Original Article

Predictors of Stroke Recovery: A Cross-Sectional Study

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Abstract

Background & Aim: A stroke is a sudden disruption of brain functions. Stroke is the second leading cause of death worldwide, with millions of people experiencing physical and/or mental disabilities. Rehabilitation promotes patients' functional recovery; however, investigations of the factors that may facilitate or impede rehabilitation are needed. The aim of this study was to explore how the type of stroke and the associated impairments impact patients' perceptions of improvement following their discharge from physical therapy.

Methods: A cross-sectional sample was recruited in Saudi Arabia between 2021 and 2022. The participants comprised 41 adults who had had a stroke and completed a rehabilitation program. They provided demographic data, completed a questionnaire regarding their stroke type and related impairments, and rated their perceived stroke improvements using the global rating of change. The sample size was computed using G*Power, which indicated that 40 participants were needed.

Results: Higher perceived improvements were reported by the patients with ischemic stroke (n = 35) than those with hemorrhagic stroke (n = 6; odds, 8.420) and the patients with weakness (n = 35) than those with no weakness (n = 6; odds, 30.629) after completing their rehabilitation program ($p < .05$). The main findings were that having an ischemic stroke (vs. a hemorrhagic stroke) and reporting weakness (vs. no weakness) significantly increased the likelihood of the patients reporting greater improvements after completing the physical therapy rehabilitation program.

Conclusion: Rehabilitation benefited ischemic stroke survivors more than hemorrhagic stroke survivors. Stroke survivors with weakness benefited the most from rehabilitation when compared to those with no weakness.

Keywords: stroke; rehabilitation; Stroke recovery

Introduction

Stroke, as defined by the World Health Organization, refers to the abrupt onset of localized or global brain function disruption, lasting for at least 24 hours or leading to death, with no clear etiology other than vascular origins. Apart from its various neurological manifestations, stroke can impede cognitive functions, verbal communication, sensory perception, and motor control.[1] It stands as the world's second leading cause of mortality, claiming approximately 6.55 million lives annually [2]. While medical progress has helped reduce the death rate, millions of individuals are still living with the physical and/or mental symptoms of having had a stroke.[3]

Rehabilitation and physical therapy play a crucial role in addressing various aspects of stroke patients' functional recovery to help them regain their independence and enhance their quality of life.[4]

Patients frequently want to know the prognosis for their illness before committing to a rehabilitation program. Multiple studies have investigated factors related to stroke recovery.[5-7]

A systematic review of studies of stroke survivors discharged from inpatient rehabilitation facilities revealed that age, functional level, dysphasia, impulsivity, neglect, and previous strokes were predictive of functional independence at discharge.[7] Various scales, including the National Institutes of Health stroke scale (NIHSS)[8], the postural assessment scale for stroke (PASS)[9], the stroke rehabilitation assessment of movement (STREAM)IO, and the stroke impact scale (SIS)[11], are used to follow stroke recovery. However, patients may not place value on the qualities assessed in such scales as these may not represent their perceptions of the progress of their condition. The global rating of change (GRC) is a universal assessment tool for health changes that utilizes the patient's own perceptions of their current health status [12]. The GRC scale consists of a single question that asks the patient to evaluate the progression of their health over a specified time period [13].

The aim of this study was to investigate the impact of stroke type and impairments on perceived improvement post-rehabilitation. We hypothesised that patients with ischemic stroke and patients with hemorrhagic stroke will report different levels of perceived improvements as assessed using the GRC.

Methods

Participants

The participants in this cross-sectional research were adult stroke survivors who had completed a physical therapy rehabilitation program for their stroke-related impairments. The inclusion criteria included adults with a history of a cerebral stroke who were hospitalized due to the stroke, referred for physical therapy, and had completed a physical therapy rehabilitation program for their stroke-related impairments. Exclusion criteria included patients with severe cognitive impairment that prevent them from completing the questionnaire as well as patients seeking rehabilitation for other health issues not related to their stroke. We used several recruiting strategies, including advertisements in physical therapy clinics and

requests to physical therapists for patient referrals. All the volunteers were recruited between 2021 and 2022 from the Saudi Arabia province of Riyadh. The research was authorized by Majmaah University's institutional review board (IRB# MU-REC-Dec.3o/COM-2022/t7-4). All the participants provided their informed consent in advance.

Outcomes Measures

All the participants completed a short questionnaire, which included demographic information The type and the location of the stroke, the associated impairments, date of the stroke, number of physical therapy sessions, and length of hospitalization were self-reported by the participants.

The participants were asked to rate the changes in the status of their stroke-related impairments from the beginning of their physical therapy program to the end of the physical therapy program at the time of their recruitment. The changes were rated using the GRC on a 9-point Likert scale that ranged from -4 (extremely worse) to 4 (extremely better), with a score of 0 indicating no change[13]. The GRC is a valid measure showing significant and strong correlations with several measures including the Oswestry low back pain disability questionnaire (Pearson's, r = 0.78)[14] and the subscales of the asthma quality of life questionnaire (r = 0.83)[15]. GRC was shown to posses a good test-retest reliability with an ICC of 0.90[16].

Ethics Approval and Consent to Participate

All methods were carried out in accordance with relevant guidelines and regulation. The research was authorized by Majmaah University's institutional review board (IRB# MU-REC-Dec.3o/COM-2022/t7-4). All the participants provided their informed consent in advance.

Statistical A nalysis

Sample size was computed by G*Power (Version 3.1.9.6) using effect size (Cohens d) from a previously published study.[17] We found that a group of 40 participants were needed.

The normality of the distribution of the data were tested using the Shapiro-Wilk test of normality. The results of the Shapiro-Wilk test will indicate using parametric or non-parametric statistics. Demographic and descriptive data are reported using the mean (m) and standard deviation (SD) for the normally distributed data and median (med), interquartile range (IQR), and range for the data that failed the normality assumption. We reported all the nominal data using frequencies and percentages.

We applied an ordinal logistic regression (OLR) to determine the odds of the patients reporting improvements in their health conditions (measured using the GRC) compared to the type of stroke and each of the stroke-related impairments. The OLR assumptions related to the number and types of data were met. The assumption of no multicollinearity was met without testing as no continuous independent variables were included in the OLR. The assumption of the proportional odds was assessed using a full likelihood ratio test and the deviance goodness-of-fit test. Effect sizes were calculated from the

odds ratio using the method described by Sánchez-Meca et al. (2003) [18]. All the statistical operations were performed using IBM SPSS (Version 28.0.0.0; IBM Corp.).

Results

Sample description

Forty-one participants (15 females and 26 males) aged 33-80 years (m = 56.4, SD = 12.1 years) with a history of stroke who had completed a post-stroke physical therapy re habilitation program were recruited for this study and completed all the testing. All the descriptive data failed the normality assumption ($p > 0.05$), so the median, IQR, and range were reported. **(Table 1)**

Table 1. Sample description.

Variables				
		Median	IQR	Range
Age (years)		58	17	33-80
GRC		3	1	1-4
Onset (months)		9	9	1-36
LOS (days)		11	16	2-240
Number of PT sessions		25	26.5	3-90
Number of impairments		3	3	1-6
		n	%	
Gender	Male	26	63%	
	Female	15	37%	
Marital status (married)		38	93%	
Stroke type	Ischemic	35	85%	
	Hemorrhagic	6	15%	
Weakness		35	85%	
Sensory impairment		17	42%	
Paralysis		12	29%	
Aphasia		21	51%	
Facial weakness		20	50%	
Visual impairment		6	15%	
Dominant side impaired		15	37%	

Onset: time between stroke and the completion of the physical therapy program; IQR: interquartile range; GRC: Global Rating of Change; LOS: length of hospitalization.

GRC

A cumulative odds ordinal logistic regression with proportional odds was run to determine the effect of the patients' post-stroke impairments, which included weakness, paralysis, sensory impairment, aphasia, facial muscle weakness, and visual impairment as well as the type of stroke, on their reports of improvements in their health status following completion of the physical therapy program. An ischemic stroke and reported weakness were significantly related to self-reports of improvement after completing the physical therapy program. The odds of an ischemic stroke survivor reporting greater improvement were 8.420 (95% CI, 1.217-58.240) times that of a hemorrhagic stroke survivor, \2(1) = 4.662, p = .031. The odds of a stroke survivor with a complaint of weakness reporting greater improvement was 30.629 (95% CI, 2.240-418.749) times that of a stroke survivor with no complaint of weakness, \2(1) = 6.576, p = .010. Reporting an impairment such as paralysis, sensory impairment, aphasia, facial muscle weakness, or visual impairment did not have a significant effect on the participants' reports of changes in their health status after completing the physical therapy program **(Table 2).**

Table 2. Cumulative odds ordinal logistic regression of the effects of stroke type and impairments on the global rating of change.

Parameter	OR	95% CI	*Cohen's d* *Effect size*	*P*- value
Ischemic stroke	8.420	(1.217-58.240)	1.175	0.031*
Weakness	30.629	(2.24-418.749)	1.887	0.010*
Sensory impairment	0.535	(0.122-2.35)	-0.345	0.407
Paralysis	1.267	(0.208-7.729)	0.130	0.797
Aphasia	0.928	(0.219-3.928)	-0.041	0.919
Facial weakness	0.770	(0.153-3.887)	-0.144	0.752
Visual impairment	3.637	(0.532-24.848)	0.712	0.188

OR: odds ratio; CI: confidence interval

* Significant at/> < 0.05

Sub-analyses were conducted to explore the differences between the participants who reported weakness and those who did not report weakness as well as the participants with ischemic stroke and those with hemorrhagic stroke (Table 3).The participants who had weakness reported significantly more improvement on the GRC than those who did not have weakness ($p < 0.05$). The other comparisons between those who did and those who did not report weakness did not show significant differences with respect to age, number of reported impairments, length of hospitalization, or number of physical therapy sessions. Comparisons between the participants with ischemic stroke and those with hemorrhagic stroke also did not show significant differences in terms of age, reported improvement on the GRC, number of reported impairments, length of hospitalization, or the number of physical therapy sessions.

Table 3. Comparison between the participants according to the type of stroke and reported weakness post-stroke.

	Stroke type, med (IQR)		*P*-value[A]	Weakness, med (IQR)		P-value[A]
	Ischemic (n=35)	Hemorrhagic (n=6)		Yes (n=35)	No (n=6)	
Age (years)	58 (18)	57.5 (18)	.815	58 (22)	62.5 (17.25)	.148
GRC	3(1)	2 (1.25)	.102	3(1)	2 (1.25)	.011*
Impairments	2(3)	3.5 (2.75)	.138	3(2)	1.5 (3)	.356
LOS (day)	10(16)	14.5 (69.25)	.412	10(16)	17.5 (90.25)	.639
PT sessions	25 (28)	23 (30.25)	.592	22.5 (21.25)	33 (57)	.754

GRC: Global Rating of Change; IQR: interquartile range; LOS: length of hospitalization; PT: physical therapy; med: median

[A] Mann-Whitney *U* test

* Significant atp < 0.05.

Discussion

In this study, we investigated the odds of rehabilitation program success for stroke survivors based on the perceptions of patients who had completed a rehabilitation program. The main findings were that having an ischemic stroke (vs. a hemorrhagic stroke) and reporting weakness (vs. no weakness) increased the likelihood of the patients reporting greater improvements after completing the physical therapy rehabilitation program.

The percentage of patients who reported having weakness before starting the rehabilitation program was 85%, which is comparable to that reported in previous studies.[19,20] The patients with stroke who reported weakness had a shorter duration of hospitalization, a lower number of impairments, and a better GRC score than those with hemorrhagic stroke. This suggests that reporting weakness at the beginning of the rehabilitation program is a better prognostic factor for improvement.

The percentage of individuals with ischemic stroke was 85%, which is comparable with the percentages reported in other studies of individuals with stroke.[21,22] The individuals with ischemic stroke in our study had less duration of hospitalization, a lower number of impairments, and better GRC scores than those with hemorrhagic stroke. This suggests that having an ischemic stroke is a better prognostic factor in terms of the amount of improvement than having a hemorrhagic stroke.

Limitations

The design of this study required the participants to rely on their memory to report their impairments and other information regarding their stroke, which had occurred up to 3 years earlier in some cases. The retrospective nature of this study makes it vulnerable to inaccurate and incomplete information. Using a prospective design to follow up with stroke survivors would have provided more accurate and detailed information and increased our confidence in the results. We found imbalances in the number of participants for each of the prognostic factors, which would have affected the statistical power to determine significant effects. The imbalance in the number of participants for these factors was expected as these factors have unequal rates of occurrence in individuals with stroke. Incorporating a stratified sampling technique would have allowed for an equal number of participants for each prognostic factor and would have provided the required statistical power to assess these effects.

Conclusion

Among the stroke survivors in our study, the type of stroke and the patients' initial impairments had significant effects on the patients'perceptions of improvement following a rehabilitation program.

Competing interests

The author declares that there is no conflict of interest to disclose regarding this manuscript.

References

Rajsic S, Gothe H, Borba HH, Sroczynski G, Vujicic J, Toell T, et al. Economic burden of stroke: a systematic review on post-stroke care. European Journal of Health Economics [Internet]. 2019 Feb 7 [cited 2022 Oct 4];20(l):107-34. Available from: https://link.springer.com/article/10.1007/sl0198-018-0984-0

2. Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol [Internet]. 2021 [cited 2024 Mar 23];20(10):l-26. Available from: https://pubmed.ncbi.nlm.nih.gov-/34487721/

3. Johnson CO, Nguyen M, Roth GA, Nichols E, Alam T, Abate D, et al. Global, regional, and national burden of stroke, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol [Internet]. 2019 May 1 [cited 2023 Jan 28];18(5):439-58. Available from: https://pubmed.ncbi.nlm.nih.gov-/30871944/

4. Bindawas SM, Vennu VS. Stroke rehabilitation. A call to action in Saudi Arabia. Neurosciences (Riyadh) [Internet], 2016 [cited 2023 Jan 28];21(4):297-305. Available from: https://pubmed.nc-bi.nlm.nih.gov/27744457/

Cramer SC. Repairing the human brain after stroke: I. Mechanisms of spontaneous recovery. Ann Neurol [Internet]. 2008 Mar [cited 2022 Oct 6];63(3):272-87. Available from: https://pubmed.nc-bi.nlm.nih.gov/27744457/

5. Cramer SC. Repairing the human brain after stroke: I. Mechanisms of spontaneous recovery. Ann Neurol [Internet]. 2008 Mar [cited 2022 Oct 6];63(3):272-87. Available from: https://pubmed. ncbi. nlm. nih. gov-/18383072/

6. Memis D, Kozanoglu E, Kelle B, Goncu MK. Assessment of demographic and clinical characteristics on functional status and disability of patients with stroke. Neurosciences Journal [Internet], 2016 Oct 1 [cited 2022 Oct 6];21(4):352-7. Available from: https://nsj.org.sa/content/21/4/352

7. Meyer MJ, Pereira S, McClure A, Teasell R, Thind A, Koval J, et al. A systematic review of studies reporting multivariable models to predict functional outcomes after post-stroke inpatient rehabilitation. https://-doi.org/103109/096382882014963706 [Internet]. 2015 [cited 2023 Jan 28];37(15):1316-23. Available from: https://www.tandfonline.com/-doi/abs/10.3109/09638288.2014.963706

Kwah LK, Diong J. National Institutes of Health Stroke Scale (NIHSS). J Physiother [Internet]. 2014 [cited 2022 Oct 4];60(l):61. Available from: https://-pubmed.ncbi.nlm.nih.gov/24856948/

9. Benaim C, Pérennou DA, Villy J, Rousseaux M, Pelissier JY. Validation of a standardized assessment of postural control in stroke patients: the Postural Assessment Scale for Stroke Patients (PASS). Stroke [Internet]. 1999 [cited 2022 Oct 4];30(9):1862-8. Available from:

https://pubmed.ncbi.nlm.nih.gov-/10471437/

10. Daley K, Mayo N, Wood-Dauphineé S. Reliability of Scores on the Stroke Rehabilitation Assessment of Movement (STREAM) Measure. Phys Ther [Internet]. 1999 Jan 1 [cited 2022 Oct 4];79(l):8-23. Available from: https ://academic.oup. com/p tj/article/79/1/8/2857712

Duncan PW, Bode RK, Lai SM, Perera S. Rasch analysis of a new stroke-specific outcome scale: The stroke impact scale. Arch Phys Med Rehabil [Internet]. 2003 Jul 1 [cited 2022 Oct 4];84(7):950-63. Available from: http://www.archives-pmr.org/ article/S0003999303000352/fulltext

12. Jaeschke R, Singer J, Guyatt GH. Measurement of health status: Ascertaining the minimal clinically important difference. Control Clin Trials. 1989 Dec l;10(4):407-15.

13. Kamper SJ, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. J Man Manip Ther [Internet], 2009;17(3):163-70. Available from: https://pubmed.ncbi.nlm.nih.gov/20046623

14. A Comparison of a Modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale, [cited 2024 May 16]; Available from: https://academic.oup.com/ptj/article/81/2/776/2829542

15. Guyatt GH, Norman GR, Juniper EF, Griffith LE. A critical look at transition ratings. J Clin Epidemiol. 2002 Sep l;55(9):900-8.

Costa LOP, Maher CG, Latimer J, Ferreira PH, Ferreira ML, Pozzi GC, et al. Clinimetric testing of three self-report outcome measures for low back pain patients in Brazil: Which one is the best? Spine (Phila Pa 1976) [Internet]. 2008 Oct 15 [cited 2024 May 16];33(22):2459-63. Available from: https://journals.lww.com/spinejournal/fulltext/2008/10150/clinimetric_testing_of_three_self_report_outcome.17.aspx

17. Ogino T, Kanata Y, Uegaki R, Yamaguchi T, Morisaki K, Nakano S, et al. Effects of gait exercise assist robot (GEAR) on subjects with chronic stroke: A randomized controlled pilot trial. Journal of Stroke and Cerebrovascular Diseases. 2020 Aug 1;29(8).

18. Sánchez-Meca J, Marin-Martinez F, Chacón-Moscoso S. Effect-size indices for dichotomized outcomes in meta-analysis. Psychol Methods [Internet], 2003 Dec [cited 2024 May 19] ;8(4):448-67. Available from: https://pubmed.ncbi.nlm.nih.gov-/14664682/

19. Ojaghihaghighi S, Vahdati SS, Mikaeilpour A, Ramouz A. Comparison of neurological clinical manifestation in patients with hemorrhagic and ischemic stroke. World J Emerg Med [Internet]. 2017 [cited 2022 Oct 2];8(1):34. Available from: /pmc/articles/PMC5263033/

Iranmanesh F. Post-stroke depression and hospital admission. Post-stroke depression and hospital admission. Neurosciences Journal. 2010;15(l).

21. Shin S, Lee Y, Chang WH, Sohn MK, Lee J, Kim DY, et al. Multifaceted Assessment of Functional Outcomes in Survivors

of First-time Stroke. JAMA Netw Open [Internet]. 2022 Sep 23 [cited 2022 Oct 2];5(9):e2233094. Available from: https://-pubmed.ncbi.nlm.nih.gov/36149652/

22. Alotaibi SM, Alotaibi HM, Alolyani AM, Abu Dali FA, Alshammari AK, Al-hwiesh AA, et al. Assessment of the stroke-specific quality-of-life scale in KFHU, Khobar. Neurosciences Journal [Internet], 2021 Apr 1 [cited 2022 Oct 6];26(2):171-8. Available from: https://n-sj. org. s a/content/2 6/2/171