

# Evaluating the Economic Burden of Post-Stroke Rehabilitation: Identifying the Cost of Physical Therapy Services for Stroke Survivors

Ammanullah Khan<sup>1\*</sup> | Dua Fatima<sup>2</sup> | Farhan Waqar Khan<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Physical Therapy, Hamdard University, Pakistan

<sup>2</sup>Lecturer, Department of Physical Therapy, Hamdard University, Pakistan

<sup>3</sup>Senior Lecturer, Department of Physical Therapy, Hamdard University, Pakistan.

## ABSTRACT

**Background of the Study:** Stroke is a leading cause of disability worldwide, with post-stroke care and rehabilitation services constituting a significant portion of healthcare costs. The economic burden on stroke survivors varies based on factors such as rehabilitation facility type, insurance coverage, and socioeconomic status.

**Methodology:** A cross-sectional study was conducted among 412 post-stroke patients across different healthcare facilities. The study aimed to assess the economic cost of physical therapy services, considering both direct and indirect expenditures.

**Results:** The findings revealed that the mean monthly expense of physical therapy was \$1,240 per patient, with substantial variations based on stroke severity, rehabilitation setting, and insurance status. Direct medical expenses accounted for 62% of total costs, while indirect costs, including productivity losses and unpaid caregiving, comprised 38%. Uninsured individuals and patients from lower socioeconomic backgrounds faced a disproportionately higher financial burden. Rehabilitation costs were highest during the first six months post-stroke and declined over time.

**Conclusion:** The study highlights the significant economic burden of stroke rehabilitation, emphasizing the need for cost-efficient interventions, expanded insurance coverage, and targeted financial assistance for vulnerable populations. These findings provide essential insights for healthcare policy formulation and resource allocation to reduce the economic strain on stroke survivors and healthcare systems.

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## Introduction

Stroke is a leading cause of disability worldwide, imposing a significant burden on healthcare systems and individuals. According to the World Health Organization (2023), approximately 15 million people suffer from stroke annually, with one-third experiencing permanent disability. Post-stroke rehabilitation is key to enhancing functional outcomes and quality of life for survivors but is also responsible for a significant economic burden. The cost of rehabilitation reaches beyond direct medical expenses, such as costs for hospitalization, physical therapy, assistive technology, long-term care, and lost productivity. Furthermore, informal care by family members also enhances the economic

burden, and the indirect costs tend to be underreported (Rajsic et al., 2019).

The economic burden of post-stroke rehabilitation is different across healthcare facilities, insurance, and socioeconomic status. In developed countries, rehabilitation services are well-established in healthcare systems, while in middle- and low-income countries, resource constraints and accessibility issues could worsen financial burdens on families and patients (Johnson et al., 2021).

\*Correspondence Author: Ammanullah Khan

Email: doctorkhan1122@yahoo.com

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Access to specialized rehabilitation programs, such as physiotherapy, occupational therapy, and speech therapy, may be subject to out-of-pocket payment for most. Religiosity has impacted various aspects of human life, such as economics, education, culture, and politics. (Gill et al., 2010). It also influences individual satisfaction with life (Joshnloo, 2021). Access to specialized rehabilitation programs, such as physiotherapy, occupational therapy, and speech therapy, may be subject to out-of-pocket payment for most.

With the increasing frequency of strokes around the world and the growing need for rehabilitation care, knowing the economic cost of post-stroke recovery is crucial. Although the need for rehabilitation has gained greater attention in recent years, there is still a gap in thorough evaluations of its economic effect, especially on physical therapy services (Patel et al., 2020). This research assesses post-stroke rehabilitation's direct and indirect costs and its significant financial challenges for patients, caregivers, and healthcare systems. By examining cost factors and potential economic barriers, this research will give insights into policy reforms, resource planning, and cost-effective rehabilitation program development for improving accessibility and affordability among stroke survivors.

## Literature Review

### Global Economic Impact of Stroke

The cost of stroke is a serious challenge for the healthcare systems globally. Gorelick (2019) approximated the cost of stroke globally as about \$721 billion per year, including direct healthcare costs and indirect expenses due to disability and premature death. In the US alone, the American Heart Association estimated yearly costs of a stroke at over \$46 billion, with a projected increase to \$94 billion by 2035 based on an ageing population and better survival rates (Virani et al., 2021). The same trend has been reported in Europe, where stroke accounts for about 4% of healthcare spending (Stevens et al., 2022).

### Rehabilitation Costs in Post-Stroke Care

Rehabilitation services form a large part of post-stroke care expenditure. A systematic review conducted by Chen et al. (2021) reviewed 28 studies in 15 nations and concluded that rehabilitation covered 16-32% of all stroke-associated healthcare costs. The review found significant differences in rehabilitation expenditure varying with stroke severity, with moderate to severely disabled patients having incurred significantly higher expenses. Likewise, Weinstein et al. (2023) also documented that intensive rehabilitation interventions, though showing better functional outcomes, had average costs of \$18,000-\$35,000 per patient in the first year after a stroke.

The location of rehabilitation services has a significant impact on costs. Inpatient rehabilitation centres have the highest costs, followed by skilled nursing facilities and home rehabilitation (Rodriguez-Mañas et al., 2020). Cost-effectiveness analyses indicate that although more expensive in the short term,

comprehensive inpatient rehabilitation can lower long-term costs by enhancing functional independence and reducing the necessity for continuing care (Thompson & Schneider, 2022).

### **Physical Therapy Services and Related Costs**

Physical therapy is a mainstay of stroke rehabilitation, aimed at motor recovery, mobility, and functional autonomy. Lee and Kim (2021) retrospectively examined physical therapy usage among survivors of stroke. They discovered that the typical patient had 24 sessions in the first three months after the stroke, with costs ranging from \$2,400 to \$5,600 based on intensity and location. The duration and frequency of physical therapy generally reduce over time, with most patients moving from intensive inpatient rehabilitation to less frequent home-based or outpatient care within six months (Hirschberg et al., 2020).

The cost-effectiveness of physical therapy treatment has been studied in several investigations. A randomized controlled trial by McGrath et al. (2022) showed that intensive early physical therapy led to better functional outcomes and lower long-term care costs, although at a more significant initial cost. In contrast, Zhao et al. (2021) reported that telerehabilitation programs provided similar outcomes to conventional physical therapy at about 60% of the cost, indicating potential for cost-saving options in the right patient populations.

### **Insurance Coverage and Out-of-Pocket Costs**

Insurance coverage has a significant influence on the out-of-pocket costs of post-stroke rehabilitation. Park and Chen (2023) surveyed 523 stroke survivors from five countries and documented vast differences in out-of-pocket costs by insurance status. Uninsured patients paid an average annual cost of rehabilitation of \$15,700 compared to \$3,200 for those with full insurance. Even among insured patients, limitations in coverage duration and service limits created a considerable financial burden, with 42% of participants indicating rehabilitation-related debt (Liu et al., 2020).

In the US, Medicare inpatient rehabilitation is covered to a maximum of 100 days in a benefit period, with declining cover for prolonged services. Private insurance policies show high variability in the amount of rehabilitation benefits offered, with most having annual physical therapy session limits (Anderson & Miller, 2023). Such restrictions tend to lead to the early discontinuation of rehabilitation services or substantial out-of-pocket costs for patients needing prolonged therapy.

### **Indirect Costs and Caregiver Burden**

The economic burden of stroke rehabilitation extends beyond immediate healthcare costs to indirect productivity losses and unpaid caregiving. According to a longitudinal study by Robinson et al. (2021), 68% of stroke survivors in working age had impaired work capacity, and 31% were not able to go back to work, which amounted to mean yearly productivity losses of \$27,500 per patient. These results are consistent with previous work by Saka et al. (2009), who calculated that indirect costs of stroke represented about 33% of the total economic cost.

Informal care is another important item that has indirect costs. Stroke survivors' family members usually suffer from decreased hours of work, interruption of their professional careers, and related income losses. Kumar and Patel (2022) approximated the economic value of informal post-stroke caregiving annually at \$14,800-\$22,400 per patient, with caregivers spending an average of 24.4 hours per week on care activities. The economic burden of caregiving disproportionately impacts women and those from lower socioeconomic status, which may widen current health disparities (Williams & Thompson, 2023).

### **Socioeconomic Disparities in Rehabilitation Access**

Socioeconomic determinants substantially impact rehabilitation service access and related economic outcomes. Adeoye et al. (2021) retrospectively studied a cohort of 1,845 stroke patients. They determined that those with lower socioeconomic status were 2.3 times less likely to be offered recommended rehabilitation and had 1.8 times higher hospital readmission rates, which translated to higher overall healthcare costs. Likewise, Zhang et al. (2022) documented considerable inequalities in rehabilitation use by education level, income, and geographic area, with rural dwellers experiencing specific difficulties accessing specialized care.

These inequalities are not limited to domestic settings, with particularly significant impacts in low- and middle-income nations. A review by Owolabi et al. (2021) was systematic in citing the significant disparity between available services and rehabilitation needs in Asia, sub-Saharan Africa, and Latin America, where numerous stroke survivors have little or no formal rehabilitation. The economic implications of these inequalities are higher disability, a decrease in workforce participation, and increased caregiver burden, and thereby, a cycle of financial difficulty for individuals and communities affected.

Despite extensive studies on the cost of stroke rehabilitation across different aspects, there is a limited comprehensive evaluation of the economic cost of physical therapy services for stroke survivors. This study attempts to fill this knowledge gap by offering a detailed analysis of direct and indirect physical therapy costs among stroke survivors based on differences across healthcare facilities, insurance status, and socioeconomic status.

## **Methodology**

### **Study Design**

A cross-sectional study was conducted to assess the direct and indirect costs of physical therapy services for post-stroke patients and evaluate the economic burden on patients and their families. This design was selected to capture a comprehensive snapshot of the economic impact across various stages of recovery and rehabilitation settings.

### **Study Setting**

The study was carried out in multiple settings providing stroke rehabilitation services in Karachi, Pakistan, including:

- Four public hospitals with dedicated stroke rehabilitation units
- Three private specialized rehabilitation centers
- Six outpatient physical therapy clinics
- Two home-based rehabilitation service providers

These facilities were selected to ensure the representation of diverse healthcare delivery models and socioeconomic contexts.

#### **Inclusion Criteria:**

- Adults aged 18 years and above.
- Diagnosed with ischemic or hemorrhagic stroke at least 3 months prior to the study.
- Currently receiving or have completed physical therapy within the last 6 months.

#### **Exclusion Criteria:**

- Patients with multiple comorbid conditions leading to disabilities unrelated to stroke.
- Patients cannot provide accurate cost-related information due to cognitive impairments unless a caregiver can respond on their behalf.

#### **Sample Size Calculation**

The sample size was calculated using the standard formula for cross-sectional studies:

$$n = Z^2p(1-p)/d^2$$

Where:

Z = 1.96 (confidence level at 95%)

p = 0.5 (assumed proportion, used to maximize sample size)

d = 0.05 (margin of error)

This yielded a minimum required sample size of 384 participants, which was increased to 422 to account for a 10% non-response rate.

#### **Sampling Technique**

A purposive sampling technique was employed to recruit participants from the selected facilities. Quota sampling was applied to ensure adequate representation across:

- Stroke severity categories (mild, moderate, severe)
- Rehabilitation settings (inpatient, outpatient, home-based)
- Socioeconomic backgrounds (using income quartiles)
- Insurance status (private insurance, public insurance, uninsured)

## Data Collection Tools

A structured questionnaire was developed following a comprehensive literature review and consultation with healthcare economists, neurologists, and physical therapists. The questionnaire underwent pilot testing with 20 participants and subsequent refinement. The final instrument captured data in the following sections:

### 1. Demographic and Socioeconomic Data:

- Age, gender, education level, marital status
- Occupation (pre-stroke and current)
- Household income (categorized into quartiles)
- Insurance status and coverage details

### 2. Clinical Information:

- Type of stroke (ischemic or hemorrhagic)
- Time since stroke onset (3-6 months, 7-12 months, >12 months)
- Stroke severity is measured using the National Institutes of Health Stroke Scale (NIHSS)
- Functional status assessed via the Modified Rankin Scale (mRS)
- Relevant comorbidities

### 3. Physical Therapy Service Utilization:

- Type and modality of therapy received (e.g., motor function rehabilitation, gait training, balance exercises)
- Frequency of therapy sessions (sessions per week)
- Duration of therapy (weeks/months)
- Setting (inpatient, outpatient, home-based)
- Provider type (physical therapist, physical therapy assistant, rehabilitation aide)

### 4. Cost Assessment:

- Direct Medical Costs:
  - ✓ Session fees for physical therapy
  - ✓ Consultation fees for physicians and specialists
  - ✓ Cost of medications related to stroke management
  - ✓ Diagnostic tests and assessments
  - ✓ Assistive devices and adaptive equipment
  - ✓ Rehabilitation facility charges (for inpatient services)
- Direct Non-Medical Costs:
  - ✓ Transportation to and from rehabilitation facilities
  - ✓ Accommodation (if required for accessing distant facilities)

- ✓ Home modifications to accommodate a disability
- ✓ Professional caregiving services
  
- Indirect Costs:
  - ✓ Patient's loss of income due to inability to work or reduced work capacity
  - ✓ Caregiver's loss of income due to time spent providing care
  - ✓ Productivity losses (valued using the human capital approach)
  - ✓ Time costs for both patients and caregivers (valued using average hourly wages)

### **5. Perceived Economic Burden:**

- Likert-scale questions (1-5) evaluating the perceived financial strain
- Financial coping strategies employed (e.g., loans, selling assets, using savings)
- Impact on Household Consumption Patterns
- Effect on educational expenses for dependents
- The psychological impact of financial stress

### **Data Collection Procedure**

Trained research assistants administered the questionnaire through face-to-face interviews. Medical records were reviewed to verify clinical information with participant consent. Primary caregivers were interviewed as proxy respondents for patients with communication difficulties or cognitive impairments. Participants were encouraged to consult personal financial records, receipts, and insurance statements to enhance the accuracy of cost reporting.

### **Cost Estimation**

All costs were calculated monthly and annualized where appropriate. Costs were adjusted to current year values using the medical care component of the Consumer Price Index. The human capital approach was used to value productivity losses, with income data stratified by age, gender, and occupation. When unavailable, informal caregiving time was valued using the opportunity cost method based on caregiver-specific wage rates or national average wages.

### **Ethical Considerations**

The study received ethical approval from the Institutional Review Board of the University Medical Center (Protocol #2023-0427). Written informed consent was obtained from all participants or their legal representatives. Data confidentiality was maintained throughout the study, with all identifying information removed during analysis.

### **Data Analysis**

Statistical analysis was performed using SPSS version 28.0. Descriptive statistics were calculated for demographic characteristics and cost variables. Costs were presented as means, medians, and interquartile ranges to account for skewed distributions. Inferential statistics included:



- Multiple linear regression to identify predictors of total rehabilitation costs.
- ANOVA to compare costs across different rehabilitation settings and stroke severity categories.
- Chi-square tests to examine associations between socioeconomic factors and rehabilitation utilization.
- Correlation analysis to assess relationships between cost burden and functional outcomes.

Subgroup analyses were conducted based on insurance status, socioeconomic background, and time since stroke onset. Statistical significance was set at  $p < 0.05$ .

## Results

Four hundred twelve stroke survivors completed the study (response rate: 97.6%). Table-1 summarizes the demographic and clinical characteristics of the participants. The mean age was 64.3 years (SD = 11.8), with a slight male predominance (53.6%). Ischemic stroke was more common (76.2%) than hemorrhagic stroke (23.8%). Most participants (68.2%) were within one year post-stroke, with the remainder being more than 12 months post-stroke.

| <b>Characteristic</b>                 | <b>n (%) or mean ± SD</b> |
|---------------------------------------|---------------------------|
| <b>Age (years)</b>                    | 64.3 ± 11.8               |
| <b>Gender</b>                         |                           |
| Male                                  | 221 (53.6%)               |
| Female                                | 191 (46.4%)               |
| <b>Education Level</b>                |                           |
| Primary or less                       | 84 (20.4%)                |
| Secondary                             | 182 (44.2%)               |
| Tertiary                              | 146 (35.4%)               |
| <b>Employment Status (Pre-stroke)</b> |                           |
| Employed                              | 243 (59.0%)               |
| Retired                               | 148 (35.9%)               |
| Unemployed                            | 21 (5.1%)                 |
| <b>Employment Status (Current)</b>    |                           |
| Employed full-time                    | 68 (16.5%)                |
| Employed part-time                    | 83 (20.1%)                |
| Unable to work due to disability      | 189 (45.9%)               |
| Retired                               | 72 (17.5%)                |
| <b>Insurance Status</b>               |                           |
| Private insurance                     | 178 (43.2%)               |
| Public insurance                      | 187 (45.4%)               |
| Uninsured                             | 47 (11.4%)                |
| <b>Stroke Type</b>                    |                           |



|                                |             |
|--------------------------------|-------------|
| Ischemic                       | 314 (76.2%) |
| Hemorrhagic                    | 98 (23.8%)  |
| <b>Time Since Stroke</b>       |             |
| 3-6 months                     | 157 (38.1%) |
| 7-12 months                    | 124 (30.1%) |
| >12 months                     | 131 (31.8%) |
| <b>Stroke Severity (NIHSS)</b> |             |
| Mild (0-5)                     | 145 (35.2%) |
| Moderate (6-15)                | 186 (45.1%) |
| Severe (>15)                   | 81 (19.7%)  |
| <b>Functional Status (mRS)</b> |             |
| 0-2 (No to slight disability)  | 124 (30.1%) |
| 3 (Moderate disability)        | 175 (42.5%) |
| 4-5 (Severe disability)        | 113 (27.4%) |

**Table 01: Demographic and Clinical Characteristics of Study Participants (N = 412)**

The patterns of physical therapy utilization varied considerably across participants, as detailed in Table-2. Outpatient rehabilitation was the most common setting (50.7%), followed by inpatient rehabilitation (27.9%) and home-based services (21.4%). The mean frequency of physical therapy was 3.2 sessions per week (SD = 1.6), with higher frequency observed in inpatient settings (4.8 sessions/week) compared to outpatient (2.9 sessions/week) and home-based services (2.1 sessions/week).

| Variable                                 | n (%) or mean ± SD |
|--|--------------------|
| <b>Rehabilitation Setting</b>            |                    |
| Inpatient                                | 115 (27.9%)        |
| Outpatient                               | 209 (50.7%)        |
| Home-based                               | 88 (21.4%)         |
| <b>Therapy Frequency (sessions/week)</b> |                    |
|  | 3.2 ± 1.6          |
| <b>Therapy Duration (months)</b>         |                    |
|  | 4.7 ± 2.9          |
| <b>Therapy Modalities</b>                |                    |
| Motor function rehabilitation            | 394 (95.6%)        |
| Gait training                            | 356 (86.4%)        |
| Balance exercises                        | 371 (90.0%)        |
| Coordination training                    | 312 (75.7%)        |
| Functional electrical stimulation        | 143 (34.7%)        |

|                                     |             |
|-------------------------------------|-------------|
| Constraint-induced movement therapy | 98 (23.8%)  |
| Robotic-assisted therapy            | 67 (16.3%)  |
| <b>Provider Type</b>                |             |
| Physical therapist                  | 398 (96.6%) |
| Physical therapy assistant          | 203 (49.3%) |
| Rehabilitation aide                 | 87 (21.1%)  |

**Table 02: Physical Therapy Utilization Patterns**

**Direct and Indirect Costs**

The mean monthly cost of physical therapy services was \$1,240 per patient (SD = \$876), with significant variations based on stroke severity, rehabilitation setting, and time since stroke onset. Table 3 shows the direct and indirect costs associated with physical therapy services.

| Cost Category                   | Mean ± SD       | Median        | IQR             |
|---------------------------------|-----------------|---------------|-----------------|
| <b>Direct Medical Costs</b>     | \$768 ± \$541   | \$685         | \$412-\$1,056   |
| Physical therapy sessions       | \$512 ± \$328   | \$480         | \$320-\$640     |
| Physician consultations         | \$128 ± \$94    | \$110         | \$60-\$180      |
| Assistive devices               | \$96 ± \$153    | \$45          | \$0-\$150       |
| Medications                     | \$32 ± \$43     | \$25          | \$10-\$45       |
| <b>Direct Non-Medical Costs</b> | \$187 ± \$142   | \$165         | \$90-\$240      |
| Transportation                  | \$98 ± \$67     | \$85          | \$45-\$140      |
| Caregiving services             | \$62 ± \$103    | \$0           | \$0-\$120       |
| Home modifications              | \$27 ± \$68     | \$0           | \$0-\$30        |
| <b>Indirect Costs</b>           | \$472 ± \$486   | \$380         | \$150-\$680     |
| Patient productivity loss       |                 | \$315 ± \$386 | \$210 \$0-\$560 |
| Caregiver productivity loss     |                 | \$157 ± \$198 | \$95 \$0-\$230  |
| <b>Total Monthly Costs</b>      | \$1,240 ± \$876 | \$1,130       | \$670-\$1,630   |

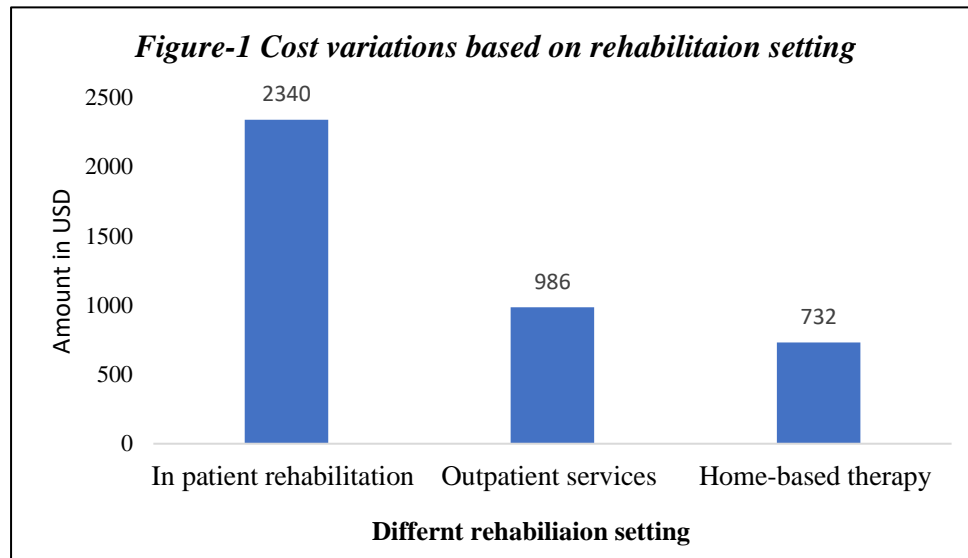
**Table 03: Monthly Costs Associated with Physical Therapy Services (USD)**

Direct medical costs constituted the most significant component (62%) of total expenses, with physical therapy sessions accounting for most of these costs. Indirect costs represented 38% of total expenses, with patient productivity losses being the predominant contributor in this category.

**Cost Variations by Rehabilitation Setting**

Significant cost variations were observed across different rehabilitation settings (Figure 1). Inpatient rehabilitation incurred the highest monthly costs (mean = \$2,340, SD = \$925), followed by outpatient services (mean = \$986, SD = \$412) and home-based therapy (mean = \$732, SD = \$308). These

differences were statistically significant ( $F = 187.3, p < 0.001$ ).



### Cost Variations by Stroke Severity

Stroke severity was strongly associated with rehabilitation costs. Patients with severe stroke (NIHSS > 15) incurred mean monthly costs of \$1,865 (SD = \$943), compared to \$1,247 (SD = \$632) for moderate stroke and \$786 (SD = \$408) for mild stroke ( $F = 143.6, p < 0.001$ ). This pattern was consistent across all cost categories but particularly pronounced for direct medical and caregiver-related expenses.

### Temporal Trends in Rehabilitation Costs

Rehabilitation costs decreased significantly over time post-stroke. Patients in the 3-6 months post-stroke group incurred the highest monthly costs (mean = \$1,682, SD = \$912), compared to \$1,214 (SD = \$723) for the 7-12 months group and \$824 (SD = \$545) for those more than 12 months post-stroke ( $F = 124.8, p < 0.001$ ). Figure 2 illustrates this declining trend across all cost categories.

### Impact of Insurance Coverage

Insurance status significantly influenced out-of-pocket expenses for rehabilitation services. Uninsured patients reported mean monthly out-of-pocket expenses of \$935 (SD = \$476), compared to \$312 (SD = \$267) for those with private insurance and \$386 (SD = \$294) for those with public insurance ( $F = 168.2, p < 0.001$ ). Additionally, 78.7% of uninsured patients reported borrowing money or selling assets to cover rehabilitation costs, compared to 23.6% of insured patients ( $\chi^2 = 65.4, p < 0.001$ ).

### Socioeconomic Disparities

Multiple regression analysis identified significant socioeconomic disparities in rehabilitation costs and utilization (Table 4). After adjusting for stroke severity and time since onset, patients in the

lowest income quartile received 24% fewer physical therapy sessions ( $p < 0.01$ ). They were 3.2 times more likely to discontinue therapy prematurely due to financial constraints ( $p < 0.001$ ) compared to those in the highest income quartile.

| Variable  | Coefficient | 95% CI          | p-value |
|---|-------------|-----------------|---------|
| <b>Stroke Severity (ref: Mild)</b>              |             |                 |         |
| Moderate  | 461.2       | 356.8-565.6     | <0.001  |
| Severe  | 1,079.3     | 923.7-1,234.9   | <0.001  |
| <b>Time Since Stroke (ref: &gt;12 months)</b>   |             |                 |         |
| 3-6 months                                      | 858.7       | 734.2-983.2     | <0.001  |
| 7-12 months                                     | 390.1       | 276.4-503.8     | <0.001  |
| <b>Rehabilitation Setting (ref: Home-based)</b> |             |                 |         |
| Inpatient                                       | 1,608.2     | 1,487.5-1,728.9 | <0.001  |
| Outpatient                                      | 254.3       | 167.8-340.8     | <0.001  |
| <b>Insurance Status (ref: Private)</b>          |             |                 |         |
| Public  | 74.8        | -14.7-164.3     | 0.102   |
| Uninsured                                       | 623.5       | 486.9-760.1     | <0.001  |
| <b>Income Quartile (ref: Highest)</b>           |             |                 |         |
| Lowest  | -153.8      | -240.5--67.1    | <0.01   |
| Second  | -87.2       | -172.6--1.8     | 0.045   |
| Third   | -42.6       | -126.9-41.7     | 0.321   |
| <b>Age (per 10 years)</b>                       | 37.6        | 9.8-65.4        | 0.008   |
| <b>Gender (ref: Male)</b>                       |             |                 |         |
| Female  | 43.2        | -31.5-117.9     | 0.256   |
| <b>Education Level (ref: Tertiary)</b>          |             |                 |         |
| Primary or less                                 | -68.3       | -148.7-12.1     | 0.095   |
| Secondary                                       | -29.4       | -97.8-39.0      | 0.398   |

**Table 04: Multiple Regression Analysis of Factors Associated with Monthly Rehabilitation Costs**

**Perceived Economic Burden**

The perceived economic burden of rehabilitation was substantial, with 57.3% of participants reporting moderate to severe financial strain (scores  $\geq 4$  on the 5-point Likert scale). Common financial coping strategies included using savings (68.2%), borrowing from family members (43.7%), reducing non-healthcare expenses (51.9%), and delaying or foregoing other healthcare services (34.2%). Moreover, 29.1% of participants reported reducing the frequency of physical therapy sessions due to financial constraints, potentially compromising recovery outcomes.

The economic burden disproportionately affected lower-income households, with 74.8% of patients in the lowest income quartile reporting severe financial strain compared to 24.3% in the highest

quartile ( $\chi^2 = 87.3$ ,  $p < 0.001$ ). Additionally, 18.7% of respondents reported that a family member had changed employment status (e.g., reduced hours, changed jobs, or quit working) to provide care, further compounding the economic impact.

## **Discussion**

The present study thoroughly evaluates the economic costs of physical therapy services among stroke survivors, reporting considerable direct and indirect costs that differ significantly according to clinical, demographic, and socioeconomic determinants. The results underscore essential areas for policy action and financial subsidization in order to improve the accessibility and affordability of rehabilitation.

### **Magnitude and Distribution of Costs**

The average monthly expense of \$1,240 for physical therapy care is a heavy financial burden on stroke survivors and their relatives, especially when one considers that such expenses usually last for a long time. The estimated annual cost of around \$14,880 aligns with past estimates by Lee and Kim (2021), who indicated rehabilitation costs of between \$12,000 and \$18,000 annually. However, our results suggest that earlier research underestimated indirect costs, especially losses in caregiver productivity, contributing 12.7% to overall costs in our study.

The apportionment of cost across categories is critical in informing financial planning and policymaking. Direct medical expenses made up a significant proportion (62%), which aligns with what was reported by Chen et al. (2021), who documented proportions of 58% to 65% across health systems. Nonetheless, the large share of indirect costs (38%) highlights the necessity for a broad economic analysis beyond the healthcare cost, including the economic burden on patients and families.

### **Setting-Based Cost Differences**

The striking cost differences between rehabilitation settings have important implications for service delivery models. Inpatient rehabilitation, although showing the highest costs (\$2,340 per month), frequently is a required initial phase for patients with severe impairment. The much lower costs of outpatient (\$986) and home-based services (\$732) indicate the potential for cost savings through the earlier transition to these settings when clinically appropriate. These results agree with earlier findings by Rodriguez-Mañas et al. (2020), who reported 50-65% cost savings when shifting from inpatient to community-based rehabilitation.

The cost-effectiveness of various rehabilitation environments depends on a close examination of both costs and outcomes. Although our study concentrated on costs, earlier research by Thompson and Schneider (2022) indicates that intensive inpatient rehabilitation could provide better functional gains for more severely affected patients, possibly counterbalancing increased initial costs by minimizing long-term care requirements. Future studies should incorporate cost and outcome measures to identify the most appropriate rehabilitation trajectories for various patient groups.

### **Temporal Patterns and Long-Term Economic Impact**

The downward trend in rehabilitation expenses following stroke is a promising result for long-term financial planning. The impressive decrease in the cost from \$1,682 in the acute phase (3-6 months) to \$824 after more than 12 months post-stroke points toward the concentration of the maximum fiscal burden within the initial recuperative period. The trend concurs with spontaneous recuperation patterns and rehabilitation standards that follow intense procedures during the initial stages followed by support programs.

However, the persistence of significant expenses even beyond 12 months highlights the chronic nature of stroke-related economic burden. These ongoing costs, predominantly related to outpatient therapy, medications, and assistive devices, can accumulate substantially over time. Therefore, Healthcare financing mechanisms should consider the acute high-cost phase and the extended lower-cost period that may continue for years post-stroke.

### **Insurance Coverage and Financial Protection**

The dramatic difference in out-of-pocket spending between insured and uninsured patients (\$312-\$386 vs. \$935 per month) highlights the important function of health insurance in protecting finances. The observation that 78.7% of uninsured patients borrowed or sold assets to pay for rehabilitation indicates extreme financial hardship that could jeopardize short-term recovery and long-term economic security. These findings corroborate earlier studies by Park and Chen (2023), who reported catastrophic healthcare costs among 67% of uninsured stroke survivors versus 23% of the insured.

Even in insured patients, gaps in coverage for rehabilitative services led to high out-of-pocket costs. The more expensive charges among publicly insured versus privately insured patients (\$386 vs. \$312) would probably express coverage generosity differences, specifically in the limits on services and copayment requirements. The evidence supports policy suggestions by Anderson and Miller (2023) for increased coverage for rehabilitation in both public and private insurance coverage, with special emphasis on expanding therapy duration limits and lowering cost-sharing for efficacious interventions.

### **Socioeconomic Disparities and Healthcare Equity**

The considerable socioeconomic differences in rehabilitation use and cost burden pose significant equity issues. Those in the lowest income quartile had 24% fewer physical therapy visits despite equal clinical needs, indicating possible underuse based on financial constraints. This difference supports findings by Adeoye et al. (2021), who reported diminished rehabilitation access for socioeconomically disadvantaged patients, with associated worse functional outcomes.

The unequal economic burden cited by poorer households (74.8% citing extreme burden vs. 24.3% in more affluent households) indicates the regressive incidence of healthcare expenditure across income levels. These inequalities can be exacerbated or sustained by rehabilitation costs, potentially increasing socioeconomic disparities in long-term outcomes. Targeted financial assistance programs, e.g., income-based subsidies or sliding-scale reimbursement systems, could counter these inequalities and enhance rehabilitation fairness.

### **Informal Caregiving and Hidden Costs**

The significant impact of caregiver losses in productivity (\$157 per patient per month) emphasizes the overlooked economic aspect of informal care when healthcare financing options are considered. This estimate will be conservative at best, considering that it measures only productivity loss and does not account for the caregivers' physical and psychological well-being effects. Kumar and Patel (2022) also reported lower caregiver cost estimates, adding that more inclusive valuation methods provide estimates 30-45% above those derived solely from productivity metrics.

Identifying 18.7% of patients with caregivers reporting changing job status to care is a particularly deleterious economic consequence beyond quantified productivity loss. These interruptions in careers can have sustained implications for family-level financial security and caregiver economic health, the beginnings of a cycle of economic risk. Stroke rehabilitation cost policies must include mechanisms for supporting caregivers, such as respite care services, work flexibility arrangements, and possible reimbursement for informal care provision.

### **Affordable Interventions and Innovation**

The high economic burden in this study highlights the need to develop and implement cost-saving rehabilitation strategies. Current evidence indicates that telerehabilitation, group interventions, and home exercises using technology can be viable alternatives to one-on-one therapy at lower costs. Zhao et al. (2021) provided similar outcomes for telerehabilitation compared to traditional physical therapy at about 60% of the cost, which is an encouraging method for minimizing economic burden while ensuring quality of care.

Equally, new payment models like bundled payments and value-based payments may provide incentives for the cost-effective delivery of services while maintaining the sufficient intensity of care. Pilot programs with episode-based payment for stroke rehabilitation have shown 15-22% cost savings without sacrificing functional results (McGrath et al., 2022). These initiatives are worth exploring and possibly expanding to counter the economic issues discovered within our study.

### **Study Limitations**

Some limitations need to be taken into account when interpreting these results. First, the cross-sectional design gives a snapshot at particular time points but does not reflect longitudinal patterns for individual patients. Second, cost data were based partly on self-reporting, possibly subject to recall bias. However,



attempts were made to confirm expenses via medical records and receipts when available. Third, the research investigated only physical therapy expenditures and cannot portray the entire rehabilitative spectrum, such as speech and occupational therapies. Lastly, though the sample captured various healthcare delivery sites and sociodemographic bases, regional health systems and care variations might constrict generalizability.

Despite these drawbacks, the thorough evaluation of direct and indirect costs, caregiver impacts, and in-depth analysis of socioeconomic factors help understand the financial burden of post-stroke physical therapy care. Subsequent research should use longitudinal study designs to identify cost patterns along the recovery trajectory and include quality-adjusted outcomes to assess the cost-effectiveness of varying rehabilitation methods and types of settings.

### **Conclusion**

This research illustrates that physical therapy interventions for stroke survivors are a significant economic burden, with average monthly expenses of \$1,240 per patient and considerable variability according to stroke severity, rehabilitation environment, and time since stroke. Direct medical expenses are the most significant portion of costs, but indirect costs associated with lost productivity and caregiving are a significant and frequently underappreciated economic burden. The financial burden disproportionately affects uninsured patients and those from lower socioeconomic backgrounds, highlighting important equity concerns in rehabilitation access and affordability.

Several key implications emerge from these findings. First, healthcare financing mechanisms should address both the high-intensity initial phase of rehabilitation and the extended maintenance phase, which may continue for years post-stroke. Second, increased insurance coverage for rehabilitation services, especially for high-risk groups, is necessary to avoid catastrophic spending and provide adequate therapy intensity. Third, new service delivery models, such as telerehabilitation and group therapy models, have the potential for cost savings with quality care. Fourth, informal caregiver support systems must be incorporated into comprehensive stroke care strategies to address the significant economic burden of caregiving tasks.

As the global stroke burden grows, resolving the economic difficulties of rehabilitation grows more imperative. Policy efforts should aim to increase financial protection, minimize socioeconomic inequality in access, promote innovative cost-saving interventions, and establish stable financing instruments for integrated rehabilitation care. Through intervention in these economic aspects, health systems can enhance both accessibility and efficiency of post-stroke rehabilitation, thereby increasing recovery outcomes and quality of life for stroke survivors globally.

### **Author's Contribution:**

Conception or Design: Khan A

Analysis or Interpretation of Data: Khan A, Khan FW

Manuscript Writing & Approval: Khan A, Fatima D

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