Predictors of Direct Medical Cost for Outpatient-based Rehabilitation Among Stroke Patients

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ABSTRACT

Background

This is the first study conducted to determine the predictors of outpatient based rehabilitation cost in the local setting. This aimed to determine whether demographic and clinical characteristics of post-stroke patients are predictors of direct medical costs for outpatient-based rehabilitation.

Methods

A retrospective single-arm cohort study was utilized to determine the predictors of direct medical cost for out-patient based post-stroke rehabilitation seen at the rehabilitation department of a tertiary hospital from January 1, 2019 to December 31, 2023.

Results

A significant association was found between direct cost and smoking. Additionally, an association between direct cost and hypertension was evident. No significant associations were identified between direct rehabilitation cost and other factors such as age, sex, mRS score, type of stroke, intervention, and other co-morbidities, aside from hypertension and smoking.

Conclusion

Smoking and hypertension are predictors of direct medical cost for outpatient-based post stroke rehabilitation. These factors necessitate more intensive therapy and longer rehabilitation periods as compared to other factors which did not have significant associations with cost.

Key words: *Post stroke rehabilitation, direct cost, outpatient rehabilitation*

INTRODUCTION

Stroke is the second leading cause of death and the third leading cause of disability worldwide, representing a significant public health challenge.[1] In 2019, an estimated 12.2 million cases of stroke were reported, reflecting a staggering 70% increase in incidence over the past three decades. By 2021, stroke accounted for approximately 7.44 million deaths globally with Oceania, Central and Southeast Asia exhibiting the highest mortality rates.[2] An article published by World Bank and World Health Organization (WHO) has revealed that half of the global population lacks access to essential health services, resulting in over 100 million families being pushed into extreme poverty due to healthcare expenses.[3] This rising burden of stroke not only threatens individual health but also exacerbates the vulnerabilities of healthcare systems particularly in low and middle income countries like the Philippines.[4]

In a country with limited resources, addressing gaps in health policies and programs is crucial for effectively reducing stroke-related mortality and morbidity.[5] Stroke is a prevalent health issue in the Philippines, and while it can often be prevented through cost-effective measures, patients face significant financial burdens when seeking medical rehabilitation to

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enhance their quality of life.[6] Acute treatment for stroke can be prohibitively expensive however, the national health insurance system only reimburses 76,000 PhP (1,351.47 USD) and 80,000 PhP (1,422.60 USD) for ischemic and hemorrhagic strokes respectively.[7] These amounts are insufficient to cover the overall professional and institutional fees associated with hospital admission for stroke patients. Upon discharge, most of the stroke survivors encounter challenges in financing ongoing maintenance medications and prescribed rehabilitation programs in the outpatient setting. This financial strain complicates timely access to treatment, as most rehabilitation costs are borne out-of-pocket.[8] Although some private health insurance plans offer limited coverage for rehabilitation services.[9], the lack of a dedicated national benefit package for these essential services remains a primary driver of post-stroke care expenses.[10] To the best of our knowledge, this is the first study conducted to determine the predictors of outpatient based rehabilitation cost in the local setting.

This study aimed to determine whether demographic and clinical characteristics of post-stroke patients are predictors of direct medical costs for outpatient-based rehabilitation. The findings of this study may provide a reliable foundation for developing tailored rehabilitation plans that consider the patients' financial circumstances. This may also serve as a critical reference for healthcare professionals, law-making bodies and future researchers, helping to bridge the gap of knowledge in making post stroke rehabilitation more accessible for all.

METHODOLOGY

Research Design

A retrospective single-arm cohort study was utilized to determine the predictors of direct medical cost for out-patient based post-stroke rehabilitation.

Research Setting

The researcher enrolled patients seen at the rehabilitation department of a tertiary hospital from January 1, 2019 to December 31, 2023.

Sampling Method

A purposive sampling method was utilized in selecting patients from the target population.

Sample Size Determination

Sample size was computed using G*Power version 3.1. A minimum sample size of 395 was needed to achieve 80% power with 5% level of significance in a linear regression analysis with 11 predictor variables of interest to detect a significant predictor of cost with small effect size (Cohen's $f2 = 0.02$). Final number of patients included in the analysis of this study was 396.

Procedure

The researcher utilized a chart review to determine the demographic and clinical characteristics of stroke patients referred for outpatient rehabilitation within the specified timeframe. The direct costs of rehabilitation per session and the total number of sessions per patient were also identified from the patients' charts. Following the document review, data extraction was performed using a standardized data collection form which was encoded in a password-protected spreadsheet to ensure data integrity and confidentiality.

Statistical Analysis

The demographic and clinical profiles of stroke patients who underwent rehabilitation at the outpatient center of a tertiary hospital from January 1, 2019 to December 31, 2023 were summarized using descriptive statistics. The non-normally distributed continuous numerical variables were reported as median and interquartile

range (IQR) while categorical variables were described as frequency and percentage.

A Logarithmic transformations outcome in linear regression analysis at 95% confidence interval was performed to determine the significant predictors of direct medical cost for post-stroke patients referred to outpatient-based post-stroke rehabilitation.

Data was processed and analyzed using SPSS27. The normality of the distribution of continuous numerical variables was assessed by Shapiro-Wilk test of normality. All tests of hypothesis were evaluated with significance level set at α=0.05.

PARTICIPANTS

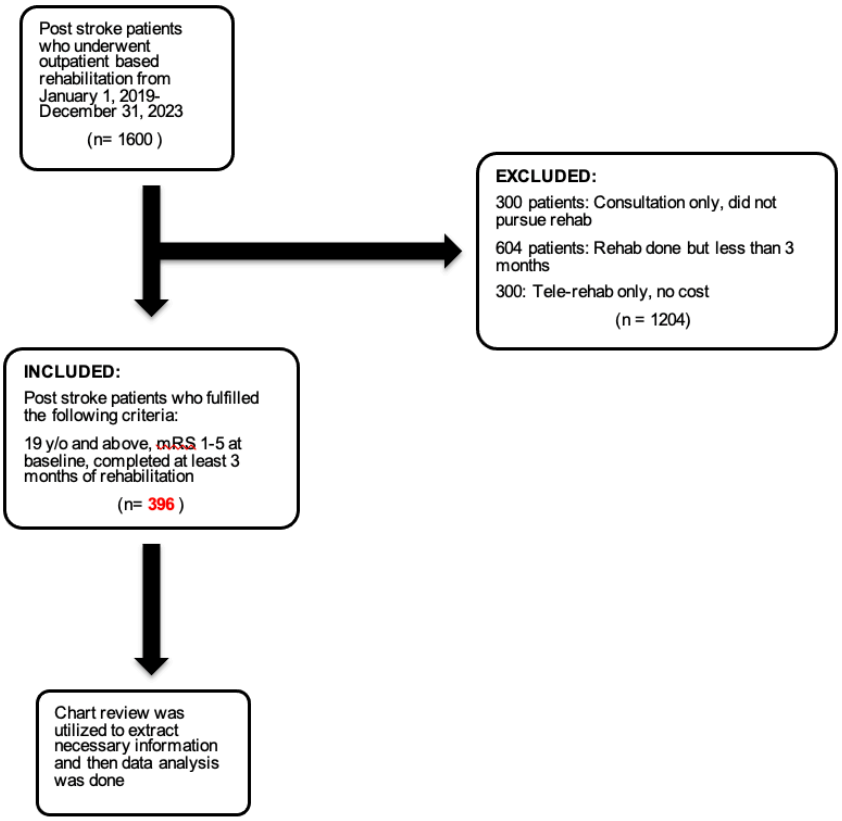
Patients 19 years old and above who were diagnosed with either ischemic or hemorrhagic stroke, with MRS score of 1-5 upon discharge and who have completed at least 3 months of prescribed rehabilitation regimen were included in this study.

Patients who were diagnosed with stroke due to other causes (Vasculitis, Cerebral venous sinus thrombosis etc.) or those who were diagnosed with transient ischemic attack (TIA), those who had recurrent strokes or who died during the course of rehabilitation were excluded in this study.

Data Collection Process

After seeking approval from the Institutional Ethics Review Board (IERB) and Technical Review Board (TRB), data collection was started. Demographic variables such as age and gender, clinical profile such as type of stroke, risk factors such as smoking, comorbities such as hypertension, diabetes mellitus, dyslipidemia etc, baseline MRS score prior to start of outpatient rehabilitation, and total sessions as well as cost of rehabilitation were extracted through a chart review. Results and data were analyzed and collated in a confidential manner.

Figure 1. Flow Diagram of Study Population



Ethical Considerations

This research commenced after obtaining approval from the IERB and TRB. The research committee of the rehabilitation center was also notified and an approval to conduct the research was secured. A waiver of Informed Consent was requested due to the retrospective nature of this research. There was no conflict of interest in this study.

To ensure confidentiality of information gathered, it was contained and validated only by the researcher. Data was treated with non-discriminatory, non-judgmental, and non-biased retrieval from the patients' charts. All information obtained was done in accordance with the right to privacy and confidentiality.

RESULTS AND DISCUSSION

A total of 396 patients were included in the study. Demographic and clinical profiles such as age, sex, co-morbidities, type of stroke, intervention and stroke severity were presented in Table 1. Of the total, 256 (64.65%) patients had ischemic while 140 (35.53%) patients had hemorrhagic strokes. In terms of age distribution, 255 (64.39%) patients were aged 19-59 years, while 141 (35.61%) were 60 years and older. Majority of patients were male comprising 246 (62.12%), with females making up 150 (37.88%). Regarding stroke severity, 269 (67.93%) patients had modified Rankin Scale (mRS) scores of 3-5 indicating moderate to severe disability, while 127 (32.07%) had scores of 1-2, indicating mild to no significant disability. Co-morbidities were prevalent, with 330 (83.33%) patients having hypertension. Other notable co-morbidities included a smoking history in 101 (25.50%), diabetes mellitus in 82 (20.71%), cardiovascular disease in 64 (16.16%), dyslipidemia in 63 (15.91%), kidney disease in 32 (8.08%), bronchial asthma in 19 (4.80%), chronic obstructive pulmonary disease (COPD) in 17 (4.29%), and malignacy in 7 (1.77%). In terms of interventions, 370 (93.43%) patients received medical treatment (either antiplatelet, anti-coagulant or antihypertensives), 22 (5.55%) underwent surgical management and 5 (1.26%) received intravenous thrombolysis.

Table 1. Demographic and clinical profile of post-stroke patients.

Indicators	Frequency	Percentage
Age		
19-59 y ≥60 y	255 141	64.39% 35.61%
Sex		
Male Female	246 150	62.12% 37.88%
mRS score		
Scores 1-2 (good functional outcome) Scores 3-5 (poor functional outcome)	127 269	32.07% 67.93%
Comorbidities		
Cardiovascular disease Kidney disease Malignancy Bronchial asthma Diabetes Mellitus COPD Dyslipidemia Smoking Hypertension	64 32 7 19 82 17 63 101 330	16.16% 8.08% 1.77% 4.80% 20.71% 4.29% 15.91% 25.50% 83.33%
Type of stroke [n=396]		
Ischemic Hemorrhagic	256 140	64.65% 35.53%
Intervention		
IV Thrombolysis Surgical (Craniotomy or hemicraniectomy) Medical	5 22 370	1.26% 5.55% 93.43%
Direct rehabilitation cost, *pesos*, median (IQR)	5400	8100

Direct rehabilitation cost was reported using median and interquartile rate (IQR) due to the skewness of data distribution which warranted a logarithmic transformation of the outcome variable. This study revealed that in a minimum of three

months rehabilitation, median cost was 5,400 PhP with an IQR of 8, 100 PhP.

Considering the ideal formal rehabilitation of at least 5-9 sessions per week with an average of 3 hours per session within 3-4 months as mentioned in the 2016 AHA/ASA Guidelines for Adult Stroke Rehabilitation and Recovery,[11] rehabilitation cost analyses were done (Table 2). Since there was no mentioned actual cost on the available guidelines, the researcher used the actual minimum cost of rehabilitation per session (500 PhP) in the institution in which this study was conducted as depicted in Table 3. The average 3-month cost of rehabilitation was 5,211 PhP while the average 4-month cost was 11,067 PhP. These costs were lower than the minimum cost of prescribed rehabilitation regimen. Furthermore, the average session in 3 months was 10 while the average session in 4 months was 19. Based on these data, patients enrolled at the outpatient rehabilitation department of a tertiary hospital did not meet the prescribed minimum sessions of rehabilitation.

Table 2. Three and Four Months Rehabilitation Cost Analysis

	3 MONTHS	4 MONTHS
MEAN	5, 211 PHP	11, 067 PHP
MEDIAN	4, 000 PHP	9,000 PHP
STANDARD DEVIATION	4,758 PHP	7,258 PHP
IQR	4,425 PHP	10,725 PHP

Table 3. Prescribed Rehabilitation Regimen based on the current ASA/AHA Guidelines

		Ideal Rehabilitation Cost	
		3 MONTHS	4 MONTHS
COST	Minimum	6,000 php	30, 000 php
	Maximum	30,000 php	54,000 php
SESSION	Minimum	60	80
	Maximum	108	144

** Computed based on the actual rehabilitation cost in the local setting (500 php per session)*

The predictors of direct rehabilitation cost were summarized in Table 4. Table 5 had shown how a logarithmic transformation in linear regression model was utilized in identifying the notable predictors of cost. Following this model, a significant association was found between direct cost and smoking with a p-value of 0.002. Additionally, an association between direct cost and hypertension was evident, with a p-value of 0.022. No significant associations were identified between direct rehabilitation cost and other factors such as age, sex, mRS score, type of stroke, intervention, and other co-morbidities, aside from hypertension and smoking. The varied demographic and clinical profiles of patients who were included in this study affected the significant results. Even though the disability level depicted by mRS score played an important role in the cost-effectiveness of inpatient rehabilitation, results for outpatient based rehabilitation in our local setting had shown no significant associations with cost.[12]

Although results vary across studies, overall evidence suggested that certain co-morbidities may have an effect on post-stroke rehabilitation.[12] In this study, smoking was significantly associated with outpatient-based direct rehabilitation cost. This finding was congruent to previous published studies which revealed that smokers recovering from a stroke may incur higher rehabilitation costs, sometimes up to 20-30% more, due to prolonged hospital stays and increased likelihood of complications.[13] Subsequently, smoking could lead to a more intensive therapy needs, ultimately raising the financial burden of rehabilitation. A significant association of hypertension with direct rehabilitation cost was also evident in this study. This finding was also compatible to previous studies indicating that the annual costs of stroke care were significantly higher for hypertensive patients, with estimates showing that hypertension-related strokes could result in overall costs that are 30-50% greater than those of non-hypertensive strokes.[14, 15] Hypertension-related stroke may

Table 4. Predictors of Direct Rehabilitation Cost.

Factors	P-Value	Standardized Beta	Lower Bound	Upper Bound
Age	0.781	0.014	-0.18	0.239
Sex	0.593	0.027	-0.151	0.263
Stroke Type	0.326	0.05	-0.105	0.315
mRS Score	0.702	0.019	-0.173	0.257
Hypertension	0.022	0.115	0.045	0.576
Diabetes Mellitus	0.917	0.005	-0.234	0.261
Cardiovascular	0.425	0.04	-0.162	0.383
Kidney Disease	0.345	0.048	-0.191	0.544
COPD	0.112	0.08	-0.093	0.893
Bronchial Asthma	0.361	-0.046	-0.686	0.251
Malignancy	0.319	-0.05	-1.145	0.374
Smoking	0.002	0.156	0.11	0.48
Medical Intervention	0.194	0.066	-0.077	0.378
Surgical Intervention	0.066	0.092	-0.028	0.863

** IV Thrombolysis was included under medical intervention*

Table 5. Predictor Models of Direct Rehabilitation Cost.

	Unstandardized Coefficients Beta	Standardized Coefficients Beta	Lower Bound	Upper Bound	Sig.
(Constant)	8.364	67.918	8.122	8.606	<0.001
Hypertension	0.311	2.299	0.045	0.576	0.022
(Constant)	8.546	152.91	8.437	8.656	<0.001
Smoking	0.295	3.13	0.11	0.48	0.002

Model: log(Y)=β0+β1X1--> Hypertension: log(Y)=8.364+0.311(X1) ; Smoking: log(Y)=8.546+0.295(X1)

** IV Thrombolysis was included under medical intervention*

require extended rehabilitation programs due to the lasting effects on mobility and cognitive function, increasing long-term rehabilitation costs compared to patients without hypertension.[16]

STUDY LIMITATIONS

The retrospective nature of this research was considered as one of the study limitations since it could lead to a varying recollection of data. Poorly recorded and incomplete or missing information were obstacles in getting accurate data in a chart review. The risk for recall bias was also considered as limitation. This research only included the direct cost of outpatient based post-stroke rehabilitation and did not calculate additional logistic fees such as food, travel or other miscellaneous expenses. Actual patients' perspective regarding total rehabilitation cost was not included in this study. Furthermore, professional fees of physicians and physical therapists were also excluded.

CONCLUSION

This study concluded that smoking and hypertension are predictors of direct medical cost for outpatient-based post stroke rehabilitation. These factors necessitate more intensive therapy and longer rehabilitation periods as compared to other factors which did not have significant associations with cost. Efforts to promote smoking cessation and thorough blood pressure monitoring and control especially in known hypertensive patients must be maximized. Direct medical costs for outpatient rehabilitation vary depending on stroke type, stroke severity, demographics and co-morbidities, highlighting the need for tailored financial planning in rehabilitation services. Findings of this study may help address the healthcare accessibility gaps of rehabilitation services particularly in resource-limited settings that mostly cater to marginalized patients.

RECOMMENDATIONS

A larger prospective and multi-center study is recommended to further explore the long-term effects of co-morbidities on rehabilitation outcomes, aiming to create evidence-based interventions that can reduce costs and improve quality of care. In a prospective study, patients' perspective on cost must be included to incorporate a more holistic approach in determining the predictors of post stroke rehabilitation cost. Further studies is recommended to include not only the direct cost but also the logistic, professional and miscellaneous costs in order to have more realistic and relevant results.

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