PLOS ONE

Health related quality of life and satisfaction with care of stroke patients in Budapest: A substudy of the EuroHOPE project

Ildikó Szőcs[1,2]*, Balázs Dobi[2,3], Judit Lám[4], Károly Orbán-Kis[5], Unto Häkkinen[6], Éva Belicza[4], Dániel Bereczki[1,2], Ildikó Vastagh[1,7]

1 Department of Neurology, Semmelweis University, Budapest, Hungary, 2 MTA-SE Neuroepidemiological Research Group, Budapest, Hungary, 3 Department of Probability Theory and Statistics, Eötvös Loránd University, Budapest, Hungary, 4 Health Services Management Training Centre, Semmelweis University, Budapest, Hungary, 5 Department of Physiology, University of Medicine and Pharmacy of Tirgu-Mures, Targu-Mures, Romania, 6 Finnish Institute for Health and Welfare, Helsinki, Finland, 7 Department of Neurology, Bajcsy-Zsilinszky Hospital, Budapest, Hungary

* szocsiko@gmail.com

Abstract

Background

Disadvantaged socioeconomic status is associated with higher stroke incidence and mortality, and higher readmission rate. We aimed to assess the effect of socioeconomic factors on case fatality, health related quality of life (HRQoL), and satisfaction with care of stroke survivors in the framework of the European Health Care Outcomes, Performance and Efficiency (EuroHOPE) study in Hungary, one of the leading countries regarding stroke mortality.

Methods

We evaluated 200 consecutive patients admitted for first-ever ischemic stroke in a single center and performed a follow-up at 3 months after stroke. We recorded pre- and post-stroke socioeconomic factors, and assessed case fatality, HRQoL and patient satisfaction with the care received. Stroke severity at onset was scored by the National Institutes of Health Stroke scale (NIHSS), disability at discharge from acute care was evaluated by the modified Rankin Score (mRS). To evaluate HRQoL and patient satisfaction with care we used the EQ-5D-5L, 15D and EORTC IN PATSAT 32 questionnaires.

Results

At 3 months after stroke the odds of death was significantly increased by stroke severity (NIHSS, OR = 1.209, 95%CI: 1.125–1.299, p<0.001) and age (OR = 1.045, 95%CI: 1.003–1.089, p = 0.038). In a multiple linear regression model, independent predictors of HRQoL were age, disability at discharge, satisfaction with care, type of social dwelling after stroke, length of acute hospital stay and rehospitalization. Satisfaction with care was influenced negatively by stroke severity (Coef. = -1.111, 95%C.I.: -2.159- -0.062, p = 0.040), and positively by having had thrombolysis (Coef. = 25.635, 95%C.I.: 5.212–46.058, p = 0.016) and better HRQoL (Coef. = 22.858, 95%C.I.: 6.007–39.708, p = 0.009).

Conclusion

In addition to age, disability, and satisfaction with care, length of hospital stay and type of social dwelling after stroke also predicted HRQoL. Long-term outcome after stroke could be improved by reducing time spent in hospital, i.e. by developing home care rehabilitation facilities thus reducing the need for readmission to inpatient care.

Introduction

Stroke has a major impact on the quality of life of patients [1, 2], with considerable differences between populations with various socioeconomic background [3]. People of lower socioeconomic status show higher stroke incidence and mortality, higher severity in the acute phase, higher readmission rate to hospital and lose more disability-adjusted life-years [4–7]. Disparities in clinical or behavioral risk factors or differential access to healthcare facilities do not completely explain regional differences in stroke incidence and outcome [8–12].

The impact of differences in social background on post-stroke health-related quality of life (HRQoL) has not been sufficiently evaluated in Central-Eastern European countries. Although there are some data on the consequences of social inequalities on stroke features among neighborhoods within the capital city of Hungary [13], reports evaluating HRQoL data after stroke are scarce from Central-Eastern European countries [14].

The European Health Care Outcomes, Performance and Efficiency (EuroHOPE) project compared health system performance in 6 European countries (Italy, Finland, Sweden, Scotland, the Netherlands and Hungary) [15], evaluating stroke, acute myocardial infarction, hip fracture, breast cancer, and low-birth-weight. In the EuroHOPE study Hungary had the highest stroke incidence, the largest all-cause case fatality 1 year after stroke and the largest regional differences [16, 17].

To improve long-term outcome after stroke, it would be of major importance to identify social groups and features of post-stroke care that are associated with fatality or reduced HRQoL. We previously found worse stroke outcome in patients residing in the poorest district of Budapest compared to those of the wealthiest neighborhood [18, 19], and also found that the lower the annual taxable income, the lower the age at stroke onset in the 23 districts of Budapest [13].

The aim of the present study was to assess the impact of stroke-related, demographic and socioeconomic factors on acute and 3-months case fatality, on HRQoL and on satisfaction with care of patients after stroke.

Methods

Study setting and recruitment of participants

Data presented here were collected within the framework of the EuroHOPE project [15], a retrospective study based on national hospital healthcare administrative records in 6 European countries, with the index ischemic stroke between 2006–2008 [16, 20]. The present study was conducted according to Work Package 2 of the EuroHOPE project (*"HRQol protocol and patient satisfaction questionnaire–Stroke"*). We prospectively included patients with ischemic stroke (International Classification Diseases, ICD-10, I63). According to the study protocol, inclusion of consecutive patients with first-ever ischemic stroke was planned up till including 200 patients. That was intended to be an exploratory study with no formal sample size estimation. Exclusion criteria were history of previous ischemic stroke and refusal by the patient to participate in the survey.

Patients were recruited between September 2012 and May 2013, and evaluated at the Department of Neurology of Semmelweis University, a stroke center with a catchment area covering Districts 8 and 9 of Budapest, and the Ráckeve region. The catchment area of this stroke center was defined by geographic availability, i.e. to be the nearest stroke center for the regions of the catchment area. From the socioeconomic point of view, District 8 ranks the last of the 23 districts of Budapest on the list of income; the other regions of the catchment area are in the medium or high income categories. Income constitutes the major socioeconomic difference between the regions in the catchment area. Due to consecutive patient inclusion, our set of patients may be considered representative of ischemic stroke patients of this stroke center's catchment area.

Study design

Ethical approval was obtained from the Regional and Institutional Committee of Science and Research Ethics of Semmelweis University (no. 98/2012) and written consent was obtained from each patient or from the carer in case of patients who were unable to consent. Initial evaluation of the patients was performed at admission by the physician on duty. The research investigators re-evaluated each case to ascertain that it is indeed an acute first-ever ischemic stroke. As the next step, clinical features, pre-stroke demographic and socioeconomic factors (Table 1) were recorded by a standard questionnaire. Follow-up was performed three months after the onset of stroke by personal visit or by phone interview to assess post-stroke socioeconomic factors, HRQoL and patient satisfaction with care. Length of post-acute hospital stay (i.e. institutional rehabilitation or rehospitalization for any other reason after discharge from

Table 1. Parameters assessed in the study.

Sociodemographic factors	• age
	• gender
	• education
	• marital status prior and after stroke
Socioeconomic factors	• working status prior and after stroke
	• dwelling prior to stroke:
	○ location (resident of poorest District 8 or other neighborhood)
	○ conditions (home or institute)
	○ type of social dwelling (alone, with company, with family help, with professional help)
	• dwelling after stroke:
	○ conditions
	○ type of social dwelling
Clinical features	• pre-stroke clinical factors: degree of assistance needed, pre-stroke depression or dementia, vascular risk factors, prior drug therapy
	• strictly stroke related: severity at onset by the NIHSS, disability at discharge from acute care in mRS, stroke type (TOAST classification)
	• management related: thrombolysis status, necessity of intensive care or endarterectomy, motor rehabilitation therapy, post-stroke drug therapy, acute and post-acute length of stay (LOS)
Outcome measures	• case fatality: acute (inpatient) and at follow-up
	• health-related quality of life of survivors at follow-up
	• patient satisfaction with care at follow-up

NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale; TOAST: Trial of Org 10172 in Acute Stroke Treatment; LOS: length of stay.

https://doi.org/10.1371/journal.pone.0241059.t001

the acute setting) was recorded. Post-acute hospital stay was defined as the number of all inpatient days after discharge from the index hospital admission within the three months of follow-up.

Outcome measures were case fatality during the initial hospitalization and during follow-up, HRQoL and satisfaction with care of the survivors at follow-up.

Data collection instruments

During admission and at follow-up we have used detailed, standardized questionnaires to assess sociodemographic and socioeconomic factors listed in Table 1.

Initial stroke severity was assessed by the National Institutes of Health Stroke Scale (NIHSS), [21] on admission, whereas disability at discharge was scored by the modified Rankin Scale (mRS), [22]. The NIHSS is a 15-item neurological examination scale used to evaluate the effect of stroke on the level of consciousness, language, neglect, visual-field loss, extraocular movement, motor strength, coordination, dysarthria, and sensory loss. The NIHSS score ranges from 0 to 42, higher scores representing more severe states. The mRS addresses disability ranging from 0 (asymptomatic) to 6 (death). The classification of ischemic stroke was performed using Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria [23]. According to TOAST, ischemic stroke can be classified into large-artery atherosclerosis, cardioembolism, small-vessel disease, stroke of other determined etiology, and stroke of undetermined etiology.

Stroke and its consequences have significant effects on health related quality of life (HRQoL). We applied indirect methods to evaluate HRQoL in our study with the use of multi-attribute utility (MAU) instruments: by the EuroQoL-5 Dimension-5 Levels (hereafter EQ-5D), developed by the EuroQoL group [24], and by the HRQoL 15D instrument (hereafter 15D) [25, 26]. Both questionnaires are indirect generic instruments to evaluate HRQoL. EQ-5D addresses 5 dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression, grading these on 5 levels and a visual analog scale. The overall HRQoL described by the EQ-5D can be used to derive health state utility values, and has been found to be a valid descriptive system as a generic health outcome measure in patients with acute stroke [27]. The 15D is a comprehensive, self-administered health-related QoL instrument, which consists of 15 dimensions: breathing, mental function, speech, vision, mobility, usual activity, vitality, hearing, eating, elimination, sleeping, distress, discomfort and symptoms, depression and sexual activity. While the EQ-5D is widely used [28], the results might vary depending on the regression method used [29]. EQ-5D seems somewhat less sensitive when it comes to evaluating several chronic diseases [30–33]. The 15D performs better in terms of reliability, discrimination and responsiveness [34], and performs well after critical illness [28]. The agreement between the two utility measures was only moderate [28], and both the mean utilities and the standard deviation differs between EQ-5D and 15D [35]. For these reasons–as recommended by Feeny et al. [36]–we decided to use multiple questionnaires in this study.

We have also assessed the experience of patients with the care received during the hospital stay by EORTC IN-PATSAT32 (hereafter PATSAT), a tool that was developed by the European Organization for Research and Treatment of Cancer [37]. It evaluates 32 items regarding the satisfaction with technical competence, information provision, interpersonal skills, availability, waiting time, access, comfort and overall care perception. The following terms can be used: global patient satisfaction expressed by the PATSAT score of the questionnaire; three subcategories of patient satisfaction (with doctors, with nurses and with services and care organization) and the item number 32 of the questionnaire which is the general satisfaction with care received during the hospital stay of the patient. A higher scale score represents a higher level of satisfaction with care.

Statistical modeling

The relationship between variables was first assessed independently of any other effects (i.e. without control variables), followed by multivariate analysis.

We have built two types of statistical models, the first using variables related to pre-stroke features, characteristics of the acute stroke, stroke management and post-stroke variables as well. Including stroke related and post-stroke variables in the analysis was especially important when inspecting patient satisfaction with the care received, as the care received is necessarily applied after the onset of stroke. In a supplementary analysis we excluded variables that describe the patients after the acute stroke.

Logistic regression was used to evaluate acute and follow-up fatality. Linear regression was used during the analysis of the aggregated, continuous scores of HRQoL and patient satisfaction. The ordinal elements and scores of HRQoL and patient satisfaction were analyzed with ordered logistic regression. While HRQoL can be defined for the deceased, we chose to create HRQoL-related models only for the survivors, as the imputation of values for deceased patients could have introduced a bias. We also conducted analysis using post-stroke information, which were only available among the survivors.

Linear and logistic regression tables include the intercept, which is just the mean of the dependent variable or odds of the event when the values of the explanatory variables are zero or at the reference value. The ordered logistic regression models include multiple intercepts, but these are omitted from the tables since their value is not important for model interpretation.

In multivariate model building, first all potential covariates were included in the regression model alone to check their effect on the dependent variable. The multiple regression models then were built in the following way: we defined a set of control variables which were included in all models of a given type of dependent variable. Age, sex and NIHSS were control variables in all models. Discharge mRS was also included as control variable in all models that allowed post-stroke information. Additional control variables in the PATSAT models were education and marital status, in the HRQoL models education and in the death models dwelling district (8th or not). We then assessed the effect of all other possible covariates one-by-one, controlled by the previously set variables. In the next step, we placed the control variables and all the other variables which in the previous step had a coefficient significant at the 0.1 level into the model. We then checked which variables were significant at the 0.05 level and eliminated those which were not. In this last step we also considered the viability of the model and checked the effect of pre-stroke and post-stroke version and the original and pooled version of the same variables and also interaction terms. We also aimed to synchronize models with similar dependent variables. The reason behind this algorithm is that it allowed us to check the effect of the variables together with the control variables and then all together. This way we were able to discover relationships which might have remained hidden if the variable selection was based only on univariate analysis. Automatized tools such as stepwise regression were considered but discarded due to low patient number.

Statistical tests

Distribution of continuous variables was checked by the Shapiro-Wilk test. In case of non-normal distribution, non-parametric tests (Mann-Whitney test and Kruskal-Wallis ANOVA) were used for comparisons. Univariate relationship between two continuous variables were analyzed by correlation analysis (Pearson, Kendall, Spearman), Kruskal-Wallis test, and the Mann-Whitney test. The relationship between two discrete variables was assessed using the chi-squared test of independence. The overall significance of a categorical variable with more than 2 levels in a multiple regression model was checked using likelihood-ratio test.

Goodness of fit of regression models was tested using statistical and visual tools. The Hosmer-Lemeshow test and separation plot [38] were used for logistic regression. Shapiro-Wilk test and quantile-quantile plot were used for linear regression. The ordinal models were also inspected by the Hosmer-Lemeshow test. Multicollinearity was checked using the variable inflation factor. R version 3.5.2 was used for data analysis with packages ggplot2, MASS, separationplot, generalhoslem, car, rms.

Results

Participant characteristics

In total 200 patients participated in the study. The general description of the study population can be seen in Table 2. Patients from District 8 had more severe strokes (higher NIHSS on

Table 2. Patient characteristics.

Variable	Variable level	Overall	Not District 8	District 8	p-value	Response rate* (% of all 200)
N		**200**	**159**	**41**		
Age at stroke (mean (SD))	-	68.53 (12.86)	67.67 (12.53)	71.88 (13.72)	0.033	200 (100%)
Age at acute death (mean (SD))	-	75.00 (14.53)	78.70 (13.30)	67.60 (15.44)	0.198	15 (7.50%)
Age at follow-up death (mean (SD))	-	75.91 (12.28)	77.25 (11.66)	72.33 (13.90)	0.331	33 (16.50%)
Sex (%)	Female	88 (44.0)	72 (45.3)	16 (39.0)	0.587	200 (100%)
	Male	112 (56.0)	87 (54.7)	25 (61.0)		
Years in education (mean (SD))	-	10.81 (2.80)	10.77 (2.71)	10.95 (3.14)	0.983	183 (91.50%)
Marital status (%)	With partner	112 (56.0)	88 (55.3)	24 (58.5)	0.849	200 (100%)
	Living alone	88 (44.0)	71 (44.7)	17 (41.5)		
Pre-stroke employment (%)	Not in employment	160 (81.6)	124 (79.5)	36 (90.0)	0.193	196 (98%)
	In employment	36 (18.4)	32 (20.5)	4 (10.0)		
Post-stroke employment (%)	Not in employment	118 (88.1)	94 (87.0)	24 (92.3)	0.684	134 (67%)
	In employment	16 (11.9)	14 (13.0)	2 (7.7)		
Social type of pre-stroke dwelling (%)	Home alone	64 (32.0)	54 (34.0)	10 (24.4)	0.189	200 (100%)
	Home with company	126 (63.0)	99 (62.3)	27 (65.9)		
	Institution	10 (5.0)	6 (3.8)	4 (9.8)		
Social type of post-stroke dwelling (%)	Home alone	22 (16.5)	19 (17.4)	3 (12.5)	0.591	133 (66.50%)
	Home with company	96 (72.2)	79 (72.5)	17 (70.8)		
	Institution	15 (11.3)	11 (10.1)	4 (16.7)		
Acute fatality (%)	No	185 (92.5)	149 (93.7)	36 (87.8)	0.343	200 (100%)
	Yes	15 (7.5)	10 (6.3)	5 (12.2)		
Three-month fatality (including acute death) (%)	No	167 (83.5)	135 (84.9)	32 (78.0)	0.413	200 (100%)
	Yes	33 (16.5)	24 (15.1)	9 (22.0)		
NIHSS on admission (mean (SD))	-	7.88 (6.37)	7.36 (5.87)	9.88 (7.79)	0.141	200 (100%)
Discharge mRS (mean (SD)) (median (IQR))	-	2.68 (1.80) 2 (3)	2.57 (1.78) 2 (3)	3.10 (1.84) 3 (4)	0.111	200 (100%)
PATSAT score (mean (SD))	-	73.02 (22.38)	74.22 (22.35)	67.28 (22.17)	0.171	122 (61%)
EQ-5D utility index (mean (SD))	-	0.73 (0.29)	0.75 (0.28)	0.65 (0.34)	0.16	126 (63%)
15D utility index (mean (SD))	-	0.77 (0.16)	0.78 (0.16)	0.73 (0.17)	0.156	124 (62%)

Tests used: Mann-Whitney test for age variables, education, PATSAT, EQ-5D utility index, 15D utility index and NIHSS, chi-squared test for patient numbers and mRS.

*Response rate may mean data availably or number of events (i.e. death) depending on the variable. The number/percentage of respondents in complex scores and indices indicates the number of patients where these could be calculated. Individual items may have different response rate. In addition, 15D utility indices were calculated using imputation, thus the response rate of the final score may be higher than the one of the individual items.

NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale; PATSAT: EORTC IN-PATSAT32 questionnaire, assessing patient satisfaction; EQ-5D: the EuroQOL-5 Dimensions-5 Levels questionnaire; 15D: generic 15 dimensional measure of HRQoL [26]; IQR: interquartile range.

https://doi.org/10.1371/journal.pone.0241059.t002

admission) and more severe disability at discharge (higher mRS scores). Despite an older age at stroke, fatal cases of dwellers of District 8 were younger both at the initial hospitalization and at 3 months after stroke, although none of these differences were statistically significant.

Case fatality

Overall hospital case fatality was 7.5% (12% among District 8 residents and 6% among those living outside District 8). At 3 months after stroke overall case fatality was 16.5% (22% vs 15% among District 8 residents and those living outside District 8). In a multiple logistic regression model admission NIHSS and living alone prior to stroke (vs. living with partner) increased the odds of acute death. No other variables–including the sociodemographic variables—had a statistically significant effect. At follow-up at 3 months, age at stroke onset, and stroke severity by the NIHSS were significant predictors of case fatality, while living alone vs. living with partner lost its significance. For further information, see Table 3. Our study was underpowered to make reliable comparisons between features of inhabitants of the poorer District 8 and other regions.

Questionnaire completion

Assessment of HRQoL and patient satisfaction at follow-up could have been possible in 81% of the survivors (136 cases alive, able and willing to express themselves, 7 unable—aphasic, demented or comatose, 24 patients declined to answer). The response rates among the 167 patients surviving 3 months were 122 (73%) for PATSAT score, 126 (75%) for EQ-5D utility index and 124 (74%) for 15D utility index. The difference from 136 is due to incomplete answers at item level. The response rate for HRQoL and patient satisfaction questionnaires were almost the same (73%-75%), while initial stroke severity and disability data (i.e. NIHSS and mRS) could be gathered from all 167 survivors. The 15D missing data were imputed at the item level using an SPSS algorithm for those with less than 4 missing items, based on the age and gender of the patients [25, 26].

Table 3. Multiple logistic regression models for case fatality.

Acute fatality (n = 200, McFadden's R^2 = 0.287)					
Variables	**Reference categories**	**Odds-ratio**	**Lower 95% C.I.**	**Upper 95% C.I.**	**p-value**
Intercept	-	0.001	0.000	0.043	<0.001
Sex–Male	Female	2.724	0.688	10.786	0.154
Age at stroke	-	1.025	0.973	1.081	0.354
Dwelling location–District 8	Not District 8	1.144	0.288	4.539	0.848
NIHSS on admission	-	1.167	1.077	1.264	<0.001
Living alone	Living with partner	4.448	1.043	18.973	0.044
Three-month fatality (n = 200, McFadden's R^2 = 0.315)					
Variables	**Reference categories**	**Odds-ratio**	**Lower 95% C.I.**	**Upper 95% C.I.**	**p-value**
Intercept	-	0.001	0.000	0.020	<0.001
Sex–Male	Female	1.406	0.520	3.803	0.502
Age at stroke	-	1.045	1.003	1.089	0.038
Dwelling location–District 8	Not District 8	0.788	0.257	2.417	0.677
NIHSS on admission	-	1.209	1.125	1.299	<0.001
Living alone	Living with partner	2.460	0.925	6.540	0.071

NIHSS: National Institutes of Health Stroke Scale.

https://doi.org/10.1371/journal.pone.0241059.t003

Health-related quality of life

A. Main analysis. During the statistical model building we have initially included at least in the univariate analysis all the factors assessed in the study (see Table 1). The control variables were sex, age, education, NIHSS and discharge mRS. The effect of patient satisfaction was also checked in every HRQoL model. In the multiple linear regression model, we have found that out of all the factors assessed (Table 1) the following had a significant independent impact on the HRQoL measured by EQ-5D index at 90-days after stroke: age, mRS at discharge from the acute hospitalization, stroke type, patient satisfaction, acute and post-acute length of hospital stay, and the type of dwelling after stroke (Table 4). These last two features were related but caused no multicollinearity issues during statistical analysis. The effect of employment status prior to stroke and admission source were only marginally significant predictors of the EQ-5D index, while admission from hospital entailed significantly lower 15D utility scores on average.

The association of age and disability (i.e. mRS at discharge) with HRQoL is already known: the older and the more disabled report poorer quality of life. Some effects are worthy of closer inspection, though. TOAST classification influenced HRQoL in the study population. Cardioembolism was associated with better HRQoL compared to large-artery atherosclerosis

Table 4. Predictors of EQ-5D utility index in multiple linear regression model.

		EQ-5D utility index (n = 109, adjusted R^2 = 0.640)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value	Overall p-value	No. of patients
Intercept	-	1.008	0.673	1.344	<0.001		109
Sex–Male	Female	0.050	-0.022	0.123	0.177		61
Age at stroke	-	-0.005	-0.009	-0.002	0.005		109
Education	-	0.009	-0.004	0.023	0.174		109
NIHSS at admission	-	-0.006	-0.016	0.004	0.230		109
Discharge mRS = 2–5	mRS = 0–1	-0.114	-0.207	-0.021	0.018		64
TOAST 2	TOAST 1	0.169	0.050	0.287	0.006	0.045	21
TOAST 3		0.099	-0.015	0.212	0.094		33
TOAST 4		0.194	-0.096	0.483	0.194		2
TOAST 5		0.046	-0.073	0.164	0.452		29
Employment prior to stroke: not employed	Employed	0.110	-0.001	0.220	0.056		88
Admitted from: other hospital	Admitted from home	-0.189	-0.385	0.008	0.063	0.142	4
From other institution		-0.067	-0.225	0.092	0.414		7
Acute LOS	-	-0.011	-0.017	-0.005	<0.001		109
Dwelling after: at home with company	Dwelling after: home alone	-0.169	-0.268	-0.070	0.001	0.003	78
In institute or with professionals		-0.161	-0.307	-0.015	0.034		12
Post-acute LOS: 1–5 days	Post-acute LOS: 0 days	0.109	-0.033	0.251	0.137	<0.001	8
6–15 days		-0.114	-0.228	0.001	0.055		13
16–30 days		-0.103	-0.262	0.055	0.204		7
More than 30 days		-0.243	-0.370	-0.117	<0.001		13
PATSAT score	-	0.002	0.001	0.004	0.007		109

EQ-5D: the EuroQOL-5 Dimensions-5 Levels questionnaire developed by the EuroQoL group, assessing HRQoL; NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale; TOAST 1: large-artery atherosclerosis, TOAST 2: cardioembolism, TOAST 3: small-vessel occlusion, TOAST 4: stroke of other determined etiology, TOAST 5: stroke of undetermined etiology; LOS: length of stay; PATSAT: the questionnaire developed by the European Organization for Research and Treatment of Cancer, named EORTC IN-PATSAT32, assessing patient satisfaction.

expressed in EQ-5D, with marginal effect on 15D (see Tables 4 and 5). Out of the socioeconomic factors assessed in this study, the type of social dwelling after stroke proved to be an independent predictor of EQ-5D index, meaning that the HRQoL at follow-up was highest in patients living alone independently in their home, somewhat lower in those at home with company, even lower in case of patients receiving family help; the poorest results were reported in patients dwelling with a professional carer (Fig 1). The length of post-acute hospital stay also proved to be an independent predictor of both the EQ-5D index and the 15D utility score: the longer the duration of post-acute hospitalization, the lower the HRQoL (Fig 2).

We have also inspected the correlation between the scores of different instruments (EQ-5D utility index, 15D utility index, PATSAT score and its subcategories) and we have found that there is a significant positive correlation between each pair (see S4 Table). When examining the sub-item of general patient satisfaction (item 32 of the PATSAT questionnaire), we have also found a significant relationship with both HRQoL indices (S5 Table, Kruskal-Wallis test p-value = 0.019 for EQ-5D and 0.040 for 15D).

Patient satisfaction with care

Although 81% of the survivors were able and willing to respond to the questionnaires at follow-up, the response rate of PATSAT was 73%. Even less patients chose the categories of poor,

Table 5. Predictors of 15D utility index in multiple linear regression model.

Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value	Overall p-value	No. of patients
15D utility index (n = 108, adjusted R^2 = 0.522)							
Intercept	-	0.943	0.727	1.159	<0.001		108
Sex–Male	Female	0.037	-0.010	0.085	0.126		61
Age at stroke	-	-0.003	-0.005	-0.001	0.017		108
Education	-	0.008	-0.001	0.017	0.087		108
NIHSS at admission	-	-0.004	-0.011	0.002	0.186		108
Discharge mRS = 2–5	mRS = 0–1	-0.112	-0.172	-0.051	<0.001		65
TOAST 2	TOAST 1	0.066	-0.011	0.143	0.096	0.119	21
TOAST 3		0.015	-0.061	0.090	0.701		31
TOAST 4		0.095	-0.094	0.284	0.326		2
TOAST 5		-0.021	-0.098	0.056	0.591		30
Employment prior to stroke: not employed	Employed	0.061	-0.012	0.134	0.104		87
Admitted from: other hospital	Admitted from home	-0.209	-0.337	-0.081	0.002	0.005	4
From other institution		-0.048	-0.152	0.055	0.362		7
Acute LOS	-	-0.004	-0.008	-0.001	0.027		108
Dwelling after: at home with company	Dwelling after: home alone	-0.107	-0.171	-0.042	0.002	0.004	77
In institute or with professionals		-0.044	-0.139	0.051	0.370		12
Post-acute LOS: 1–5 days	Post-acute LOS: 0 days	0.109	0.011	0.208	0.032	0.106	7
6–15 days		-0.028	-0.106	0.049	0.475		12
16–30 days		-0.056	-0.159	0.046	0.284		7
More than 30 days		-0.009	-0.091	0.073	0.831		13
PATSAT score	-	0.001	0.000	0.002	0.031		108

15D: the 15-dimension questionnaire assessing HRQoL [26]; NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale; TOAST 1: large-artery atherosclerosis, TOAST 2: cardioembolism, TOAST 3: small-vessel occlusion, TOAST 4: stroke of other determined etiology, TOAST 5: stroke of undetermined etiology; LOS: length of stay; PATSAT: the EORTC IN-PATSAT32 questionnaire developed by the European Organization for Research and Treatment of Cancer, assessing patient satisfaction.
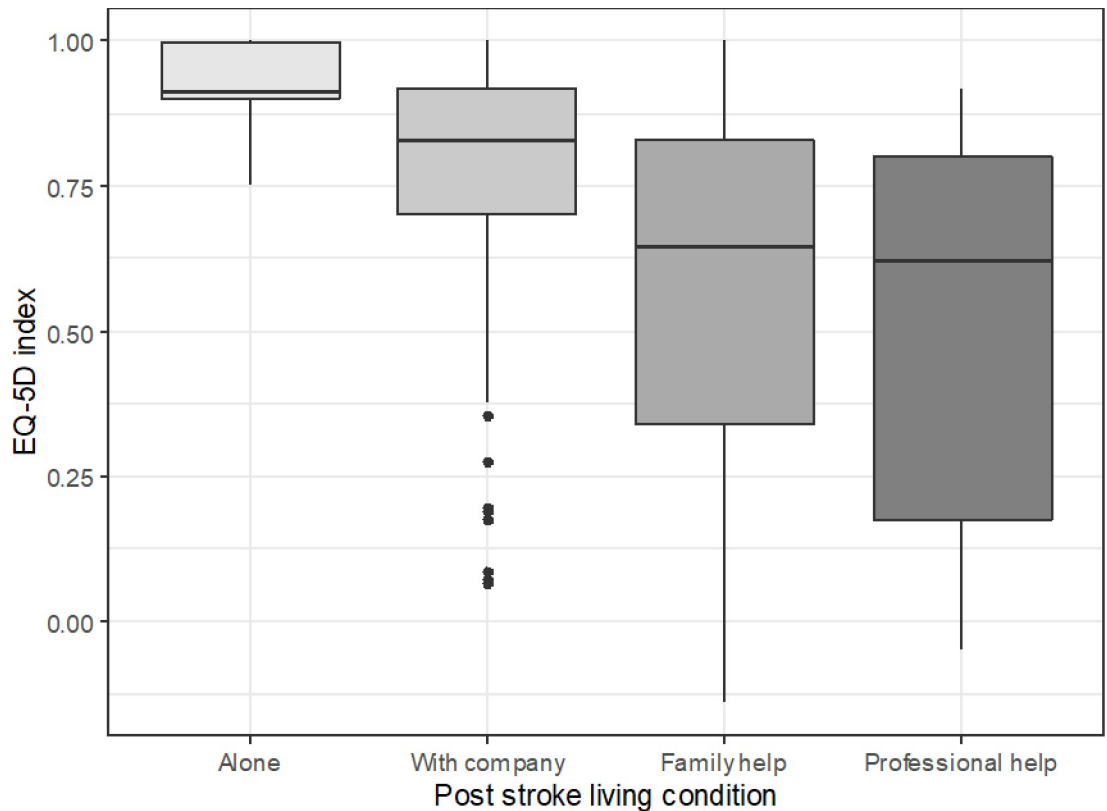
Fig 1. EQ-5D index by living condition, Kruskal-Wallis chi-squared test p-value < 0.001. Middle line: median, box borders: IQR, whiskers: range of non-outlier values, points: outliers in Tukey's sense (at least 1.5*IQR distance from the lower or upper quartile), outliers were taken into account when calculating the median and IQR. EQ-5D: the EuroQoL-5 Dimensions-5 Levels questionnaire developed by the EuroQoL group, assessing the health-related quality of life; IQR: interquartile range.

fair or good satisfaction. Thus, when performing ordinal logistic regression analysis, these categories had to be merged due to low patient numbers.

In the *main analyses* of patient satisfaction (see Table 6), the control variables were sex, age, education, NIHSS, discharge mRS and marital status. The effect of HRQoL was also checked in every patient satisfaction model, even if it was not included by the algorithm. Severity of stroke at onset measured by the NIHSS significantly influenced the global patient satisfaction. The EQ-5D index was found in the multiple regression model to be an independent predictor of the global PATSAT score and all its sub-categories at least at a marginally significant level (p<0.1). Thrombolysis also predicted better satisfaction globally, with the care provided by nurses and with organization. Altogether, the multiple linear regression models showed that the patient satisfaction is reduced by stroke severity at admission and is improved by better EQ-5D scores and by having had thrombolysis. The rest of the parameters described in Table 1 showed no effect on global patient satisfaction score or its subcategories. When we performed the multiple ordinal logistic regression model analysis on the question of general patient satisfaction (item 32 of the PATSAT), we have found that both mRS at discharge and EQ-5D index had a marginally significant effect on this item (see Table 6). All patient satisfaction linear regression models showed some deviation from normality (Shapiro-Wilk p<0.05), this somewhat weakens the reliability of the results. There were no significant problems with the fit of the ordinal logistic regression models.
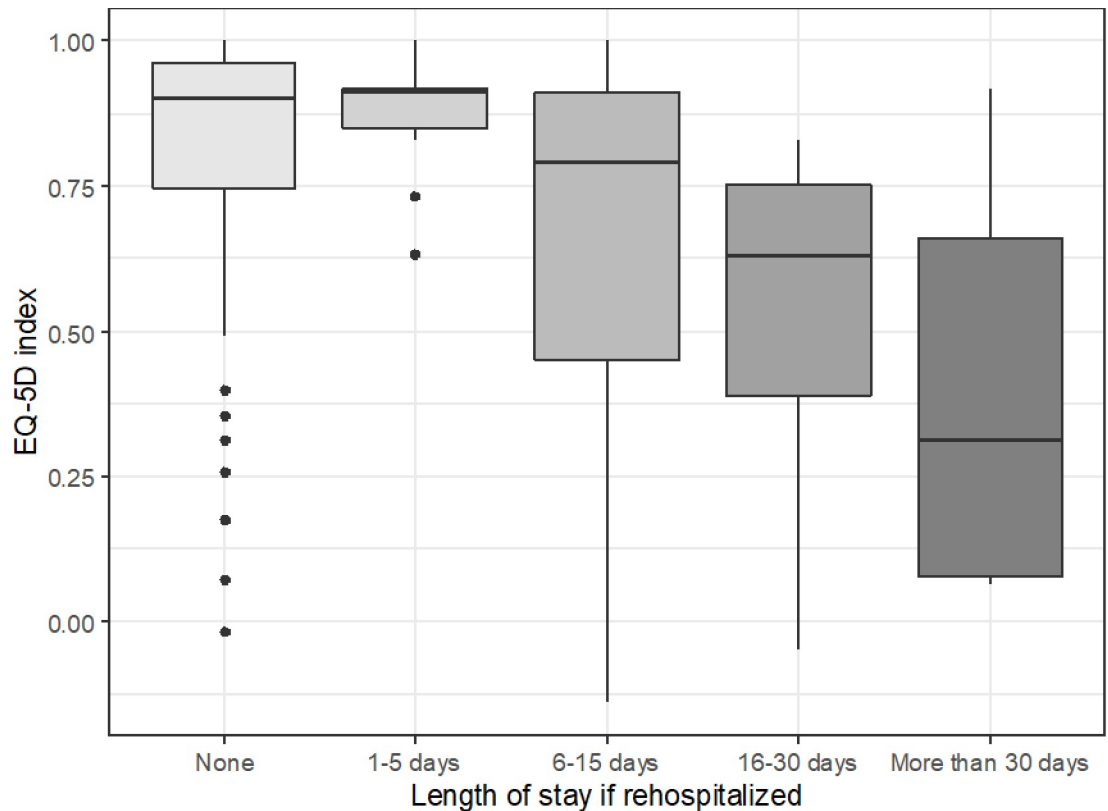
Fig 2. EQ-5D index by post-acute LOS, Kruskal-Wallis chi-squared test p-value < 0.001. Middle line: median, box borders: IQR, whiskers: range of non-outlier values, points: outliers in Tukey's sense (at least 1.5*IQR distance from the lower or upper quartile), outliers were taken into account when calculating the median and IQR. EQ-5D: the EuroQOL-5 Dimensions-5 Levels questionnaire developed by the EuroQoL group, assessing the health-related quality of life; LOS: length of stay; IQR: interquartile range.

https://doi.org/10.1371/journal.pone.0241059.g002

B. Analysis excluding post-stroke variables. We excluded post-stroke variables during this type of model building: we included only age, sex, education, social and anamnestic factors, admission NIHSS and TOAST category. The control variables were sex, age, education and NIHSS. We present the results of these analyses for EQ-5D, 15D and PATSAT in S1–S3 Tables. The multiple linear regression models showed that more advanced age and higher stroke severity were associated with poorer utility indices of both the EQ-5D and 15D (see S1 and S2 Tables). It also showed that ischemic stroke subtype, determined by TOAST criteria might influence 3-month-post-stroke HRQoL. We have found that in this restricted model not only patients who have suffered cardioembolism but also those with small vessel occlusion reported better HRQoL at 3 months after stroke (expressed as higher utility indices of both EQ-5D and 15D) compared to patients who have suffered large vessel atherosclerosis. The stroke subtypes of other determined or undetermined etiology also showed a marginally significant effect on EQ-5D utility index, while this relationship was not detectable in terms of 15D utility index (see S1 and S2 Tables).

We have also found two associations detectable on only one of the two HRQoL instruments used. By the EQ-5D utility index, we have detected that patients who have not been employed prior to their stroke reported higher HRQoL compared to those patients who were employed at time of the stroke. By the 15D utility index, we have seen that patients admitted from another hospital at the onset of the index stroke reported poorer HRQoL compared to their

Table 6. Multiple linear regression model of the global patient satisfaction (PATSAT score).

PATSAT score (n = 111, adjusted R^2 = 0.107)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value
Intercept	-	75.113	40.075	110.151	<0.001
Sex: male	Female	1.530	-6.679	9.738	0.716
Age at stroke	-	-0.204	-0.555	0.148	0.259
Education	-	-0.508	-1.968	0.953	0.497
NIHSS at admission	-	-1.111	-2.159	-0.062	0.040
mRS on discharge: 2–5	mRS: 0–1	8.410	-1.714	18.535	0.107
Marital status: living alone	Living with partner	2.957	-5.569	11.483	0.498
Thrombolysis	No thrombolysis	25.635	5.212	46.058	0.016
EQ-5D utility index	-	22.858	6.007	39.708	0.009
PATSAT physicians (n = 115, adjusted R^2 = 0.046)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value
Intercept	-	78.219	39.693	116.746	<0.001
Sex: male	Female	-0.538	-9.507	8.431	0.907
Age at stroke	-	-0.237	-0.625	0.152	0.235
Education	-	0.132	-1.436	1.700	0.869
NIHSS at admission	-	-0.775	-1.923	0.372	0.188
mRS on discharge: 2–5	mRS: 0–1	4.653	-6.323	15.629	0.408
Marital status: living alone	Living with partner	2.894	-6.375	12.163	0.542
Thrombolysis	No thrombolysis	20.890	-1.843	43.624	0.075
EQ-5D utility index	-	18.014	-0.294	36.321	0.056
PATSAT nurses (n = 116, adjusted R^2 = 0.062)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value
Intercept	-	70.984	29.478	112.491	0.001
Sex: male	Female	5.121	-4.543	14.785	0.301
Age at stroke	-	-0.269	-0.688	0.151	0.212
Education	-	0.059	-1.593	1.711	0.944
NIHSS at admission	-	-0.696	-1.933	0.541	0.272
mRS on discharge: 2–5	mRS: 0–1	3.120	-8.652	14.892	0.605
Marital status: living alone	Living with partner	1.175	-8.826	11.175	0.818
Thrombolysis	No thrombolysis	32.025	7.469	56.581	0.012
EQ-5D utility index	-	18.512	-1.166	38.189	0.068
PATSAT services and care organization (n = 113, adjusted R^2 = 0.070)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value
Intercept	-	60.287	22.805	97.769	0.002
Sex: male	Female	4.029	-4.718	12.777	0.369
Age at stroke	-	-0.115	-0.492	0.262	0.552
Education	-	0.134	-1.382	1.649	0.863
NIHSS at admission	-	-1.035	-2.155	0.086	0.073
mRS on discharge: 2–5	mRS: 0–1	6.090	-4.547	16.727	0.264
Marital status: living alone	Living with partner	3.135	-5.977	12.246	0.502
Thrombolysis	No thrombolysis	22.648	0.730	44.567	0.045
EQ-5D utility index	-	20.266	2.469	38.064	0.028
PATSAT item 32 general satisfaction, ordered logistic regression (n = 112, Nagelkerke R^2 = 0.132)					
Variables	Reference categories	Odds-ratio	Lower 95% C.I.	Upper 95% C.I.	p-value
Sex: male	Female	1.404	0.685	2.878	0.354
Age at stroke	-	0.977	0.946	1.009	0.152

(Continued)

Table 6. (Continued)

PATSAT score (n = 111, adjusted R^2 = 0.107)					
Variables	Reference categories	Coefficient	Lower 95% C.I.	Upper 95% C.I.	p-value
Education	-	1.025	0.901	1.165	0.710
NIHSS at admission	-	0.929	0.848	1.017	0.109
mRS on discharge: 2–5	mRS: 0–1	2.177	0.924	5.132	0.075
Marital status: living alone	Living with partner	1.042	0.494	2.200	0.914
EQ-5D utility index	-	3.897	0.918	16.542	0.065

NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale; PATSAT: the EORTC IN-PATSAT32 questionnaire, assessing patient satisfaction; EQ-5D: the EuroQOL-5 Dimensions-5 Levels questionnaire developed by the EuroQoL group, assessing HRQoL.

https://doi.org/10.1371/journal.pone.0241059.t006

fellows admitted from their home. The only model that showed significant fitting problems (Shapiro-Wilk p = 0.009) among the HRQoL models was the EQ-5D multiple linear regression model excluding post-stroke variables (S1 Table). The result of the quantile-quantile plot was more dubious. As this was just a sub-analysis and the variable effects are similar in the other models this does not undermine our overall conclusions.

In the supplementary set of analyses (excluding post-stroke variables) we have found that the PATSAT score, satisfaction with services and care organization and the sub-item 32 are significantly influenced by admission NIHSS (see S3 Table). Namely, more severe stroke at admission results in poorer patient satisfaction. We found no significant predictors in these models for satisfaction with physicians and satisfaction with nurses. The control variables were sex, age, education, NIHSS and marital status.

Discussion

In a consecutive sample of 200 patients with acute ischemic stroke we evaluated predictors of case fatality, health-related quality of life and patient satisfaction. Predictors of acute in-hospital case fatality were stroke severity and living alone prior to stroke. At 3 months after stroke, similarly to previous reports, we also found that case fatality related to initial stroke severity and age. *Health utility index* was diminished after stroke compared to the population norm for EQ-5D for Hungary, and utility indices tended to be lower in the disadvantaged District 8 than in wealthier regions both by EQ-5D and 15D, suggesting that in addition to the consequences of stroke, the general living standard of the patient also affects post-stroke HRQoL. Independent predictors of HRQoL at 3 months after stroke, similarly to other reports, were age, disability at discharge from the acute hospitalization, stroke type, and patient satisfaction. As far as we know, it has not been reported previously that acute and post-acute length of hospital stay after stroke also affect HRQoL. We found evidence that post-acute inpatient management might adversely affect HRQoL: longer than 5 days post-acute LOS was associated with poorer HRQoL. In our study the single independent predictor of all subcategories of *patient satisfaction* was HRQoL. Global patient satisfaction was influenced negatively by initial stroke severity and positively by thrombolysis and HRQoL. According to our knowledge, this positive effect of the provision of thrombolysis on patient satisfaction has not been described before.

Case fatality

For fatality in the acute phase and at follow-up, the number of patients was low in the different subgroups. This restricted the detailed data analysis and conclusion regarding socioeconomic factors. Nevertheless, we have found that stroke severity and living alone prior to the stroke

increase the odds of dying. These associations are well known. Advanced age and case severity are the most important predictors of early and late case fatality [39, 40]. Living alone was also documented to increase long-term mortality after stroke [41].

Health-related quality of life

As to the effect of location of residence, we have found that, although dwellers of the socioeconomically disadvantaged District 8 scored less by both health utility measures compared to residents of wealthier regions (Table 1), similarly to case fatality, the number of patients was not sufficient for this difference to reach statistical significance. We have considered the rate of respondents acceptable as it was similar or higher compared to the proportions reported after stroke [42, 43]. Nonetheless we found that the average EQ-5D utility index in both subgroups (0.65±0.34 for District 8 and 0.75±0.28 for other regions) are reduced compared to the population norm of 0.82 [44]. Using EQ-5D the health state utility values after stroke were relatively stable in time: in a systematic review of a total of 199 publications on stroke the median value was 0.63 in studies before 2013 versus 0.65 in studies after 2013 [45]. For 15D, the difference in health utility values between the socioeconomically disadvantaged district and the other areas also did not reach the level of statistical significance in our study (0.73±0.17 for District 8 and 0.78±0.16 for other regions). These values for 15D are within the range reported for stroke patients with or without vision problems (0.73–0.89); [46]. It has been reported that EQ-5D and 15D should not be used interchangeably in economic evaluations after stroke, as the utility scores generated from the two instruments, although correlated well, they differed significantly from each other [47]. Using the same health state utility measures 3 months after intracerebral hemorrhage, predictors for lower HRQoL by both scales were higher NIHSS and older age, with similar ORs for EQ-5D-5L, and 15D [48].

Minimally important differences (MIDs) for health state utilities vary by measure and methods, and are not well established [49]. It has been suggested that for EQ-5D differences among health state utilities of at least 0.036 can be considered clinically important [50]. For EQ-5D, the mean MID among non-stroke patients was 0.074 (range -0.011–0.140) [51]. In a Korean version of the EQ-5D-3L questionnaire, MID in stroke patients ranged from 0.08 to 0.12 [52], and a similar value of 0.10 was reported by Chen et al [53]. Considering the population norms of EQ-5D reported for Hungary (0.82) [44] the mean state utility value for EQ-5D in our patients (0.65 for District 8 and 0.75 for the wealthier regions) is considerably reduced, i.e. HRQoL is obviously adversely affected in stroke survivors 3 months after the acute event with a signal for reduced HRQoL in District 8. As far as 15D is concerned, there is a lack of information on MID values in stroke patients, and also no population norms are known for Hungary. In other patient groups MID for 15D was estimated between 0.01–0.03 [54]. Although by standard statistical methods–similarly to our findings for EQ-5D –the difference between health state utilities by the 15D was not statistically significant, the difference between the mean values of District 8 and other regions (i.e. 0.78–0.73 = 0.05) suggests that HRQoL after stroke is reduced more in socioeconomically deprived regions than in wealthier areas.

It is understandable that graver disability after stroke has a major impact on numerous aspects of the patient's physical, mental, professional and social life which might all be translatable to HRQoL. In the statistical models which excluded post-stroke variables, we have also found that admission stroke severity and advanced age both reduce post-stroke HRQoL [55, 56]. What seems more interesting, though, is the effect of ischemic stroke subtype as to TOAST classification on HRQoL. TOAST classification as a possible predictor of outcome (death or dependency) was extensively studied: only lacunar stroke was found to influence outcome independently from stroke severity measured by the NIHSS [23]. There is scarcity of

data regarding TOAST classification as a predictor of HRQoL. Our finding that cardioembolism was associated with better HRQoL than large-artery atherosclerosis is not in line with previous studies stating that cardioembolism predicts graver physical dependency [57].

Including all variables, we found several independent predictors of HRQoL: age, disability at discharge from acute management, stroke type, patient satisfaction, longer duration of acute and post-acute care and social dwelling type after stroke.

The condition of the patients at discharge from acute management expressed in mRS predicts HRQoL of patients expressed both in EQ-5D and 15D. The more disabled the patients at discharge, the lower the HRQoL of patients at follow-up. This association is quite comprehensible and has been already described [55, 56]. Age is also a well-known predictor of post-stroke HRQoL [58].

The social type of dwelling of patients after stroke also seemed to have an impact on HRQoL at follow-up. Those patients able to live alone independently reported better HRQoL compared to those living with company, and especially compared to those requiring professional help. The finding, that the type of social dwelling itself is associated with a certain HRQoL outcome, independently of the known confounders like stroke severity or disability, is unexpected. The other relationship–onset stroke severity predicting both post-stroke HRQoL and dependence on others—is well-documented [55] and understandable. The social aspects of the dwelling circumstances after stroke might contribute to post-stroke HRQoL above the immediate effects of the stroke related disability on HRQoL.

A strong association between HRQoL and acute length of stay was already described [59, 60]. In our stroke population, above length of acute stay, the duration of post-acute management (i.e. length of stay in rehabilitation or other hospitalization after discharge from the acute care setting) was also associated to poorer post-stroke HRQoL: longer than 5 days (especially more than 30 days) of post-acute hospital-stay had a negative impact on HRQoL. Thus, longer post-acute hospital stay represents not only a costly intervention, but could also contribute to reduced HRQoL of patients. The length of post-acute management can be an expression of graver disability, i.e. definite need for treatment prolongation. On the other hand, it can also be the expression of poorer social background, as patients who are not entirely independent after stroke and are lacking family help will have longer hospital-stays to enable arranging the dwelling conditions necessary after discharge. The association of stroke severity at onset with length of stay and with discharge disposition was already described [61, 62]. Still, length of post-acute hospital-stay was not mentioned yet among the many predictors of post-stroke HRQoL, as far as we know [63, 64]. There is a large body of evidence supporting the benefits of inpatient rehabilitation [65, 66]. What is more important, Stroke Units' Trialists Collaboration [67] states that "people with acute stroke are more likely to survive, return home and regain independence if they receive stroke unit care . . . that can offer a substantial period of rehabilitation if required". In spite of the latter recommendation, a decline in the long-term HRQoL after inpatient rehabilitation of stroke patients was also reported [68]. Early Supported Discharge Trialists bring convincing arguments in favor of shortening the length of inpatient care in selected patients in order to reduce long-term dependency [69, 70]. Further research is needed regarding post-acute management of stroke patients to assess the long-term outcome of inpatient and home-based rehabilitation. Our results suggest that shorter hospital stays followed by well-organized regular outpatient care could contribute to better post-stroke HRQoL. These outpatient interventions could be motor or non-motor rehabilitation sessions, regular home-based check-ups for improving the adherence to secondary prevention, nurses available for administering drugs and assisting the patients in their every-day grooming and medical attendance.

Although non-married status and poorer social support was linked to poorer rehabilitation potential after stroke [71, 72], marital status was not among the predictors of HRQoL in our study.

Patient satisfaction

In our study, patients reporting better HRQoL also report better satisfaction with the care received and vice versa. There is evidence for each subcategory of patient satisfaction being influenced by the HRQoL, although in certain subcategories the evidence is weak. Our data suggest that patients with better HRQoL are more satisfied with physicians, nurses, organization of care and globally. Patient satisfaction was already known to be one of the most important predictors of HRQoL [73].

In addition to HRQoL, stroke severity also has a major impact on patient satisfaction: more severe strokes are associated with lower global satisfaction. On the other hand, the provision of thrombolysis had a significant positive impact on global patient satisfaction and the subcategory of satisfaction with nurses and care organization. We have not found any description of this association yet.

Patient satisfaction after stroke was not influenced by the rest of the numerous factors assessed. This is consistent with the known difficulty to influence patient satisfaction with direct measures [74, 75] and questions patients' awareness of stroke management possibilities. Supposedly, patients socialized to have an impact on the care received would have valued their own satisfaction in a more differentiated manner. Patient satisfaction improved when they could actively influence the received care [76] and with better patient to nurse ratios [77]. Better patient satisfaction was also linked to outpatient rehabilitation [76–78], but in our study the patients discharged to their home, receiving professional help or living independently, have not valued the stroke care received any more than those discharged to rehabilitation or chronic care facilities.

Strengths and limitations of the study

The strengths of our study are the consecutive inclusion of patients thus reducing selection bias; the detailed systematic data collection, and the use of dual measures of HRQoL. Our study also has several limitations. First, the sample was relatively small, therefore does not have enough power to evaluate several possible predictors of HRQoL or patient satisfaction. Second, we have taken into account only the presence of pre-stroke depression but did not assess the patients for post-stroke depression, though according to published reports, depression has a significant impact on HRQoL and it can also influence negatively patient satisfaction [79]. Third, we have not assessed HRQoL in the acute phase of stroke, nor in a serial manner, therefore we cannot assess the change in HRQoL. Fourth, among those who did not return for an in-person check-up for the follow-up the rate of less satisfied patients may have been higher, and as the survey was done at 3 months after stroke, recall bias may have had an effect on patient satisfaction. Fifth, although EQ-5D is widely used, this might be a limitation considering its lower sensitivity in evaluating chronic diseases [30, 32, 33, 47]. For this reason, we used 15D as well, adding higher sensitivity and reliability for evaluating HRQoL [30, 32–34, 47].

Conclusions

Similarly to other studies, we found that initial stroke severity and age are the most important predictors of case fatality at 3 months after stroke. In addition to previously already identified predictors, we found that longer acute and post-acute hospital stay and the type of social dwelling were also associated with HRQoL of stroke survivors. These associations raise the issue

whether long-term outcome could be improved by more intensive inpatient rehabilitation or rather by developing home care facilities. More research is needed regarding the effect of early discharge to patients' home supported by outpatient rehabilitation on HRQoL of the patients.

Supporting information

S1 Table. Predictors of EQ-5D utility index in multiple linear regression model excluding post-stroke variables.
(DOCX)

S2 Table. Predictors of 15D utility index in multiple linear regression model excluding post-stroke variables.
(DOCX)

S3 Table. Predictors of PATSAT score and its subcategories in multiple linear regression and ordered logistic regression models excluding post-stroke variables.
(DOCX)

S4 Table. Correlation between EQ-5D utility index, 15D utility index, PATSAT score and its subcategories.
(DOCX)

S5 Table. Association between the sub-item of general patient satisfaction (item 32 of the PATSAT questionnaire) and quality of life indices.
(DOCX)

S1 Data.
(XLSX)

Acknowledgments

Author Contributions

Conceptualization: Judit Lám, Unto Häkkinen, Éva Belicza, Dániel Bereczki.

Data curation: Ildikó Szőcs, Balázs Dobi, Károly Orbán-Kis, Dániel Bereczki.

Formal analysis: Ildikó Szőcs, Balázs Dobi, Károly Orbán-Kis, Dániel Bereczki.

Funding acquisition: Unto Häkkinen, Éva Belicza, Dániel Bereczki.

Investigation: Ildikó Szőcs, Ildikó Vastagh.

Methodology: Ildikó Szőcs, Judit Lám, Éva Belicza, Dániel Bereczki, Ildikó Vastagh.

Project administration: Ildikó Szőcs, Éva Belicza, Dániel Bereczki.

Resources: Éva Belicza, Dániel Bereczki.

Software: Balázs Dobi, Éva Belicza.

Supervision: Unto Häkkinen, Éva Belicza, Dániel Bereczki.

Writing – original draft: Ildikó Szőcs, Balázs Dobi, Károly Orbán-Kis.

Writing – review & editing: Ildikó Szőcs, Judit Lám, Unto Häkkinen, Éva Belicza, Dániel Bereczki, Ildikó Vastagh.

References

1. Wang R, Langhammer B. Predictors of quality of life for chronic stroke survivors in relation to cultural differences: A literature review. Scand J Caring Sci. 2018; 32(2): 502–514. https://doi.org/10.1111/scs.12533 PMID: 28949412

2. Ramos-Lima MJM, Carvalho Brasileiro I, Lima TL, Braga-Neto P. Quality of life after stroke: impact of clinical and sociodemographic factors. Clinics (Sao Paulo). 2018; 73: e418. https://doi.org/10.6061/clinics/2017/e418 PMID: 30304300

3. Addo J, Ayerbe L, Mohan KM, Crichton S, Sheldenkar A, Chen R, et al. Socioeconomic status and stroke—An updated review. Stroke. 2012; 43: 1186–1191. https://doi.org/10.1161/STROKEAHA.111.639732 PMID: 22363052

4. Avendano M, Boshuizen HC, Schellevis FG, Mackenbach JP, Van Lenthe FJ, Van den Bos GAM. Disparities in stroke preventive care in general practice did not explain socioeconomic disparities in stroke. J Clin Epidemiol. 2006; 59: 1285–1294. https://doi.org/10.1016/j.jclinepi.2006.03.010 PMID: 17098571

5. Avendano M, Kunst AE, Huisman M, van Lenthe F, Bopp M, Borrell C, et al. Educational level and stroke mortality. A comparison of 10 European populations during the 1990s. Stroke. 2004; 35: 432–437. https://doi.org/10.1161/01.STR.0000109225.11509.EE PMID: 14726555

6. Cox AM, McKevitt C, Rudd AG, Wolfe D. Socioeconomic status and stroke. Lancet Neurol. 2006; 5: 181–188. https://doi.org/10.1016/S1474-4422(06)70351-9 PMID: 16426994

7. Grube MM, Koennecke HC, Walter G, Thümmler J, Meisel A, Wellwood I, et al on behalf of the Berlin Stroke Register. Association between socioeconomic status and functional impairment 3 months after ischemic stroke: the Berlin Stroke Register. Stroke. 2012; 43: 3325–3330. https://doi.org/10.1161/STROKEAHA.112.669580 PMID: 23033351

8. Kerr GD, Slavin H, Clark D, Coupar F, Langhorne P, Stott DJ. Do vascular risk factors explain the association between socioeconomic status and stroke incidence: a meta-analysis. Cerebrovasc Dis. 2011; 31: 57–63. https://doi.org/10.1159/000320855 PMID: 20980755

9. Mackenbach JP, Stirbu I, Roskam AJ, Chaap M, Menvielle G, Leinsalu M, et al for the European Union Working Group on Socioeconomic Inequalities in Health. Socioeconomic inequalities in health in 22 European countries. N Engl J Med. 2008; 358: 2468–2481. https://doi.org/10.1056/NEJMsa0707519 PMID: 18525043

10. Cesaroni G, Agabiti N, Forastiere F, Perucci CA. Socioeconomic differences in stroke incidence and prognosis under a universal healthcare system. Stroke. 2009; 4: 2812–2819. https://doi.org/10.1161/STROKEAHA.108.542944 PMID: 19478229

11. Vastagh I, Horváth T, Nagy G, Varga T, Juhász E, Juhász V, et al. Evolution and predictors of morphological and functional arterial changes in the course of type 1 diabetes mellitus. Diabetes Metab Res Rev. 2010; 26(8): 646–655. https://doi.org/10.1002/dmrr.1133 PMID: 20922819

12. Bereczki D, Vastagh I. The clinical significance of peripheral and central blood pressure form the neurologist's point of view. Hypertonia és nephrologia. 2011; 15(1): 11–15. Available from: https://lib.semmelweis.hu/sepub/pdf/2011/a83

13. Szőcs I, Bereczki D, Ajtay A, Oberfrank F, Vastagh I. Socioeconomic gap between neighborhoods of Budapest: Striking impact on stroke and possible explanations. PLoS ONE. 2019; 14(2): e0212519. https://doi.org/10.1371/journal.pone.0212519 PMID: 30785925

14. Prevolnik Rupel V, Divjak M, Zrubka Z, Rencz F, Gulácsi L, Golicki D, et al. EQ-5D studies in nervous system diseases in eight Central and East European countries: a systematic literature review. Eur J Health Econ. 2019; 20(Suppl 1): 109–117. https://doi.org/10.1007/s10198-019-01068-9 PMID: 31098882

15. Häkkinen U, Iversen T, Peltola M, Seppälä TT, Malmivaara A, Belicza É, et al. Health care performance comparison using a disease-based approach: the EuroHOPE project. Health Policy. 2013; 112(1–2): 100–109. https://doi.org/10.1016/j.healthpol.2013.04.013 PMID: 23680074

16. Malmivaara A, Meretoja A, Peltola M, Numerato D, Heijink R, Engelfriet D, et al. Comparing ischemic stroke in six European countries. The EuroHOPE register study. Eur J Neurol. 2015; 22(2): 284–291. https://doi.org/10.1111/ene.12560 PMID: 25196190

17. EuroHope. Atlas Map Reports EuroHOPE. 2016 [cited 25 Aug 2020]. Available from: http://www.eurohope.info/map/atlas.html

18. Szőcs I, Szatmári S, Fekete K, Orbán-Kis K, Vastagh I, Folyovich A, et al. One-year follow-up after stroke. A preliminary feasibility study in Josephtown of Budapest. Ideggyogy Sz. 2012; 65: 107–112. Hungarian. PMID: 23136728

19. Folyovich A, Vastagh I, Kéri A, Majoros A, Koppány LK, Ajtay A, et al. Living standard is related to microregional differences in stroke characteristics within one city: the Budapest Districts 8–12 Project. Int J Public Health. 2015; 60: 487–494. https://doi.org/10.1007/s00038-015-0674-y PMID: 25850531

20. Malmivaara A.: EuroHOPE stroke: material, methods and indicators. EuroHOPE Discussion Papers No. 6. 2013. Nov 21. [cited: 25 Aug 2020]. Available from: http://www.eurohope.info/doc/EHDP6_Stroke.pdf.

21. Brott T, Adams HP Jr, Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: a clinical examination scale. Stroke 1989; 20: 864–870. https://doi.org/10.1161/01.str.20.7.864 PMID: 2749846

22. Rankin J. Cerebral vascular accidents in patients over the age of 60. II. Prognosis. Scott Med J. 1957; 2 (5): 200–215. https://doi.org/10.1177/003693305700200504 PMID: 13432835

23. Adams HP, Davis PH, Leira EC, Chang KC, Bendixen BH, Clarke WR, et al. Baseline NIH Stroke Scale score strongly predicts outcome after stroke—A report of the Trial of Org 10172 in Acute Stroke Treatment (TOAST). Neurology. 1999; 53(1): 126–131. https://doi.org/10.1212/wnl.53.1.126 PMID: 10408548

24. Herdman M, Gudex C, Lloyd A, Janssen MF, Kind P, Parkin D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). Qual Life Res. 2011; 20(10): 1727–1736. https://doi.org/10.1007/s11136-011-9903-x PMID: 21479777

25. Sintonen H. The 15D-measure of health-related quality of life. I. Reliability, validity and sensitivity of its health state descriptive system. National Centre for Health Program Evaluation, Working Paper 41, Melbourne 1994 [cited 25 Aug 2020]. Available from: https://www.monash.edu/__data/assets/pdf_file/0007/886633/wp41-1.pdf

26. Sintonen H. The 15D instrument of health-related quality of life: properties and applications. Ann Med. 2001; 33(5): 328–336. https://doi.org/10.3109/07853890109002086 PMID: 11491191

27. Golicki D, Niewada M, Buczek J, Karlinska A, Kobayashi A, Janssen MF, et al. Validity of the EQ-5D-5L in stroke patients. Value Health. 2014; 17(7): A570. https://doi.org/10.1016/j.jval.2014.08.1906 PMID: 27201901

28. Vainiola T, Pettilä V, Roine RP, Räsänen P, Rissanen AM, Sintonen H. Comparison of two utility instruments, the EQ-5D and the 15D, in the critical care setting. Intensive Care Med. 2010; 36(12): 2090–2093. https://doi.org/10.1007/s00134-010-1979-1 PMID: 20689933

29. Saarni S, Harkanen T, Sintonen H, Suvisaari J, Koskinen S, Aromaa A et al. The impact of 29 chronic conditions on health-related quality of life: A general population survey in Finland using 15D and EQ-5D. Qual Life Res. 2006; 15: 1403–1414. https://doi.org/10.1007/s11136-006-0020-1 PMID: 16960751

30. Vartiainen P, Mäntyselkä P, Heiskanen T, Hagelberg N, Mustola S, Forssell H, et al. Validation of EQ-5D and 15D in the assessment of health-related quality of life in chronic pain. Pain. 2017; 158(8): 1577–1585. https://doi.org/10.1097/j.pain.0000000000000954 PMID: 28715354

31. Moock J, Kohlmann T. Comparing preference-based quality-of-life measures: Results from rehabilitation patients with musculoskeletal, cardiovascular, or psychosomatic disorders. Qual Life Res. 2008; 17 (3): 485–495. https://doi.org/10.1007/s11136-008-9317-6 PMID: 18288590

32. Kontodimopoulos N, Pappa E, Chadjiapostolou Z, Arvanitaki E, Papadopoulos AA, Niakas D. Comparing the sensitivity of EQ-5D, SF-6D and 15D utilities to the specific effect of diabetic complications Eur J Health Econ. 2012; 13(1): 111–120. https://doi.org/10.1007/s10198-010-0290-y PMID: 21132558

33. Heiskanen J, Tolppanen AM, Roine RP, Hartikainen J, Hippeläinen M, Miettinen H, et al. Comparison of EQ-5D and 15D instruments for assessing the health-related quality of life in cardiac surgery patients. Eur Heart J Qual Care Clin Outcomes. 2016; 2: 193–200. https://doi.org/10.1093/ehjqcco/qcw002 PMID: 29342253

34. Sintonen H. Comparing properties of the 15D and the EQ-5D in measuring health-related quality of life. Arch Hell Med. 2001; 18(2): 156–160. Available from: http://www.mednet.gr/archives/2001-2/pdf/156.pdf

35. Richardson J, Iezzi A, Khan MA. Why do multi-attribute utility instruments produce different utilities: the relative importance of the descriptive systems, scale and 'micro-utility' effects. Qual Life Res. 2015; 24 (8): 2045–2053. https://doi.org/10.1007/s11136-015-0926-6 PMID: 25636660

36. Feeny D, Furlong W, Torrance GW. Commentary. In praise of studies that use more than one generic preference-based measure. Int J Technol Assess Health Care. 2019; 35(4): 257–262. https://doi.org/10.1017/S0266462319000412 PMID: 31296277

37. EORTC QOL Group. EORTC-PATSAT32. [cited: 25 Aug 2020] Available from: https://www.eortc.org/app/uploads/sites/2/2018/08/Specimen-IN-PATSAT32-English.pdf

38. Greenhill B, Ward MD, Sacks A. The separation plot: A new visual method for evaluating the fit of binary models. AJPS 2011; 55(4): 991–1002. https://doi.org/10.1111/j.1540-5907.2011.00525.x

39. Andersen KK, Andersen ZJ, Olsen TJ. Predictors of early and late case-fatality in a nationwide Danish study of 26 818 patients with first-ever ischemic stroke. Stroke. 2011; 42: 2806–2812. https://doi.org/10.1161/STROKEAHA.111.619049 PMID: 21817152

40. Bentsen L, Christensen L, Christensen A, Christensen H. Outcome and risk factors presented in old patients above 80 years of age versus younger patients after ischemic stroke. J Stroke Cerebrovasc Dis. 2014; 23: 1944–1948. https://doi.org/10.1016/j.jstrokecerebrovasdis.2014.02.002 PMID: 24794945

41. Redfors P, Isaksén D, Lappas G, Blomstrand C, Rosengren A, Jood K et al. Living alone predicts mortality in patients with ischemic stroke before 70 years of age: a long-term prospective follow-up study. BMC Neurol. 2016; 16: 80. https://doi.org/10.1186/s12883-016-0599-y PMID: 27411309

42. Mahesh PKB, Gunathunga MW, Jayasinghe S, Arnold SM, Liyanage SN. Factors influencing pre-stroke and post-stroke quality of life among stroke survivors in a lower middle-income country. Neurol Sci. 2018; 39(2): 287–295. https://doi.org/10.1007/s10072-017-3172-6 PMID: 29103178

43. Westerlind E, Singh R, Persson HC, Sunnerhagen KS. Experienced pain after stroke: a cross-sectional 5-year follow-up study. BMC Neurol. 2020; 20(1): 4. https://doi.org/10.1186/s12883-019-1584-z PMID: 31910805

44. Janssen B, Szende A. Population norms for the EQ-5D. In: Szende A, Janssen B, Cabases J, eds. Self-Reported Population Health: An International Perspective based on EQ-5D. Dordrecht (NL): Springer; 2014,19–30. https://doi.org/10.1007/978-94-007-7596-1_3

45. Betts MB, Rane P, Bergrath E, Chitnis M, Bhutani MK, Gulea C, et al. Utility value estimates in cardiovascular disease and the effect of changing elicitation methods: a systematic literature review. Health Qual Life Outcomes. 2020; 18(1): 251. https://doi.org/10.1186/s12955-020-01407-y PMID: 32718355

46. Sand KM, Wilhelmsen G, Naess H, Midelfart A, Thomassen L, Hoff JM. Vision problems in ischaemic stroke patients: effects on life quality and disability. Eur J Neurol. 2016; 23(Suppl 1): 1–7. https://doi.org/10.1111/ene.12848 PMID: 26563092

47. Lunde L. Can EQ-5D and 15D be used interchangeably in economic evaluations? Assessing quality of life in post-stroke patients. Eur J Health Econ. 2013; 14(3): 539–550. https://doi.org/10.1007/s10198-012-0402-y PMID: 22678657

48. Sallinen H, Sairanen T, Strbian D. Quality of life and depression 3 months after intracerebral hemorrhage. Brain Behav. 2019; 9(5): e01270. https://doi.org/10.1002/brb3.1270 PMID: 30907075

49. Mouelhi Y, Jouve E, Castelli C, Gentile S. How is the minimal clinically important difference established in health-related quality of life instruments? Review of anchors and methods. Health Qual Life Outcomes. 2020; 18(1): 136. https://doi.org/10.1186/s12955-020-01344-w PMID: 32398083

50. Feeny D. Preference-based measures: utility and quality-adjusted life years. In: Fayers P, Hays R, editors. Assessing Quality of Life in Clinical Trials, vol. 2. 2nd ed. New York: Oxford University Press; 2005; 406–429.

51. Walters SJ, Brazier JE. Comparison of the minimally important difference for two health state utility measures: EQ-5D and SF-6D. Qual Life Res. 2005; 14(6): 1523–1532. https://doi.org/10.1007/s11136-004-7713-0 PMID: 16110932

52. Kim SK, Kim SH, Jo MW, Lee SI. Estimation of minimally important differences in the EQ-5D and SF-6D indices and their utility in stroke. Health Qual Life Outcomes. 2015; 13: 32. https://doi.org/10.1186/s12955-015-0227-3 PMID: 25889191

53. Chen P, Lin KC, Liing RJ, Wu CY, Chen CL, Chang KC. Validity, responsiveness, and minimal clinically important difference of EQ-5D-5L in stroke patients undergoing rehabilitation. Qual Life Res. 2016; 25(6): 1585–1596. https://doi.org/10.1007/s11136-015-1196-z PMID: 26714699

54. Alanne S, Roine RP, Räsänen P, Vainiola T, Sintonen H. Estimating the minimum important change in the 15D scores. Qual Life Res. 2015; 24(3): 599–606. https://doi.org/10.1007/s11136-014-0787-4 PMID: 25145637

55. Carod-Artal FJ, Egido JA. Quality of life after stroke: the importance of a good recovery. Cerebrovasc Dis. 2009; 27(1): 204–214. https://doi.org/10.1159/000200461 PMID: 19342853

56. Opara JA, Jaracz K. Quality of life of post-stroke patients and their caregivers. J Med Life. 2010; 3(3): 216–220. PMID: 20945810

57. Tu HT, Campbell BC, Christensen S, Desmond PM, De Silva DA, Parsons MW, et al on behalf of EPI-THET-DEFUSE Investigators. Worse stroke outcome in atrial fibrillation is explained by more severe

hypoperfusion, infarct growth, and hemorrhagic transformation. Int J Stroke. 2015; 10(4): 534–540. https://doi.org/10.1111/ijs.12007 PMID: 23489996

58. King RB. Quality of life after stroke. Stroke. 1996; 27: 1467–1472. https://doi.org/10.1161/01.str.27.9.1467 PMID: 8784114

59. Fjaertoft H, Indredavik B, Johnsen R, Lydersen S. Acute stroke unit care combined with early supported discharge. Long-term effects on quality of life. A randomized controlled trial. Clin Rehabil. 2004; 18(5): 580–586. https://doi.org/10.1191/0269215504cr773oa PMID: 15293492

60. Cumming TB, Churilov L, Collier J, Donnan G, Ellery F, Dewey H, et al, AVERT Trial Collaboration group. Early mobilization and quality of life after stroke: Findings from AVERT. Neurology. 2019; 93(7): e717–e728. https://doi.org/10.1212/WNL.0000000000007937 PMID: 31350296

61. Elwood D, Rashbaum I, Bonder J, Pantel A, Berliner J, Yoon S, et al. Length of stay in rehabilitation is associated with admission neurologic deficit and discharge destination. PM R. 2009; 1: 147–151. https://doi.org/10.1016/j.pmrj.2008.10.010 PMID: 19627888

62. Brown A, Therneau TM, Schultz TM, Niewczyk PM, Granger CV. Measure of functional independence dominates discharge outcome prediction after inpatient rehabilitation for stroke. Stroke. 2015; 46: 1038–1044. https://doi.org/10.1161/STROKEAHA.114.007392 PMID: 25712941

63. Owolabi MO. What are the consistent predictors of generic and specific post-stroke health-related quality of life? Cerebrovasc Dis. 2010; 29: 105–110. https://doi.org/10.1159/000262305 PMID: 19955733

64. Lopez-Espuela F, Zamorano JD, Ramírez-Moreno JM, Jiménez-Caballero PE, Portilla-Cuenca JC, Lavado-García JM, et al. Determinants of quality of life in stroke survivors after 6 months, from a comprehensive stroke unit: a longitudinal study. Biol Res Nurs. 2015; 5: 461–468. https://doi.org/10.1177/1099800414553658 PMID: 25294362

65. Deutsch A, Granger CV, Heinemann AW, Fiedler RC, Dejong G, Kane RL, et al. Poststroke rehabilitation: outcomes and reimbursement of inpatient rehabilitation facilities and subacute rehabilitation programs. Stroke. 2006; 37: 1477–1482. https://doi.org/10.1161/01.STR.0000221172.99375.5a PMID: 16627797

66. Conroy BE, DeJong G, Horn SD. Hospital-based stroke rehabilitation in the United States. Top Stroke Rehabil. 2009; 16: 34–43. https://doi.org/10.1310/tsr1601-34 PMID: 19443346

67. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database Syst Rev. 2020; 4(4): CD000197. https://doi.org/10.1002/14651858.CD000197.pub3 PMID: 24026639

68. Hopman WM, Verner J. Quality of life during and after inpatient stroke rehabilitation. Stroke. 2003; 34: 801–805. https://doi.org/10.1161/01.STR.0000057978.15397.6F PMID: 12624313

69. Early Supported Discharge Trialists. Services for reducing duration of hospital care for acute stroke patients. Cochrane Database Syst Rev. 2005;(2): CD000443. https://doi.org/10.1002/14651858.CD000443.pub2 PMID: 15846604

70. Langhorne P, Baylan S; Early Supported Discharge Trialists. Early supported discharge services for people with acute stroke. Cochrane Database Syst Rev. 2017; 7: CD000443. https://doi.org/10.1002/14651858.CD000443.pub4 PMID: 28703869

71. Twigg AR, Cifu DX, Keyser-Marcus L, Swartz Z. The association between gender, race and marital status on functional outcome at rehabilitation discharge after thromboembolic stroke: a prospective analysis. NeuroRehabilitation. 1998; 11: 249–254. https://doi.org/10.3233/NRE-1998-11308 PMID: 24525927

72. Ween JE, Mernoff ST, Alexander MP. Recovery rates after stroke and their impact on outcome prediction. Neurorehabil Neural Repair. 2000; 14: 229–235. https://doi.org/10.1177/154596830001400309 PMID: 11272480

73. Nunes HJ, Queirós PJ. Patient with stroke: hospital discharge planning, functionality and quality of life. Rev Bras Enferm. 2017; 70(2): 415–423. https://doi.org/10.1590/0034-7167-2016-0166 PMID: 28403308

74. Hall JA, Dornan MC. Patient sociodemographic characteristics as predictors of satisfaction with medical care: a meta-analysis. Soc Sci Med. 1990; 30: 811–818. https://doi.org/10.1016/0277-9536(90)90205-7 PMID: 2138357

75. Tucker JL 3rd, Kelley VA. The influence of patient sociodemographic characteristics on patient satisfaction. Mil Med. 2000; 165: 72–76. PMID: 10658433

76. Holmqvist LW, Koch L, Pedro-Cuesta J. Use of healthcare, impact on family caregivers and patient satisfaction of rehabilitation at home after stroke in Southwest Stockholm. Scand J Rehab Med. 2000; 32: 173–179. https://doi.org/10.1080/003655000750060922 PMID: 11201624

77. Aiken LH, Sermeus W, Van den Heede K, Sloane DM, Busse R, McKee M et al. Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in

Europe and the United States. BMJ. 2012; 344: e1717. https://doi.org/10.1136/bmj.e1717 PMID: 22434089

78. Chumbler NR, Li X, Quigley P, Morey MC, Rose D, Griffiths P, Sanford J, et al. A randomized controlled trial on stroke telerehabilitation: The effects on falls self-efficacy and satisfaction with care. J Telemed Telecare. 2015; 21: 139–143. https://doi.org/10.1177/1357633X15571995 PMID: 25680390

79. Katzan IL, Schuster A, Bain M, Lapin B. Clinical symptom profiles after mild-moderate stroke. J Am Heart Assoc. 2019; 8(11):e012421. https://doi.org/10.1161/JAHA.119.012421 PMID: 31131666