DOI: 10.5114/areh.2024.138148
Original article
Advances in Rehabilitation, 2024, 38(1), 43–51

A – Research concept and design
B – Collection and/or assembly of data
C – Data analysis and interpretation
D – Writing the article
E – Critical revision of the article
F – Final approval of article

Adults with acquired brain injury at inpatient rehabilitation: discharge comparison of patient-reported outcomes at follow-up with functional status

Pamela S Roberts*[1,A-F], Debra Ouellette[2,A-F], Jeffrey Wertheimer[1,A-F]

[1]Cedars-Sinai and California Rehabilitation Institute, Los Angeles, United States
[2]Casa Colina Hospital and Centers for Healthcare, Ponona, United States

Received: 2024-01-05
Accepted: 2024-03-17
Published: 2024-03-27

*Corresponding author: Pamela S Roberts; Cedars-Sinai and California Rehabilitation Institute, Los Angeles (CA), United States; email: pamela.roberts@cshs.org

Abstract

Introduction: The aim of the article was to determine the correlation between self-care and mobility status at time of discharge from an inpatient rehabilitation hospital, and examine patient-reported physical and mental health outcomes among individuals with acquired brain injury (ABI).
Material and methods: Electronic health data was collected retrospectively as part of routine care from an inpatient rehabilitation hospital. Clinician-rated functional data was collected at the time of discharge, and follow-up data assessing health-related quality of life was acquired by telephone. Data was obtained from patients discharged between the dates of January 1, 2020-December 31, 2021 with final data being collected via telephone at a point in time after discharge.
Results: The study included 143 individuals with ABI, mean age 70 years; 55.42% were female and 68.53% were white. The model predicting patient perception of good physical health had 69.23% sensitivity and 62.5% specificity: C statistic 0.72. Sex and mobility scores at discharge were found to be significant predictors of good mental health, with a sensitivity of 63.55% and specificity of 63.89%: C statistic 0.68.
Conclusions: Despite their importance, little data exists regarding the relationship between patient-reported outcomes (PROs) and clinician-rated measures. There is a need to better understand the relationship between clinician-rated functional status, demographic variables, comorbidities and patient-reported outcomes. Such data can assist in proactively addressing expectations related to physical and mental health, and can guide rehabilitation and behavioral health intervention during home and community reintegration.

Keywords: brain injuries, functional status, patient-reported outcomes, stroke

Introduction

The use of patient-reported outcomes is gaining importance as a method for understanding and engaging clinical care and outcomes among the neurological population [1-3]. In the management of acquired brain injury (ABI), outcomes generally focus on survival, prevention of secondary complications, burden of care, and measures

of function [4]. Assessments often employ questionnaires measuring important health domains, such as Quality of Life (QOL), in conjunction with other clinician-reported measures [4]. The combination of both clinician-rated functional status and patient-reported outcomes can have a strong impact in directing the care of the patient and designing program components.

A patient-reported outcome (PRO) is "any report of the status of a patient's health condition that comes directly from the patient, without any interpretation of the patient's response by a clinician, or anyone else" [5]. Patient-reported outcome measures (PROM) are "tools or instruments used to measure PROs" [6]. The inclusion of PROMs is widely endorsed by such agencies as the National Quality Forum (NQF) and the National Institute of Health (NIH). The Patient-reported Outcome Information System (PROMIS®) was developed by the NIH as a research initiative to establish measurement across a variety of conditions [1]. Initiatives that drive patient engagement and patient-centered care inform healthcare consumers and contribute to the need for inclusion of PROMs in routine care. In a paper on the use of PROs specific to ischemic or hemorrhagic stroke; the International Consortium of Health Outcomes Measurement (ICHOM) notes that most PROMs were generic and not specific to stroke, and that industry-funded studies collected the fewest PROs [7]. Similarly, there has been limited research on clinical application of health-related quality-of-life PROs for individuals with traumatic brain injury [8].

While patient-reported outcomes have received increasing interest and support in clinical practice, the integration of such measures has been met with suboptimal success. Among health practitioners, the collection of outcome data may be seen as a barrier or a facilitator, depending on time and resources [9]. The relationship between PROs and clinician-rated performance measures has been beset by measurement challenges in clinical practice and uncertainty about their clinical utility [10]. Hence, although the feasibility of incorporating PROM collection in inpatient rehabilitation has been established, adoption into the clinical setting remains a challenge [11].

A fuller understanding of the relationship between clinician-rated measures and PROMs may incentivize the use of PROs. Further, understanding which clinical factors have the most effect on patient-perceived physical and mental health may focus interventions. As such, instituting processes that facilitate the use of PROMs in practice may improve quality of care, the patient experience, and the fulfillment of regulatory and reimbursement standards.

The aims of this study were as follows: (1) to determine how clinician-rated functional status regarding self-care and mobility at discharge from an inpatient rehabilitation hospital relates to patient-reported physical health outcomes in acquired brain injury at follow-up, (2) to determine whether clinician-rated functional status in self-care and mobility at discharge from an inpatient rehabilitation hospital correlates with patient-reported mental health outcomes at follow-up, and (3) to identify demographic and clinical factors that impact the patient-reported outcomes regarding physical and mental health.

Materials and methods

Study design

The data was collected as part of routine quality improvement programs aimed at monitoring patient-reported health-related quality of life at a rehabilitation hospital in an urban area. The collected data focused on quality of life associated with physical health and mental health using the PROMIS-10 Global Health (PROMIS GH) tool. Clinical data were obtained from patients discharged between the dates of January 1, 2020 and December 31, 2021. The PROMIS GH was completed via telephone by rehabilitation clinicians on one occasion between 30 days and one year after discharge. The electronic demographic and functional outcome data were linked to the quality PROMIS data at follow-up based on name, admission date and date of birth, using a deidentified code. The study was approved by the Institutional Review Board.

Inclusion/exclusion criteria

Inclusion criteria comprised age 18 and older, a diagnosis of acquired brain injury (stroke or other acquired brain injury such as traumatic brain injury [TBI] and non-traumatic brain injury), admission to a free-standing rehabilitation hospital in Los Angeles, California, and completion of the PROMIS GH [12] measure at follow-up after discharge from inpatient rehabilitation. The exclusion criteria comprised age under 18, any cognitive impairment or cognitive-linguistic impairment (e.g. aphasia) that would prevent survey completion, expired during the inpatient rehabilitation stay or before follow-up; discharge to hospice, short-term general hospital, long-term care hospital, inpatient psychiatric facility or critical access hospital if the initial rehabilitation stay was less than three days; lack of response to PROMIS-GH questions at follow-up.

Data from the electronic health record included demographic data such as: age, sex (male/female), population type (American Indian, Asian, African American, Hispanic/Latino, Pacific Islander, White), marital status (single, married, divorced, widowed, separated), time from onset of diagnosis to follow-up (less than or equal to three months or greater than three months), and time from discharge to follow-up (less than or equal to three months or greater than three months). Medical variables

and health conditions included etiologic diagnosis, and number of comorbidities (less than or equal to 14 or greater than 14) using a median cutoff. Comorbidities included diseases or medical conditions that occur at the same time and are often chronic or long-term conditions.

Functional variables included quality data, the patient-reported outcome data, self-care functional score at the time of inpatient rehabilitation discharge, and mobility functional score at the time of inpatient rehabilitation discharge. Self-care and mobility scores at discharge were displayed as sums and calculated according to the Inpatient Rehabilitation Facility (IRF) manual [13]. Discharge functional status is measured in two domains, self-care and mobility, as referenced in the functional section of the Inpatient Rehabilitation Facility-Patient Assessment Instrument (IRF-PAI) manual [13]. Specifically, the functional section is a standardized assessment used by the Centers for Medicare and Medicaid Services (CMS) in post-acute care settings; it is designed to measure a patient's need for assistance with self-care and mobility.

The patient-reported outcome variables represent the patient's perception of their mental and physical health. The PROMIS-GH [14] is a 10-item questionnaire designed to measure constructs related to health-related quality of life. Nine of the 10 PROMIS-GH items are scored on a Likert scale from 1 to 5, with "1" representing the worst possible rating and "5" representing the best possible rating. One item, "How would you rate your pain on average," is scored from 0 (no pain) to 10 (worst pain imaginable), and recoded to a 5-point scale per instrument instructions. The PROMIS-GH produces two index scores: Physical Health and Mental Health [15]. The Physical Health index score comprises four items on physical health, physical functioning, pain intensity and fatigue, and the Mental Health index score includes another four items, overall quality of life, mental health (mood and ability to think), satisfaction with social activities and relationships, and emotional problems (i.e., feeling anxious, depressed, or irritable). Two PROMIS-GH items, general health and social roles, are not used to calculate the Physical Health or Mental Health index score.

The index scores are compared to United States population-based standard scores and are transformed to a T-score metric with a mean of 50 and SD of 10. Higher scores indicate perceived higher levels of physical and mental well-being. Physical health was perceived as "good" if the physical health t-scores were greater than or equal than 46.71, and "fair-poor" if less than 46.71. Mental health was perceived as "good" if the mental health t-scores were greater than or equal to 40 and "fair-poor" if less than 40 [16]. Duplicate records were identified and records with an earlier date of admission were kept for analysis.

Statistical Analysis

Statistical analysis was carried out using SAS® Version 9.4 and STATA® Version 17. For predictive modeling, separate univariate analyses were conducted for each independent variable and either physical or mental health as the outcome. Collinearity was assessed among continuous predictors. Clinically-relevant predictor variables were compared with the mobility score at discharge and self-care score at discharge. Since the sample is skewed toward older adults, and the clinical characteristics of elderly patients vary by age, the age groups were analyzed by quartile (younger cohort, < 62 years; youngest-old, 63 to 70 years; middle-old, 71 to 83 years; and oldest-old, > 84 years); this classification is comparable to those used in previous studies [17,18]. Statistically significant variables were included in the final models ($p < 0.05$). Fractional polynomials were used to assess the linearity of continuous predictors. R-square, goodness-of-fit tests, and ROC curves were used to assess the best-fitted model for each health outcome. Sensitivity and specificity were determined for the chosen prediction models. Any observations with extreme residual values were identified using model diagnostics.

Results

The descriptive statistics for the participants are found in table 1. One hundred and forty-three were admitted for acquired brain injury and included in the analysis, of which 55% had experienced stroke and 45% had received an acquired brain injury. Of the patients with acquired brain injury, the mean age was 70 years, over half (55.42%) were female, the majority (68.53%) were white, and 57.35% were divorced, widowed, never married, or separated.

The majority of acquired brain injury patients had greater than 14 comorbidities (55.24%), with an increased incidence observed within the oldest-old cohort (table 2). The mean mobility score at discharge for acquired brain injury patients was 58.48, with a standard deviation of 18.65. Mean self-care score at discharge was 31.91 with a standard deviation of 8.28; of the functional classifications, 69.9% were set-up/independent, 19.6% supervision/touching assist, and 10.5% moderate/maximal/dependent assist. Mean mobility score at discharge of 58.48 with a standard deviation of 18.65; of the functional classifications 48.3% were set-up/independent, 30.8% were supervision/touching assist, and 21.0% were moderate/maximal/dependent assist. The oldest-old cohort demonstrated significantly lower self-care and mobility functional deficits compared to the other age cohorts (table 2). On average, follow-up from onset of diagnosis was less than three months. The univariate logistic regression outcomes are shown in table 3.

Tab. 1. Descriptive variables

Variable	Acquired Brain Injury (n = 143)	Perception of Good Physical Health (n = 39)	Perception of Good Mental Health (n = 107)
Age (years)	70.53 (14.98)	65.18 (17.61)	69.81 (15.85)
Sex			
Male	64 (44.76)	20 (51.28)	46 (43.00)
Female	79 (55.42)	19 (48.72)	61 (57.00)
Population type			
American Indian	1 (0.70)	0	0
Asian	13 (9.09)	4 (10.26)	8 (7.50)
African American	22 (15.38)	4 (10.26)	15 (14.00)
Hispanic/Latino	8 (5.59)	2 (5.13)	7 (6.54)
Pacific Islander	1 (0.70)	0	0
White	98 (68.53)	29 (74.36)	77 (72.00)
*n=1 missing			
Marital Status			
Divorced, widowed, never married, separated	78 (57.35)	17 (47.22)	60 (58.20)
Married	58 (42.65)	19 (52.78)	42 (41.18)
*n=9 missing			
Comorbidities			
≤ 14	64 (44.76)	19 (48.72)	50 (46.73)
> 14	79 (55.24)	20 (51.28)	57 (53.27)
Mobility score at discharge	58.48 (18.65)	65.38 (17.71)	59.55 (17.69)
Moderate/Maximal/Dependent	21.00%	12.80%	17.80%
Supervision/Touching Assist	30.80%	23.10%	29.90%
Set-up/Independent	48.30%	64.10%	52.30%
Self-care score at discharge	31.91 (8.28)	35.36 (7.36)	32.64 (7.76)
Moderate/Maximal/Dependent	10.50%	5.10%	7.50%
Supervision/Touching Assist	19.60%	10.30%	16.80%
Set-up/Independent	69.90%	84.60%	75.70%
Time from onset of diagnosis to follow-up			
≤ 3 months	64 (44.76)	18 (46.15)	47 (43.93)
> 3 months	79 (55.24)	21 (53.85)	60 (56.07)
Time from discharge to follow-up			
≤ 3 months	81 (56.64)	21 (53.85)	59 (55.14)
> 3 months	62 (43.36)	18 (46.15)	48 (44.86)

Frequencies and percentages are shown for categorical variables. Mean and standard deviation are shown for continuous variables.

Tab. 2. Clinical variables across age quartiles

Variable	1st Quartile Younger Cohort (n = 34)	2nd Quartile Younger-old (n = 33)	3rd Quartile Middle-old (n = 39)	4th Quartile Oldest-old (n = 37)	p-value
Age (years)	49.91 (11.00)	66.61 (2.45)	75.49 (3.71)	87.8 (3.01)	0.34
Comorbidities					
≤ 14	47.1%	51.5%	43.6%	37.8%	0.33
> 14	52.9%	48.5%	56.4%	62.2%	
Mobility					
Moderate/Maximal/Dependent	20.6%	15.2%	20.5%	27.0%	0.03
Supervision/Touching	20.6%	42.4%	17.9%	43.2%	
Set-up/Independent	58.8%	42.4%	61.5%	29.7%	
Self-Care					
Moderate/Maximal/Dependent	5.9%	9.1%	7.7%	18.9%	0.01
Supervision/Touching	8.8%	21.2%	17.9%	29.7%	
Set-up/Independent	85.3%	69.7%	74.4%	51.4%	
Physical Health					
Fair/Poor	58.8%	78.8%	66.7%	86.5%	0.03
Excellent/Very Good/Good	41.2%	21.2%	33.3%	13.5%	
Mental Health					
Fair/Poor	20.6%	30.3%	20.5%	29.7%	0.46
Excellent/Very Good/Good	79.4%	69.7%	79.5%	70.3%	

Tab. 3. Relationship between demographic variables with perception of physical and mental health

	Perception of Physical Health			Perception of Mental Health		
Variable	OR	CI	p-value	OR	CI	p-value
Age (years)	0.96	[0.94, 0.99]	0.01	0.98	[0.96, 1.01]	0.34
Sex						
Male	1.24	[0.59, 2.60]	0.56	0.75	[0.35, 1.61]	0.47
Female	1.00			1.0		
Ethnicity						
Other	0.68	[0.29, 1.55]	0.36	0.55	[0.25, 1.19]	0.13
White	1.00			1.0		
Marital status						
Married	1.74	[0.81, 3.77]	0.15	0.78	[0.36, 1.72]	0.54
Divorced, widowed, never married, separated	1.00			1.0		
No. of comorbidities						
> 14	0.80	[0.38, 1.68]	0.56	0.73	[0.34, 1.57]	0.41
≤ 14	1.00			1.00		
Mobility score at discharge	1.03	[1.01, 1.05]	0.008	1.01	[0.99, 1.03]	0.23
Self-care score at discharge	1.09	[1.03, 1.16]	0.003	1.04	[0.99, 1.09]	0.08
Time from onset of diagnosis to follow-up						
> 3 months	0.93	[0.22, 1.04]	0.84	1.14	[0.54, 2.44]	0.73
≤ 3 months	1.00			1.00		

	Perception of Physical Health			Perception of Mental Health		
Time from discharge to follow-up						
> 3 months	1.17	[0.56, 2.45]	0.67	1.27	[0.59, 2.76]	0.53
≤ 3 months	1.00	[0.94, 0.99]	0.01	1.00	[0.96, 1.01]	0.34

CI- confidence interval, OR- odds ratio. Significance level is set at an alpha of 0.05.

Physical Health Outcomes

Due to high collinearity between mobility and self-care scores at discharge, these variables were considered separately in models for predicting good physical and mental health in acquired brain injury patients ($R = 0.86$, $p < 0.001$). Age at admission was the only statistically significant predictor of good physical health with mobility scores at discharge (table 3). Sex, ethnicity, marital status, and number of comorbidities were tested as potential effect modifiers in the relationship between mobility scores and physical health outcomes. The number of comorbidities was found to have a significant relationship with mobility scores at discharge, and with physical health outcomes at follow-up (Table 3).

In the initial model predicting physical health outcomes, an association was found between mobility scores at discharge and number of comorbidities, and age at admission; the model was characterized by an R2 of 0.11, ROC of 0.7244, 69.23% sensitivity and 62.5% specificity. No statistically significant association was found between physical health and self-care scores at discharge. Additionally, no significant relationships were observed for any other variables, and these were not included in the model. After controlling for age, those with fewer than 14 comorbidities are 1.89 times more likely to perceive a good physical health result than those with greater than or equal to 14 comorbidities.

Mental Health Outcomes

Mobility score at discharge was significantly associated with mental health outcomes ($p < 0.01$). Sex was found to have a significant relationship with mobility score at discharge (Table 3) and with mental health outcome at follow-up (Table 3). The initial model found to predict mental health outcomes in acquired brain injury patients included an association between sex and mobility score at discharge (R2 0.07, ROC 0.68). Univariate analysis did not identify any significant association between self-care score at discharge and mental health outcomes (Table 3); however, a significant association was found between self-care scores and sex ($p = 0.035$). The model that predicted mental health outcomes in acquired brain injury patients included mobility scores at discharge and sex (R2 value of 0.07, ROC of 0.6816, sensitivity of 63.55% and specificity of 63.89%). In the final model, the odds of perceiving a good mental health outcome was found to be 1.86 times higher among female patients than male patients.

Discussion

This study provides a deeper understanding of the demographic, clinician-rated performance-based metrics, and medical variables related to the outcomes of acquired brain injury based on the perspectives of both clinicians and patients. Statistically significant associations were found between clinician-rated mobility and both physical health and mental health outcomes. Similarly, self-care discharge scores were found to have a significant relationship with patient-reported physical and mental health outcomes; the analysis employed relevant clinical and demographic variables that provide an insight into the perspective of the patient regarding clinical outcomes.

Both age and number of comorbidities were significant predictors of the patient perception of physical health, while sex predicted the patient perception of mental health. The importance of understanding patient-reported outcomes in the field of rehabilitative medicine is growing; however, little data exists regarding the relationship between patient-reported outcomes and clinician-rated performance-based measures, such as mobility and self-care, particularly in the presence of potential covariates [10].

Our results confirm that functional status impacts perceived health related quality of life. In this study, 73% of individuals with acquired brain injury perceive themselves as having fair to poor physical health, which is in line with clinician-reported mobility scores indicating moderate functional deficits. Our data also indicate that age and number of comorbidities explained some of the variation in the relationship between mobility score, as a functional measure, and perception of good physical health. Notably, a study examining the relationship between various predictors and QoL measures found reports of lower quality of life among older populations [19]. Our present findings suggest that reduced health-related QoL appears to be driven by the self-perception of physical health status in all age groups; this appears to be most pronounced in older adults, regardless of mental health status perception. Furthermore, the presence of negative self-perceptions is

linked to poor physical health and functional outcomes in late life [20]. In the present study, the mean age of those with perceived good physical health was five years younger than that of the entire sample; this may explain poor perception among the older populations, who may be particularly vulnerable to a worsening perception of their physical health, especially the oldest cohort, who are characterized by an elevated risk of co-morbidities.

Seventy-five percent of the patients in the present study demonstrated a good perception of mental health outcomes, despite having only moderate clinician-rate scores for functional status. Thus, mobility scores alone do not drive perception of mental health outcomes. Moreover, and not surprisingly, many factors contribute to perception of mental health; in the present study, most of the participants reported mental health outcomes that were categorized as at least "good" in all age groups, despite compromised physical functioning.

There may be several possible reasons for the patients demonstrating elevated outcomes for good mental health perception while also being subject to physical functional deficits, one of which is the *disability paradox* [21]. It has been found that self-rated health perception in disability may be influenced by context and individual traits and not just on functional limitations. That is, individuals with significant functional difficulties may report higher levels of quality of life as it relates to mental health, despite experiencing objective and subjective poor physical health. Moreover, functional difficulties and disability are not attributes of individuals, but rather a set of obstacles that one may encounter while interacting with the social and physical environments [22]. The better perception of "mental health" outcomes over "physical health" could also be explained by contextual factors, such as family support and individual personality traits such as resilience to stressors [23]. Additionally, individuals who perceive their acquired brain injury to have functional consequences commonly experience post-traumatic growth (PTG) [19]. PTG can be defined as growth or perception leading to the experience of positive changes after a traumatic event [24]; its presence following acquired brain injury may yield beneficial psychological outcomes, despite actual or perceived physical functional deficits [19,24]. Furthermore, some individuals with acquired brain injury may possess a diminished insight into some of their deficits [25,26]; such poor insight may result in a discrepancy between objective level of functional impairment and higher levels of subjective mental health. In addition, focusing attention on physical function deficits may also overshadow that associated with mental health difficulties.

Upon additional analysis, sex was found to be significant in the relationship between mobility score at discharge and mental health outcome ($p < 0.01$). Though univariate analysis revealed no significant association between mobility scores at discharge and follow-up mental health outcomes, a significant association was found after controlling for the interaction of sex and mobility scores (Table 3). For this sample, the model reported lower odds of perception of good mental health in males compared to females; univariate analysis also indicated that 57% of those who reported good perception of mental health were female. Moreover, the women were generally more likely to report a good perception of mental health compared to the men. This finding may be supported by theories regarding gender roles and emotional processing. While being cautious about gender bias, structural equation modelling has found greater conflict between the gender roles to be associated with lower emotional expression [27], and in turn, with greater distress.

Research is mixed regarding the association between sex and emotional disturbance following acquired brain injury [28]. For example, research on stroke patients has found that depression is more common in women than men [28], while other studies report that depression is greater in men than women [28]. Furthermore, while some publications on stroke survivors show higher reported depressive symptoms among women than men, while others note the opposite, data from a Canadian registry reported no differences in QOL six months after discharge using the Health Utilities Index [28-30]. A comprehensive neuropsychological assessment on a large sample of stroke patients ($n = 325$) by Dulay and colleagues [29] did not find any significant correlation between sex and depression.

The discrepancies observed across publications can be attributed to differences in the instruments used for measuring QOL, which vary in terms of validity and reliability [4]. In addition, the risk factors for mental health disturbance occurring at different time points following a stroke are complex and diverse [31]. Similarly, while sex has been found to influence some mental health outcomes for individuals with traumatic brain injury (TBI) [32,33], the prevalence of mental health disturbance in persons with TBI may not be gender-specific [34,35]. There remains a need for a greater understanding of the baseline patient characteristics that may contribute to observed sex differences, i.e. pre-neurologic insult necessitating IRF intervention, such as access to clinical care and rehabilitation services following neurologic injury, as well as various social, mental health, and socioeconomic factors. While the literature remains divided, our findings highlight the important role of sex in prognosticating mental health outcomes in patients with acquired brain injury, among various other biological, psychological, and socio-cultural factors.

Previous studies, including Dupre and Lopes [36], have indicated better survival rates among stroke pa-

tients who were married compared to those widowed or single. However, our present findings indicate no statistically significant differences in patient-reported physical or mental health outcomes according to marital status. Further research may help understand the role of marital status in patient-reported mental health outcomes.

Limitations

There are several limitations in the study. First, the small sample size, the use of a single hospital, and limited ethnic diversity in the participants may interfere with the generalizability of the findings.

Second, the follow-up instrument was performed at a single point in time, which varied from 30 days post discharge to one year post discharge from inpatient rehabilitation: the responses may have been influenced by the amount of time post-discharge, and the life or health-related experiences between discharge and follow-up.

Third, the follow-up patient-reported outcomes did not have performance-based metrics at the time of follow-up; therefore, while performance-based metrics were found to predict patient-reported outcomes, the broader context of functional status and the variables influencing patient-reported outcome in the months post-ABI onset remain unknown. Moreover, while meaningful associations were identified between performance-based metrics and PROs, it would also be valuable to collect further clinician-rated functional status data at follow-up.

Fourth, this model did not include potentially significant predictors of PROs, such as lifestyle habits (i.e., smoking and drinking), psychiatric status, socioeconomic status (i.e., impacting access to health care following discharge), and specific comorbidity details known to possibly affect stroke patient recovery. The definition of comorbidities used in this study also includes complications, which may make it difficult to compare outcomes across different publications.

In addition, although just over half of the participants were high functioning at discharge, a greater spread was noted with regard to functional deficits in mobility. Similarly, self-care metrics were skewed towards high functioning patients at the time of discharge, even more so than mobility metrics. Consequently, in the final models, mobility scores were used instead of self-care scores because they explained more of the variation in physical and mental health outcomes and produced better ROC curves. As a result, the model could not capture both functional status measures simultaneously.

Also, due to the small sample size, the models were not externally validated. Hence, to better generalize the findings, further validation is needed in larger datasets with a wider distribution of performance status at the time of discharge.

Conclusions

Age, number of comorbidities, and mobility scores at discharge were found to be significant predictors of patient-reported physical health outcomes. Sex and mobility scores at discharge were found to be significant predictors of good mental health. Knowledge about clinician-rated functional status and patient perception following inpatient rehabilitation due to ABI can assist in proactively addressing the specific needs of the patients, and their expectations related to physical and mental health during home, community, and workplace reintegration

Funding

This research received no external funding.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Lavallee DC, Chenok KE, Love RM, Petersen C, Holve E, Segal CD, et al. Incorporating Patient-Reported Outcomes Into Health Care To Engage Patients And Enhance Care. Health Aff (Millwood). 2016; 35(4): 575–82.
2. Hudon C, Fortin M, Haggerty JL, Lambert M, Poitras ME. Measuring patients' perceptions of patient-centered care: a systematic review of tools for family medicine. Ann Fam Med. 2011; 9: 155–64.
3. Kupfer DJ, Frank E, Phillips ML. Major depressive disorder: new clinical, neurobiological, and treatment perspectives. Lancet. 2012; 379(9820): 1045–55.
4. Reeves M, Lisabeth L, Williams L, Katzan I, Kapral M, Deutsch A, et al. Patient-Reported Outcome Measures (PROMs) for Acute Stroke: Rationale, Methods and Future Directions. Stroke. 2018; 49(6): 1549–56.
5. U.S Department of Health and Human Services Food and Drug Administration. Patient-Reported Outcome Measures: Use in Medical Product Development to Support Labeling Claims. [Internet] 2009 Dec [cited 2024, March 2]. Available from: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/patient-reported-outcome-measures-use-medical-product-development-support-labeling-claims
6. Weldring T, Smith SM. Patient-Reported Outcomes (PROs) and Patient-Reported Outcome Measures (PROMs). Health Serv Insights. 2013; 6: 61–8.
7. Price-Haywood EG, Harden-Barrios J, Carr C, Reddy L, Bazzano LA, van Driel ML. Patient-reported outcomes in stroke clinical trials 2002-2016: a systematic review. Qual Life Res. 2019; 28(5): 1119–28
8. Tulsky DS, Kisala PA, Victorson D, Carlozzi N, Bushnik T, Sherer M, et al. TBI-QOL: Development and Calibration of Item Banks to Measure Patient-reported Outcomes Follow-

ing Traumatic Brain Injury. J Head Trauma Rehabil. 2016; 31(1): 40–51.
9. Duncan EA, Murray J. The barriers and facilitators to routine outcome measurement by allied health professionals in practice: a systematic review. BMC Health Serv Res. 2012; 12: 96.
10. Amtmann D, Cook KF, Johnson KL, Cella D. The PROMIS initiative: involvement of rehabilitation stakeholders in development and examples of applications in rehabilitation research. Arch Phys Med Rehabil. 2011; 92(10 Suppl): 12–9.
11. Heinemann AW, Nitsch KP, Gracz K, Ehrlich-Jones L, Engel E, Wilson M, et al. Implementing Patient-Reported Outcome Measures in Inpatient Rehabilitation: Challenges and Solutions. Arch Phys Med Rehabil. 2022; 103(5S): 67–77.
12. Katzan IL, Lapin B. PROMIS GH (Patient-Reported Outcomes Measurement Information System Global Health) Scale in Stroke: A Validation Study. Stroke. 2018; 49(1): 147–54.
13. Centers for Medicare and Medicaid Services. IRF-PAI Manual-Version 4.0. [Internet]. Available from: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/IRF-Quality-Reporting/IRF-PAI-and-IRF-PAI-Manual
14. Cella D, Riley W, Stone A, Rothrock N, Reeve B, Yount S, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. J Clin Epidemiol. 2010; 63(11): 1179–94.
15. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. Qual Life Res. 2009; 18: 873–80.
16. Hays RD, Spritzer KL, Thompson WW, Cella D. U.S. General Population Estimate for "Excellent" to "Poor" Self-Rated Health Item. J Gen Intern Med. 2015; 30(10): 1511–6.
17. Lee SB, Oh JH, Park JH, Choi SP, Wee JH. Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. Clin Exp Emerg Med. 2018; 5(4): 249–55.
18. Alterovitz SS, Mendelsohn GA. Relationship goals of middle-aged, young-old, and old-old Internet daters: an analysis of online personal ads. J Aging Stud. 2013; 27(2): 159–65.
19. Silva J, Ownsworth T, Shields C, & Fleming J. Enhanced Appreciation of Life Following Acquired Brain Injury: Posttraumatic Growth at 6 Months Postdischarge. Brain Impairment. 2011; 12(2): 93–104.
20. Sargent-Cox KA, Anstey KJ, Luszcz MA. The relationship between change in self-perceptions of aging and physical functioning in older adults. Psychol Aging. 2012; 27(3): 750–60.
21. Mavaddat N, Sadler E, Lim L, Williams K, Warburton E, Kinmonth AL, et al. What underlies the difference between self-reported health and disability after stroke? A qualitative study in the UK. BMC Neurol. 2021; 21(1): 315.
22. WHO. International Classification of Functioning, Disability and Health (ICF). Geneva: WHO Press; 2001.
23. Dell'Osso L, Lorenzi P, Nardi B, Carmassi C, Carpita B. Post Traumatic Growth (PTG) in the Frame of Traumatic Experiences. Clin Neuropsychiatry. 2022; 19(6): 390–3.
24. Karagiorgou O, Evans JJ, Cullen B. Post-traumatic growth in adult survivors of brain injury: a qualitative study of participants completing a pilot trial of brief positive psychotherapy. Disabil Rehabil. 2018; 40(6): 655–9.
25. De Witte L, Brouns R, Kavadias D, Engelborghs S, De Deyn PP, Mariën P. Cognitive, affective and behavioural disturbances following vascular thalamic lesions: a review. Cortex. 2011; 47(3): 273–319.
26. Guo J, Wang J, Sun W, Liu X. The advances of post-stroke depression: 2021 update. J Neurol. 2022; 269(3): 1236–49.
27. Hamano T, Li X, Lonn SL, et al. Depression, stroke and gender: evidence of a stronger association in men. J Neurol Neurosurg Psychiatry. 2015 Mar: 86 (3): 319-23.
28. Kapral MK, Fang J, Hill MD, Silver F, Richards J, et al. Sex differences in stroke care and outcomes: results from the Registry of the Canadian Stroke Network. Stroke. 2005; 36(4): 809–14.
29. Dulay MF, Criswell A, Hodics TM. Biological, Psychiatric, Psychosocial, and Cognitive Factors of Poststroke Depression. Int J Environ Res Public Health. 2023; 20(7): 5328.
30. Gargano JW, Reeves MJ, Paul Coverdell National Acute Stroke Registry Michigan Prototype Investigators. Sex differences in stroke recovery and stroke-specific quality of life: results from a statewide stroke registry. Stroke. 2007; 38(9): 2541–8.
31. Shi Y, Yang D, Zeng Y, Wu W. Risk Factors for Post-stroke Depression: A Meta-analysis. Front Aging Neurosci. 2017; 9: 218.
32. Cogan AM, McCaughey VK, Scholten J. Gender Differences in Outcomes after Traumatic Brain Injury among Service Members and Veterans. PM R. 2020; 12(3): 301–14.
33. Hellewell SC, Beaton CS, Welton T, & Grieve SM. Characterizing the Risk of Depression Following Mild Traumatic Brain Injury: A Meta-Analysis of the Literature Comparing Chronic mTBI to Non-mTBI Populations. Front Neurol. 2020; 11: 350.
34. Lavoie S, Sechrist S, Quach N, Ehsanian R, Duong T, Gotlib IH, et al. Depression in men and women one year following traumatic brain injury (TBI): a TBI model systems study. Front Psychol. 2017; 8: 634.
35. Roy D, Koliatsos V, Vaishnavi S, Han D, Rao V. Risk Factors for New-Onset Depression After First-Time Traumatic Brain Injury. Psychosomatics 2018; 59(1), 47–57.
36. Dupre ME, Lopes RD. Marital History and Survival After Stroke. J Am Heart Assoc. 2016; 5(12): e004647.