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# Evaluating Price Disparities Among Anti-Parkinson's Disease Drugs in the Indian Pharmaceutical Market

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**Abstract:**

- ***Introduction:***

**Pharmacoeconomics observes, measures, and compares the economic burden and detrimental impact of pharmacological therapy on the healthcare system, and it plays an important part in medical practices. Parkinson's disease (PD) has a large socioeconomic impact on society. It has become increasingly common over the past 25 years and resulted in 5.8 million disability-adjusted life years (DALYs) in 2019.**

- ***Aims and Objectives:***

**The purpose is to determine the number of brands and pricing variations for each antiparkinsonian drug available in India. Which can help to develop more cost-effective treatment regimens that improve patient compliance and provide great care.**

- ***Methods:***

**The cost of particular antiparkinsonian drugs of different strengths was sourced from the "Current Index of Medical Specialties" (CIMS) and "India Drug Review" (IDR 2024 issue 3). The difference between the maximum price and minimum price was analysed, and the percentage variation in prices was calculated. Results: In total, 208 brands representing five different groups of antiparkinsonian medicines were found. A total of 10 medications were introduced, each with a distinct strength (mg), as well as 2 fixed-dose combination drugs with 6 different strengths. Procyclidine 2.5 mg (central anticholinergics) had the highest cost ratio (4.58 percentage) and cost variation (358.33 percentage). Pramipexole 0.75 mg (a dopaminergic agonist) had the lowest cost ratio (1.16) and cost variation (16.4 percentage). While in the fixed dose combination, Levodopa + Carbidopa (250/25 mg) had the highest cost ratio (7.39) and Percentage cost variation (639.89 Percentage). Levodoapa+Carbidopa+Entacapone (100/25/200 mg) had the lowest cost ratio (1.12) and Percentage cost variation (12.5 percent).**

- ***Conclusion:***

**The study emphasises the significance of the selection of most appropriate brand of medicine which helps to reduce the patient economic burden results in effective medication adherence and creates awareness to the healthcare workers on the wide variations of cost and selection of Anti-Parkinson drugs.**

***Keywords****: Pharmacoeconomics, Economic Burden, Cost Analysis, Cost Ratio, Parkinson Disease.*

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## I. INTRODUCTION

Pharmacoeconomics identifies, measures, and compares, the financial burden and detrimental impacts of pharmacological therapy on healthcare System and play a crucial role in medical practices[1]. Prescribing a drug solely on cost might be challenging for practitioners hence studies aim to improve policy formulation, decision-making, prescribing, and resource utilization. The goal is to persuade individuals or groups to adopt a more efficient course of action. In industrialized countries with medical insurance, medications may not be as expensive as in developing countries like India, where medical insurance is still in its early stages, affordability remains a significant challenge result in major economic ramifications for patients and impacts treatment compliance. The cost of medications affects medical treatment adherence and rational prescribing practices. Medical expenses are classified into three types: direct, indirect, and intangible costs[2,3,4].

The global incidence of neurodegenerative disease has steadily increased as the world's population. The economic consequences of Parkinson's disease include both direct healthcare expenditures (for drugs, medical care, and hospitalization) and intangible expenses (for decreased worker productivity[5,6]. In 2019, global estimates indicated that there were over 8.5 million people with Parkinson's disease. According to current estimates, Parkinson's disease (PD) caused 5.8 million disability adjusted life years (DALYs) in 2019, an 81% rise since 2000, and 329000 deaths, a more than 100% increase since 2000[7].

Parkinson's disease is characterized by a condition bradykinesia, tremor, stiffness, and postural instability. Comorbidities such as mental illnesses, autonomic dysfunction, swallowing and speech difficulties, and sleep deprivation may develop along the course of the disease has a significant socioeconomic impact on society[8,9]. Epidemiologic research indicates that environmental factors such as rural living, drinking well waters, and exposure to heavy metals and hydrocarbons play a minor but significant role in Idiopathic Parkinson Disease risk. Cigarette smoking, coffee consumption, and use of nonsteroidal anti-inflammatory drugs have been linked to avoidance of illness[10].

The disease's chronic, progressive course, which frequently results in severe disability, incurs large costs for medical resources utilized for patient treatment, care, and rehabilitation, as well as reduced or lost productivity due to illness or early death. In countries with low resources, such as India, the healthcare sector has been negatively affected, resulting in higher drug prices[11].

This study aims to analyses the cost of different brands of the same generic antiparkinsonian drug and to assess the number of brands and cost variations for each formulation. Understanding the cost variations of anti-parkinson medications can lead to more cost-effective treatment regimens results in positive patient compliance, reduce therapy failure rates, and provide excellent care.

## II. MATERIALS & METHODS

The ethics committee's review was not evaluated since no human or animal subjects were involved. Prices in INR* (Indian National Rupees) for anti- Parkinson's medications manufactured by several pharmaceutical companies in India in the same strength and dose form were obtained from the "Current Index of Medical Specialties" (CIMS) (10.5) and "India Drug Review" (IDR 2024 issue 3). The cost of ten oral and two fixed dose combination (FDC) antiparkinsonian medications produced by various pharmaceutical businesses and available in the Indian market was studied.

➢ *Inclusion Criteria*

- All antiparkinsonian medications, both single molecules and fixed drugs combinations.
- Medication manufactured by multiple companies available in Indian market.

➢ *Exclusion Criteria*

- Drug formulation manufactured by only one pharmaceutical company.
- Drug formulation having no price information.

➢ *Study Procedure*

A total of 10 oral and 2 Fixed dose combination (FDCs) of antiparkinsonian drugs with different strength were extracted from various sources. The cost of antiparkinsonian drugs was analysed based on different classes, such as Glutamate agonist, Dopaminergic agonist, Vesicular monoamine transporter 2 inhibitors, Central anticholinergics, MOA-B inhibitors and COMT inhibitors. The cost of particular antiparkinsonian drugs with the same dose and dosage form, manufactured by different companies was compared. The price of Antiparkinsonian medications was calculated based on an average of 10 tablets of each strip, with variations in availability. The cost ratio was calculated by the ratio of most expensive brand to the least expensive brand.

The cost ratio was calculated by dividing the maximum brand price/least brand price[12],

$$\%\ \text{COST VARIATION} = \frac{\text{MAXIMUM PRICE} - \text{MINIMUM PRICE}}{\text{MINIMUM PRICE}} \times 100$$

The percentage variance in price was estimated by comparing the maximum and minimum prices of the same drug formulation from different pharmaceutical companies.

The percentage variation in price was calculated using the formula[13],

$$\text{COST RATIO} = \frac{\text{MAXIMUM PRICE}}{\text{MINIMUM PRICE}}$$

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➢ *Statistical Analysis:*

The data collected for the study was entered in both Microsoft Excel 2021 and Word 2021 and the result was interpreted with the absolute numbers and percentages. The findings were used to calculate the % cost variance and the cost ratio and data were presented in the form of tables, figures, and charts.

## III. RESULTS

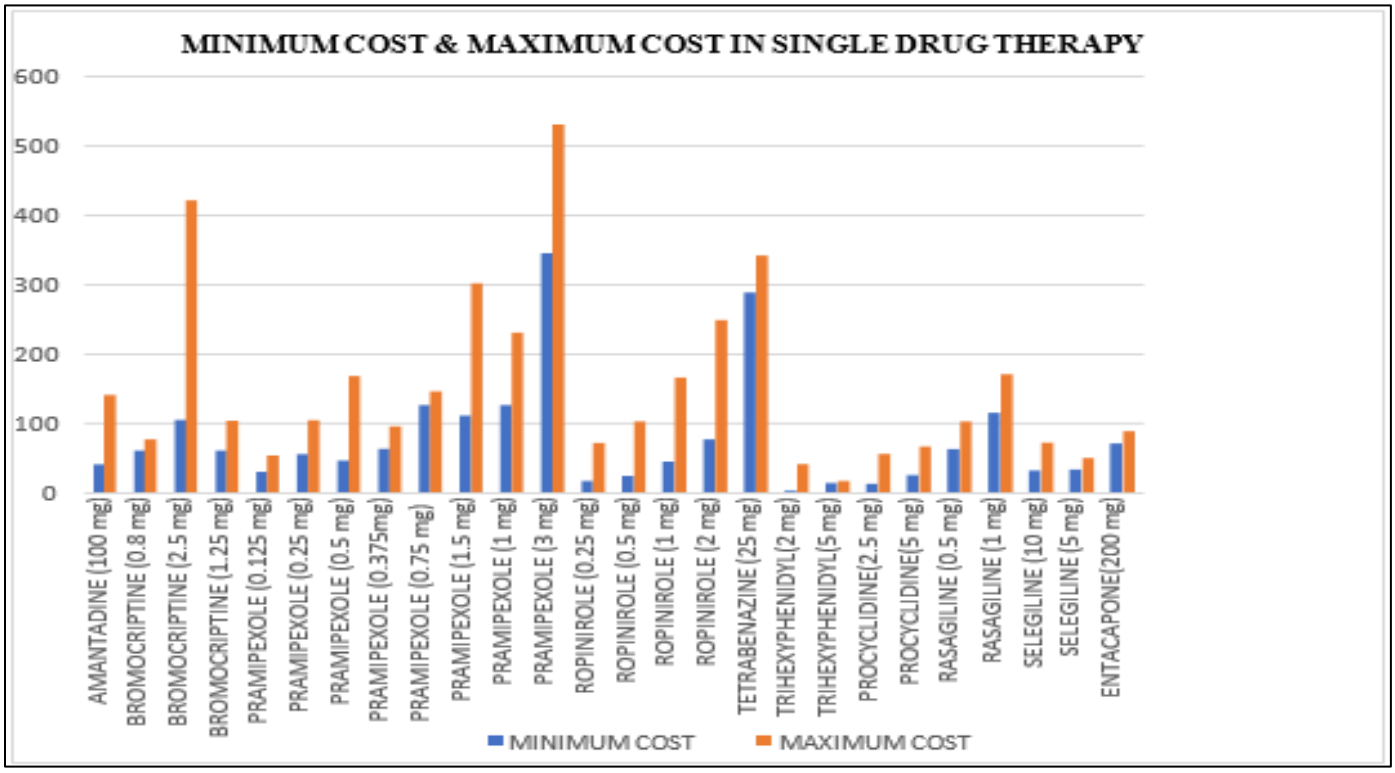


Fig 1 Cost Difference (Minimum and Maximum) of Antiparkinsonian Drugs of Single Oral Drug Therapy**.**

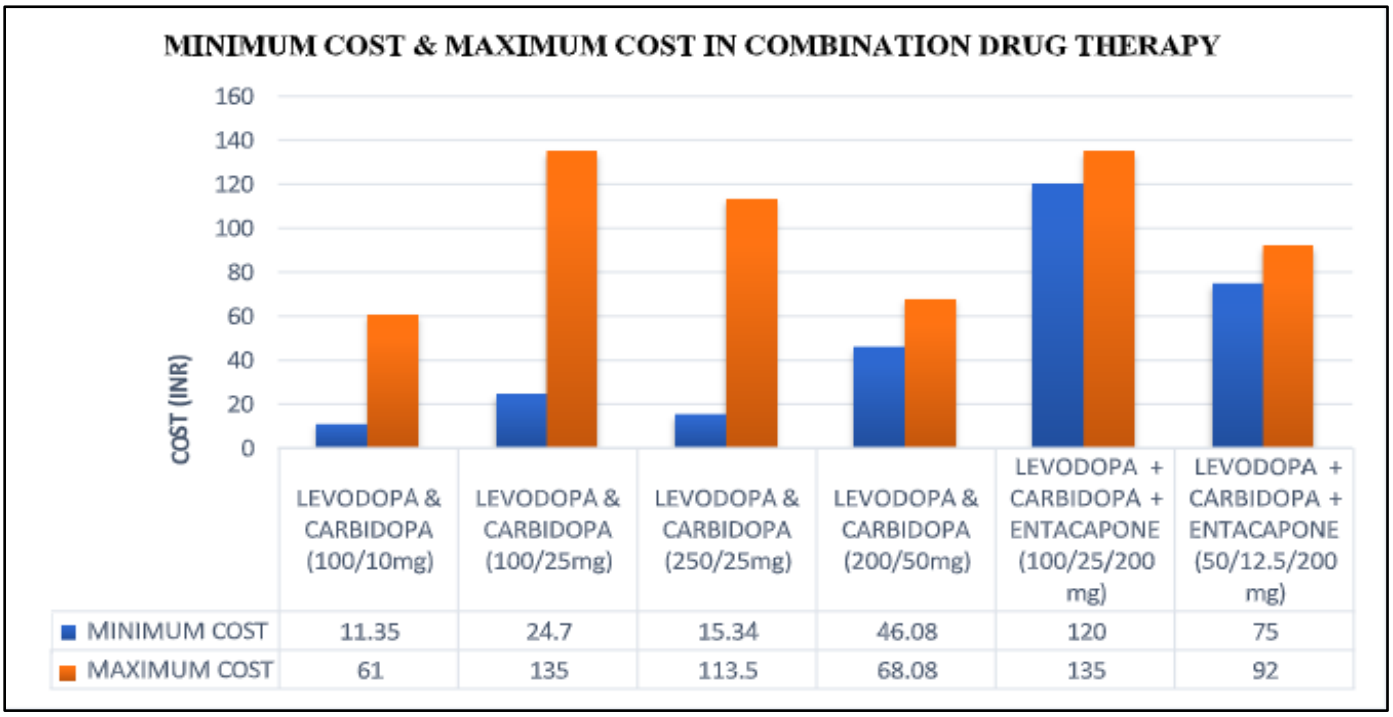


Fig 2 Cost Difference (Minimum And Maximum) of Antiparkinsonian Drugs of Fixed Dose Combination Drugs.

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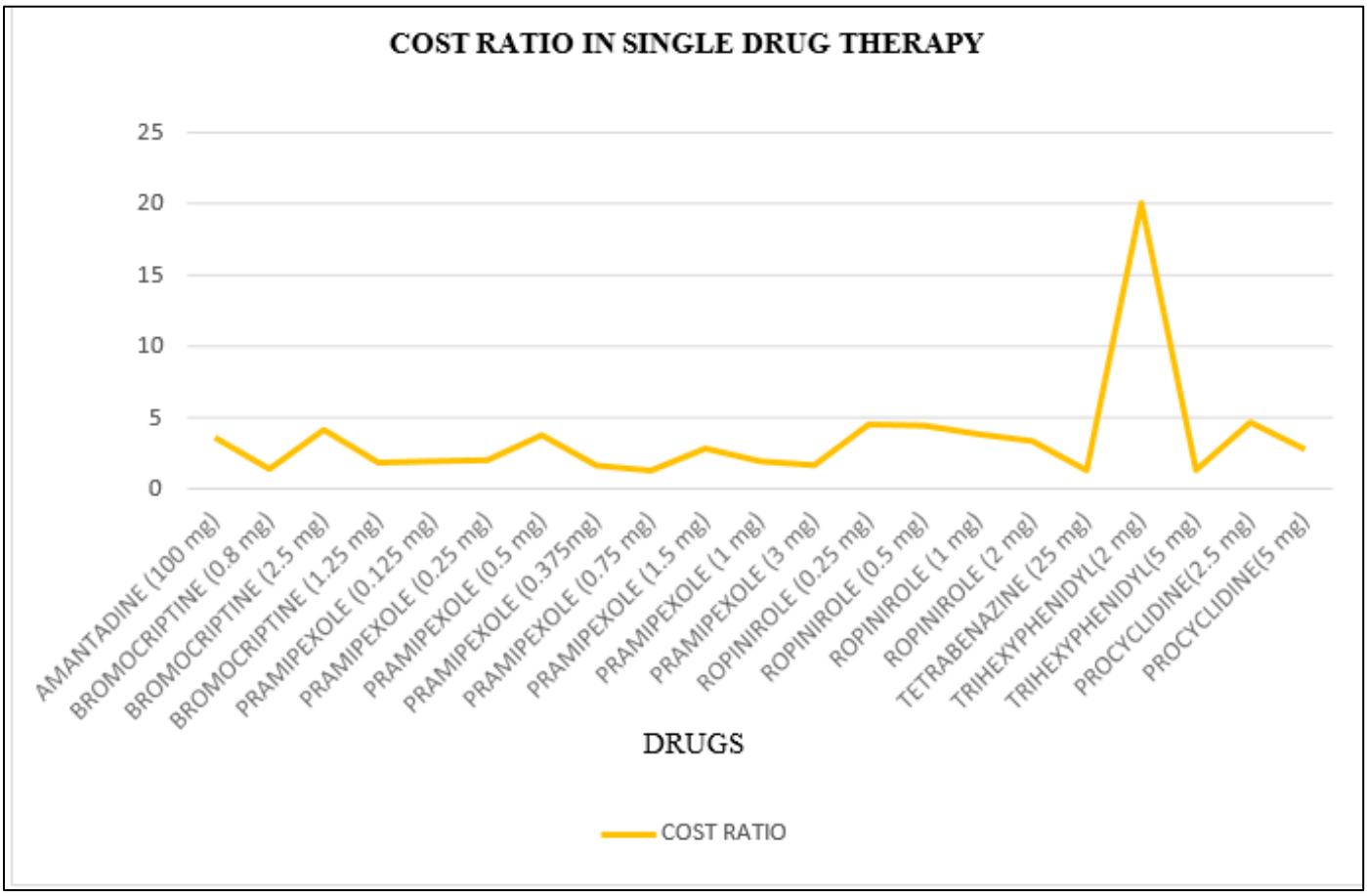


Fig 3 Cost Ratio (Minimum and Maximum) of Antiparkinsonian Drugs of Single Oral Drug Therapy.

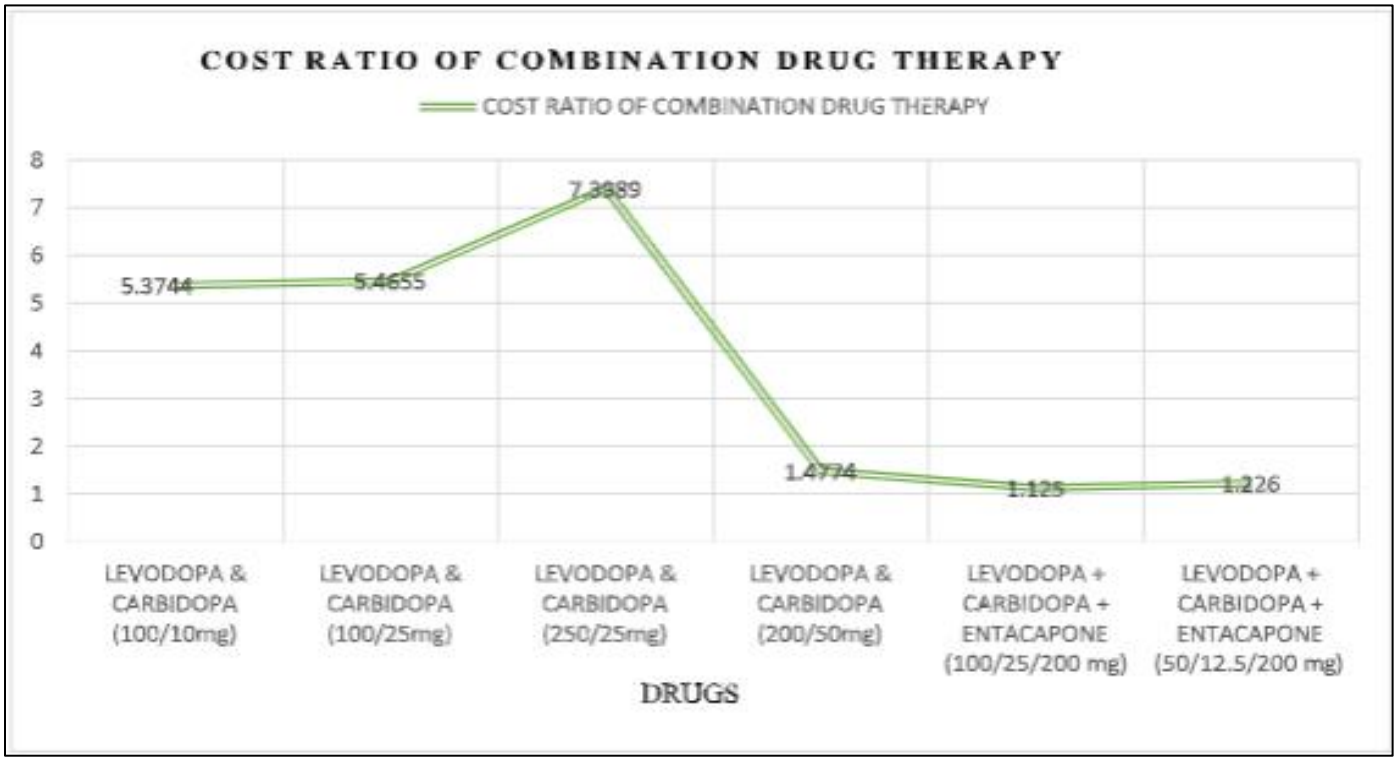


Fig 4 Cost Ratio (Minimum and Maximum) of Antiparkinsonian Drugs of Fixed Dose Combination Drugs.

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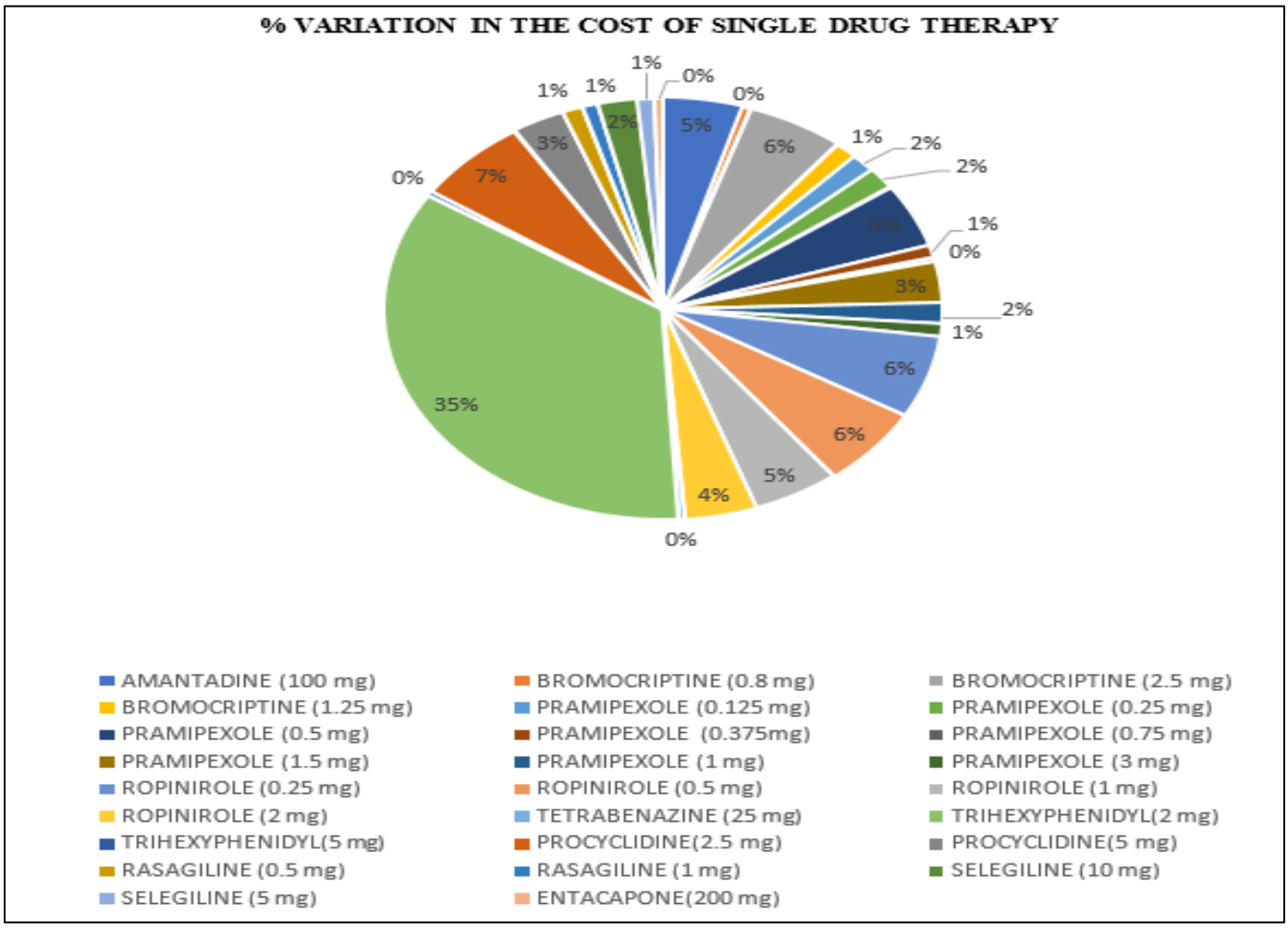


Fig 5 Cost Variation (Minimum and Maximum) of Antiparkinsonian Drugs of Single Oral Drug Therapy.

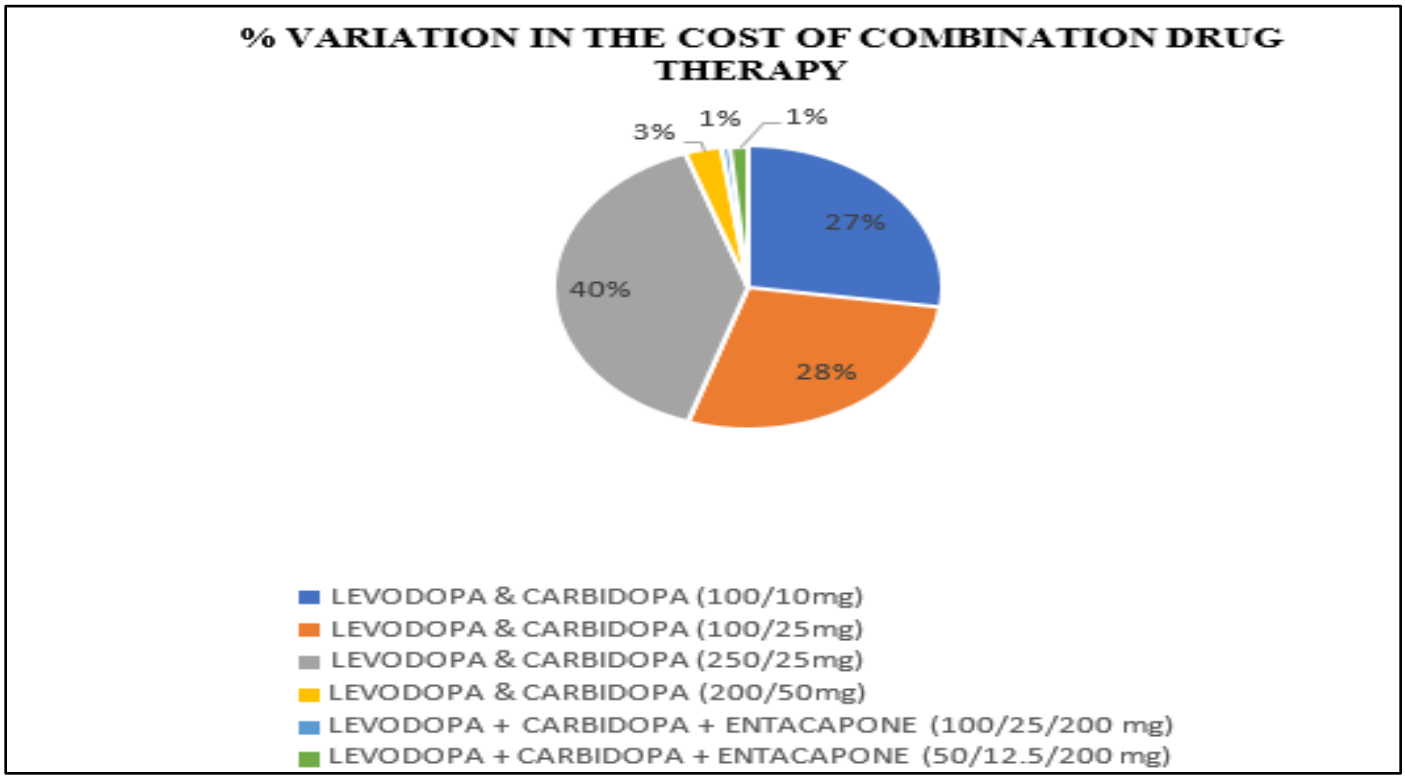


Fig 6 Cost Variations (Minimum and Maximum) of Antiparkinsonian Drugs of Fixed Dose Combination Drugs.

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Table 1 Show the Detailed Information of the Collected Data which Includes Minimum Cost Maximum Cost, Cost Ratio and Percentage Cost Variation.

| DRUG | DOSE | NUMBER OF MANUFACTURING COMPANIES | MINIMUM COST (INR) | MAXIMUM COST (INR) | COST RATIO | % VARIATION IN THE COST |
|---|---|---|---|---|---|---|
| **VARIATION IN COST & COST RATIO OF SINGLE ORAL DRUG THERAPY.** | | | | | | |
| **GLUTAMATE AGONIST** | | | | | | |
| AMANTADINE | 100mg | 5 | 40 | 140 | 3.5 | 250 |
| **DOPAMINERGIC AGONIST** | | | | | | |
| BROMOCRIPTINE | 0.8 mg | 5 | 60 | 76 | 1.266 | 26.66 |
| | 2.5 mg | 17 | 104 | 420.9 | 4.0471 | 304.711 |
| | 1.25 mg | 9 | 60 | 103 | 1.7166 | 71.666 |
| PRAMIPEXOLE | 0.125 mg | 8 | 29 | 53 | 1.8275 | 82.7586 |
| | 0.25 | 10 | 54.5 | 103.68 | 1.9023 | 90.2385 |
| | 0.5 mg | 12 | 45.63 | 167.4 | 3.6686 | 266.8639 |
| | 0.375 mg | 2 | 62.5 | 95 | 1.52 | 52 |
| | 0.75 mg | 2 | 125 | 145.5 | 1.164 | 16.4 |
| | 1.5 mg | 4 | 110 | 301 | 2.7363 | 173.6363 |
| | 1 mg | 8 | 125 | 230 | 1.84 | 84 |
| | 3 mg | 2 | 344 | 529.9 | 1.5404 | 54.0406 |
| ROPINIROLE | 0.25 mg | 5 | 16 | 71 | 4.4375 | 343.75 |
| | 0.5 mg | 6 | 23.5 | 102 | 4.3404 | 334.0425 |
| | 1 mg | 7 | 43.9 | 165 | 3.7585 | 275.8542 |
| | 2 mg | 7 | 76 | 248 | 3.2631 | 226.3157 |
| **VESICULAR MONOAMINE TRANSPORTER 2 INHIBITORS** | | | | | | |
| TETRABENAZINE | 25 mg | 3 | 287.38 | 341 | 1.1865 | 18.6582 |
| **CENTRAL ANTICHOLIERGICS** | | | | | | |
| TRIHEXYPHENIDYL | 2 mg | 28 | 2 | 40.15 | 20.075 | 1907.5 |
| | 5 mg | 2 | 13.26 | 15.86 | 1.196 | 19.6078 |
| PROCYCLIDINE | 2.5 mg | 9 | 12 | 55 | 4.5833 | 358.3333 |
| | 5 mg | 10 | 24.5 | 65.5 | 2.6734 | 167.3469 |
| **MOA – B INHIBITTORS** | | | | | | |
| RASAGILINE | 0.5 mg | 4 | 62 | 102 | 1.6451 | 64.5161 |
| | 1 mg | 4 | 114 | 170 | 1.4912 | 49.1228 |
| SELEGILINE | 10 mg | 2 | 31.38 | 71.5 | 2.2785 | 127.8521 |
| | 5 mg | 7 | 32.5 | 49.26 | 1.5156 | 51.5692 |
| **COMT INHIBITORS** | | | | | | |
| ENTACAPONE | 200 mg | 2 | 70 | 88 | 1.2571 | 25.7142 |
| **VARIATION IN COST & COST RATIO OF FIXED DOSE COMBINATION DRUGS** | | | | | | |
| LEVODOPA& CARBIDOPA | 100/10mg | 6 | 11.35 | 61 | 5.3744 | 437.444 |
| | 100/25mg | 9 | 24.7 | 135 | 5.4655 | 446.5587 |
| | 250/25mg | 6 | 15.34 | 113.5 | 7.3989 | 639.8956 |
| | 200/50mg | 3 | 46.08 | 68.08 | 1.4774 | 47.743 |
| Levodopa + Carbidopa + Entacapone | 50/12.5/200mg | 2 | 75 | 92 | 1.226 | 22.6666 |

## IV. DISCUSSION

In total, 208 brands representing five different groups of antiparkinsonian medications were gathered from the sources. A total of ten medications were introduced, with 26 distinct strengths (mg), as well as two fixed dose combination drugs with six different strengths. The results indicated that,

- *Glutamate Agonist Drug: Amantadine*

In the class of glutamate agonist, the drug Amantadine is included, which is available in formulation of 100mg and 129mg. The percentage variation for 100mg is 250% and the cost ratio is 3.5. Amantadine 129mg was excluded from the study as the price of both brands is same.

- *Dopaminergic Agonists Drug: Bromocriptine*

Bromocriptine is available in three different formulations 0.8mg, 2.5mg and 1.25mg. The highest cost variation is with Bromocriptine 2.5mg (304.7%) and cost ratio (4.04). While the least cost variation is with the 0.8mg (26.66%) and cost ratio (1.26).

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➢ *Drug: Pramipexole*

Pramipexole is available in seven different formulations, 0.125mg, 0.25mg, 0.5mg, 0.375mg, 1.5mg, 1mg and 3mg. The highest cost variation (266.86%) and cost ratio (3.66) is with Pramipexole 0.5mg. While the least cost variation was with the 0.75mg including (16.4%) and cost ratio of 1.164.

➢ *Drug: Ropinirole*

Ropinirole is available in four different formulations, 0.25mg, 0.5mg,1mg and 2mg. The highest cost variation is with 0.25mg (343.75%) and cost ratio of (4.43). While the least cost variation is with the 2mg including (226.3%) and cost ratio of (3.26).

➢ *COMT Inhibitors Drug: Entacapone*

Among the COMT inhibitors the drug Entacapone was included for the study and available in formulation of 200mg. The percentage variation is 25.71% and the cost ratio is 1.25.

➢ *Central Anticholinergics*

- *Drug: Procyclidine*

Procyclidine is available in two different formulations,2.5mg and 5mg. The highest cost variation (358.33%) and cost ratio (4.58) is with Procyclidine 2.5mg. While the least cost variation (167.34%) and cost ratio (2.67) for Procyclidine on 5mg.

- *Drug: Trihexyphenidyl*

Trihexyphenidyl is available in two different formulations, 2mg and 5mg. The highest cost variation (1907.5%) and cost ratio (20.07) is with Trihexyphenidyl 2mg. While the least cost variation is for 5mg (19.60%) and cost ratio is (1.19).

- *MAO Inhibitors Drug: Rasagiline*

Rasagiline is available in two different formulations, 0.5mg and 1mg. The highest cost variation (64.51%) and cost ratio (1.64) is with Rasagiline 0.5mg. While the least cost variation for 1mg is (49.12%) and cost ratio (1.49).

- *Drug: Selegiline*

Selegiline is available in two different formulations, 5mg and 10mg. Among the selegiline the highest cost variation (127.85%) and cost ratio (2.27) is with Selegiline 10mg. While the least cost variation is with 5mg is (51.56%) and cost ratio (1.51).

- *Fixed dose combination (FDC) Drug: Levodopa and Carbidopa*

The combination of levodopa and carbidopa is available in four different formulations

Levodopa100mg/Carbidopa10mg
Levodopa100mg/Carbidopa25mg
Levodopa250mg/Carbidopa25mg
Levodopa200mg/Carbidopa50mg

Among this combinations, Levodopa 250mg/Carbidopa 25mg has highest cost variations 639.89% and cost ratio was 7.3. While the least cost variation was Levodopa200mg/Carbidopa50mg 47.74 and the cost ratio was 1.47.

➢ *Drug: Levodopa, Carbidopa and Entacapone:*

The combination of levodopa, Carbidopa and Entacapone is available in two different formulations,

Levodopa (100mg) + Carbidopa (25mg) + Entacapone (200mg)

Levodopa(50mg) +Carbidopa (12.5mg) + Entacapone (200mg)

Among this combinations, Levodopa100mg/Carbidopa25mg/Entacap one200mg has highest cost variations 12.5% and cost ratio was 1.1. While the least cost variation was Levodopa50mg/Carbidopa12.5mg/ Entacapone200mg cost variations 22.6% and the cost ratio was 1.2.

PD is a most common cognitive disease that affects millions of people worldwide[14]. The severity of Parkinson's disease may impact the consequences, including anxiety and depression, sleep disturbances, mental disorders, cognitive impairment or dementia, constipation, etc., which require additional treatments and result in increased expenditures[15].

To the best of our knowledge, till now no study has been conducted to assess the variation in anti-parkinsonian medication pricing in India. For the first time, our study examined the pricing differences between several brands of anti- parkinsonian medications accessible in the Indian market which can influence the healthcare professionals across globe.

Patients' low purchasing power and high drug expenses prevent them from accessing necessary medications resulting in negative therapeutics outcomes. The Indian pharmaceutical market is predominantly branded generic, which means that numerous companies sell the same drug under different brand names, excluding the manufacturer's company. The market has a high number of pharmaceutical drugs, leading in increased price variety among marketed medications[16]. In 2019, the World Health Assembly raised concerns about the high costs of medications and medical items, which limit progress towards universal health coverage. The cost of medicines must be reviewed on a regular basis to investigate the patient affordability[17].

However, in the majority of cases, cost information is not readily accessible to doctors, and even when it is, the significant difference between expensive and non- expensive alternatives is not highlighted[18].The National Pharmaceutical Pricing Authority (NPPA) of the Government of India regulates medicine prices in the Indian market. The Drugs Prices Control Order (DPCO) establishes a ceiling price for drugs based on their essentiality. Pharmaceutical companies must set prices for their products that are equal to or lower than the DPCO ceiling price. They are not permitted to sell any medicine on the DPCO list at a higher price[19]. Implementing price ceilings for vital pharmaceuticals poses additional hurdles in these nations. This might be attributed

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to inadequate national health systems and policies, ineffective program implementation and monitoring, and administrative challenges[20]. Rising prescription drug expenses and consumer goods prices may exacerbate cost-related medication nonadherence[21]. Perhaps the most essential yet tough, barriers to healthcare parity are the cost of medicine[22].

The results indicated that, Procyclidine 2.5mg (central anticholinergics) showed the highest cost ratio (4.58) and cost variation (358.33) While the Pramipexole 0.75mg (Dopaminergic agonist) showed the least cost ratio (1.16) and cost variation (16.4) While for the fixed dose combination, Levodopa +Carbidopa (250/25mg) Showed the highest cost ratio (7.39) and cost variation(639.89). Levodoapa+Carbidopa+Entacapone (100/25/200mg) showed the least cost ratio (1.12) and cost variation (12.5). The government should include all life savings drugs and combinations under price control orders. So, advantages of the study are to reduce the out of packet expenses this may lead to more compliance for treatment and reduce economic burden among the Parkinson patients.

## V. CONCLUSION

Our studies demonstrated significant cost difference in antiparkinsonian medications available in Indian market. The Government of India should manage medicine costs by bringing them under the Drug Pricing Control Order (DPCO), which has minimal price variations. The study emphasizes the significance of the selection of most appropriate brand of medicine which helps to reduce the patient economic burden results in effective medication adherence and creates awareness to the healthcare workers on the wide variations of cost. Only a collaborative effort can propel us toward the goal of "Health for All".

## CONFLICT OF INTEREST

The authors have no conflicts of interest regarding these investigations.

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