Section: Pharmacology

Original Research Article

MEDICATION ADHERENCE AND TREATMENT COSTS AMONG STROKE PATIENTS: A PROSPECTIVE OBSERVATIONAL STUDY IN A TERTIARY CARE HOSPITAL

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Received : 01/04/2025
Received in revised form : 16/05/2025
Accepted : 02/06/2025

Keywords:
Stroke, Medication Adherence, Treatment Cost, Morisky Scale, Secondary Prevention, Ischemic Stroke, Compliance.

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DOI: 10.47009/jamp.2025.7.3.111

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (3); 580-584

ABSTRACT

Background: Stroke remains a major public health challenge, particularly in low- and middle-income countries, where it significantly contributes to disability and economic burden. Medication adherence plays a critical role in preventing stroke recurrence, but various factors—including treatment cost—can affect patient compliance. This study aimed to assess medication adherence among ischemic stroke patients and evaluate the association between treatment costs and adherence levels in a tertiary care setting. **Materials and Methods:** A prospective observational study was conducted over 12 months at a tertiary care hospital involving 139 ischemic stroke patients who completed a 6-month follow-up. Patients aged ≥18 years, with radiological confirmation of stroke, were included. Medication adherence was assessed using the Morisky 8-Item Medication Adherence Scale (MMAS-8), with adherence classified as high (score = 0), medium (score = 1–2), and low (score = 3). Treatment costs were extracted from pharmacy bills, and data on clinical and demographic factors were collected via structured interviews. Chi-square and ANOVA tests were used for statistical analysis. **Result:** Among 139 patients, 54% were male and 56.1% aged 50–70 years. Hypertension (59.7%) and diabetes (39.6%) were common comorbidities. High adherence was observed in 41% of patients, while 31.7% had moderate and 15.8% low adherence. A statistically significant association was found between treatment cost and adherence ($\chi^2 = 8.651$, $p = 0.003$), with the lowest adherence in patients spending <₹500. No significant associations were found between adherence and factors such as age, smoking, alcohol use, blood pressure trends, duration of hospital stay, or biochemical parameters. **Conclusion:** Medication adherence in stroke patients is significantly influenced by treatment costs, with poorer adherence observed among those with lower expenditures. Targeted interventions are essential to improve adherence in this subgroup to prevent stroke recurrence and enhance treatment outcomes.

INTRODUCTION

The global burden of stroke is rising steadily, with the condition contributing significantly to long-term disability across populations.[1] It is recognized as the fourth leading cause of death worldwide. It is defined by the World Health Organization (WHO) as "rapidly developing clinical symptoms and signs of focal and global loss of cerebral function lasting more than 24 hours, or leading to death, with no apparent cause other than of vascular origin."[2] Stroke imposes a substantial financial strain not only on patients but also on their families and the broader healthcare system.[3] In low and middle-income countries, the stroke burden is cumbersome. The disease burden is more profound for stroke recurrence, where compliance to treatment constitutes a key factor in preventing secondary stroke.[4] Long-term strategies, such as drug therapy, lifestyle modification, and exercise, are crucial in post-stroke treatment. Among various treatment strategies, pharmacotherapy plays a central role in the clinical management of stroke.[5] The types of medication used in stroke patients usually include anti-hypertensive drugs, antiplatelets, and lipid-lowering agents, in addition to medications prescribed for coexisting diseases.[6]

Stroke recurrences are essentially reduced by long-term drug therapy, which effectively controls blood pressure, improves cerebral circulation, prevents secondary thrombosis and occlusion in distal blood vessels, and reduces the occurrence of microembolisms.[7] However, all the above benefits cannot be achieved if adherence to drug therapy is not followed. Poor medication adherence is considered to be the biggest problem at present in stroke patients. The WHO has noted that "drug non-compliance is a major problem worldwide". As per studies on patients with chronic illness, approximately 33–50% of patients do not adhere to the prescribed drug regimen on a long-term basis.[7] A systematic review further reveals that nearly one-third of patients do not comply with their medication plans.[8]

What makes patients not stick to their treatment plans is not well understood. A myriad of factors can influence compliance with a prescribed drug regimen, such as education, the general attitude towards medications, negative influences brought on by online resources on drug side effects, personal experience of minor side effects, forgetfulness, polypharmacy, and lack of care at home. In addition to this, the ensuing physical deformities, weaknesses, and psychological complications associated with stroke can increase susceptibility to reduced drug compliance and self-care. Adherence to long-term therapy has been defined as the extent to which a person's behavior, such as taking medications, following a diet, and incorporating lifestyle changes, synchronizes with the tailored recommendations from a physician.[9]

Moreover, the existence of multiple co-morbid conditions commonly seen in stroke patients can also impact adherence by having many more medications, eventually overwhelming the patient. However, strictly adhering to the medication regimen alone ensures treatment success, prevents stroke recurrence, improves overall quality of life, and significantly curbs the economic burden of the disease.

Therefore, it is indispensable to assess the adherence to stroke medications for effective and efficient treatment of stroke. As there are no specific gold standard tests to assess adherence,[10] large-scale studies in different population samples are crucial to check overall adherence to treatment to collectively understand the limitations in adhering to appropriate treatment regimens.

Hence, this study was conducted to assess the degree of adherence to drug therapy and understand if the cost of therapy can influence treatment adherence, thereby improving the disease outcome.[11]

MATERIALS AND METHODS

The study was conducted in a tertiary care hospital, equipped with modern diagnostic and treatment facilities. It was a prospective observational study of 12 months duration to assess medication adherence in patients diagnosed with ischemic stroke. The study commenced after being granted permission from the Institutional Ethics Committee. All patients with ischemic stroke, lasting at least 6 months, who attended routine follow-up visits at the outpatient neurology department during 12 months were included in the study. The inclusion criteria included age above 18 years, radiological diagnosis of Ischemic stroke, both genders, and all patients capable of giving consent, comprehending, and answering the structured questionnaire. Patients with dementia, aphasia, and mental disorders were excluded from the study. Informed consent was obtained from eligible patients after explaining the study process and purpose in the patient's language. At baseline, patients were interviewed with a structured questionnaire. The data were collected in a case record form, which contained demographic information, first onset of stroke and disability status. Medication data was collected from the respective prescriptions given to each patient at the initial visit following hospital discharge. The respective medication cost was computed from pharmacy billing.

Each participant was followed up for 6 months for the assessment of treatment compliance using the Morisky 8-Item Medication Adherence Questionnaire, a validated tool that scores adherence as: High (score = 8), Medium (score 6 to <8), Low (score < 6).[12]

Those patients who failed to report for follow-up were contacted over the telephone. The patients were followed up with a buffer of one week of the allotted follow-up date. The patients who did not visit the hospital or who were missed at the Outpatient follow-up were interviewed over the telephone. Three attempts per patient were made at different intervals for those whose telephones were not reachable at the initial attempt. The remaining patients who did not visit the hospital (confirmed by Outpatient folders) and those unreachable by phone were declared as lost to follow-up.

A formal sample size calculation was not performed for this study, as all patients admitted with cerebrovascular accident (CVA) during the one-year study period who met the inclusion and exclusion criteria were enrolled. The recruitment target of 155 patients was based on the expected number of eligible admissions over 12 months, considering usual rates of informed consent. The data of the first 139 patients who completed the follow-up period of 6 months were included in this study. The remaining 16 patients were considered as lost to follow-up.

The results were analyzed using one-way ANOVA. Values less than 0.05 were considered statistically significant.

RESULTS

As part of secondary prevention of stroke, the study participants were prescribed Anti-platelets, Statins,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Anti-epileptics, and Neuroprotective medications for a long-term basis in addition to other medications addressing co-morbidities such as hypertension and diabetes. [Table 1] lists the main medications prescribed to the sample study population.

Table 1: Prescribed medications for stroke patients

Drugs	Number(n=139)	Percentage (%)
Antiplatelets	116	83.5
Statins	118	84.9
Anticoagulants	10	7.2
Anti-epileptics	31	22.3
Neuroprotectants	12	8.64

A total of 139 stroke patients were included in the study. 54% of the patients were male, and 46% were female. The majority of patients were aged 50–70 years (56.1%), followed by 70–90 years (33.8%), 9.4% were aged <50 years and 0.7% aged >90 years. Nearly half of the patients (48.9%) reported a history of smoking, while 19.4% reported alcohol consumption.

Clinical Profile and Comorbidities

Modified Rankin Scale (mRS): At admission, the majority of patients exhibited either moderately severe disability (32.4%) or moderate disability (30.2%) as per the Modified Rankin Scale. By discharge, there was a notable shift, with 38.8% of patients demonstrating moderate disability and a reduction in those with moderately severe disability to 25.2%, reflecting functional improvement during hospitalization [Figure 1].

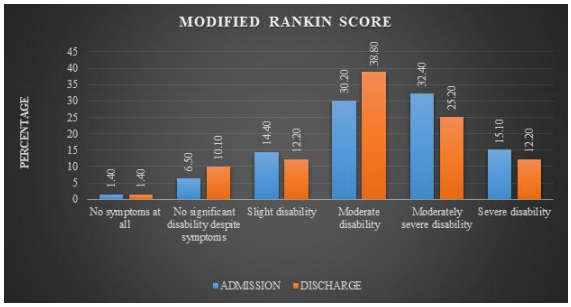

Figure 1: Modified Rankin Score at Admission and at Discharge

Comorbidities: Hypertension (59.7%) and diabetes mellitus (39.6%) were the most common comorbid conditions observed. Others included ischemic heart disease (10.1%), rheumatic heart disease (2.9%), previous cerebrovascular accident (28.1%), and transient ischemic attack (3.6%).

Hospitalization Details: More than half of the patients (52.5%) were hospitalized for less than 5 days, while 36.7% stayed between 5–10 days, and 10.8% had a hospital stay exceeding 10 days.

The cost of hospitalization varied, with 41% incurring expenses between ₹500–₹1000. Additionally, 18.7% of patients spent less than ₹500, 10.1% between ₹1000–₹1500, 17.3% between ₹1500–₹2000, and 6.5% each reported costs in the ranges of ₹2000–₹2500 and above ₹2500.

Medication Adherence: Medication adherence among the study participants was assessed using the Morisky Medication Adherence Scale (MMAS), which ranges from 0 to 3, with a score of 0 indicating high adherence. Of the total 139 patients assessed, 41.0% (n = 57) demonstrated high adherence (score 0), 31.7% (n = 44) had a score of 1, 11.5% (n = 16) had a score of 2, and 15.8% (n = 22) exhibited low adherence with a score of 3.

Cost and Medication Adherence: In the present study, a significant association was found between treatment cost and medication adherence (Chi-square = 8.651, p = 0.003). Patients who spent less than ₹500 had the lowest adherence, with only 19.2% fully adhering to medication. The best adherence was seen in the ₹500–₹1000 group, where 36.8% were fully adherent. As treatment costs increased, adherence varied but generally declined, except for a small group in the ₹2000–₹2500 range who showed better adherence. Overall, the study suggests that lower treatment costs are linked to poorer medication adherence, highlighting the need for targeted support for low-spending patients. [Table 2].

Table 2: Association Between Treatment Cost and Medication Adherence

Cost	Morisky Adherence Score				Total	χ^2	p value
	Score 0 (High)	Score 1	Score 2	Score 3 (Low)			
< 500	5	11	2	8	26	8.651	0.003
500 - 1000	21	18	9	9	57		
1000 - 1500	7	6	0	1	14		
1500 - 2000	13	4	3	4	24		
2000 - 2500	6	3	0	0	9		
> 2500	5	2	2	0	9		
Total	57	44	16	22	139		

Other Factors and Their Association with Adherence: In the present study, no statistically significant associations were found between medication adherence and various patient-related factors, including age group (p = 0.427), duration of hospital stay (p = 0.531), smoking status (p = 0.878), alcohol use (p = 0.678), blood pressure trends on admission (p = 0.773), serum cholesterol levels (p =

ISSN (O): 2687-5365; ISSN (P): 2753-6556

0.638), serum urea (p = 0.096), and serum creatinine (p = 0.054), indicating that these variables did not significantly influence adherence behavior in the study population.

Table 3: Association between Day 1 blood pressure and Morisky adherence scores

BP Day1	Morisky Adherence Score				Total	χ^2	p value
	Score 0 (High)	Score 1	Score 2	Score 3 (Low)			
0	24	14	6	8	52	1.135	0.773
1	33	30	10	14	87		
Total	57	44	16	22	139		

In the present study, no statistically significant association was observed between Day 1 blood pressure and medication adherence as measured by the Morisky Adherence Scale (Chi-square = 1.135, p = 0.773). Among patients with normal blood pressure on Day 1, 46.2% (24 out of 52) demonstrated complete adherence (score 0), while 53.8% had varying levels of non-adherence. Similarly, in those with elevated blood pressure, 37.9% (33 out of 87) were fully adherent, with the remaining 62.1% showing some degree of non-adherence. These findings suggest that Day 1 blood pressure levels did not significantly influence medication adherence patterns in the study population [Table 3].

The relationship between length of hospital stay and medication adherence was evaluated using chi-square analysis ($\chi^2 = 5.09$, p = 0.531), indicating no statistically significant association. Among those hospitalized for less than 5 days, 34.2% (25/73) achieved high adherence (score 0), compared with 49.0% (25/51) in the 5–10-day group and 46.7% (7/15) in patients with stays exceeding 10 days. Moderate to low adherence patterns were similarly distributed across the three stay-duration categories [Table 4].

Table 4: Association Between Hospital Stay Duration and Medication Adherence

Length of Stay	Morisky Adherence Score				Total	χ^2	p value
	Score 0 (High)	Score 1	Score 2	Score 3 (Low)			
< 5 days	25	27	8	13	73	5.09	0.531
5–10 days	25	13	5	8	51		
> 10 days	7	4	3	1	15		
Total	57	44	16	22	139		

DISCUSSION

The present study evaluated medication adherence and its association with treatment cost among stroke patients in a tertiary care hospital setting. Using Morisky Medication Adherence Scale (MMAS), we found that 41% of the patients demonstrated high adherence, while the remainder had varying degrees of moderate to low adherence. Notably, treatment cost was found to be a significant determinant of adherence, with higher costs correlating with lower adherence rates (p = 0.003).

These findings align with the results of previous studies that underscore the impact of economic burden on medication compliance. For instance, Kronish et al. reported that cost-related nonadherence was common among stroke survivors, particularly those lacking insurance coverage or receiving multiple medications.[13] A similar study by O'Carroll et al. showed that adherence was significantly lower among patients who had to make out-of-pocket payments for their prescriptions.[14]

The high prevalence of hypertension and diabetes as comorbid conditions in our study population is consistent with global trends. Hypertension was present in 59.7% of our patients, closely mirroring findings from Mukherjee and Patil, who reported that hypertension and diabetes were the leading risk factors in stroke populations in India 3. These conditions often necessitate polypharmacy, which in turn can reduce adherence, particularly when the cost burden is significant.

Although cost was found to be a significant factor, no association was observed between adherence and other sociodemographic or clinical variables, such as age, duration of hospital stay, or lifestyle factors like smoking and alcohol use. This finding is consistent with those of Williams et al., who found no significant correlation between age or gender and adherence but emphasized the role of health literacy and socioeconomic factors.[15]

Interestingly, serum biomarkers such as cholesterol, urea, and creatinine did not show a significant association with adherence in our study. This may suggest that patient behavior regarding medication use is more influenced by perceived necessity and external barriers (e.g., cost) than by disease severity or biochemical parameters, an idea also supported by Horne and Weinman's necessity-concerns framework.[16]

In terms of functional outcomes, the improvement in Modified Rankin Scale (mRS) scores from admission to discharge highlights the importance of early and continuous pharmacological management. However, long-term adherence remains crucial for sustained benefits. Studies by Haynes et al. have shown that even short lapses in adherence in post-stroke patients can significantly increase the risk of recurrence and mortality.[10]

This study is strengthened by its prospective design, structured follow-up protocol, and use of a validated adherence scale. However, limitations include its single-center setting, potential recall bias in self-

ISSN (O): 2687-5365; ISSN (P): 2753-6556

reported adherence data, and exclusion of patients with cognitive or speech impairments, which might underestimate nonadherence in real-world settings.

CONCLUSION

In conclusion, this study confirms that cost is a significant barrier to medication adherence in post-stroke patients, emphasizing the need for cost-effective treatment regimens, improved patient education, and policy measures to subsidize essential medications. Targeted interventions addressing affordability may improve long-term outcomes and reduce stroke recurrence.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556