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Research Article

COMPARATIVE COST ANALYSIS OF HYPERCHOLESTEROLEMIA TREATMENT: ALLOPATHIC MEDICINE AND AYURVEDA MEDICINE

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ABSTRACT

The cost of treatment is very high for CVD and the prevalence of hypercholesterolemia is also very high in developing countries. Many Indian people do not have basic amenities and medical facilities are also not accessible. So alternative medicine can play an important role in the treatment of high cholesterol. *Arjuna* and *Kutki* are effective medicines in treating high cholesterol. **Methodology:** Comparative cross sectional study was planned to determine the socio-economic, and demographic status and comparison of treatment costs of high cholesterol patients in SS Hospital, IMS, BHU, Varanasi. **Result:** The overall expenditure for Group B is significantly high (3670.06) compared to Group A (1341.10). Medicine costs form the largest portion of expenses in Group B (1:4.8), while laboratory costs are the largest in Group A. **Discussion:** The economic burden poses a significant challenge in the treatment of any illness. Elevated cholesterol levels pose a significant problem in the current state of affairs in India. Developing countries face significant challenges in managing their financial issues.

INTRODUCTION

India is the nation with the highest population in the world. India's population has seen numerous economic downturns, and both rural and urban areas have extremely diverse socioeconomic condition. There is high rate of sickness, as well. The expense of treating various illnesses is very expensive in India[1-2] Following COVID-19, backstrokes, heart attacks are highly frequent. However, cardiovascular disease is also very common nowadays across the world [3].

The incidence of cardiovascular diseases (CVDs) is rapidly increasing worldwide and is currently considered to be the leading cause of death in both developing and developed countries.[4]

Rapid economic development and increasing westernized lifestyle of the past few decades have led to increased prevalence of these diseases and have attained alarming proportions among Indians in recent years [5 -6].

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Behavioral risk factors like unhealthy diet (rich in salt, fat, and sugars), physical inactivity, harmful use of alcohol and tobacco, raised body mass index, waist-hip ratio, and metabolic risk factors like hyperglycemia, hyperlipidemia and raised blood pressure are well-known causes of CVDs.[7]

The financial pressure and other related issues that patients and their families face as a result of the high expenses on healthcare are referred to as the "treatment burden of medical costs[8]." This load can be complex, impacting all facets of the lives of the patients and possibly affecting the way their health turns out.

In our Indian system, the two primary therapy categories utilized are contemporary medicine (allopathy) and AYUSH. Ayurvedic therapy is highly popular in AYUSH. With our current lifestyle high cholesterol is very common in India.

Dyslipidaemia is the primary risk factor for the development of atherosclerosis. An analysis of population-based studies conducted in India reveals a progressive rise in average total cholesterol levels. Recent studies have indicated that elevated levels of cholesterol are found in approximately 25-30% of individuals living in urban areas and 15-20% of individuals living in rural areas.[9]

This prevalence is lower than that of high-income countries. In India, the prevalent dyslipidemia conditions include borderline elevated LDL cholesterol, reduced HDL cholesterol, and elevated triglyceride levels. Research has indicated that metropolitan populations have experienced a rise in total cholesterol, LDL cholesterol, and triglyceride levels during a span of 20 years.[10]

The cost of treatment is very high for CVD and the prevalence of high cholesterol in developing countries is very high[11]. Many Indian people do not have basic amenities and medical facilities are also not accessible. So, alternative medicine can play an important role in the treatment of high cholesterol. *Arjuna* and *Kukti* are effective medicines in treating high cholesterol. [12]

The cost of treatment of both systems modern and Ayurvedic are also different. Cost analysis of both systems is very important. Developing countries face significant economic challenges, particularly when it comes to the cost of treating diseases. Health insurance coverage is significantly limited in poor nations [13]. Ayurvedic medicine is highly efficacious in treating numerous ailments.

Research on the burden of disease can be used to determine health policy priorities and justify the need for supporting social interventions, disease management, and prevention. We conducted a cost-of-treatment study to evaluate the direct medical and direct non-medical expenses associated with the therapy.

OBJECTIVES

1. To assess the socio-demographic conditions of the patients of high cholesterol.
2. To compare the cost of a one-month treatment of *Arjuna Kutki* with Atorvastatin in the management of cholesterol.

Methodology

For our research, we partitioned the study groups into two distinct groups. Initially, individuals who are undergoing treatment at the Modern Medicine outpatient department (OPD) The second group consists of individuals who are undergoing therapy for high cholesterol in the Ayurvedic outpatient department (OPD).

Planning of the Study

A Hospital-based Interventional Study was planned to determine the socio-economic, and demographic status and comparison of treatment costs of High Cholesterol patients in SS Hospital, IMS, BHU, Varanasi.

Research Strategy: Comparative Cross-sectional Study.

Research Setting: The study was hospital-based in the SS Hospital, IMS, BHU, Varanasi.

Diagnostic Criteria

Where the participants had total cholesterol levels >200mg/dL (5.2mmol/L) or low-density lipoprotein cholesterol (LDL-C) levels > 130mg/dL (3.4mmol/L) or triglycerides < less than 150mg/dl or HDL< 40mg/dl.

Sample Size

$$\text{Sample Size (n)} = \frac{(z1-\alpha+Z1-\beta)^2[p1(1-p1)+p2(1-p2)]}{[d-(p1-p2)]^2}$$

- Anticipated event rate during a fixed period in standard treatment group = p_1
- Anticipated event rate during a fixed period in new treatment group = p_2
- Maximum clinical difference allowed for standard treatment considered to be non-inferior =d
- Value of the normal deviate at considered level of confidence = $z_{1-\alpha}$ (one sided test)
- Value of the normal deviate at considered power of the study = $Z_{1-\beta}$

p_1 = 50%, p_2 = 70%, $z_{1-\alpha}$ = 1.645, $Z_{1-\beta}$ = 0.842, d = 10 %, α = 5%, β = 80 %

$$n = \frac{(1.645+0.842)^2[0.50(1-0.50)+0.70(1-0.70)]}{[0.10-(0.50-0.70)]2} = 31.61$$

n = 32, considering 10% loss to follow up

N = 32+3 = 35

Total Sample Size = 35 * 2 = **70**

Inclusion Criteria

1. People with abnormal cholesterol levels.
2. Participants should be in stable health.
3. Participants should be physically capable of complying with the study's requirements, including attending regular clinic visits and adhering to the treatment regimen.

Exclusion Criteria

1. The patient not giving consent to participate in the study.
2. Patient whose blood sugar is uncontrolled.
3. Patient with acute medical conditions or recent cardiovascular events (e.g., heart attack, stroke) within the past three months.
4. Participants with significant comorbidities such as uncontrolled hypertension, severe kidney disease, liver dysfunction, or active inflammatory conditions.

A total of 70 patients with a diagnosis of high cholesterol were enrolled for clinical trial. The cases were randomly allocated regardless of their age, sex, religion, socio-economic status etc. All 70 patients were recruited randomly by numbering methods into two groups as below-

Group B	Group A
Diagnosis-Deranged Lipid Profile **Treatment –** Statins	**Diagnosis**- Deranged Lipid Profile **Treatment**- *Arjuna* and *Kutki*

Group A- 35 clinically diagnosed and registered patients of High cholesterol were treated by

(1) *Arjuna* (*Terminalia arjuna*) - 2gm in Tablet form, twice a day

(2) *Kutki* (*Picrorhiza kurrooa*) –1gm in Tablet form twice a day

Group B - 35 clinically diagnosed and registered patients of Deranged Lipid Profile were treated by **Statin**

1: Atorvastatin 10 mg OD tab – 90 days. And other medicine which is prescribed by physician.

Table: Different Types of Cost

Direct Cost	
Direct Medical Cost	**Direct Non-Medical Cost**
Medicine Cost	Transportation cost
Laboratory Cost	Cost of food
Hospital Registration Cost	Residential cost
	Personal cost

RESULT

Along with literary and conceptual studies in the present study observation have been made on following aspects:

1. Socio-demographic profile
2. Treatment Cost Profile

A. Socio-Demographic Profile

Table-1: Assess the Socio-Demographic Status of High Cholesterol patients within two groups (Atorvastatin vs *Arjuna* & *Kutki*)

		Group A (*Arjuna* and *Kutki)*		Group B (Atorvastatin)	
Characteristics	**Categories**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Sex	Male	22	62.86	14	40
	Female	13	37.14	21	60
Age	30-40	17	48.57	8	22.86
	40-50	10	28.57	11	31.43
	50-60	8	22.86	12	34.29
	60-65	0	0	4	11.43
Marital Status	Never married	0	0	2	5.71
	Currently married	34	97.14	31	88.57
	Widowed/widower	1	2.86	2	5.71
Education	No education	1	2.86	14	40
	Primary	0	0	4	11.43
	Secondary	3	8.57	1	2.86
	Higher	31	88.57	16	45.71
Employment Status	Full time	22	62.86	6	17.14
	Self Employed	1	2.86	13	37.14
	Home Maker	8	22.86	12	34.29
	others	4	11.43	4	11.43
Caste	General	16	45.71	11	31.43
	OBC	8	22.86	17	48.57
	SC/ST	11	31.43	7	20
Residence	Rural	5	14.29	21	60
	Urban	30	85.71	14	40
Religion	Hindu	35	100	33	94.29

	Muslim	0	0	2	5.71
Family Members	1-5	24	68.57	13	37.14
	5-10	8	22.86	15	42.86
	10 and above	3	8.57	7	20

When comparing Group A (consisting of *Arjun* and *Kutti*) with Group B (consisting of Atrovastatin), various distinct individual and household characteristics become apparent. Group A has a greater proportion of men (62.86%) in contrast to females (37.14%), while Group B demonstrates a higher number of females (60%) in comparison to males (40%).

The age distribution in Group A is predominantly focused on the 30-40 age range, accounting for 48.57% of participants. This is followed by the 40-50 age range, which comprises 28.57% of individuals, and the 50-60 age range, which accounts for 22.86% of member Group B exhibits a more even distribution of ages, with the largest proportion (34.29%) being within the 50-60 age range. This is followed by the 40-50 age range (31.43%), the 30-40 age range (22.86%), and the 60-65 age range (11.43%).

The majority of individuals in Group A have attained higher education (88.57%), while a small percentage have completed secondary education (8.57%), and there are essentially no individuals with primary education or no education. In contrast, Group B comprises a substantial proportion of individuals with no education (40%), followed by those with higher education (45.71%), primary education (11.43%), and secondary education (2.86%).

Group A consists of General (45.71%), OBC (22.86%), and SC/ST (31.43%), whereas Group B is predominantly composed of OBC (48.57%), with General (31.43%) and SC/ST (20%) following suit.

The majority of residents in Group A live in urban areas (85.71%), while a smaller percentage live in rural areas (14.29%). In contrast, Group B is mainly composed of residents living in rural areas (60%), with a smaller proportion residing in urban areas (40%).

In Group A, the majority of families consist of 1-5 members (68.57%), followed by 5-10 members (22.86%), and a smaller percentage have 10 or more members (8.57%). In contrast, Group B has a higher proportion of families with 5-10 members (42.86%), followed by 1-5 members (37.14%), and a smaller percentage have 10 or more members (20%).

B. Treatment Cost Profile

Table 2: Distribution of High Cholesterol patients with in two groups according to Direct Medical Cost of Treatment

Particulars	**Group A**		**Group B**		**Ratio A: B**
	Cost	**%**	**Cost**	**%**	
Medicine Cost	400	29.82	1938.24	52.81	1:4.8
Laboratory Cost	911.10	67.94	1701.82	46.37	1:1.86
Hospital Registration Cost	30	2.24	30	0.82	1:1
Total	1341.10		3670.06		1:2.73

The overall expenditure for Group B is significantly higher (3670.06) compared to Group A (1341.10). Medicine costs form the largest portion of expenses in Group B, while laboratory costs are the largest in Group A. Despite identical registration costs, their percentage impacts differ due to the disparity in total costs between the groups.

Table 3: Distribution of High Cholesterol patients with in two groups according to Direct Non-Medical Cost of Treatment

Particulars	**Group A**		**Group B**		**Ratio A:B**
	Cost	**%**	**Cost**	**%**	
Transportation Cost	120.59	100	658.82	52.33	1:5.4
Cost of Food	NA		200	15.88	
Personal Cost	NA		100	7.95	
Residential Cost	NA		300	23.84	
Total	120.59		1258.82		1:10.4

The non-medical direct cost for Group B is substantially more (1258.82) than that of Group A (120.59). Group B incurs further expenses related to food, personal items, and housing, which are absent from the data of Group A because the maximum number of patients from Group A belongs to BHU Staff. So there is no cost of food, personal cost, and residential costs.

Fig- 1: Treatment Cost of High Cholesterol Patients in group A

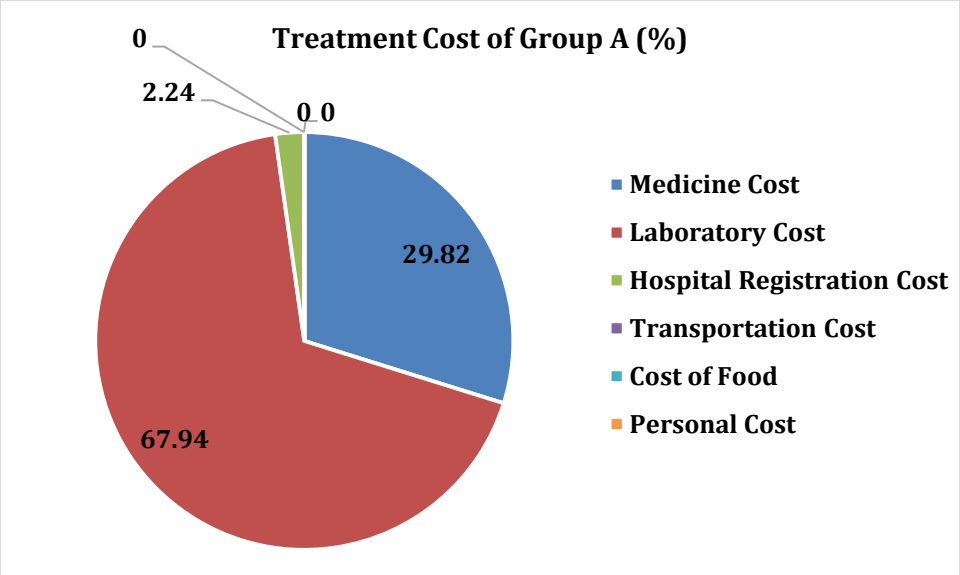

Fig- 2: Treatment Cost of High Cholesterol Patients in group B

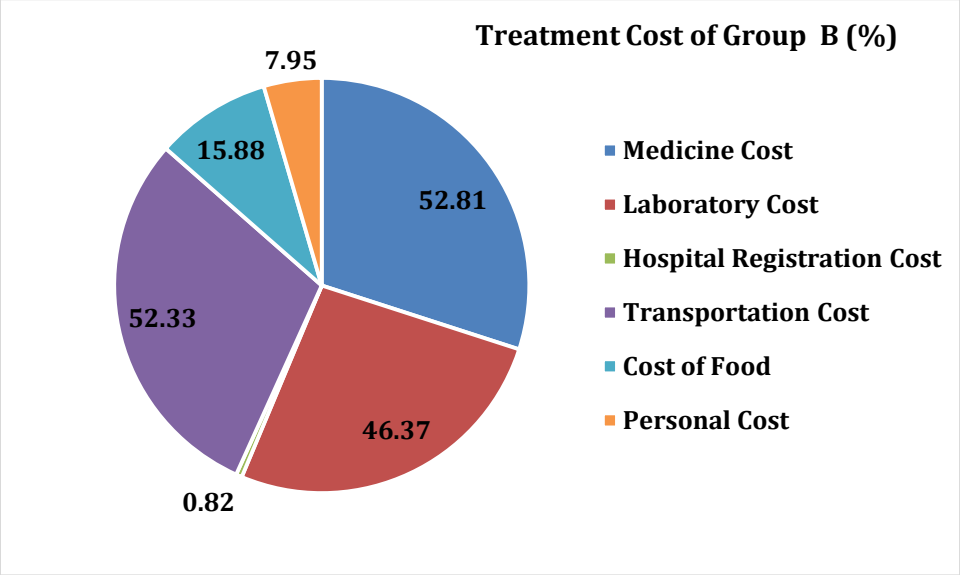

Table 4: Distribution of High Cholesterol Patients within two groups according to Total Direct Cost of Treatment

Particulars	Group A		Group B		Ratio A: B
	Cost	%	Cost	%	
Direct Medical Cost	1341.10	91.74	3670.06	74.46	1:2.7
Direct Non-Medical Cost	120.59	8.26	1258.82	25.54	1:10.4
Total	1461.69	100	4928.88	100	1:37

Overall, the overall cost for Group A is Rs 1461.69, whereas the total cost for Group B is 4928.88. In Group A, 91.74% of the entire cost is allocated to direct medical expenses, while in Group B, 74.46% of the total cost is allocated to direct expenses.

Table 5: Total Cost/ Month medicines used in the treatment of (Group A)

Medicine	No. of Patients	Cost of Drug/ Day(Rs)	Cost of Drug/ Month(Rs)
Arjuna	35	3.80	114.20
Kutki	35	9.52	285.71
Total	70	13.32	399.91

This table displays the expenses associated with Ayurvedic treatment for high cholesterol. The treatment includes two medications, namely *Arjuna* and *Kutki*. On average, patients spent 3.80rs per day on cost and 9.52rs on *Kutki.*

Table 6: Total Cost/Month medicines used in the treatment of (Group B)

Medicine	No. of Patients	Cost of Drug/ Day (Rs)	Cost of Drug/Month(Rs)
Atorvastatin	35	20	600
Others Medicine	35	44.60	1338.24
Total	70	64.60	1938.24

H_0 = There is no difference in the mean values of medicine cost in both groups A and B.

Table 7: Comparison of Medicine Cost between Group A *(Arjuna* and *Kutki*) and Group B ((Atorvastatin)

Group	Medicine Cost		Between-group comparison (Mann-Whitney U Test)
	Q1:Q3	Q2 (Median)	
Group A (n=35)	1000:1625	1000	Z=-2.552 P=.011
Group B (n=35)	1000:2125	1800	

There is a substantial disparity in the medication expenses between Group A and Group B. Group B exhibits a notably greater median expenditure on medications in comparison to Group A. These findings indicate that patients in Group B experience greater costs for medications, potentially attributed to variations in treatment procedures, prescribed medication kinds, or other characteristics unique to the group's treatment strategy

DISCUSSION AND CONCLUSION

The study emphasized notable discrepancies in terms of treatment expenses. Group B saw much greater medication expenses, amounting to INR 1938.24, in contrast to Group A's expenditure of INR 400. The laboratory expenses for Group A amounted to INR 911.10, whereas for Group B, they were INR 1701.82. However, the relative effect was more significant in Group A due to its lower total cost. The hospital registration fees were the same for both groups, amounting to INR 30. However, the percentage effect varied because of the difference in overall spending. Non-medical expenses also differed, with Group B incurring much higher transportation expenses (INR 658.82) compared to Group A (INR 120.59). Group B also saw supplementary expenditures for meals, personal expenses, and residential costs, which were not present in Group A as the majority of its patients, were BHU workers who did not have these expenses.

Group A incurred a total direct cost of INR 1461.69, with 91.74% of this amount allocated to direct medical expenses. On the other hand, Group B had a total cost of INR 4928.88, with 74.46% dedicated to direct medical expenses. The results indicate that Ayurvedic therapy for hypercholesterolemia is considerably more economical than conventional medicine, especially in terms of pharmaceutical expenses.

The economic burden poses a significant challenge in the treatment of any illness. Elevated cholesterol levels pose a significant problem in the current state of affairs in India. Developing countries face significant challenges in managing their financial issues. The alternative treatment can significantly contribute to alleviating the financial load on patients. The incremental cost-effectiveness ratios for primary prevention with step I diet varied between $1900 and $500,000 per quality-adjusted life-year (QALY) gained, depending on the features of the risk subgroup.[14] The cost-effectiveness of primary prevention with a statin, as compared to diet therapy, ranged from $54,000 each quality-adjusted life year (QALY) to $1,400,000 per QALY. The cost of secondary prevention with a statin is below $50,000 per QALY for all risk groupings.[15] As per the American Diabetes Association (ADA), individuals with diagnosed diabetes often incur medical expenses that are around 2.3 times greater compared to what the expenses would be if they did not have diabetes. The research findings about diabetes suggest that the global indirect and direct costs associated with diabetes are significantly high. The primary expenses incurred due to diabetes include both medical and non-medical costs, including the strain placed on the individual and their household.[16]

This study has significant ramifications for healthcare policy in developing nations such as India, where the economic burden of medical treatment is a crucial concern. The economic benefit of Ayurvedic treatment underscores the necessity of incorporating these cost-efficient options into the conventional healthcare system. Providing support and financial resources for alternative medicine can relieve the economic burden on patients and the healthcare system. Subsequent investigations should prioritize examining the enduring effectiveness and safety of Ayurvedic therapies in comparison to contemporary medicine. Additionally, conducting more extensive demographic studies can yield a more full comprehension of the treatment's influence on various population segments. In summary, this research highlights the capacity of Ayurvedic medicine to serve

as a practical and economical substitute for contemporary medicines in managing hypercholesterolemia.

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