VOLUME 03 ISSUE 02 (2024)

AMERICAN JOURNAL OF MEDICAL SCIENCE AND INNOVATION (AJMSI)

ISSN: 2836-8509 (ONLINE)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Medical Science and Innovation (AJMSI)

Volume 3 Issue 2, Year 2024
ISSN: 2836-8509 (Online)
DOI: https://doi.org/10.54536/ajmsi.v3i2.3074
https://journals.e-palli.com/home/index.php/ajmsi

Relationship between the Injury Location and Swallowing Difficulty among Stroke Patients, A Retrospective Cohort Study

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Article Information

Received: May 29, 2024
Accepted: June 30, 2024
Published: July 03, 2024

Keywords

Stroke, Post-Stroke Dysphagia, Swallowing, Speech Therapy, Video Fluoroscopy

ABSTRACT

Post-stroke dysphagia (PSD), a neurological or mechanical disorder that hinders food transport from the oral cavity to the stomach. It has been widely associated with severe complications with higher mortality and morbidity rates. Traditional therapies for the treatment of dysphagia mainly focused on compensatory methods and behavioural rehabilitation approaches. The retrospective cohort study aimed to determine the association and correlation between developments of dysphagia in relation to the location of the stroke and to identify the swallowing recovery period following the stroke. A retrospective cohort study investigated swallowing difficulties in 64 stroke patients at an ambulatory care centre over a year. Data collection involved reviewing medical records and imaging reports, with analyses conducted using SPSS software, ANOVA and chi-square methods to assess associations between injury location and swallowing difficulty. Hemorrhagic stroke was more prevalent (65.6%) than ischemic stroke (34.4%). A significant association was found between gender and stroke type, with males exhibiting a higher prevalence of ischemic strokes (71.4%) compared to females (29.8%). Age differences between stroke types, gender and affected swallowing phases and stroke type and affected swallowing phase revealed no significant associations. Distinct differences were noted in swallowing difficulties across stroke types. Furthermore, recovery time varied depending on the intervention method, with speech therapy linked to shorter recovery periods. The study underscores the importance of considering gender and stroke-type-specific differences in stroke prevalence, age distribution, and swallowing difficulties. These findings contribute valuable insights to understanding stroke characteristics and their implications for clinical management and rehabilitation strategies.

INTRODUCTION

Stroke has been one of the major leading causes of mortality and morbidity globally. In recent years, the number of stroke patients in the world has increased, simultaneously increasing the cost of health care (Qiao *et al.*, 2022). Cardiovascular disease (CVD) has been included as the major cause of mortality, accounting for 931,578 deaths in the United States (US) in 2021. After cancer and other CVDs, stroke has been ranked as the third major cause of about 150,000 deaths in the US (Goldstein, 2019; Heart Disease and Stroke Statistics Update Fact Sheet, 2024). In 2021, stroke accounted for 1 in every 21 US deaths, with an average death every 3 minutes 14 seconds. In the US, the stroke death rate increased by 8.4% from 2011, while the total number of deaths increased 26.3%. Globally, 7.44 million deaths were attributable to stroke in 2021 (Heart Disease and Stroke Statistics Update Fact Sheet, 2024). Patients who have been affected by the stroke face several severe clinical conditions such as oesophagal or oropharyngeal dysphagia, hemiparesis, cognitive impairment, loss of dexterity and others (Goldstein, 2019; Qiao *et al.*, 2022).

Swallowing dysfunction or Oropharyngeal dysphagia is a neurological or mechanical disorder that hinders food transport from the oral cavity to the stomach. It involves the coordination of multiple muscle groups to transport food from the oral cavity to the gastric region while protecting the airway (Jones *et al.*, 2020; Qiao *et al.*, 2022). Post-stroke dysphagia (PSD) has been widely associated with severe complications, mortality and morbidity rate in 29-78% of patients (Zhong *et al.*, 2021). The most typical symptoms of dysphagia include cough, nasal regurgitation, weight loss, throat clearing, residue in the mouth, and others. This condition can lead to complications such as malnutrition, dehydration, frailty, respiratory infections, and pneumonia (Serra-Prat *et al.*, 2012; Wilmskoetter *et al.*, 2020).

The primary condition of PSD has been associated with the physiological and biochemical swallowing complexities in patients that might result in the disruption of brain activities. The incidence, severity and patterns of PSD have been associated with brain lesions at different brain locations where the stroke of the brainstem has been the major incentive (Zhong *et al.*, 2021). During PSD, swallowing difficulties might occur in four phases: oral, pharyngeal, oral preparatory, and oesophagal phases. The condition of PSD might show improvements in the early days of stroke treatment. However, in some cases, it might also persist as a chronic condition, leading to severe complications such as aspiration, pneumonia, and malnourishment (Jones *et al.*, 2020).

PSD has been the major cause of morbidity in patients with stroke that might arise from various types of brain injuries, such as unilateral or bilateral cerebral hemispheres,

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while the supratentorial anatomical location, specifically associated with healthy swallowing has remained unclear (Shi *et al.*, 2017). Studies employing magnetic resonance imaging (MRI) or computed tomography (CT) images of focal lesions in stroke patients have often focused on unilateral ischemic strokes affecting either hemisphere of the brain (Dehkharghani & Andre, 2017; Zameer *et al.*, 2021). While some research suggests lateralization of swallowing actions to the left and right hemispheres, its exact nature and implications for dysphagia remain uncertain (Cheng *et al.*, 2022).

Specifically, it has been proposed that damage to the right hemisphere (RHD) may be associated with dysmotility and aspiration during the pharyngeal stage of swallowing, while damage to the left hemisphere (LHD) may affect oral stage function. RHD has also been linked to persistent dysphagia and aspiration. However, these hemisphere-specific variations in swallowing behaviour, severity, pharyngeal transit durations, lingual coordination, or aspiration incidence have not been consistently observed across studies (Daniels *et al.*, 2019; Galera *et al.*, 2019).

Stroke patients often experience PSD, while up to 50% of the patients spontaneously recover within the first seven days of stroke treatment (Coleman *et al.*, 2017). Therapies for the treatment of PSD might help the patients who may not be improved by medications. Several interdisciplinary professionals collaborate to manage the symptoms of PSD (Cabib *et al.*, 2016; Cohen *et al.*, 2016; Lindsay *et al.*, 2020). New technologies like Brain-Computer Interface Devices and Virtual Reality-Based therapy might improve swallowing rehabilitation.

Traditional therapies for the treatment of dysphagia mainly focused on compensatory methods and behavioural rehabilitation approaches. It is necessary to understand that the spontaneous recovery of post-stroke swallowing problems has been constantly evolving with the development of novel treatment methods and implementation on PSD patients to understand better, manage, and enhance the recovery phase of PSD. These treatments have been patient-specific, and successful therapies for one patient might not generate the same results for other patients (Fang *et al.*, 2022; Felix *et al.*, 2019).

Speech therapy (ST) has been one of the most important treatment methods to improve or treat the symptoms of PSD. ST for dysphagia treatment involves various techniques and exercises aimed at improving swallowing function. Sensory and motor effects are generated by stimulating the swallowing-related muscle activity. These effects enhance the motor ability and the coordination of laryngeal life and pharyngeal muscles utilized in swallowing and also help restore the linguistic and swallowing abilities of the patient (Fang *et al.*, 2022). Speech-language pathologists (SLPs) employ oral motor exercises to strengthen swallowing muscles, muscles coordination, and diet modifications to ensure safe swallowing. Compensatory strategies like chin tucks and sensory stimulation techniques may also be utilized (Caesar & Kitila, 2020; Murry *et al.*, 2020).

Video fluoroscopy (VF) for dysphagia detection has been a diagnostic procedure used to assess swallowing function by using VFS equipment to provide real-time assessment/visualization by capturing real-time X-ray images (fluoroscopy) of the oral and pharyngeal phases of swallowing (González-Fernández *et al.*, 2015). VF can identify aspirations or silent (aspirations aspiration without the presence of a cough reflex), a factor of 20% mortality rate in elderly stroke patients within a year (Carucci & Turner, 2015). During the therapy, the patients were usually asked to consume food or liquid (mixed with a contrast agent) under professional' observation (Thiyagalingam *et al.*, 2021). The fluoroscopic images allowed the health care professionals to assess the movement of food or liquid passing from the oral cavity to the pharynx. This procedure provides insight into detecting abnormalities or difficulties in swallowing in PSD patients (Carbo *et al.*, 2021; Matsuo & Palmer, 2016). Simultaneously, with the continuous development of understanding the difficulties in swallowing after stroke, advanced treatment methods combined with traditional therapies highlighted the better management and enhancement of treatment methods for PSD (Fang *et al.*, 2022).

However, 10%-50% of patients with chronic PSD might not be recovered (Sheng *et al.*, 2023). Therefore, the retrospective cohort study aimed to explore the relationship between injury location and swallowing difficulty among stroke patients and identify the swallowing recovery period following stroke.

METHODOLOGY

Area of Study

A retrospective cohort study was conducted in the ambulatory care centre, Hamad Medical Corporation, from July 2021 to July 2022. The study aimed to investigate the swallowing difficulties in stroke patients. A total of 64 individuals with documented swallowing issues in their medical records were identified and included in the study after obtaining their consent.

Inclusion and Exclusion Criteria

The study population consisted of individuals meeting the specific criteria, including radiological evidence of stroke, a Glasgow Coma Scale (GCS) score of 15, age exceeding 18 years, and assessments conducted using Fiber Optic Endoscopic Evaluation of Swallowing (FEES). Exclusion criteria included participants under the age of 18, those with a history of previous strokes, unconscious individuals, and those with Traumatic Brain Injury (TBI). Additionally, patients with PSD unrelated to stroke and those with brain lesions other than cerebrovascular accident (CVA) were excluded.

Data Collection

Data collection involved a comprehensive review of medical records and imaging reports. The primary

variables of interest included injury location, age, GCS score, and the presence or absence of swallowing difficulty. Descriptive statistics were employed to summarize demographics, and the association between injury location and swallowing difficulty along with the recovery period was assessed through appropriate statistical tests, such as the chi-square test and logistic regression.

This study design ensured a focused examination of swallowing difficulties in stroke patients while adhering to specific inclusion and exclusion criteria to maintain the integrity and validity of the findings.

Data Analysis

Data analysis for the retrospective cohort study was conducted using the SPSS (Statistical Package for Social Science) software version 26 for Windows and Microsoft Excel 2020. Descriptive metrics, including mean, standard deviation, and frequency, were calculated to summarize the demographic characteristics of the study population, such as age, GCS scores, and injury locations. The relationship between injury location and swallowing difficulty was assessed for the primary analysis. Chi-square tests were utilized to analyze categorical variables, and logistic regression models were employed to explore associations while adjusting for potential confounding factors. The significance level was set at 0.05. Furthermore, Microsoft Excel 2020 was utilized for data visualization, including the formation of graphs and charts to illustrate the distribution of injury locations and the prevalence of swallowing difficulty among stroke patients.

RESULTS

Medical Records of Patients

A total of 64 patients were identified in the medical records. Table 1 represents the sociodemographic profile of the patients. The profile included 57 males (89.1%) and seven females (10.1%). The mean age of the patients was 69.41 ± 8.1 years, with a mean age of 68.51 ± 7.926 years for males and 76.71 ± 5.707 years for females, respectively.

Table 1: Sociodemographic Profile of The Patients

	Categories	Frequency	Percentage
Gender	Male	57	89.06
	Female	7	10.94
Type of Stroke	Ischemic	22	34.375
	Hemorrhagic	42	65.625
Location	Bulbar	55	85.9375
	Pseudobulbar	9	14.0625
Affected Swallowing Phase	Pharyngeal	46	71.875
	Oral Propulsive	5	7.8125
	Esophageal	11	17.1875
	Oral Preparatory	2	3.125
Total		**64**	**100**

Association of Gender with Stroke

According to the Kolmogorov-Smirnov test results, the data has a normal distribution (p = 0.091). The prevalence of different types of strokes among the participants was investigated. The majority of patients (65.6%, n = 42) experienced Hemorrhagic Strokes (HS), while 34.4%

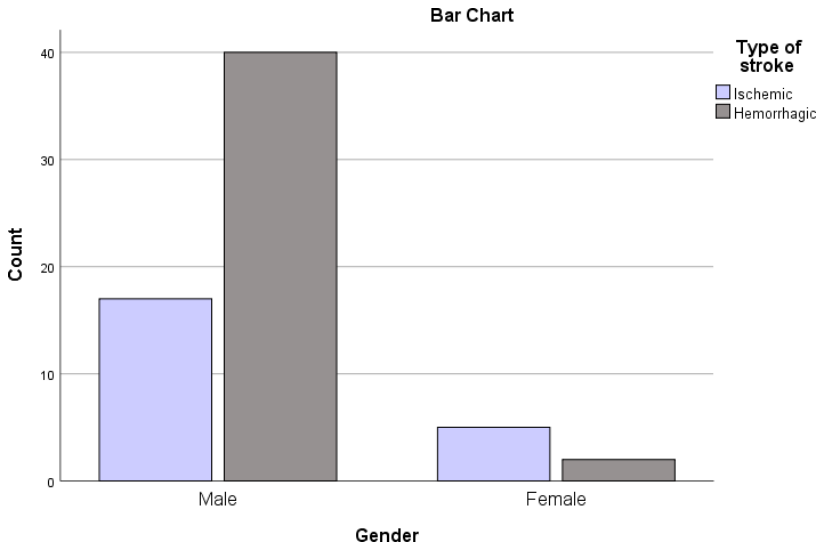

Figure 1: Prevalence of Ischemic and Homographic Stroke

(n = 22) had Ischemic Strokes (IS). A cross-tabulation analysis revealed a significant association between the gender and stroke types (χ^2 = 4.784, p = 0.029), with a higher prevalence of IS among females (71.4%, n = 17) compared to males (29.8%, n = 5) and higher prevalence of HS among males (70.2%, n = 40) as compared to female (28.6%, n = 2) as shown in Figure 1.

Association of Age with Stroke Types

An analysis of variance (ANOVA) was performed to examine age differences across different types of strokes, as shown in Figure 2. The mean age of patients with IS (M = 67.8, SD = 7.5) was compared to HS (M = 62.2, SD = 9.1), revealing a non-significant difference, F (1, 198) = 0.734, p = 0.395). The analysis of age distribution across different stroke types revealed distinct characteristics. Patients with IS exhibited a higher mean age (M = 73.36, SD = 8.215) than those with HS (M = 67.33, SD = 7.311). The 95% confidence interval for the mean age of patients with IS ranged from 69.72 to 77.01, while for HS, it ranged from 65.06 to 69.61. These findings suggested notable differences in the age distribution between the two types of strokes.

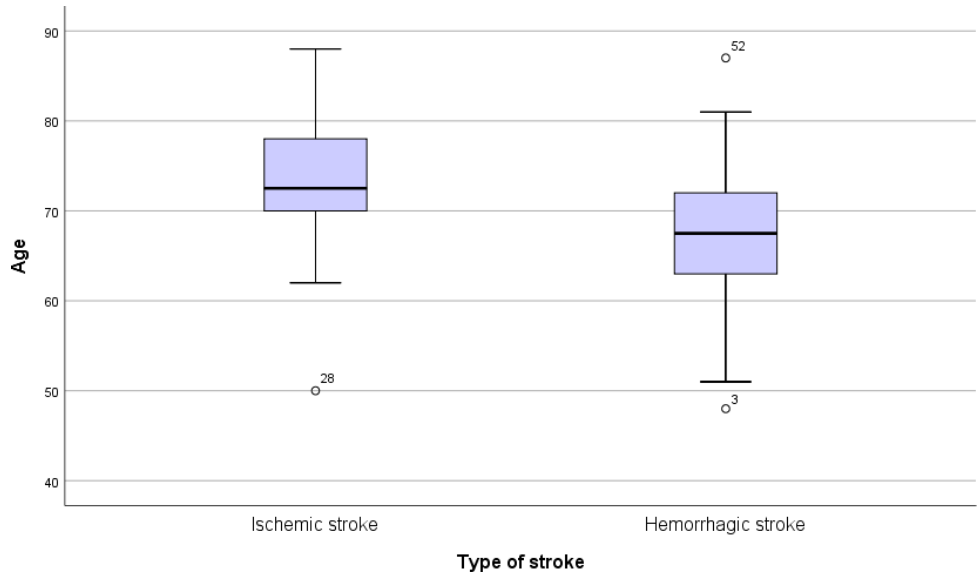

Figure 2: Age Distribution Between the Two Types of Strokes

Association of Mean Age with Affected Swallowing Phases

An independent samples t-test was conducted to compare the mean age with the affected swallowing phases in patients with IS and HS. The results indicated a statistically significant difference. Patients with IS (M = 73.36 ± 8.215) were older than HS patients (M = 67.33 ± 7.311), t (198) = 3.003, p = 0.004. The analysis of variance (ANOVA), as shown in Figure 3. indicated a non-significant difference in the mean age across the various affected swallowing phases, F (3, 60) = 0.922, p = 0.436.

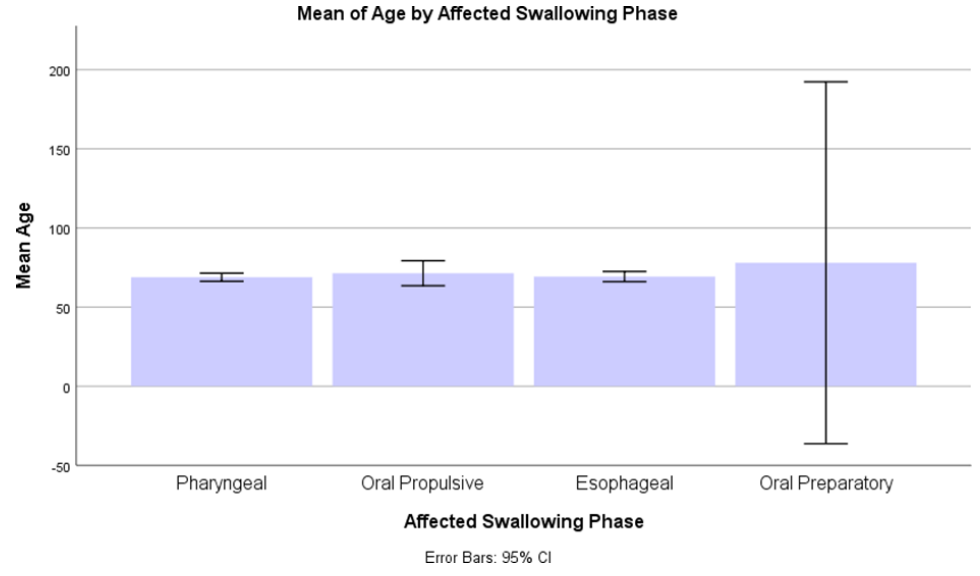

Figure 3: Mean Age by Affected Swallowing Phases

Association of Gender and Affected Swallowing Phases
The chi-square test examined whether a significant association existed between gender and the affected swallowing phases. Statistically, no significant association has been found between gender and the affected swallowing phases (χ^2 (3) = 4.577, p = 0.206).

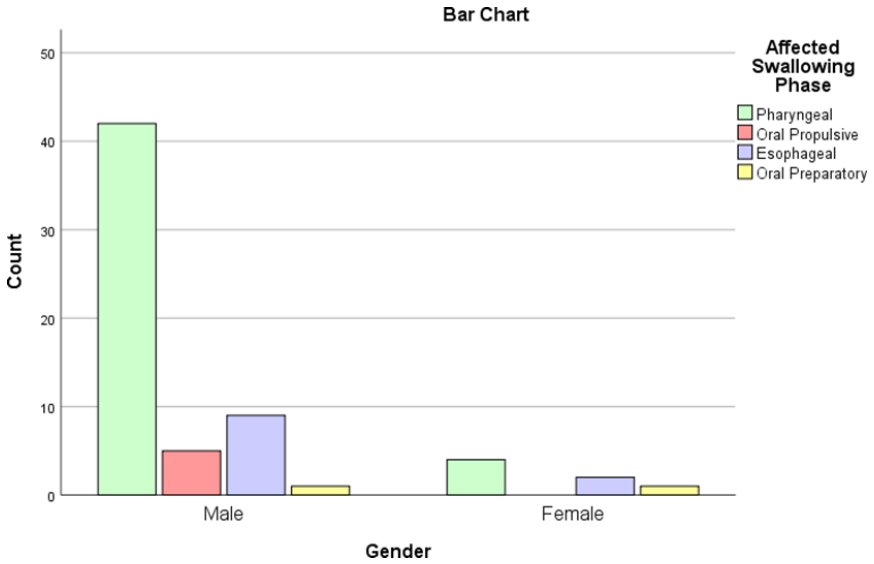

Figure 4: Association Between Gender and the Affected Swallowing Phases

Association between Stroke Types and Affected Swallowing Phase
The chi-square test determined the association between stroke types and the affected swallowing phase. Among patients with IS, 15 individuals were observed to have difficulty in the pharyngeal phase, with 2 experiencing challenges in the oral propulsive phase, 4 in the oesophagal phase, and 1 in the oral preparatory phase, resulting in 22 patients.
Conversely, among those with HS, more patients (42) exhibited difficulty across all phases: 31 in the pharyngeal phase, 3 in the oral propulsive phase, 7 in the oesophagal phase, and 1 in the oral preparatory phase. When considering both stroke types, 46 patients experienced difficulty in the pharyngeal phase, 5 in the oral propulsive phase, 11 in the oesophagal phase, and 2 in the oral preparatory phase, resulting in a cohort size of 64 patients. However, no significant relationship has been found between the two variables (p = 0.946), as shown in Figure 5.

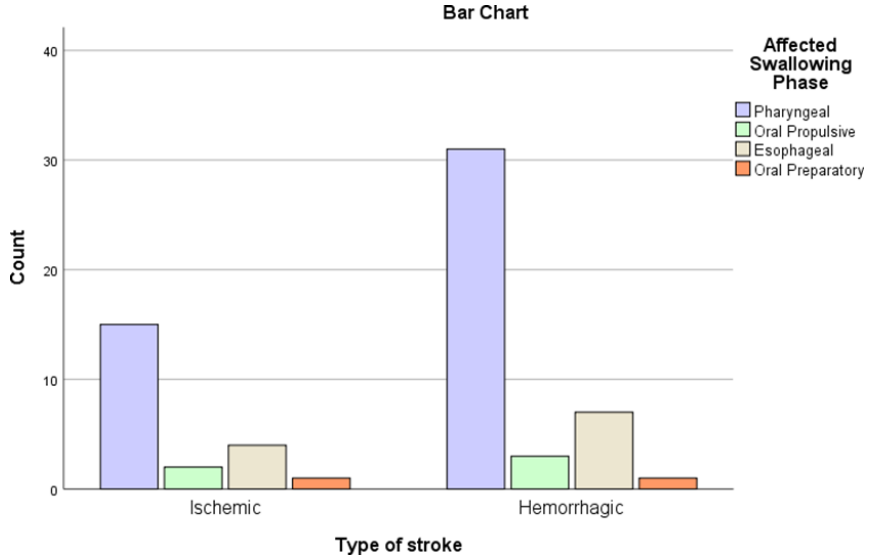

Figure 5: Association Between Type of Stroke and the Affected Swallowing Phase

Association between Location of Stroke and Affected Swallowing Phases
The chi-square test of independence indicated a significant association between the location of the stroke and the affected swallowing phases (χ^2 = 8.674, df = 3, p = .034). It was found that most patients with bulbar strokes experienced difficulty in the pharyngeal phase (43 out of 55 cases), with fewer instances in the oral

propulsive, oesophagal, or oral preparatory phases, as shown in Figure 6.

Conversely, patients with pseudobulbar strokes exhibited a more evenly distributed pattern across the swallowing phases. The linear-by-linear association test supported these findings ($\chi^2 = 6.590$, df = 1, p = .010), indicating an observable pattern in the data. These results suggested a relationship between stroke location and the specific affected phases of swallowing, underscoring the importance of considering both factors in stroke management and rehabilitation strategies.

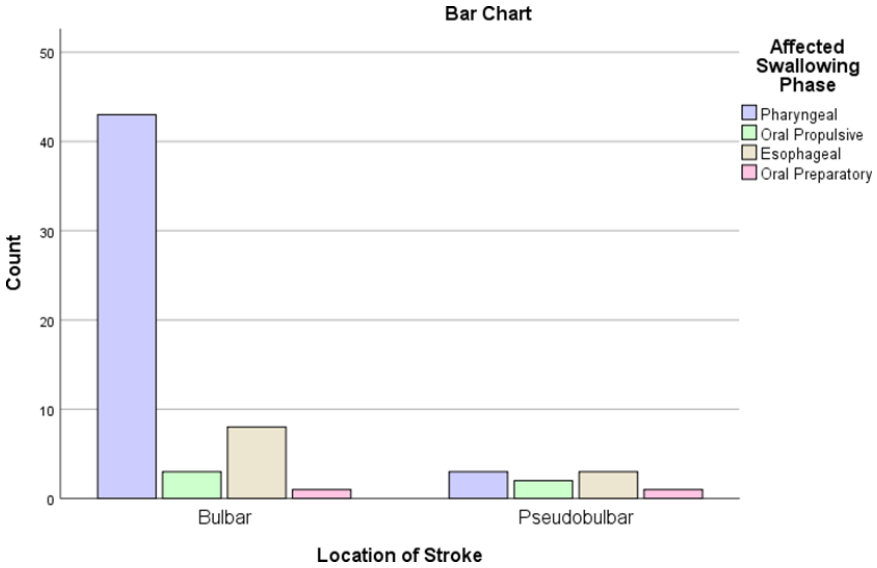

Figure 6: Association between the Location of Stroke and the Affected Swallowing Phases

Descriptive Statistics for Recovery Time

According to different methods of recovery and follow-up, the descriptive statistics for recovery time (in months) have been presented in Table 2. Patients who underwent ST had a mean recovery time of approximately 8.83 months (95% CI: 7.70 - 9.96), those who recovered spontaneously had a mean recovery time of approximately 6.39 months (95% CI: 5.23 - 7.55), and patients who received VF had a mean recovery time of approximately 8.91 months (95% CI: 7.20 - 10.62).

Table 2: Statistics for Recovery Time (in months)

Variable	Method of Recovery	Mean	Std. Error	Std. Deviation	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Recovery Time (months)	Speech Therapy	8.83	0.555	3.285	7.700	9.957
	Spontaneously	6.39	0.549	2.329	5.230	7.547
	Video Fluoroscopy	8.91	0.768	2.548	7.197	10.621

The ANOVA results for the recovery time, as shown in Figure 7, revealed a statistically significant difference among the groups (F (2, 61) = 4.555, p = .014). This indicates that the mean recovery time varied significantly depending on the method of recovery and follow-up. Based on the results of Levene's test for homogeneity of variances, which yielded non-significant findings (p > 0.05), indicating the correlation of the assumption of homogeneity of variances, Bonferroni correction was applied to assess pairwise differences in recovery time between different methods of recovery. The results indicated significant differences in the recovery time between patients undergoing ST and those recovering spontaneously (mean difference = 2.43968, p = 0.017, 95% CI [0.3466, 4.5328]), as well as between patients recovering spontaneously and those undergoing VF (mean difference = -2.52020, p = 0.085, 95% CI [-5.2820, 0.2415]). However, there was no significant difference in the recovery time between patients undergoing ST and those receiving VF (mean difference = -0.08052, p = 1.000, 95% CI [-2.5749, 2.4139]). These findings suggest that recovery time varies significantly depending on the intervention method, with ST showing a shorter recovery time than spontaneous recovery, while no significant difference was observed between VF and the other methods.

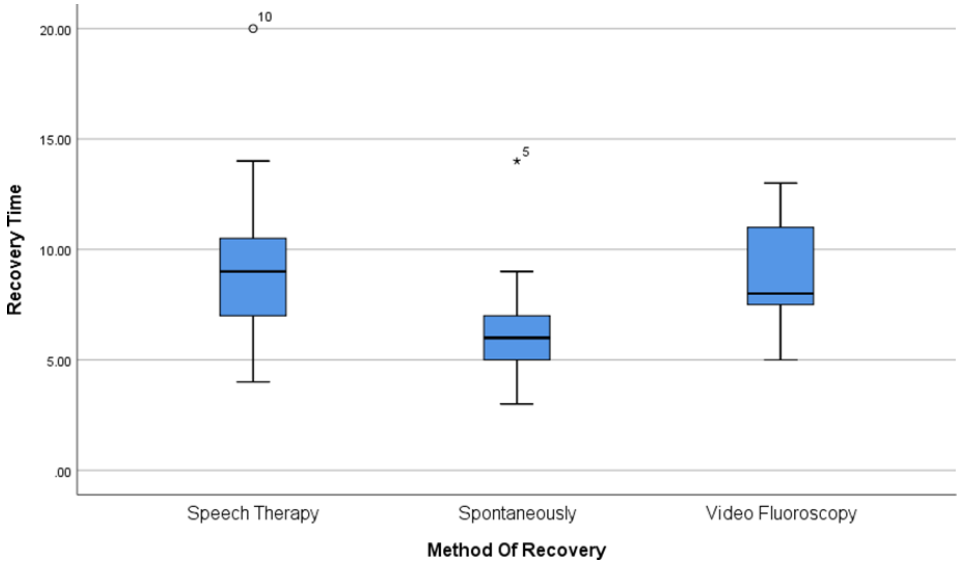

Figure 7: ANOVA Results for the Recovery Time

Multiple Comparisons
Dependent Variable: Recovery Time
Bonferroni

Based on the analysis conducted, the mean recovery time for patients with ischemic stroke was found to be 7.64 months (SD = 3.62), whereas for patients with hemorrhagic stroke, it was 8.43 months (SD = 2.79). An independent samples t-test was performed to compare the mean recovery time between these two groups, yielding a t-value of -0.973 (df = 62, p = 0.334), assuming equal variances. These results indicate that there is no significant difference in the mean recovery time between patients with ischemic and hemorrhagic strokes ($p > 0.05$). Therefore, stroke type does not appear to influence the duration of recovery time significantly in our sample.

Table 3: Analysis of Treatments

Variable	Method of Recovery	Mean	Std. Error	Sig.	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Speech Therapy	Spontaneously	2.43968*	.85023	.017	.3466	4.5328
	Video Fluoroscopy	-.08052	1.01325	1.000	-2.5749	2.4139
Simultaneously	Speech therapy	-2.43968*	.85023	.017	-4.5328	-.3466
	Video fluoroscopy	-2.52020	1.12184	.085	-5.2820	.2415
Video fluoroscopy	Speech therapy	.08052	1.01325	1.000	-2.4139	2.5749
	Spontaneously	2.52020	1.12184	.085	-.2415	5.2820

The mean difference is significant at the 0.05 level

Table 4: Correlation Analysis between Age and Recovery Time

Recovery	Type of stroke	N	Mean	Std. Deviation	St. Error Mean
Recovery Time (months)	Ischemic	22	7.64	3.62	0.77
	Hemorrhagic	42	8.43	2.79	0.43

The correlation analysis between age and recovery time, as shown in Figure 4, yielded a Pearson correlation coefficient of 0.300, statistically significant at the 0.05 level (2-tailed), with a p-value of 0.016. This indicates a moderate statistically significant positive correlation between age and recovery time. As age increases, recovery time tends to increase as well, suggesting that older patients may require more recovery time than younger patients.

A multinomial logistic regression analysis was conducted to examine the relationship between the phase affected in swallowing (pharyngeal, oral propulsive, oesophagal) and covariates, including age and location of stroke. Model fitting information revealed that the final model

did not significantly differ from the Intercept Only model (χ^2 = 9.580, df = 6, p = 0.143), indicating adequate model fit.

Pseudo R-Square values indicated that the model explained 13.9% to 17.0% of the variance in the dependent Variable. Likelihood ratio tests compared the final model to reduced models without covariates. Results showed that neither the location (χ^2 = 6.635, df = 3, p = 0.084) nor age (χ^2 = 2.173, df = 3, p = 0.537) significantly improved model fit. Parameter estimates revealed that the location of the stroke had a borderline significant effect on the likelihood of the pharyngeal phase (p = 0.144), while age did not significantly predict the phase of swallowing, as shown in Table 5.

Table 5: Pseudo R-Square Test

Phase Affected	Covariate	B	St. Error	Wald	df	Sig.	Exp (B)	95% CI	
								Lower Bound	Upper Bound
Pharyngeal	Intercept	15.995	7.938	4.06	1	0.044			
	Location	-2.355	1.611	2.136	1	0.144	0.095	0.004	2.233
	Age	8.848	8.512	1.081	1	0.299			
Oral Propulsive	Intercept	8.848	8.512	1.081	1	0.299			
	Location	-0.146	1.741	0.007	1	0.933	0.864	0.029	26.199
	Age	-0.103	0.111	0.868	1	0.351	0.902	0.726	1.121
Esophageal	Intercept	12.408	8.13	2.329	1	0.127			
	Location	-0.676	1.643	0.169	1	0.681	0.509	0.02	12.726
	Age	-0.133	0.105	1.596	1	0.207	0.876	0.713	1.076

DISCUSSION

This study provides valuable insights into the sociodemographic characteristics of stroke patients and identifies significant associations between age, gender, type of stroke, location of stroke, recovery time and method that helped in recovery. The observed age difference across stroke types emphasizes the need for personalized approaches in stroke management. Additionally, the absence of significant associations between gender and affected swallowing phase and type of stroke and swallowing phase highlights the complexity of these relationships. It underscores the importance of further research in this area. The analysis revealed a statistically significant difference in recovery time based on the intervention approach. Patients receiving ST exhibit a shorter recovery time compared to those recovering spontaneously. In contrast, VF did not show a significant difference in recovery time compared to other methods.

The Kolmogorov-Smirnov test confirmed a normal distribution of the data, while the analysis of stroke prevalence revealed a significant association between gender and stroke types. In the past few years, the prevalence of IS has become higher in women compared to men. Women in middle age highlighted the higher risk IS with the onset of menopause, oral contraceptive pill use, pregnancy, imbalance of female sex hormones and hormone replacement therapy. After the era of middle age, the incidence risk was reported to be higher in elderly women (age >85 years) than in elderly men (Roy-O'Reilly & McCullough, 2018). However, critical factors such as hypertension (weakened blood vessel walls, making them more prone to rupture and cause HS), smoking, obesity, and the utilization of opioids have been significantly associated with higher rates of HS in men compared to women (Ahangar *et al.*, 2018).

The analysis of variance (ANOVA) comparing age differences across different types of strokes did not yield a significant difference, indicating that the mean age of patients with IS was comparable to that of patients with HS. However, upon further examination, patients with IS exhibited a notably higher mean age than those with HS. Ageing has been the most common factor of stroke, varying from 6.6 to 11.4 in 100,000 adults per year, while in older people, the risk factors were higher (Lutski *et al.*, 2017). Structural changes in blood vessels, such as atherosclerosis, where the arteries narrow and become less flexible (Okeahialam & Sirisena, 2023). This narrowing restricts blood flow to the brain, increasing the likelihood of blood clots forming and causing an ischemic stroke (El Amki & Wegener, 2017). Additionally, higher prevalence of risk factors for stroke in older individuals have been found, including high cholesterol, hypertension, diabetes, and atrial fibrillation. These conditions can damage blood vessels over time and promote the formation of blood clots, further elevating the risk of stroke (Hu *et al.*, 2017; Morseth *et al.*, 2021).

According to the chi-square test results, no statistically significant association has been found between gender and the affected swallowing phases (χ^2 (3) = 4.577, p = 0.206). In contrast, the association of stroke types and the affected swallowing in patients with IS and HS were observed to have difficulty in the pharyngeal, oral propulsive, oesophagal, and oral preparatory phases. Dysphagia following a stroke occurs due to disturbance of upper motor neurons toward nuclei in the medulla

oblongata (pseudobulbar palsy) or brain stem lesions (bulbar palsy), resulting in delayed swallowing reflex, decreased movement of larynx, residual food in the pyriform sinus, loss of swallowing reflex, and insufficient opening of the oesophagal orifice (Maeshima, 2019).

The chi-square test between the location of the stroke and the affected swallowing phases revealed a significant association. It highlighted the importance of considering both factors in stroke management and rehabilitation strategies, with bulbar strokes predominantly associated with difficulty in the pharyngeal phase and pseudobulbar strokes exhibiting a more evenly distributed pattern across swallowing phases. In cases of bulbar strokes, this critical phase of swallowing can be significantly impacted, leading to swallowing difficulties and an increased risk of aspiration.

According to a study, the major cases of PSD have been distributed into two categories: pseudo bulbar, responsible for disturbing the motor neurons on the upper side towards the medulla oblongata nuclei, while bulbar has been associated with the lower neurons from the nuclei of the medulla in the brain stem (Maeshima, 2019). Bulbar strokes affect the medulla oblongata, which controls various essential functions, including swallowing (Iordanova & Reddivari, 2019), while pseudobulbar strokes affect the corticobulbar pathways, which are responsible for transmitting motor signals from the cerebral cortex to the brainstem nuclei involved in swallowing and other functions (Iordanova & Reddivari, 2019).

According to the results of ANOVA, patients who received ST recovered faster than those who recovered spontaneously. Meanwhile, VF showed a trend towards faster recovery than spontaneous healing. However, there was no significant difference between the ST and VF groups. The study highlights that the ST was linked to a shorter recovery than other therapies. This evidence has been supported by the findings of several studies concluding that the ST showed a statistically significant improvement in dysphagia and assessment of oral intake in stroke patients (Choy *et al.*, 2024; Jones *et al.*, 2018; Tanashyan *et al.*, 2018; Turra *et al.*, 2021). However, several studies have also identified video fluoroscopic swallowing training as being substantially effective in alleviating PSD (Carbo *et al.*, 2021; Carucci & Turner, 2015; González-Fernández *et al.*, 2015; Thiyagalingam *et al.*, 2021). The results suggested that ST may be the most promising strategy for quicker recovery from swallowing difficulties after a stroke.

These findings highlight significant factors leading to IS and HS, highlighting the importance of considering them as potential factors in stroke subtype classification and management strategies. The findings contribute to the existing knowledge in stroke research and may guide healthcare professionals in tailoring interventions based on patient-specific characteristics.

Study Limitations and Future Recommendations

A few limitations were encountered in the study. The limitations include the relatively small sample size and the retrospective design, which might have constrained the generalizability of the findings. While the study focused on the association between the stroke location and swallowing difficulty, the analysis did not encompass other potential factors, such as comorbidities or the severity of the stroke. Additionally, the lack of long-term follow-up information has limited the specific results of the study to assess the persistence or resolution of swallowing difficulties over time. These limitations revealed the importance of future research with large prospective studies, larger sample sizes, and long-term follow-up assessments to understand better the effectiveness of different rehabilitation approaches and the various factors responsible for chronic PSD.

However, further research is warranted to explore innovative approaches and technologies to improve swallowing function, reduce complications in this vulnerable population, and validate these findings in larger and more diverse patient populations.

CONCLUSION

Dysphagia is a common and significant complication of stroke, with profound implications for patient health and well-being. This study provides valuable insights into stroke patients' demographic characteristics and clinical features, particularly regarding stroke types, age differences, and affected swallowing phases. Significant associations between gender and stroke type, as well as stroke location and affected swallowing phases, have been found. Additionally, recovery time varied significantly depending on the method of intervention, with ST associated with shorter recovery times. Notably, patients undergoing speech therapy exhibited shorter recovery times than spontaneous recovery, highlighting the efficacy of this intervention. These findings underscore the importance of considering these factors in stroke patients' diagnosis, treatment, and management.

Ethical Concern

The study was conducted after obtaining ethical approval from the Department of Otolaryngology, HMC, Doha, Qatar. In addition, consent was obtained from the participants or their relatives, but participants could not provide consent due to their medical condition.

Acknowledgements

The authors extend their appreciation to the Iran University of Medical Sciences.

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