in Min Cost
140	146
148	140
140	141
140	150
145	150
145	140
142	150
138	132
140	130
148	143
166	135
140	140
150	150
130	140
135	135
140	140
128	136
160	137
130	150

P value- 0.6920

P value summary – ns 95% confidence interval

Mean ± SEM of column A – 142.4 ± 2.179, n=19

Mean ± SEM of column B – 141.3 ± 1.483, n=19

Table No: 6.8.3 Average diastole pressure for maximum and minimum cost drugs

Diastolic Pressure in Max Cost	Diastolic Pressure in Min Cost
90	98
90	80
80	90
90	100
95	95
93	94
95	100
90	90
90	90
90	83
90	90
93	90
80	80
80	100
88	88
95	95
84	88
100	90
90	90

P Value- 0.4355

P value summary- ns

Mean ± SEM of column A – 89.63 ± 1.245, n=19

Mean ± SEM of column B – 91.11 ± 1.393, n=19

95% confidence interval

VI. Discussion

Hypertension is a condition which involves increased force of blood flow on lateral walls of arteries and veins. It is a major risk factor for most of the cardiovascular diseases like coronary heart disease, stroke, congestive heart failure, impaired renal function. It is a treatable condition which can be treated with continuous

treatment by anti-hypertensive drugs. Blood pressure is determined by resistance to blood flow in arteries and amount of blood heart pumps.

As prevalence of hypertension increased there is also an increase in investment of treatment and this shows impact on our health economics. Physicians prescribe drugs from many pharmacological agents to treat hypertension. Clinical pharmacist play an important role in managing cost by providing information to the physicians for prescribing cost effective drugs when it is appropriate. Evidence based therapy with safety and efficacy and low cost must be selected. By this we can reduce economic burden and quality of patient care can be enhanced.

Now, the present study is mainly to analyze the cost and prescribing patterns of anti-hypertensive drugs among various physicians. For this study, data of 600 subjects was collected who are on treatment with anti-hypertensive drugs. The data included age, gender, range of BP, class of drug, brand name and generic names of drug and their cost per 10 tablets. Descriptive analysis of the collected data was conducted along with the statistical analysis.

The age of both males and females were observed and calculated average of age of subjects. Average age of males with hypertension was found to be 58yrs and average age of females on anti-hypertensive therapy was found to be 57yrs. Average systolic and diastolic pressures of males was found to be 144 and 93 mm of Hg respectively. Average systolic and diastolic pressures of females was found to be 145 and 94 mm oh Hg respectively. There is no significant difference in average age and ranges of BP between males and females.

Based on the ages of the total study population, the subjects were separated according to the range of their ages. From this it was observed that highest number of male subjects with hypertension were at the range of 50-59 years of age with the percentage of 18.17% and female subjects with hypertension were more at the age of 40-49 years with the percentage of 11.50%.

There are various stages of hypertension namely Pre-hypertension, Stage 1 hypertension and Stage 2 hypertension. From this study, it was found that out of 600 subjects maximum number of male subjects were with Stage 1 hypertension with percentage of 34% and maximum number of female subjects were with stage-1 hypertension with percentage of 23%.

There are two types of anti-hypertensive therapy included in the study namely monotherapy and fixed drug combination. The total number of male subjects under monotherapy were 239 which is of 39.83% and subjects under FDC were 98 which is of 16.33%. The total number of female subjects under monotherapy were 203 which is of 33.83% and subjects under FDC were 60 which is of 10%.

There are various anti-hypertensive drugs that are being used for therapy of hypertension. In this study it was observed that Telmisartan was prescribed for maximum number of male subjects for about 80 subjects which is of 13.33%. The maximum number of female subjects of about 48 subjects were prescribed with the same Telmisartan which is of 8%. In case of FDC, both males and females, maximum were prescribed with Telmisartan + Hydrochlorothiazide.

From the collected data it was observed that male subjects were mostly prescribed with ARB's and female subjects were prescribed highly with Beta blockers. In case of combination therapy, maximum male subjects were with ARB's+Diuretics and females also with the same class.

Percentage cost variation was calculated by using the formula. In case of monotherapy highest percentage variation was observed for Metoprolol and in case of FDC it was observed for Amlodipine +Atenolol. Average systolic and diastolic pressures were compared and there is no significant difference observed.

From this study it was observed that average maximum cost of drugs is Rs.80.00 and average minimum cost of drugs is Rs.33.00. The average range of B.P for maximum cost drugs is 142/89 and for minimum cost drugs is 141/91. From this it was observed that for both maximum and minimum cost drugs the range of B.P remains same. So, the clinical outcome is same for both maximum and minimum cost drugs.

The unpaired T-test was performed and the results shown that extremely significant difference in cost of drugs and no significant difference in average systolic and diastolic pressures.

VII. Conclusion

It was concluded that the maximum number of male and female subjects were prescribed with the drug Telmisartan, In case of FDC, maximum number of male and female subjects were prescribed with Telmisartan + Hydrochlorothiazide. There is an extremely significant difference in maximum and minimum costs of prescribed Anti-hypertensive drugs but the range of Blood pressure remains same for both maximum and minimum cost drugs. Hence, minimum cost drugs can be prescribed instead of maximum cost drugs to provide cost effective Anti-hypertensive treatment.

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