

# Predictors of Health-Related Quality of Life in Stroke Survivors After Inpatient rehabilitation

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## Research article

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# Abstract

**Background.** Disordered and decreased quality of life is the most important consequence of stroke for stroke survivors. The aim of the study was to determine the predictors of the health-related quality of life (HRQOL) in stroke survivors six months after discharge from inpatient rehabilitation.

**Methods.** We conducted prospective cohort study which involved 136 (48.5% males and 51.5% females) survivors. We examined seven potential predictors of HRQOL: age, sex, stroke type, stroke side, functional status (Barthel Index-BI and modified Rankin Scale-mRS), cognition (Mini-Mental State Examination; MMSE) and stroke severity (National Institutes of Health Stroke Scale; NIHSS). HRQOL was assessed by Stroke Impact Scale (SIS) 3.0. Using Pearson's correlation and multiple logistic regression analysis we described the relationships between mRS, NIHSS, BI, MMSE and HRQOL.

**Results.** Baseline mRS and NIHSS scores negatively correlated with seven SIS domains except with strength. Baseline BI scores positively correlated with seven SIS domains except mobility and baseline MMSE scores positive correlated with memory, ADL, hand function and participation role and negatively correlated with emotion, communication and mobility domains. Decrease of both mRS and NIHSS scores during the observed period positively correlated with increase of all SIS domains. Ischaemic stroke positively correlated with emotion and communication and stroke in brainstem negatively correlated with communication domain. Memory domain positively correlated with female sex and with stroke in the right hemisphere. Age wasn't significantly associated with any SIS domain.

**Conclusion.** We conclude that major factors in predicting the improvement of strength, physical functioning, mobility, hand function, ADL and participation role were increase of BI and decrease of mRS and NIHSS scores. Female sex, stroke in right hemisphere and increase of BI and MMSE scores predicted better memory. Baseline mRS and NIHSS scores were predictors for improvement of hand function and increase of mRS predicted decrease of hand function and participation role.

**Key words:** stroke, survivors, health-related quality of life, inpatient rehabilitation

## Background

Stroke is one of most devastating neurological diseases and one of the leading causes of significant disability [1]. The World Health Organization (WHO) defines stroke as a focal or global neurological impairment of sudden onset, lasting more than 24 hours or leading to death of presumed vascular origin [2].

Stroke is the second cause of death worldwide and 87% of recorded deaths occur in low- and middle-income countries [3]. Stroke mortality declined in high-income countries like the United States of America (USA) [4,5] and today stroke is on the fourth place as cause of death in the USA [6,7].

More than one third, out of 15 million people who suffered from stroke every year worldwide, will die and about 30% of stroke survivors will be significantly disabled [8,9]. Both physical and mental disabilities are common after stroke but the cognitive impairments are very often unrecognized despite of their high prevalence which ranged from 20% to 80% [10]. While physical disabilities tend to improve during the time cognitive impairments are progressively worsening [10,11].

Impaired and decreased quality of life is the most important consequence of stroke for stroke survivors (12). Health-Related Quality of Life [HRQOL] is a broad, multidimensional concept referring to those aspects of people's lives that reasonably relate to their health [13].

Age, sex, socioeconomic status, stroke severity, motor impairments and depression are some of factors associated with poor HRQOL in stroke survivors [14-16]. Static and dynamic balance ability, cognition function, motor function, neurological deficit, stroke side and stroke type may influence on the total HRQOL or on some domains such as strength, memory, hand function, emotions, activity of daily living (ADL) [17,18].

Assessment of the HRQOL is important measure of stroke treatment and rehabilitation efficacy [19]. It is assessed that only 10% of survivors make a full recovery, about 25% of all survivors recover with minor impairments and about 40% all survivors continue to live with moderate disabilities, while 15 to 30% live with severe disabilities and are full dependent [20]. About 25% of survivors need additional treatment and rehabilitation in specialized institutions [21].

The aim of the study was to determine the potential predictors of the HRQOL in stroke survivors six months after discharge from inpatient rehabilitation.

## Methods

We carried out prospective cohort study which involved at first 216 survivors. Out of all of them 11 dropped out, 9 died, 60 didn't go to inpatient rehabilitation. Finally, cohort included 136 stroke survivors aged 40-79 years of age from the territory of the Southeastern Serbia. All stroke survivors had inpatient rehabilitation in tertiary health institutions in the period of 30 days at Clinic for Physical Medicine and Rehabilitation, of the Clinical Centre Niš, Serbia, followed by prolonged rehabilitation in spa conditions for 30 days under medical control.

In Serbia, most stroke survivors with functional deficit after acute treatment in intensive care units (ICU) are offered 14 to 30 days of inpatient rehabilitation. Rehabilitation begins in the ICU when patient state is stable and after discharged majority of survivors from the territory of the Southeastern Serbia continue rehabilitation at the Clinic for Physical Medicine and Rehabilitation, of the Clinical Centre Niš.

**The inclusion criteria** were: the first-ever stroke, the age from 40 to 79 years, possible communication with all participants and the written consent of all participants to participate in the study.

**The excluding criteria** were: previously experienced stroke, pre-stroke cognitive impairments, insufficient cooperation of patients, psycho-organic syndrome, aphasia, transient ischaemic attack (TIA), new stroke within 90 days of the first stroke, complications after stroke, the death of the participant.

The study took place from 1 April 2012 to 1 April 2016. The first assessments (baseline) were done at the admission to the Clinic for Rehabilitation and Physical Medicine and included functional status, cognitive function, neurological status and HRQOL. Data about survivors and stroke-related clinical characteristics were collected too. The second assessments were done six months after discharged from rehabilitation.

## Functional status

Functional status was assessed with Barthel Index (BI) and by the modified Rankin scale (mRS).

BI measures the patient's performance in 10 activities of Activities of Daily Living (ADL), a group of questions that is related to self-care (feeding, grooming, bathing, dressing, bowel and bladder care, and toilet use) and a group related to mobility (ambulation, transfers, and stair climbing). The maximal score for BI is 100 indicating that the patient is fully independent in physical functioning. The lowest score is 0, representing a totally dependent bedridden state [22].

The modified Rankin scale (mRS) [23] is regarded as a global stroke scale scoring patients' daily functioning from 0 (no symptoms) to 5 (severe disability, bedridden, in need of constant care) or 6 (death). Higher points indicate a severe disability.

## Cognitive function assessment

Cognitive function was assessed by the Mini Mental State Examination (MMSE). MMSE is considered as a useful measure for the assessment of cognitive decline in stroke survivors [24]. This scale examines orientation, memorizing, attention and calculation, delayed memory, speaking, reading, writing and drawing. The maximum score is 30, and a score of less than 24 points indicates the cognitive impairments.

## The National Institutes of Health Stroke Scale

Neurological impairments were assessed by the National Institutes of Health Stroke Scale (NIHSS). This scale is consisted of 15 items for evaluation of size and location of stroke in the acute phase and as measure of neurological handicap. Total scores range from 0 to 42 and higher scores indicate greater stroke severity [25].

## The Stroke Impact Scale

The Stroke Impact Scale (SIS) is a stroke-specific and self-reported questionnaire which consists of 59 items measuring eight domains (strength, hand function, activities of daily living/instrumental activities of daily living, mobility, communication, emotion, memory and thinking, and participation role). Each domain of SIS has a range of 0–100 and higher scores indicated better HRQOL [26].

## The statistical analysis

All the calculations were done into the SPSS software package version 18.0 and S-PLAS programme, version 2000. Student's t-test was used to compare numerical differences of normal distribution and the Mann-Whitney U test was used to compare two values when there were not normally distributed. Chi squared test and Fisher's test of exact probability were used too.

The Pearson's correlation analysis was calculated for the association among the continuous variables (age, BI, mRS, MMSE, NIHSS). Effects of independent variables (for continuous variables) on the dependent variable (SIS domains) were assessed by multivariate stepwise linear regression analysis. Regression coefficient (B) and the 95% confidence intervals (95%CI for B) were calculated too. Statistical significance was accepted when the corresponding p-values was less than 0.05 ( $p < 0.05$ ).

## Results

The total of 136 (48.5% males and 51.5% females) stroke survivors participated in the study. The average age of participants was  $63.72 \pm 8.73$ .

Table 1. Basic demographic and clinical characteristics of the study population

Table 1  
Basic demographic and clinical characteristics of the study population

Characteristic		n	(%)
Age ± SD 63.72 ± 8.73			
Sex	Men	66	48.5
	Women	70	51.5
Stroke type	Ischaemic	105	77.2
	Hemorrhagic	31	22.8
Stroke side	Left hemisphere	62	45.6
	Right hemisphere	60	44.1
	Both hemispheres	4	2.9
	Brainstem	2	1.5
	Infratentorially	2	1.5
	Other stroke localizations	6	4.4

There were more women than men 51.5%:48.5% and there were more survivors with ischaemic stroke (77.2%:22.8%) than with hemorrhage. Determined differences were not significant (Chi square, Fisher's test:  $p > 0.05$ ).

The most common localization of stroke was the left hemisphere (45.6%), followed by the right hemisphere (44.1%). Stroke localizations in both hemispheres accounted for 2.9%, stroke in brainstem represented 1.5% and infratentorially localized stroke accounted for 1.5%. Other stroke localizations represented 4.4% of all strokes.

Table 2 presents the average scores of SIS domains at admission to inpatient rehabilitation and six months after discharge

Table 2

The average scores of SIS domains at admission to inpatient rehabilitation and six months after discharge

	<b>Average scores</b>	<b>Average scores</b>
SIS domains	at admission	six months after inpatient rehabilitation
Strength	24.82 ± 21.46	69.67 ± 27.43
Memory	49.72 ± 28.18	80.88 ± 23.16
Emotion	49.39 ± 12.51	58.82 ± 9.83
Communication	65.49 ± 28.77	91.02 ± 18.74
ADL	9.34 ± 14.77	60.82 ± 31.88
Mobility	10.81 ± 18.64	69.96 ± 28.13
Hand function	2.87 ± 13.75	45.51 ± 41.60
Participation role	2.98 ± 9.60	38.44 ± 34.11

Baseline average scores of hand function, mobility, strength, ADL and participation role domains were the most decreased at the admission to inpatient rehabilitation. The highest average scores were found in communication, memory and emotion domains. Significant increase of all eight domains was determined six months after discharge from inpatient rehabilitation.

Table 3 presents Pearson's correlation coefficients of the examined possible predictors and the scores of SIS domains.

Table 3

Relationships between the potential predictors of HRQOL and the SIS domains in stroke survivors:  
results of correlation analysis

Variables		B constant	95% CI		p	
Dependent variables	Independent Variables		Lower limit	Upper limit		
Strength	Constant	-12.995	-22.493	-3.497	0.008	
	BI	0.603	0.491	0.716	< 0.001	
	NIHSS	-1.587	-2.254	-0.921	< 0.001	
Memory	Constant	-45.249	-65.580	-24.919	< 0.001	
	Female gender	6.025	1.659	10.391	0.007	
	Left hemisfere	11.456	6.833	16.078	< 0.001	
	mRS	-4.494	-7.236	-1.752	0.001	
	BI	0.208	0.094	0.321	< 0.001	
Emotion	MMSE	1.979	1.139	2.818	< 0.001	
	Constant	1.024	-2.263	4.311	0.540	
	BI	0.149	0.095	0.203	< 0.001	
	Communication	Constant	4.772	-5.886	15.431	0.378
		BI	-0.259	-0.386	-0.133	< 0.001
MMSE		0.741	0.088	1.394	0,026	
NIHSS		3.081	1.829	4.332	< 0.001	
ADL	Constant	15.759	-19.279	50.798	0.376	
	mRS	-10.097	-13.290	-6.905	< 0.001	
	BI	0.531	0.325	0.738	< 0.001	
	MMSE	0.396	0.004	0.787	0.047	
Mobility	Constant	-115.064	-151.964	-78.164	< 0.001	
	mRS	11.067	4.791	17.343	0.001	
	BI	0.985	0.818	1.153	< 0.001	
	MMSE	1.172	0.413	1.931	0.003	
	NIHSS	-1.541	-2.188	-0.894	< 0.001	

Variables		B constant	95% CI		p
Dependent variables	Independent Variables		Lower limit	Upper limit	
Hand function	Constant	89.459	56.541	122.378	< 0.001
	mRS	-16.381	-24.330	-8.431	< 0.001
	NIHSS	-4.245	-5.988	-2.502	< 0.001
Participation Role	Constant	110.731	80.309	141.152	< 0.001
	mRS	-29.573	-35.012	-24.133	< 0.001
	MMSE	0.808	0.292	1.324	0.002
* P<0.05; † P<0.01					

Correlation between examined predictors (age, sex, stroke side, stroke type, mRS, BI, MMSE and NIHSS) with each of the SIS domains is shown in Table 3.

Baseline mRS was negatively correlated with seven SIS domains except with strength. Similar findings were observed for NIHSS scores. Baseline BI scores positively correlated with seven SIS domains except mobility and baseline MMSE scores significantly positive correlated with memory, ADL, hand function and participation role and negatively correlated with emotion, communication and mobility domains.

Six months after discharge, decreased of both mRS and NIHSS scores were significantly correlated with increase of all SIS domains. Significantly positive correlation was determined between memory domain and female sex and with stroke in right hemisphere. Memory domain significantly positive correlated with decrease of mRS and NIHSS scores during the study and negatively correlated with stroke in left hemisphere. There was a significant positive correlation between memory domain and increase of MMSE scores.

Emotion domain significantly positive correlated with stroke type, infratentorially stroke, increase of BI and MMSE scores and significant decrease of mRS during the study.

Significantly positive correlation was found between communication and stroke type and increase of BI and MMSE scores and with significant decrease of NIHSS scores. Communication domain was significantly negative correlated with stroke in brainstem.

A significantly positive correlation was determined between ADL and mobility domain, hand function, participation role with decrease of mRS and NIHSS scores during the study. Increase of BI and MMSE scores significantly positive correlated with ADL and mobility and decrease of mRS and increase of BI scores significantly positive correlated with hand function. There was a significant positive correlation between hand function and stroke in brainstem. Increase of mRS and NIHSS significantly negative correlated with participation role.

Table 4 presents relationships between the possible predictors and the SIS domains of stroke survivors six months after discharge from rehabilitation

Table 4

Factors affecting the SIS domains of HRQOL: results of multivariate logistic regression analysis

Variables		B constant	95% CI		p
Dependent variables	Independent Variables		Lower limit	Upper limit	
Strength	Constant	-12.995	-22.493	-3.497	0.008
	BI	0.603	0.491	0.716	< 0.001
	NIHSS	-1.587	-2.254	-0.921	< 0.001
Memory	Constant	-45.249	-65.580	-24.919	< 0.001
	Female sex	6.025	1.659	10.391	0.007
	Right hemisfere	11.456	6.833	16.078	< 0.001
	mRS	-4.494	-7.236	-1.752	0.001
	BI	0.208	0.094	0.321	< 0.001
	MMSE	1.979	1.139	2.818	< 0.001
Emotion	Constant	1.024	-2.263	4.311	0.540
	BI	0.149	0.095	0.203	< 0.001
Communication	Constant	4.772	-5.886	15.431	0.378
	BI	-0.259	-0.386	-0.133	< 0.001
	MMSE	0.741	0.088	1.394	0,026
	NIHSS	3.081	1.829	4.332	< 0.001
ADL	Constant	15.759	-19.279	50.798	0.376
	mRS	-10.097	-13.290	-6.905	< 0.001
	BI	0.531	0.325	0.738	< 0.001
	MMSE	0.396	0.004	0.787	0.047
Mobility	Constant	-115.064	-151.964	-78.164	< 0.001
	mRS	11.067	4.791	17.343	0.001
	BI	0.985	0.818	1.153	< 0.001
	MMSE	1.172	0.413	1.931	0.003
	NIHSS	-1.541	-2.188	-0.894	< 0.001
Hand function	Constant	89.459	56.541	122.378	< 0.001

Variables		B constant	95% CI		p
Dependent variables	Independent Variables		Lower limit	Upper limit	
	mRS	-16.381	-24.330	-8.431	< 0.001
	NIHSS	-4.245	-5.988	-2.502	< 0.001
Participation Role	Constant	110.731	80.309	141.152	< 0.001
	mRS	-29.573	-35.012	-24.133	< 0.001
	MMSE	0.808	0.292	1.324	0.002

Major factors in predicting the improvement of strength domain were BI and NIHSS scores. Increase of BI score (95% CI: 0.491 to 0.716;  $p < 0.001$ ) was associated with significant increase of strength and increase of NIHSS score was associated with significant decrease of strength domain (95% CI: -2.254 to -0.921;  $p < 0.001$ ).

Factors associated with improvement of memory domain were: female sex, stroke in right hemisphere, increase of BI scores (95% CI: 0.094 to 0.321;  $p < 0.001$ ). The increase of memory domain during the study was significantly higher in women than in men (95% CI: 1.659 to 10.391;  $p = 0.007$ ). Increase of memory domain was significantly higher if stroke was in right hemisphere (95% CI: 6.833 to 16.078;  $p < 0.001$ ).

Increase of BI (95% CI: 0.095 to 0.203;  $p < 0.001$ ) during the study was significantly associated with increase of emotion domain.

The most important factors associated with communication domain were: baseline BI (95% CI: -0.386 to -0.133;  $p < 0.001$ ) and NIHSS scores (95% CI: 1.829 to 4.332;  $p < 0.001$ ) and increase of MMSE (95% CI: 0.088 to 1.394;  $p = 0.026$ ) during the study period.

The most important factors associated with ADL domain were baseline BI (95% CI: 0.325 to 0.738;  $p < 0.001$ ) and MMSE scores (95% CI: 0.004 to 0.787;  $p = 0.047$ ). Increase of BI (95% CI: 0.752 to 1.091;  $p < 0.001$ ) was associated with significant increase of ADL and increase of mRS (95% CI: -13.290 to -6.905;  $p < 0.001$ ) was associated with significant decrease of ADL domain.

The possible predictors of the mobility domain were baseline mRS (95% CI: 4.791 to 17.343;  $p = 0.001$ ). Increase of BI (95% CI: 0.818 to 1.153;  $p < 0.001$ ) and MMSE scores (95% CI: 0.413 to 1.931;  $p = 0.003$ ), were significantly positive associated with increase of mobility domain. But, increase of mRS (95% CI: -9.424 to -3.017;  $p < 0.001$ ) and NIHSS scores (95% CI: -2.188 to -0.894;  $p < 0.001$ ) were significantly associated with decreased of mobility.

Baseline value of mRS (95% CI: -24.580 to -18.262;  $p < 0.001$ ) was important predictor for physical functioning and increase of mRS (95% CI: -25.125 to -12.628;  $p < 0.001$ ) was associated with significantly

decreased of physical functioning.

The most important predictors for improvement of hand function were baseline mRS and NIHSS scores and increase of the mRS during the study.

The most important factor predicting decreased of participation role was increase of mRS (95% CI: -35.012 to -24.133;  $p < 0.001$ ).

## Discussion

We found that stroke survivors were significantly disabled with decreased of all eight domains of HRQOL when they were admitted to the inpatient rehabilitation. Hand function, physical functioning, mobility and ADL domains were the most affected.

According to the presented results, baseline mRS and NIHSS scores were significantly negatively correlated with HRQOL. Decreasing of mRS and NIHSS scores during the six months were positively correlated with the recovery of all affected domains, especially with the recovery of physical functioning, hand function and participation role.

Recovery of physical function in our study had great impact on the improvement of all other domains of HRQOL such as emotion, communication, ADL and participation role. Numminen et al. [27] found that despite of good physical recovery stroke survivors reported some impairments in HRQOL six months after the stroke.

In our study improvement of hand function significantly influenced on the overall HRQOL of survivors. In the study of Carod-Artal et al. [19], NIHSS, BI and mRS were the main predictors for the recovery of strength domain, the MMSE was the main predictor for the memory and communication domains, BI and mRS were predictors for the ADL and hand function domains. Our results are partially in agreement with these findings.

In our study, factors that significantly correlated with lower HRQOL scores were greater stroke severity, physical disability and hand dysfunction. Our findings are in agreement with the findings of Numminen et al. [27], Alguren et al. [28], Pinkey et al. [29] and Yeoh et al. [30].

Stroke severity, dependence in ADL, degree of handicap, and length of hospitalization were important factors associated with worsen quality of life in stroke survivors after thromolytic therapy [27]. Findings of Alguren et al. [28] showed the predictability of baseline NIHSS score for HRQOL in the chronic phase. Greater stroke severity measured by NIHSS at admission was predictor of worsen HRQOL [29]. Our results are in agreement with results of these studies.

Study of Rønning and Stavem [33] showed that neither age, sex, comorbidity, nor baseline disability was an important determinant of change in HRQOL from one to six months following acute stroke. Only

baseline scores in SF-36 questionnaire were associated with changes in HRQOL from one month to six months after stroke.

In our study age was not associated with any SIS domain six months after discharge from the inpatient rehabilitation. One more study didn't find any association between age and sex and HRQOL in stroke survivors [21]. Pinkey et al. [29] found insignificant association between older age and worsen HRQOL in stroke survivors. Gurcay et al. [16] found that age and functional status were the most important independent factors which were associated with HRQOL.

We found that female sex with stroke in right hemisphere and increase of BI scores during the six months was predictor for improvement of memory domain. In our study right hemisphere stroke predicted lower emotion domain in survivors six months after discharged from inpatient rehabilitation. Chen et al. [21] showed similar findings. Yeoh et al. [30] showed that stroke side only had impact on the motoric functions, but not on the emotional domain of HRQOL.

Different results presented Hopman et al. [34]. They found that the left hemisphere stroke predicted worse emotional functioning even six months of follow-up. Study of de Haan et al. [35] showed that locations of stroke and stroke types did not affect emotional domain of quality of life.

In our study communication domain was significantly negative correlated with stroke in the brainstem. The brainstem stroke can result in loss of motor function and with appearance of other symptoms such as ataxia, double vision, vertigo, and dizziness, difficulty swallowing, speech deficits, numbness, and even paralysis of one side of the body or both.

Niemi et al. [31] found that patients with either a right or left hemisphere stroke had more frequently evidenced deterioration of quality of life than patients with no brainstem lesions. One study showed worse quality of life in patients with left hemispheric stroke [32].

Survivors in our study with ischaemic stroke had significantly higher scores in memory, communication and hand domains compared with those with hemorrhage. Chen et al. [21] showed similar results.

Recovery of hand function wasn't significant until six months after the inpatient rehabilitation and recovery of this domain significantly increases the overall HRQOL of stroke survivors in our study. Morris et al. found that impairment of hand function and ADL independence predicted perceived physical activity [17]. According to the results of Nichols-Larsenet al. [36] worsen HRQOL in the physical domain was associated with age, more comorbidities and reduced hand function.

## Conclusion

According to presented results, major factors in predicting the improvement of strength, physical functioning, mobility, hand function, ADL and participation role were increase of BI and decrease of mRS and NIHSS scores. Female sex, stroke in right hemisphere and increase of BI and MMSE scores predicted

better memory. Baseline mRS and NIHSS scores were predictors for improvement of hand function and increase of the mRS predicted decrease of hand function and participation role.

## Abbreviations

WHO-The World Health Organization

USA-the United States of America

HRQOL-Health-Related Quality of Life

CI-confidence interval

BI- Barthel Index

mRS- modified Rankin Scale

MMSE- Mini-Mental State Examination;

NIHSS- National Institutes of Health Stroke Scale

SIS-Stroke Impact Scale

SF-36-Short Form health survey questionnaire

ADL-activity of daily living

TIA-transient ischaemic attack

## Declarations

**Ethics approval and consent to participate:** The study was approved by the Ethics Committee of the Medical Faculty in Niš, Serbia, number of Decision: 01-206-8. Also, permission to conduct this study gave the Ethics Committee of the Clinical Center of Niš, Serbia, number of Decision: 2280/12.

We require from all participants the written consent to participate in the study. It was one of condition to involve them to the study.

**Consent for publication:** “Not applicable”

**Availability of data and materials:** The datasets generated and analysed during the current study are not publicly available due [content data from medical histories of participants] but are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Author contributions:**

1. RN-create the study design, distributed the questionnaires to the participants formed data base for statistical analysis, wrote the manuscript, act as corresponding author
2. MM-helped in distribution of questionnaires to the participants, collected data from the survivors, did the clinical examination
3. BD-did all statistical analysis
4. KB- substantively revised the manuscript
5. LK- approved the submitted version

All authors have read and approved the final manuscript.

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