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RESEARCH

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Associations between self-efficacy and health-related quality of life in haemorrhagic stroke survivors: a longitudinal study

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Abstract

Background The impact of recovery self-efficacy on health-related quality of life in haemorrhagic stroke survivors remains unclear. This longitudinal study examined this association through a one-year follow-up after discharge.

Methods A prospective, longitudinal design was conducted. A total of 184 haemorrhagic stroke survivors in a tertiary hospital in western China from January 2020 to December 2021 were recruited by the convenience sampling method. The three-level EuroQol five-dimension questionnaire (EQ-5D-3 L) and Stoke Self-efficacy Questionnaire (SSEQ) were assessed at four post-discharge time points: 1 month (T1), 3 months (T2), 6 months (T3), and 12 months (T4). The generalized estimating equation analysis was used to evaluate the associations between recovery self-efficacy and health-related quality of life.

Results The mean age of included participants were 54.0, with 65.2% of female. Generalized estimating equation analysis revealed significant interactions between time and SSEQ on EQ-5D-3 L ($p < 0.001$). The simple effects of time showed significant increases in EQ-5D-3 L scores from T3 to T4 in the low SSEQ group ($\beta = 0.113–0.203$, $p < 0.001$) and from T2 to T4 in the high SSEQ group ($\beta = 0.038–0.054$, $p < 0.05$). The simple effects of SSEQ showed that patients with higher SSEQ scores had significantly higher EQ-5D-3 L scores at T1 ($\beta = 0.187$, 95%CI: 0.132–0.242, $p < 0.001$), T2 ($\beta = 0.154$, 95%CI: 0.111–0.196, $p < 0.001$), and T3 ($\beta = 0.084$, 95%CI: 0.054–0.113, $p < 0.001$), but not at T4 ($p = 0.803$).

Conclusion Recovery self-efficacy significantly interacted with time in shaping haemorrhagic stroke survivors' health-related quality of life recovery. Higher self-efficacy was associated with earlier improvements, while lower self-efficacy was associated with delayed but larger improvements of health-related quality of life levels, with effects diminishing by one year after stroke.

Keywords Stroke, Generalized estimating equation, Longitudinal study, Self-efficacy

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Background

In 2019, there were 3.94 million newly reported stroke cases and 2.19 million stroke-related deaths in China, making stroke the third leading cause of death and the primary cause of disability-adjusted life years [1]. Haemorrhagic stroke, accounting for 53% of all stroke-related deaths, is devastating and, along with ischemic stroke, is a leading cause of long-term disability [1, 2]. While advancements in acute stroke treatment and nursing care have increased survival rates, survivors often face persistent physical, cognitive, and emotional impairments [3–5]. These challenges underscore the urgent need to address health-related quality of life (HRQoL) [6], defined as an individual's capacity to function and perceive well-being across physical, mental, and social domains [7].

Rehabilitation interventions targeting physical and neurological recovery, such as motor training and cognitive therapies, have demonstrated efficacy in improving body structure and physical function in stroke survivors [8–10]. However, their impact on societal reintegration and sustained improvement of HRQoL remains limited [11]. This discrepancy highlights a critical insight: psychosocial factors, rather than physical impairments alone, are important predictors of unfavourable HRQoL trajectories in stroke survivors [7]. Among these factors, self-efficacy, an individual's belief in their ability to achieve desired outcomes emerges as a pivotal psychological construct [12]. According to the Social Cognitive Theory, self-efficacy can directly influence health behaviours and adaptation processes, thereby shaping HRQoL. Self-efficacy derives from four main sources: performance mastery, vicarious experiences, verbal persuasion or encouragement, and emotional states [13]. These sources provide potential pathways to enhance recovery outcomes through cognitive, motivational, and emotional processes [11].

Several studies have investigated the relationship between self-efficacy and quality of life in stroke survivors. However, previous studies have predominantly focused on general or task-specific self-efficacy, such as confidence in performing exercises or maintaining balance [6, 14, 15]. For instance, Minshall, Ski [15] reported a moderate correlation ($r = 0.53$) between general self-efficacy and HRQoL, while Ogwumike, Omoregie [6] identified exercise self-efficacy as a predictor of HRQoL in outpatient stroke survivors. Despite their value for stroke recovery, these findings fail to capture recovery self-efficacy, which encompasses broader and specific beliefs in self-management and daily functional activities in stroke recovery [16]. In addition, stroke recovery is a dynamic and time-consuming process, while there is a limited understanding of the dynamic associations between recovery self-efficacy and the HRQoL.

Therefore, we aimed to addresses these gaps by examining the association between recovery self-efficacy and HRQoL in haemorrhagic stroke survivors across a one-year post-discharge period, to explore how recovery self-efficacy impacts HRQoL. The findings will inform targeted interventions to enhance psychosocial resilience, ultimately improving survivors' capacity to reintegrate into societal roles and sustain well-being.

Methods

Study design

This prospective longitudinal study was conducted from January 2020 to December 2022, with patient recruitment occurring between January 2020 and December 2021. Data were collected via telephone interviews at four standardized time points: 1 month (T1), 3 months (T2), 6 months (T3), and 12 months (T4) after discharge.

Setting and sampling

A convenience sampling method was used to recruit haemorrhagic stroke survivors who were consecutively admitted to the neurosurgery department of a tertiary hospital in western China. The inclusion criteria were: [1] first-ever haemorrhagic stroke diagnosed by CT/MRI [2], Glasgow Coma Scale score ≥ 9 [3, 17] discharged home, and [4] volunteered to participate in the study. The exclusion criteria were: [1] hearing or cognitive impairment (Mini-Mental State Examination < 24) [18], and [2] inability to communicate in Mandarin through the telephone.

The sample size was calculated using the Edland method for longitudinal linear mixed models, which was implemented in the *longpower* R package [19]. Based on previous results [20], we selected a minimal clinically important difference of 0.12 on the EQ-5D-3 L scale. The random slope variance and residual error variance were set to the square of 0.23. With a significance level (α) of 0.05 and a power (1-β) of 0.80, the minimum required sample size was calculated to be 139. Considering a 20% nonresponse rate, the final sample size was determined to be 167.

Measurement

The three-level EuroQol five-dimension questionnaire (EQ-5D-3 L) severed to evaluate the HRQoL. This scale consists of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is rated on a severity scale from 1 (no problem) to 3 (severe problem), resulting in a total of 243 possible health states [21]. Health outcomes are represented by a single index score ranging from 0 (death) to 1 (full health). This score is derived using the national value set for the Chinese population, established through the time trade-off method [22].

The Stoke Self-efficacy Questionnaire (SSEQ), which was developed by Jones, Partridge and Reid [23] and translated to the Chinese version by Li, Fang [24], was used to evaluate the recovery self-efficacy in stoke survivors. The Chinese version of SSEQ consists of two dimensions: self-efficacy in performing daily functional activities and self-management with 11 items. The total scores range from 0 to 110, with higher scores indicating higher self-efficacy. The Chinese version of SSEQ has good internal consistency with a Cronbach'α coefficient of 0.97.

The Chinese version of Barthel Index scale (BI), developed by Mahoney and Barthel [25] and translated by Hou, Zhang [26], was utilized to evaluate the basic activities of daily living. The scale consists of 10 items, with total scores ranging from 0 to 100, where higher scores indicate greater independence. The Chinese version of Barthel Index scale has good internal consistency with a Cronbach'α coefficient of 0.92.

Neurological impairment was assessed using the Chinese version of the Scandinavian Stroke Scale (SSS). This scale consists of nine items, with total scores ranging from 0 to 58. Higher scores indicate better neurological function. The Chinese version of SSS has demonstrated good internal consistency, with a Cronbach's α coefficient of 0.85 among Chinese haemorrhagic stroke survivors [2].

The Hospital Anxiety and Depression Scale (HADS) was used to evaluate the mental health status of the participants, as this scale is extensively used to assess anxiety and depression levels in both hospital and community settings. The HADS consists of two subscales: one for anxiety and one for depression, each containing 7 items. The total scores for each subscale are categorized as follows: no symptom (0–7), possible symptom [8–10], and probable symptom. The Chinese version of HADS was translated by and has good internal consistency with a Cronbach'α coefficient of 0.88 [27].

Data collection

Data were collected by a nursing specialist in neurosurgery who served as a research assistant. Stroke survivors who had discharge arrangements were continuously screened for eligibility and were informed of this study. For patients with physical limitation, their legal guardians signed the informed consents after obtaining the patients' authorization. Once written informed consent was obtained, the research assistant collected the sociodemographic data (including age, gender, marital status, and nationality) and clinical characteristics (such as emergency admission, haemorrhagic type, surgical treatment, and Glasgow Coma Scale (GCS) scores) from the Health Information System one or two days before discharge. Additionally, telephone numbers of stroke survivors and their caregivers were recorded to maintain contact whenever possible. At one month (T1), three months (T2), six months (T3), and one year (T4) after discharge, the research assistant evaluated the basic activities of daily living, HRQoL, anxiety and depression symptoms, neurological function, and recovery self-efficacy levels via telephone, with each assessment taking an average of 15 min. Patients/caregivers were allowed to choose interview times flexibly, avoiding post-stroke fatigue periods. If the research assistant was unable to contact the stroke survivors or their caregivers for three consecutive days, the event was recorded as lost to follow-up. All follow-up data were entered into an electronic follow-up system in real-time during the phone calls, which featured real-time logical checks and automated prompts for incomplete or inconsistent responses.

Data analysis

Continuous variables were described using either the mean ± standard deviation (SD) or the median together with the interquartile range (IQR), depending on the distribution of data. Friedman's two-way ANOVA test with multiple comparisons by all pairwise comparisons was conducted to analyse the differences of variables at different time points. The generalized estimating equation (GEE) analyses were used to evaluate the associations between recovery self-efficacy and the HRQoL, with an unstructured correlation structure. The interaction effects between time and recovery self-efficacy on the HRQoL were explored. Given the presence of significant interaction effects, we further examined the simple effects of time and recovery self-efficacy separately to understand their individual contributions to HRQoL. Age, gender, BI, HADS, and SSS were entered into GEE models as covariates. The goodness of fit was assessed by Quasi Likelihood under Independence Model Criterion (QIC). A two-tiled p value of < 0.05 was regarded as significance. All statistics were conducted in SPSS (V24.0, IBM Corp., Armonk, N.Y., USA).

Results

Baseline characteristics of included stroke survivors

Figure 1 displays the flow diagram of this study. A total of 172 patients completed the one-year follow-up, and 184 patients were included in the generalized estimate equation analysis (Fig. 1). The mean age of the stroke survivors was 54.0 and the majority (65.2%) were female. Most of the stroke survivors (88.0%) were subarachnoid haemorrhage. And 94.0% of the stroke survivors received surgical treatment (Table 1).

HRQoL and recovery status at each time point

Table 2 displays the HRQoL and recovery status at each time point. EQ-5D-3 L scores improved significantly over

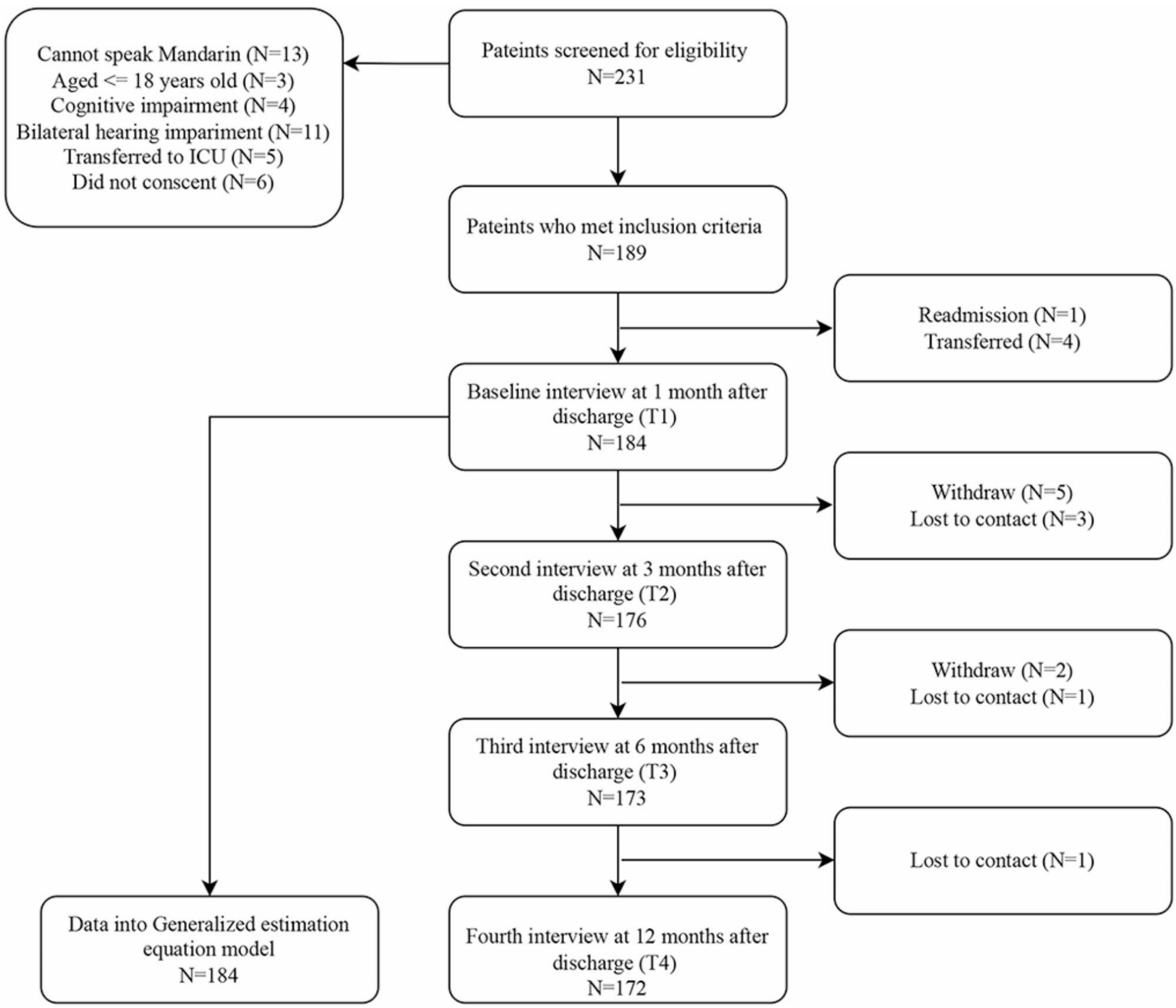

Fig. 1 Flow diagram of this study

time, with the largest gains between T1 (median = 0.87, IQR: 0.65-1) and T4 (median = 1, IQR: 1–1) ($p < 0.001$). SSEQ scores increased significantly from T1 (98, IQR: 84.25–107) to T4 (110, IQR: 108–110) ($p < 0.001$), while BI scores remained stable at 90 (IQR: 85–90 at T1; 90–90 at T2-T4). Neurological function, as measured by the Scandinavian Stroke Scale, improved significantly, with median scores increasing from 50 (IQR: 42–58) at T1 to 58 (IQR: 58–58) at T2-T4 ($p < 0.001$). For psychological status, HADS(A) scores increased from T1 (median = 1, IQR: 0–2) to T3 (median = 3, IQR: 2–5) ($p = 0.001$), then decreased by T4 (median = 2, IQR: 0–4), while HADS(D) scores followed a similar trend, peaking at T3 before improving to their lowest levels by T4. Figure 2 illustrates the temporal changes in these outcomes.

Simple effects of time on the HRQoL

The GEE analysis revealed significant interactions between time and SSEQ on EQ-5D-3 L ($p < 0.001$). Given these interactions, we further evaluated the simple effects of time and SSEQ on EQ-5D-3 L. The results indicated significant simple effects for both time and SSEQ ($p < 0.001$). In the low SSEQ group, patients exhibited significant increases in EQ-5D-3 L scores at T3 ($\beta = 0.113$, 95%CI: 0.068–0.158, $p < 0.001$) and T4 ($\beta = 0.203$, 95%CI: 0.159–0.248, $p < 0.001$) compared with T1. In the high SSEQ group, significant increases of EQ-5D-3 L were observed at T2 ($\beta = 0.046$, 95%CI: 0.012–0.081, $p = 0.009$), T3($\beta = 0.054$, 95%CI: 0.020–0.088, $p = 0.002$), and T4 ($\beta = 0.038$, 95% CI: 0.006–0.070, $p = 0.021$) compared with T1 (Table 3). The estimated marginal means of EQ-5D-3 L across different time points for both SSEQ groups are presented in Table S2, showing a significant

Table 1 Baseline characteristics of included patients ($N = 184$)

Variables	N (%) / Mean (SD)
Age	54.0 ± 11.1
18–44 years old	32 (17.4)
45–64 years old	113 (61.4)
≥ 65 years old	39 (21.2)
Gender	
Male	64 (34.8)
Female	120 (65.2)
Emergency admission	
Yes	159 (86.4)
No	25 (13.6)
Marital status	
Married	166 (90.2)
Single	18 (9.8)
Nation	
Han	171 (92.9)
Others	13 (7.1)
Haemorrhagic type	
SAH	162 (88.0)
ICH	22 (12.0)
Surgical treatment	
Yes	173 (94.0)
No	11 (6.0)
GCS	14.7 ± 0.9
9–12	29 (15.8)
13–14	38 (26.1)
15	107 (58.1)

SAH: subarachnoid haemorrhage; ICH: intracranial haemorrhage; GCS: Glasgow Coma Scale

increase of EQ-5D-3 L from T1 to T4 in the low SSEQ group and from T1 to T3 in the high SSEQ group ($p < 0.05$).

Simple effects of SSEQ on the HRQoL

Table 4 shows the simple effects of SSEQ on EQ-5D-3 L. Compared with patients with lower SSEQ scores, those with higher SSEQ scores exhibited significant increases in EQ-5D-3 L scores at T1 (β = 0.187, 95%CI: 0.132–0.242, $p < 0.001$), T2 (β = 0.154, 95%CI: 0.111–0.196, $p < 0.001$), and T3 (β = 0.084, 95%CI: 0.054–0.113, $p < 0.001$). No significant differences in EQ-5D-3 L scores were observed between the low and high SSEQ groups at T4 ($p = 0.803$). The estimated marginal means of EQ-5D-3 L across different SSEQ groups at each time point are presented in Table S3, indicating significant increases in EQ-5D-3 L scores in the high SSEQ group at T1, T2, and T3 ($p < 0.05$).

Discussion

This study found that haemorrhagic stroke survivors showed consistent improvements in daily living, neurological function, recovery self-efficacy, and HRQoL in the first year after discharge, with mental health status fluctuating. Recovery self-efficacy influenced HRQoL recovery, with higher baseline self-efficacy predicting earlier recovery and lower self-efficacy leading to delayed but comparable outcomes by one year, with effects diminishing by one year after discharge.

This study confirmed an improving trend in basic activities of daily living and neurological function in the first year after discharge, aligning with previous research [28, 29]. In haemorrhagic stroke survivors, physical and neurological functions gradually improve as symptoms such as cerebral edema and intracranial hypertension subside between two and six months post-stroke [30], explaining the slowed improvement after six months. However, functional recovery may not be permanent, with some studies showing deterioration over a long period [29]. For example, Meyer, Verheyden [31] reported that physical function returned to two-month post-stroke levels after five years. Thus, more research on long-term physical function attrition in haemorrhagic stroke is needed. As physical and neurological function improved, stroke survivors' self-efficacy and HRQoL increased. In this study, HADS(D) scores peaked at six months but decreased by one year, consistent with Aström [32] and De Wit, Putman [33], who reported depression incidence peaking at three or four months post-discharge and then declining. However, earlier studies have indicated a continuous decreasing trend of anxiety [34, 35], which contradicts the results of this study. Differences in stroke subtypes across studies may account for this discrepancy.

Table 2 Health-related quality of life and recovery status at each time point

Variables	T1 ($N = 185$)	T2 ($N = 176$)	T3 ($N = 173$)	T4 ($N = 172$)
BI	90 (85, 90)	90 (90, 90)	90 (90, 90)	90 (90, 90)
SSS	50 (42, 58)	58 (58, 58)	58 (58, 58)	58 (58, 58)
HADS				
HADS(A)	2 (0, 4)	3 (1, 4)	3 (2, 5)	2 (0, 4)
HADS(D)	1 (0, 2)	1 (1, 2)	2 (1, 2)	0 (0, 1.25)
SSEQ	98 (84.25, 107)	106 (100, 110)	108 (103.50, 110)	110 (108, 110)
EQ-5D-3L	0.87 (0.65, 1)	1 (0.87, 1)	1 (0.87, 1)	1 (1, 1)

T1: one month after discharge; T2: three months after discharge; T3: six months after discharge; T4: one year after discharge; BI: Barthel index; SSS: Scandinavian Stroke Scale; HADS: Hospital Anxiety and Depression Scale; SSEQ: Stroke Self-Efficacy Questionnaire; EQ-5D-3 L: the three-level EuroQol five-dimension questionnaire

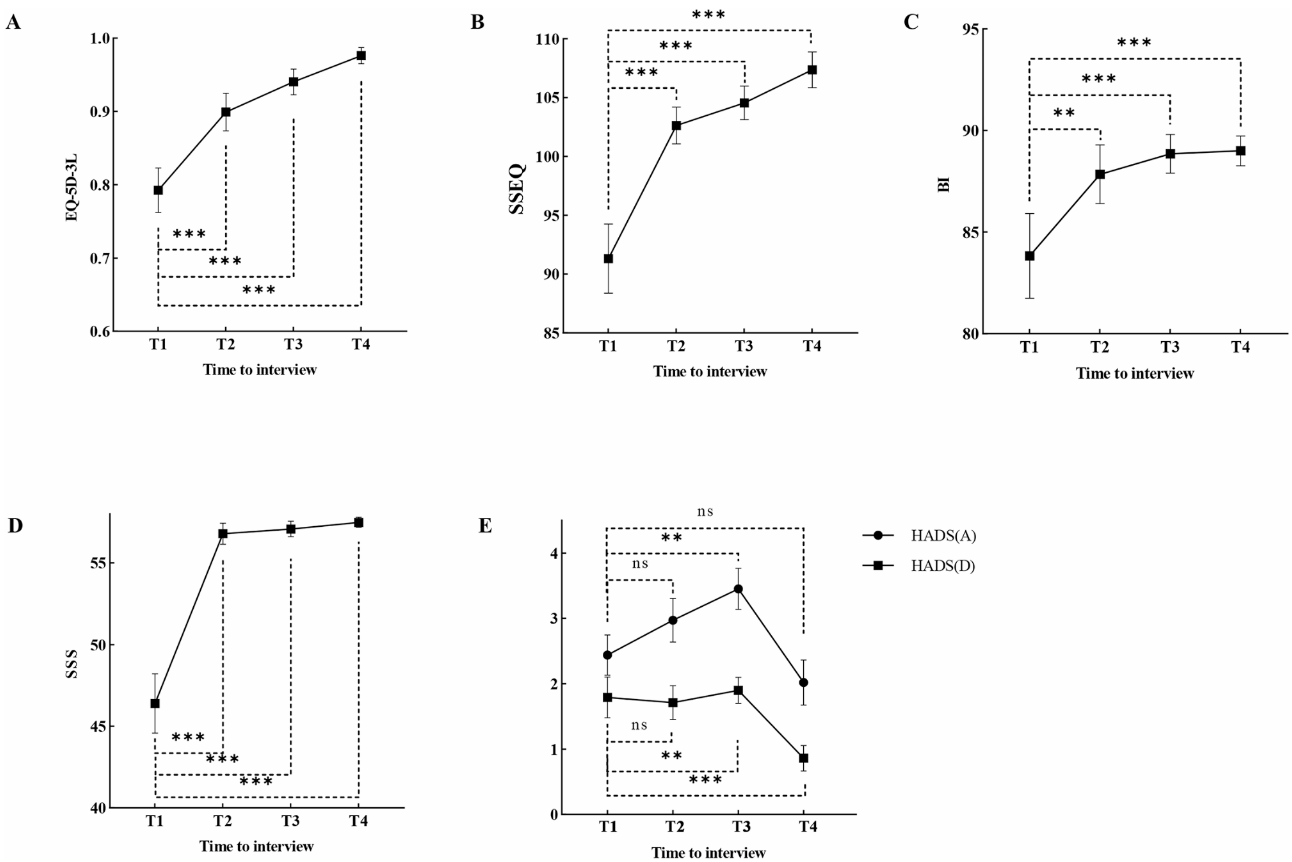

Fig. 2 Variables in different time points after discharge (**A**: EQ-5D-3 L; **B**: SSEQ; **C**: BI; **D**: SSS; **E**: HADS). T1: one month after discharge; T2: three months after discharge; T3: six months after discharge; T4: one year after discharge; BI: Barthel index; SSS: Scandinavian Stroke Scale; HADS: Hospital Anxiety and Depression Scale; SSEQ: Stroke Self-Efficacy Questionnaire; EQ-5D-3 L: the three-level EuroQol five-dimension questionnaire

This study revealed the temporal dynamics between recovery self-efficacy and HRQoL in haemorrhagic stroke survivors. Patients with high recovery self-efficacy demonstrated statistically significant improvements in HRQoL as early as 3 months post-discharge (T2, $\beta = 0.046$, $p = 0.009$). The robust association between baseline recovery self-efficacy and early HRQoL improvements underscores its role as a cognitive-motivational catalyst during acute recovery phases. This finding is consistent with Bandura's theory that strong self-efficacy enhances mental simulations of recovery success, thereby accelerating goal-directed rehabilitation behaviours [36–38]. This early advantage of high recovery self-efficacy level aligns with observations by French, Miller [39], where self-efficacy mediated the translation of physical capacity into functional participation, suggesting that belief-driven motivation optimizes stroke recovery. Notably, the delayed but substantial HRQoL improvements in low recovery self-efficacy patients at 12 months (T4, $\beta = 0.203$, $p < 0.001$) challenge conventional assumptions about recovery limitations. While initial cognitive and motivational deficits may restrict early progress, the magnitude of late-phase improvements suggests the existence of alternative recovery pathways. For example, gradual mastery experiences likely facilitated emotional recalibration, reducing anxiety and depression [40–42] and thereby lowering psychological barriers to sustained adherence of recovery plan. This compensatory growth pattern highlights the therapeutic potential of late-phase interventions targeting behavioural momentum to improve stroke recovery. The finding that low recovery self-efficacy patients ultimately surpassed their high-efficacy counterparts' improvement of HRQoL at 12 months (T4, $\beta = 0.203$ vs. 0.038) suggested that early psychological advantages may reach a "ceiling effect", while environmental adaptations in chronic phases can facilitate catch-up mechanisms. Additionally, the differences of HRQoL between low and high recovery self-efficacy group from statistically significant disparities at T1-T3 ($p < 0.001$) to nonsignificant at T4 ($p = 0.803$), indicating phase-dependent shifts in recovery mechanisms. During the acute and subacute phases of recovery, internal cognitive-emotional resources, such as recovery self-efficacy, are the primary drivers of HRQoL trajectories, as evidenced by the early HRQoL improvements observed in patients with high self-efficacy. However, in chronic

Table 3 Simple effects of time on EQ-5D-3 L by generalized estimating equation model

Variables	β	95% CI		*P* value
		Lower	Upper	
SSEQ-low				
Intercept	0.503	0.350	0.656	< 0.001
Time				
T1	-	-	-	-
T2	0.012	-0.029	0.052	0.567
T3	0.113	0.068	0.158	< 0.001
T4	0.203	0.159	0.248	< 0.001
Gender (female)	-0.033	-0.069	0.004	0.081
Age	-0.003	-0.005	-0.001	0.003
BI	0.005	0.003	0.007	< 0.001
SSS	0.001	-0.002	0.002	0.823
HADS_A	0.004	-0.005	0.013	0.419
HADS_D	-0.009	-0.019	0.001	0.088
SSEQ-high				
Intercept	1.006	0.942	1.070	< 0.001
Time				
T1	-	-	-	-
T2	0.046	0.012	0.081	0.009
T3	0.054	0.020	0.088	0.002
T4	0.038	0.006	0.070	0.021
Gender (female)	-0.005	-0.015	0.004	0.293
Age	0.001	-0.001	0.001	0.207
BI	0.001	-0.001	0.002	0.358
SSS	-0.001	-0.004	0.001	0.329
HADS_A	-0.010	-0.015	-0.006	< 0.001
HADS_D	-0.001	-0.010	0.007	0.792

T1: one month after discharge; T2: three months after discharge; T3: six months after discharge; T4: one year after discharge; BI: Barthel index; SSS: Scandinavian Stroke Scale; HADS: Hospital Anxiety and Depression Scale; SSEQ: Stroke Self-Efficacy Questionnaire; EQ-5D-3 L: the three-level EuroQol five-dimension questionnaire; SSEQ was divided into low and high group by median

Table 4 Simple effects of SSEQ on EQ-5D-3 L by generalized estimating equation model

Variables	β	95% CI		*P* value
		Lower	Upper	
Intercept	0.503	0.349	0.658	< 0.001
Time				
T1	-	-	-	-
T2	0.016	-0.026	0.058	0.455
T3	0.122	0.078	0.166	< 0.001
T4	0.198	0.156	0.241	< 0.001
Time-SSEQ				
T1-SSEQ (high vs low)	0.187	0.132	0.242	< 0.001
T2-SSEQ (high vs low)	0.154	0.111	0.196	< 0.001
T3-SSEQ (high vs low)	0.084	0.054	0.113	< 0.001
T4-SSEQ (high vs low)	-0.003	-0.025	0.020	0.803
Gender (female)	-0.021	-0.043	0.001	0.061
Age	-0.001	-0.003	0.000	0.006
BI	0.004	0.003	0.006	< 0.001
SSS	0.001	-0.002	0.002	0.734
HADS_A	0.001	-0.006	0.006	0.907
HADS_D	-0.008	-0.016	0.001	0.073

T1: one month after discharge; T2: three months after discharge; T3: six months after discharge; T4: one year after discharge; BI: Barthel index; SSS: Scandinavian Stroke Scale; HADS: Hospital Anxiety and Depression Scale; SSEQ: Stroke Self-Efficacy Questionnaire; EQ-5D-3 L: the three-level EuroQol five-dimension questionnaire; SSEQ was divided into low and high group by median

stages, external environmental supports, such as institutional and home-based care [43, 44], may compensate for initial psychological disparities, thereby diminishing the predictive power of recovery self-efficacy. In clinical practice, interventions should be adapted to the recovery phase, focusing on building internal resources like recovery self-efficacy in early stages and enhancing external supports in later stages to optimize recovery outcomes. Additionally, maintaining comprehensive support throughout the recovery process, recognizing the potential for late-phase improvements and avoiding premature pessimism about long-term outcomes are also important.

There were several limitations in this study. First, we only included haemorrhagic stroke survivors with GCS scores of nine or above to ensure the feasibility of telephone follow-up. However, this may have excluded stroke survivors with more severe neurological, physical, and mental impairments, potentially introducing biases into the results. Second, the sample was from western China, where the level of medical resources and techniques are poor compared to eastern parts of the country, thus limiting the generalization of the results. Third, other psychosocial factors, such as social support, may also contribute to HRQoL trajectories. Future studies could propose integrative models that incorporate multiple psychosocial factors to examine their impacts on HRQoL in stroke survivors. Despite these limitations, our study highlighted that recovery self-efficacy serves not as a static predictor but as a dynamic agent across stroke rehabilitation phases, potentially mediated through cognitive, emotional, and environmental pathways. Future research should explore how targeted efficacy-enhancing interventions might amplify both early and late-phase recovery trajectories.

Conclusion

This study found that recovery self-efficacy significantly influenced the temporal trajectory HRQoL recovery in haemorrhagic stroke survivors. Higher baseline recovery self-efficacy was associated with earlier improvements in HRQoL, while lower recovery self-efficacy was related to delayed but comparable recovery. This suggests differential yet converging recovery pathways among stroke survivors. The diminishing effects of recovery self-efficacy one year after stroke indicated that its influence was most pronounced during the acute and subacute recovery phases. Considering baseline recovery self-efficacy levels when designing personalized rehabilitation programs, especially within the first year after stroke, was essential.

Future research should investigate the mechanisms underlying these temporal patterns and explore targeted interventions to optimize recovery trajectories across different self-efficacy subgroups.

Abbreviations

CT	Computed Tomography
MRI	Magnetic Resonance Imaging
EQ-5D-3L	three-level EuroQol five-dimension questionnaire
SSEQ	Stoke Self-efficacy Questionnaire
BI	Barthel Index
SSS	Scandinavian Stroke Scale
HADS	Hospital Anxiety and Depression Scale
GCS	Glasgow Coma Scale
IQR	interquartile range
SD	Standard deviation
GEE	Generalized estimating equation
QIC	Quasi Likelihood under Independence Model Criterion

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22655-x.

Supplementary Material 1

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Author contributions
WZ, CW, and CF conceived and designed the study. QY and BZ collected data. WZ and CW analysed data. WZ and CF drafted the paper and other authors provided constructive suggestions and edited the paper. All authors have seen and approved the final version of the paper.

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Data availability
The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study adhered to the declaration of Helsinki. Informed consent was obtained from all the participants. All data were kept anonymous and used in this study only. This study had been approved by the ethic committee of West China Hospital, Sichuan University (IRB: 2019 – 1167).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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