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Cost analysis of post-stroke dysphagia during acute hospitalisation: a cross-sectional study in Vietnam

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ABSTRACT

Objectives To estimate the healthcare costs associated with post-stroke dysphagia during acute hospitalisation and to identify factors influencing these costs in a tertiary hospital setting in Vietnam.

Design A cross-sectional study using clinical and billing data from hospital records.

Setting The study was conducted at the Neurology Center of Bach Mai Hospital, a tertiary care facility in Hanoi, Vietnam, between June 2020 and January 2022.

Participants A total of 951 patients aged ≥18 years with acute ischaemic stroke confirmed by CT or MRI were included. Dysphagia was assessed using the Gugging Swallowing Screen.

Outcome measures Direct healthcare costs during hospitalisation were collected from the hospital billing system and categorised as medications, diagnostic imaging, medical supplies, accommodation, food, procedures and laboratory tests. All costs were converted to USD. Associations between patient characteristics and total healthcare costs were analysed using generalised linear models (Gamma distribution with log link), applying robust standard errors.

Results The median treatment cost was 10.08 million VND (436.24 USD) in the dysphagia group vs 6.37 million VND (275.78 USD) in the non-dysphagia group. Costs increased with dysphagia severity, reaching 22.64 million VND (979.49 USD) among patients with severe dysphagia. In multivariate analysis, dysphagia was associated with a 21% increase in costs (exp(β) = 1.21; 95% CI 1.10 to 1.33; p<0.01). Other significant cost drivers included combined stroke lesions, National Institute of Health Stroke Scale score >14, pneumonia, prolonged hospitalisation and higher educational level.

Conclusions Post-stroke dysphagia substantially increases acute hospitalisation costs in Vietnam. Early screening, standardised management and preventive care for complications may improve outcomes and reduce costs.

Trial registration number The study was registered on the Research Registry website (https://www.researchregistry.com/) under the unique identification number: researchregistry8203.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is the first study in Vietnam to quantify the healthcare costs of post-stroke dysphagia during acute hospitalisation.
⇒ A micro-costing approach allowed for detailed analysis of cost components.
⇒ The large sample size (n=951) enhanced the robustness of the findings.
⇒ The study was conducted at a single tertiary hospital, which may limit generalisability to other settings.
⇒ Only direct medical costs were analysed; indirect and societal costs were not included.

INTRODUCTION

The economic burden associated with post-stroke dysphagia arises from multiple factors related to its treatment, management and associated complications during acute hospitalisation. Dysphagia is a prevalent condition among stroke patients, further complicating clinical management, delaying recovery and increasing healthcare resource utilisation.[1–3] This condition is strongly associated with prolonged hospital stays, a higher incidence of pneumonia and increased mortality, all contributing to escalating healthcare expenditures.[4–6] The cost implications encompass both direct medical expenses (eg, consultations, diagnostic evaluations, therapeutic interventions) and indirect costs related to extended rehabilitation and loss of productivity.[1 2]

Several studies highlighted the substantial healthcare costs associated with dysphagia in post-stroke patients.[3 7–9] Patients with post-stroke dysphagia incur significantly higher healthcare expenses than those without this condition.[3] A study conducted in France and Switzerland demonstrated that post-stroke dysphagia was linked to prolonged hospital stays and increased hospital costs.[7] Another study, although it did not measure total hospital costs per patient, found that individuals with post-stroke dysphagia required more medical services, resulting in increased healthcare expenditures.[6 8]

Several factors could influence healthcare costs for post-stroke dysphagia, including stroke severity, the presence of comorbidities and the initial assessment protocols used within hospitals.[10–13] In addition, studies indicated that the severity of dysphagia at admission was closely linked to adverse outcomes such as increased incidents of pneumonia and extended hospitalisation.[4 5] Moreover, the screening and rehabilitation processes associated with dysphagia can lead to an increase in healthcare expenditures.[4 12] Effectively managing dysphagia to enhance patient outcomes may necessitate the implementation of various strategies, which could further elevate healthcare costs during hospitalisations.[4 14 15]

Although several studies examined or discussed the healthcare costs of post-stroke dysphagia,[3 4 7] no research had been conducted on this issue in Vietnam. Specifically, no study had estimated the healthcare costs of post-stroke dysphagia during the acute hospitalisation period. Therefore, we conducted this study to determine the healthcare costs associated with post-stroke dysphagia during hospitalisation and to identify the factors that influenced these costs.

METHODS

Study setting

The study was based on data from a previous research project conducted at Bach Mai Hospital in Hanoi, Vietnam. Bach Mai Hospital is a tertiary care facility that provides healthcare services to residents of Hanoi and the northern provinces of Vietnam.[13] In addition to using data from the previous research, this study also collected cost data from patients during the acute treatment period through the hospital's billing system. Specifically, the study was conducted from June 2020 to January 2022 at the hospital's Neurology Center, which specialises in diagnosing and treating neurological conditions, including acute ischaemic stroke. The Research Ethics Committee of Nam Dinh University of Nursing approved the research protocol under decision no. 1603/GCN-HDDD. The study was registered on the Research Registry website (https://www.researchregistry.com/) under the unique identification number researchregistry8203. Patient data were anonymised and de-identified before analysis to ensure confidentiality. Informed consent was waived due to the retrospective nature of the study.

Study population

The inclusion criteria encompassed individuals aged 18 years or older diagnosed with acute ischaemic stroke. In this study, MRI or CT was used to confirm the diagnosis of acute ischaemic stroke. Furthermore, these individuals had a Glasgow Coma Scale (GCS) score >13 and were capable of communication. Patients requiring oxygen therapy or intubation or those with myocardial infarction, Wernicke's aphasia, dementia, missing teeth or a history of dysphagia were excluded. Sample size was calculated using a formula for estimating a population proportion with defined absolute precision, resulting in 951 patients. Details of the sample size calculation were described elsewhere.[13]

Variables

In this study, variables related to the characteristics of the study participants included sex (male or female), age, educational level (primary school or lower, secondary school and high school or above) and obesity (yes or no). In addition, variables related to medical history and condition were also included, such as the site of stroke (hemispheric, brainstem, cerebellar or combined), National Institute of Health Stroke Scale (NIHSS) score, communication disorder (yes or no), facial paralysis (yes or no), previous stroke (yes or no), hypertension (yes or no), diabetes mellitus (yes or no), stroke-associated pneumonia (yes or no) and length of hospital stay (days). For the assessment of dysphagia, the Gugging Swallowing Screen (GUSS) was used to evaluate all patients within 4 hours of hospital admission.[16 17] Dysphagia was defined as a GUSS score of ≤19, and the severity of dysphagia was categorised into four levels based on GUSS scores: no dysphagia (score of 20), mild dysphagia (scores of 15–19), moderate dysphagia (scores of 10–14) and severe dysphagia (scores of 0–9).[16 17]

Costing analysis

A micro-costing approach was employed to estimate healthcare costs using expenditure items recorded in the hospital's billing system. Cost analysis was conducted from the healthcare provider's perspective, focusing on direct costs incurred by the patient within the healthcare facility. After analysing and summarising detailed expenditures, patient healthcare costs were categorised into the following groups: medicines, diagnostic imaging, medical supplies, accommodation, food, procedures and laboratory tests. Medicines included expenses related to pharmaceutical products. Diagnostic imaging costs encompassed expenditures associated with radiological and imaging procedures, including X-rays, CT, MRI and ultrasound. Medical supplies covered expenses for consumable items and medical devices essential for patient care, such as syringes, catheters and dressings. Accommodation costs included expenses related to hospital stays, such as bed occupancy and nursing services. Food costs were calculated based on the meals provided to hospitalised patients, incorporating necessary dietary modifications. Procedural costs comprised expenditures related to both surgical and non-surgical interventions. Laboratory test costs encompassed expenses for diagnostic evaluations, including blood tests, biochemical analyses and microbiological cultures. All cost components were calculated in Vietnamese Dong (VND) and converted to USD using the average exchange rate in 2021.

Statistical analysis

Data on patient characteristics were derived from a previous study,[13] and no issues related to missing data were

identified. Information on healthcare costs was obtained directly from the hospital billing system, which is considered highly reliable and accurate. To assess the influence of potential outliers, we examined the top 5% of cases with the highest costs; none were deemed implausible, and all were retained in the analysis. Descriptive statistics summarised patient characteristics and cost components. Continuous variables were presented as means (SD) when approximately normally distributed and as medians (IQR) otherwise. Categorical variables were reported as counts and percentages. Associations between covariates and total treatment costs among post-stroke patients were assessed using generalised linear models (GLMs; gamma family with a log link) with robust (Huber–White) standard errors. All analyses were two-sided and conducted in Stata version 14.0 (StataCorp LLC, College Station, TX, USA), with statistical significance defined as $p<0.05$.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this study.

RESULTS

Table 1 describes the characteristics of post-stroke patients with and without dysphagia, categorised by various factors. The data indicated that there were more men than women in both groups, with a slightly lower percentage of men in the dysphagia group (62.4%) compared with the non-dysphagia group (69.3%). The average age was higher in patients with dysphagia (66.9 years) than in those without (61.3 years). A larger percentage of patients with dysphagia had only an elementary school education or lower (28.6%) compared with the non-dysphagia group (21.1%). The prevalence of obesity was comparable across categories, with approximately 16% classified as obese. In both groups, hemispheric strokes were more common, yet less frequent among dysphagia patients (74.9%) than among patients without dysphagia (85.9%). Conversely, brainstem strokes were more prevalent in the dysphagia group (19.1%) compared with the non-dysphagia group (6.7%). The NIHSS score revealed that all non-dysphagia patients experienced mild to moderate strokes, while 12.3% of patients with dysphagia had moderately severe or severe strokes. Communication disorders were more prevalent among individuals with dysphagia (48.6% vs 33.0%). Facial paralysis was more common in the dysphagia group (90.6%) than in the non-dysphagia group (38.1%). The proportion of prior strokes was higher in patients with dysphagia (21.4%) compared with patients without dysphagia (14.1%). The prevalence of hypertension and diabetes mellitus was similar across both groups. Stroke-associated pneumonia occurred more frequently in patients with dysphagia (10.3%) compared with patients without dysphagia (0.4%). The duration of hospitalisation was longer for the dysphagia cohort (11.8 days) than for the non-dysphagia cohort (7.2 days).

Table 2 shows the total treatment costs for post-stroke patients with and without dysphagia, expressed in both million VND and USD. The median treatment cost was lower among patients without dysphagia, at 6.37 million

Table 1 Characteristics of post-stroke patients with and without dysphagia by different factors

Variable	No dysphagia (n=270)	Dysphagia (n=681)
	N (%) or median (IQR)	
Sex		
Male	187 (69.3)	425 (62.4)
Female	83 (30.7)	256 (37.6)
Age group (year)	63.0 (14.0)	68.0 (15.0)
Education		
Primary school or lower	57 (21.1)	195 (28.6)
Secondary school	106 (39.3)	219 (32.2)
High school or above	107 (39.6)	267 (39.2)
Obesity		
No	225 (83.3)	570 (83.7)
Yes	45 (16.7)	111 (16.3)
Site of stroke		
Hemispheric	232 (85.9)	510 (74.9)
Brainstem	18 (6.7)	130 (19.1)
Combined and other	20 (7.4)	41 (6.0)
NIHSS score		
Mild/moderate (≤14)	270 (100.0)	597 (87.7)
Moderately severe/severe (>14)	0 (0.0)	84 (12.3)
Communication disorder		
No	181 (67.0)	350 (51.4)
Yes	89 (33.0)	331 (48.6)
Facial paralysis		
No	167 (61.9)	64 (9.4)
Yes	103 (38.1)	617 (90.6)
Previous stroke		
No	232 (85.9)	535 (78.6)
Yes	38 (14.1)	146 (21.4)
Hypertension		
No	97 (35.9)	213 (31.3)
Yes	173 (64.1)	468 (68.7)
Diabetes mellitus		
No	204 (75.6)	524 (76.9)
Yes	66 (24.4)	157 (23.1)
Stroke-associated pneumonia		
No	269 (99.6)	611 (89.7)
Yes	1 (0.4)	70 (10.3)
Length of hospital stay (day)	7.0 (3.0)	10.0 (7.0)

NIHSS, National Institute of Health Stroke Scale.

Table 2 Costs for post-stroke patients with and without dysphagia

Variable	Total treatment costs (mil. VND)	Total treatment costs (USD)
	Median (IQR)	Median (IQR)
No dysphagia	6.37 (4.78)	275.78 (206.83)
Dysphagia (all)	10.08 (13.16)	436.24 (569.28)
By degree of dysphagia		
Mild	7.94 (5.27)	343.79 (227.96)
Moderate	12.71 (13.64)	549.81 (590.26)
Severe	22.64 (35.23)	979.49 (1524.26)

mil. VND, Million Vietnam dong.

VND (275.78 USD), compared with those with dysphagia, whose median cost reached 10.08 million VND (436.24 USD). When stratified by the degree of dysphagia, the median treatment costs increased progressively with severity. Patients with mild dysphagia had a median cost of 7.94 million VND (343.79 USD), those with moderate dysphagia incurred 12.71 million VND (549.81 USD) and those with severe dysphagia had the highest median costs at 22.64 million VND (979.49 USD).

Table 3 presents the median treatment costs for different cost components in post-stroke patients with and without dysphagia, expressed in millions of VND and in USD. Across most cost components, patients with dysphagia incurred higher median expenditures compared with those without dysphagia. For medicines, the median cost increased from 1.43 million VND (62.02 USD) in patients without dysphagia to 2.61 million VND (112.76 USD) in those with dysphagia. Accommodation costs showed a similar pattern, rising from 1.95 million VND (84.40 USD) to 3.21 million VND (138.73 USD). In contrast, costs for diagnostic imaging were relatively similar between groups, at 1.76 million VND (75.94 USD) in patients without dysphagia and 1.86 million VND (80.67 USD) in those with dysphagia. Expenditures on food, procedures and laboratory tests were notably higher in patients with dysphagia, while medical supplies accounted for a small proportion of costs in both groups, but remained higher in the dysphagia group.

Table 4 reports the results of the GLM with a gamma distribution and log link to assess factors associated with total treatment costs among post-stroke patients. The presence of dysphagia was linked to a 21% higher cost compared with that in patients without dysphagia ($\exp(\beta) = 1.21$; 95% CI 1.10 to 1.33; $p<0.01$). Patients with at least a high school education incurred 13% higher treatment costs than those with primary school education or lower ($\exp(\beta) = 1.13$; 95% CI 1.04 to 1.23; $p<0.01$). For stroke location, patients categorised as having 'combined and other' lesions had 22% higher costs relative to those with brainstem strokes ($\exp(\beta) = 1.22$; 95% CI 1.02 to 1.46; $p=0.03$). Stroke severity, as indicated by an NIHSS score greater than 14, was associated with a 21% increase in costs ($\exp(\beta) = 1.21$; 95% CI 1.07 to 1.36; $p<0.01$). Stroke-associated pneumonia was linked to a 54% increase in treatment expenditures ($\exp(\beta) = 1.54$; 95% CI 1.27 to 1.86; $p<0.01$). Furthermore, each additional day of hospitalisation was associated with a 9% increase in overall costs ($\exp(\beta) = 1.09$; 95% CI 1.08 to 1.10; $p<0.01$).

Figure 1 illustrates the expected total expenses for post-stroke care during acute hospitalisation for patients with and without dysphagia. The graphic highlights the cost difference between the two groups, with individuals affected by dysphagia facing higher medical expenses. This trend shows that as the length of hospital stays for post-stroke patients increases, those with dysphagia incur a more rapid rise in total treatment costs compared with those without dysphagia.

DISCUSSION

This was the first study in Vietnam to examine the healthcare costs associated with post-stroke dysphagia. Healthcare costs were significantly higher among post-stroke

Table 3 Cost components for post-stroke patients with and without dysphagia

Variable	No dysphagia Median (IQR)		Dysphagia Median (IQR)	
	mil. VND	USD	mil. VND	USD
By cost components				
Medicines	1.43 (1.08)	62.02 (46.58)	2.61 (4.48)	112.76 (193.73)
Diagnostic imaging	1.76 (1.83)	75.94 (79.32)	1.86 (1.53)	80.67 (66.19)
Medical supplies	0.07 (0.05)	2.90 (2.08)	0.11 (0.14)	4.69 (6.10)
Accommodation	1.95 (1.95)	84.40 (84.24)	3.21 (4.49)	138.73 (194.13)
Food	0.0 (0.36)	0.0 (15.58)	0.53 (1.62)	22.83 (70.23)
Procedure	0.16 (0.09)	6.96 (3.89)	0.31 (0.82)	13.45 (35.66)
Laboratory tests	0.39 (0.39)	17.06 (16.72)	0.56 (1.14)	24.42 (49.35)

mil. VND, Million Vietnam dong.

Table 4 Association between associated factors and total healthcare costs of post-stroke patients using generalised linear model with gamma family and log link (robust standard errors)

Variable	Exp(β) (95% CI)	P value
Dysphagia (yes vs no)	1.21 (1.10 to 1.33)	<0.01
Sex (male vs female)	1.03 (0.96 to 1.11)	0.35
Age (years)	1.00 (0.99 to 1.002)	0.48
Education		
Primary school or lower	Ref.	
Secondary school	1.02 (0.94 to 1.11)	0.69
High school or above	1.13 (1.04 to 1.23)	<0.01
Obesity (yes vs no)	1.00 (0.92 to 1.09)	0.99
Stroke location		
Brainstem	Ref.	
Hemispheric	1.08 (0.99 to 1.17)	0.08
Combined and other	1.22 (1.02 to 1.46)	0.03
NIHSS score (>14 vs ≤14)	1.21 (1.07 to 1.36)	<0.01
Communication disorder (yes vs no)	1.05 (0.98 to 1.13)	0.14
Facial paralysis (yes vs no)	0.95 (0.87 to 1.04)	0.29
Previous stroke (yes vs no)	1.04 (0.95 to 1.14)	0.43
Hypertension (Yes vs No)	0.95 (0.88 to 1.03)	0.19
Diabetes mellitus (yes vs no)	1.00 (0.93 to 1.09)	0.93
Stroke-associated pneumonia (yes vs no)	1.54 (1.27 to 1.86)	<0.01
Length of hospital stay (days)	1.09 (1.08 to 1.10)	<0.01

exp(β), exponential of β; NIHSS, National Institute of Health Stroke Scale.

patients with dysphagia. These results aligned with previous studies, which demonstrated that the presence of dysphagia substantially increased healthcare costs, necessitating extended care and additional medical resources.[3 18] In addition, several other studies showed that post-stroke patients with dysphagia often had longer hospital stays, leading to higher associated treatment costs.[2] The increase in costs reflects the complexity of managing and treating dysphagia, highlighting the need for targeted interventions aimed at mitigating these costs through early diagnosis and treatment of dysphagia in post-stroke patients.

In this study, we observed that post-stroke patients with dysphagia incurred higher healthcare costs than those without dysphagia, across all cost components, including medications, diagnostic imaging, medical supplies, accommodation, food, procedures and laboratory tests. This result aligns with research analysing hospital discharges in France and Switzerland, which found that post-stroke dysphagia was associated with increased healthcare costs in both countries.[7] In addition, another comprehensive analysis indicated that post-stroke patients with dysphagia incurred higher healthcare costs, with a reported increase of USD 4510 compared with those without dysphagia, after controlling for factors such as age and comorbidities.[3] Although this was a 1 year cost and economic conditions differed from those in Vietnam,[3] making direct cost comparisons difficult, the difference in costs between post-stroke patients with and without dysphagia was consistent with our study.

The 21% increase in costs is both clinically and economically meaningful, consistent with previous studies demonstrating that dysphagia significantly increases both direct medical costs and indirect societal costs.[3 19] Dysphagia is a frequent complication after stroke and is strongly linked to adverse clinical outcomes, including malnutrition, dehydration, pneumonia and prolonged hospitalisation, all of which contribute to higher healthcare expenditures.[10 12 20 21] Patients with dysphagia often require additional diagnostic procedures, nutritional interventions (such as enteral feeding) and extended multidisciplinary care, leading to higher utilisation of hospital resources.[21 22]

Dysphagia not only increases direct medical costs but also correlates with broader socio-economic factors—such as patient education levels and challenges in nutritional management—that amplify the overall economic impact of stroke rehabilitation.[23 24] In addition, these patients tend to have longer hospital stays due to swallowing difficulties, which often necessitate more intensive management strategies. Previous research has shown that dysphagia is associated with significantly longer median hospital stays, frequently exacerbated by complications such as pneumonia and malnutrition.[6 25–27] The occurrence of dysphagia-related complications, particularly stroke-associated pneumonia, further prolongs hospitalisation and increases the likelihood of readmission, thereby intensifying cost burdens.[3 19]

Several previous studies indicated that post-stroke patients with dysphagia had a heightened risk of stroke-associated pneumonia, leading to prolonged hospital stays and increased healthcare costs.[8 19 28] In this study, we found similar results, specifically noting that stroke-associated pneumonia and length of hospital stay were significantly associated with healthcare costs among post-stroke patients. When patients developed stroke-associated pneumonia, treatment costs increased due to the need for additional medications, particularly antibiotics. Additionally, these patients had longer hospital stays, further increasing associated costs, especially for accommodation and food.

Patients with lower educational levels were more likely to experience health challenges, often leading to more frequent hospital admissions and increased

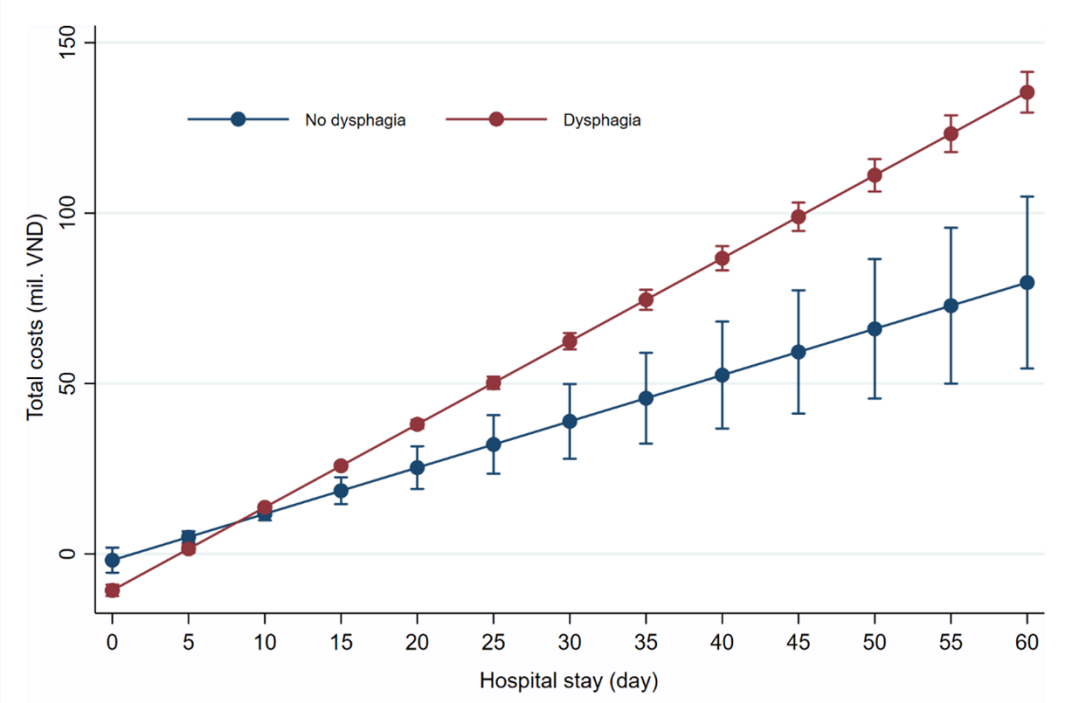

Figure 1 Expected total healthcare costs for post-stroke patients during acute hospitalisation with and without dysphagia. mil VND, million Vietnam dong.

healthcare-related expenditures.[29 30] Additionally, they tended to engage in less optimal health behaviours, resulting in higher medical expenses as they were more likely to receive unnecessary medical services. However, in this study, we found that patients with a high school education or higher incurred higher healthcare costs. This may be explained by their higher levels of education and income, which could enable them to use additional or more expensive services, such as upgraded accommodation or premium food options.

Moreover, the multifactorial nature of dysphagia-related expenses necessitates a holistic examination of post-stroke treatment approaches. Investment in early screening and effective management strategies, as supported by emerging therapeutic advancements such as neuromuscular electrical stimulation and behavioural swallowing therapy, is imperative.[31 32] Previous studies have indicated that targeted interventions can reduce recovery time and associated costs by alleviating the clinical ramifications of dysphagia, including malnutrition and respiratory complications.[33 34] The relationship between dysphagia management and reduced hospitalisation duration suggests that a sustained focus on preventative care can lead to significant cost savings for healthcare providers.

This study has several limitations that should be acknowledged. As a cross-sectional study, it did not allow for causal inferences or the assessment of long-term healthcare costs associated with post-stroke dysphagia. Additionally, variations in healthcare costs across different hospitals, influenced by institutional policies, resource availability and regional economic disparities, may have affected the generalisability of the findings. Differences in dysphagia assessment methods and management protocols across hospitals may also have introduced inconsistencies in cost estimations. Furthermore, as the study was conducted in selected hospitals, the findings may not be fully representative of all healthcare facilities in Vietnam. Finally, including only patients with GCS scores of >13 who were capable of communication may have introduced selection bias. More severely affected stroke patients, who are likely to incur the highest costs, were not represented in this study, which may limit the generalisability of the findings to the broader stroke population.

CONCLUSION

Treatment costs were higher among post-stroke patients with dysphagia compared with those without dysphagia, indicating that the presence of dysphagia is associated with higher expenditures across all cost components. Multivariate analysis confirmed that dysphagia was associated with a 21% increase in total treatment costs. Moreover, higher treatment costs among post-stroke patients were also associated with higher educational attainment, combined or other stroke locations, an NIHSS score greater than 14, stroke-associated pneumonia and prolonged hospitalisation. Early screening and intervention for dysphagia in post-stroke patients are recommended to reduce complications, shorten hospitalisation and mitigate treatment costs. In addition, cost-management

strategies should account for other significant factors, including stroke severity, lesion location and length of hospital stay. Strengthening multidisciplinary rehabilitation programmes and adopting standardised dysphagia management protocols are essential to reducing the clinical burden. Moreover, enhancing preventive care for stroke-associated pneumonia may contribute to lowering healthcare costs.

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