Health-related Quality of Life using WHODAS 2.0 and associated Factors 1 year after Stroke in Korea: a Multi-center and Cross-sectional Study

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Abstract

Background: The self-perceived level of disability for stroke survivors in community is little known. We aimed to characterize HRQoL 1 year after stroke and to investigate how socio-demographic and stroke-related factors and medical adherence explain the self-perceived level of disability among a Korean stroke population.

Methods: This study was a multi-center and cross-sectional study. A total of 382 ischemic stroke survivors at 1 year after onset recruited from 11 university hospitals underwent a one-session assessment including: socioeconomic variables, the modified Rankin Scale (mRS), various neurological sequelae, the modifed Morisky scale (MMS), and the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 36-items. The relationship between disability and different variables was analyzed using ordinal logistic regression.

Results: The prevalence of disability by global WHODAS 2.0 score was 62.6% (41.6% for mild; 16.0% for moderate; 5.0% for severe) in subjects. Prevalence of severe disability was higher in *Participation in society* (16.8%) and *Getting around* (11.8%) than in the other domains. Low MMS motivation was the only factor determining the significant association between all six domains of disability after adjustment. Different predictors for specific domains were age, mRS, dysarthria, trouble seeing, cognition problem and MMS-motivation for *Understanding and communicating*; age, recurrent stroke, mRS, hemiplegia, facial palsy, general weakness and MMS-motivation for *Getting around*; age, education, mRS, hemiplegia and MMS-motivation for *Self-care*; education, recurrent stroke, hemiplegia, dysarthria and MMS-motivation for *Getting along with people*; age, education, income, mRS, hemiplegia, dysarthria, MMS-knowledge and MMS-motivation for *Life activities*; living without spouse, mRS, hemiplegia, dysarthria, trouble seeing, cognition problem, general weakness and MMS-motivation for *Participation in society*.

Conclusions: Self-perceived disability by the WHODAS 2.0 had almost double the prevalence compared to hemiplegia, one of the most common neurological sequelae 1 year after stroke. Each domain of disability increased with various associated factors. Interventions promoting medical adherence of motivation seem to help high HRQoL in all domains.

Introduction

Stroke is common and serious non-communicable health problem. It is the second cause of mortality [1] and the third cause of disability-adjusted life years (DALYs) [2] in the world. In Korea, the Epidemiologic Research Council of the Korean Stroke Society reported an age- and sex-standardized incidence of first ever stroke of 92.2 per 100,000 populations in 2013, an age-standardized prevalence of stroke of 1.37% in Korean adults aged over 19 years in 2014, and an age-standardized stroke mortality of 29.6 per 100,000 populations in 2015 [3]. Stroke was the third leading cause of DALYs in Korea, following diabetes mellitus and low back pain in 2012 [4].

When stroke survivors suffer from becoming disabled related with neurological sequelae, outcome assessment of acute stroke traditionally focuses on prevention of deaths, alleviation of symptoms, impairments, and restoration of function [5]. However, health related quality of life (HRQoL) measures may capture patients' perception on disability better than traditional ways. Not only because they are multidimensional instruments which comprise functional, physical, cognitive, psychological and social elements [6] but also because the impact of limitation following stroke on well-being may differ by each patient [7]. Furthermore, they reflect health from patients' own perspectives [8].

WHODAS 2.0 is a generic instrument of HRQoL for measuring function and disability in major life domains linked to the International Classification of Functioning, Disability and Health (ICF). It is reliable and applicable across cultures in adult populations [9–12].

In Korea, the level of disability for stroke survivors in community is little known. We aimed to characterize HRQoL 1 year after stroke using WHODAS 2.0 and to investigate how socio-demographic, stroke-related factors and medical adherence explain the self-perceived level of disability among a Korean stroke population.

Methods

Study design and population

This study was a multi-center and cross-sectional study conducted across the period, December 2015 - March 2016. A total of 426 participants were recruited from the neurology outpatient clinics from the 11 university hospitals designated as Regional Cardiocerebrovascular Centers (RCCs) in Korea (Daegu-Gyeongbuk, Gangwon, Jeju, Chungbuk, Gwangju-Jeonnam, Gyeongnam, Daejeon-Chungnam, Jeonbuk, Busan-Ulsan, Inchoen, and Gyeongi RCC) [13]. Participants were stroke survivors who had been admitted to one of the RCC hospitals due to acute ischemic stroke occurred 12 to 15 months before the interview and were willing to be informants. A one-on-one interview was conducted by trained nurses at the 11 hospitals using a structured questionnaire. Patients who were unable to communicate independently were excluded. Written informed consent was obtained from all participants. The study protocol was approved by the institutional review board of Kangwon National University Hospital.

Measurement

Socio-demographic factors and stroke-related data

Data on socio-demographic and stroke-related characteristics were collected. The common socio-demographic variables on general characteristics were sex, age, live with spouse or not, highest education qualification (elementary school /middle school /high school/college and above) and monthly household income (1 and less/1 to 2/more than 2 million Korea won; 1.2 million Korea won≒1,000 USD). And, the stroke-related variables were recurrent or first-ever

stroke, modified Rankin Score (mRS), Complications after stroke (hemiplegia, dysarthria, facial palsy, trouble seeing, paresthesia, cognition problem, general weakness) [14]. The mRS is robust and the most commonly recommended functional measure in acute stroke research [5, 7, 14]. We categorized mRS into 'normal to mild' with score range from 0 to 2 and 'moderate to severe' from 3 to 5.

Self-reported Medication adherence

The Morisky Scale is self-reported measure of medication adherence. It had been originally developed to predict the adherence of outpatients to antihypertensive medications with four items in the mid-1980s [15]. Modified Morisky Scale (MMS) has 6 items measuring two domains of adherence (knowledge and motivation). Three items as 'When you feel better do you sometimes stop taking your medicine?', 'Sometimes if you feel worse when you take your medicine, do you stop taking it?', 'Do you know the long-term benefit of taking your medicine as told to you by your doctor or pharmacist?' are for knowledge and the other 3 items as 'Do you ever forget to take your medicine?', 'Are you careless at times about taking your medicine?', 'Sometimes do you forget to refill your prescription medicine on time?' are for motivation. Each item has the score of 0 or 1 and a higher score indicates high adherence, and MMS score can be categorized into 'low' with score range from 0 to 1 and 'high' from 2 to 3 for each subdomain [16].

Health-related quality of life (HRQoL)

We measured HRQoL of 12 to 15 month post-ischemic stroke patients with the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0), a standardized cross-cultural measurement of disability [9]. The WHODAS 2.0 questionnaire has several forms according to number of items, administration, and respondent. We used the WHODAS 2.0, 36-items covering six domains of functioning: *understanding and communicating* (UAC, 6 items), *getting around* (GAR, 5 items), *self-care* (SAC, 4 items), *getting along with people* (GAP, 5 items), *life activities* (LAC, 8 items), and *participation in society* (PSO, 8 items) [10]. We computed 6 domain-specific scores using 36-item complex scoring. Score ranged from 0 to 100, a higher score indicates greater disability like lower QoL [10]. WHODAS 2.0 domain-specific and global scores were originally categorized as 5 grades: no problem (0–4%), mild disability (5–24%), moderate disability (25–49%), severe disability (50–95%), and extreme disability (96–100%). In fact, there were few subjects with extreme disability in this study, so the 5 groups were collapsed into 4: no, mild, moderate, and severe disability. Reliability and validity of Korean version has been established [17].

Statistical analysis

We analyzed data from 382 participants who had completed all the assessments. For descriptive purposes, absolute numbers and percentages were calculated for categorical variables and means ± SDs for continuous variable. The 6 domain-specific scores of WHODAS 2.0 were separately treated as dependent variables. As we had categories for the dependent variable that were ordered, ordinal logistic regression was used. The link function used for model fitting was logit. The evaluating overall model fit to the data was done through the Model Fitting Information. It is determined that a model exhibits good fit to the data when a significant improvement in fit of the final model containing full set of independent variables over the null model. A parallel line test confirmed that the proportional odds assumption was satisfied for every model for ordinal logistic regression. Every estimated ordinal logistic regression coefficient was transformed into odds ratio, as the exponential of a particular coefficient is an estimate of the odds ratio. Data analyses were performed using SPSS version 24.0 (SPSS Inc., Chicago, IL, USA) and p-value under 0.05 is considered as statistically significant.

Results

Participants' characteristics

Table 1 showed that the participants were relatively elderly (mean age ± SD, 65.7 ± 12.2 years). Among 382 participants, 138 (36.1%) were female. Most of the participants (272, 71.2%) were living with spouse. As for their highest academic qualification, 144 (37.7%) were elementary school, 68 (17.8%) were middle school, 105 (27.5%) were high school and 65 (17.0%) were college and above. Additionally, 148 (38.7%) had a monthly family income of less than 1,000,000 Korean won.

Table 1
General characteristics of the participants (N = 382)

Characteristics	N (%)
Age	65.7 ± 12.2 years
Sex: Female	138 (36.1%)
Living with spouse	272 (71.2%)
Highest academic qualification	
Elementary school	144 (37.7%)
Middle school	68 (17.8%)
High school	105 (27.5%)
College and above	65 (17.0%)
Monthly family income (Korean won) [a]	
1,000,000 and less	148 (38.7%)
More than 1,000,000 to 2,000,000	93 (24.3%)
More than 2,000,000	141 (36.9%)
[a] 1.2 million Korean won ≒1,000 USD	

The participants' stroke-related characteristics were shown that 319 (83.5%) had experienced stroke attack only once. 332 (86.9%) counted normal to moderate level in mRS. And Hemiplegia (129, 33.8%) and Dysarthria (92, 24.1%) were the most frequent complications overall. The level of self-reported medication adherence in MMS-knowledge was higher than in MMS-motivation. 370 (96.9%) showed high level in the MMS knowledge and 331 (86.6%) in the MMS motivation (Table 2).

Table 2
Stroke-related characteristics and medication adherence of the participants

Characteristics	N (%)
First-ever stroke	319 (83.5%)
mRS [a]	
Normal to mild	332 (86.9%)
Moderate to severe	50 (13.1%)
Complication after stroke	
Hemiplegia	129 (33.8%)
Dysarthria	92 (24.1%)
Facial palsy	13 (3.4%)
Trouble seeing	17 (4.5%)
Paresthesia	13 (3.4%)
Cognition problem	10 (2.6%)
General weakness	15 (3.9%)
MMS knowledge	
Low	12 (3.1%)
High	370 (96.9%)
MMS motivation	
Low	51 (13.4%)
High	331 (86.6%)
[a] Normal to mild mRS < 3; moderate to severe mRS ≥ 3	

Domain-specific levels of WHODAS and associated factors

Among 382 participants, prevalence by WHODAS 2.0 level was 37.4% for no (disability-free), 41.6% for mild, 16.0% for moderate, and 5.0% for severe disability in Global scores. The breakdown by domain also shows that prevalence decreased with severity. People with no disability was relatively common in SCA (63.6%) and GAP (51.6%), whereas the prevalence for severe disability was higher in PSO (16.8%) and GAR (11.8%) than in the other domains of WHODAS 2.0 (Fig. 1).

Table 3 showed associations between different variables and disability in domain-specific WHODAS 2.0 scores. The aORs obtained from ordinal logistic regression models for different variables represent disability in the index group compared with that in the reference group. The results for domain-specific scores were adjusted for the 5 demographic, 9 stroke-related and 2 medication adherence variables.

Table 3
Association between WHODAS 2.0 domains and selected variables

Variable	UAC				GAR				SCA			
	aOR	(95% CI)		P	aOR	(95% CI)		P	aOR	(95% CI)		
Age (years)	**1.03**	**(1.01 - 1.05)** [a]		**0.010**	**1.06**	**(1.04 - 1.09)**		**< 0.001**	**1.07**	**(1.04 - 1.10)**		
Sex: female	1.21	(0.77 - 1.90)		0.404	1.25	(0.79 - 1.97)		0.339	0.86	(0.50 - 1.48)		
Living without spouse	0.97	(0.61 - 1.56)		0.915	1.05	(0.66 - 1.69)		0.826	1.44	(0.84 - 2.47)		
Highest academic qualification												
Elementary school	1.44	(0.68 - 3.06)		0.344	0.80	(0.38 - 1.70)		0.565	1.30	(0.50 - 3.34)		
Middle school	2.07	(0.96 - 4.45)		0.063	0.91	(0.42 - 1.94)		0.799	**2.66**	**(1.02 - 6.92)**		
High school	1.32	(0.66 - 2.63)		0.434	0.84	(0.43 - 1.66)		0.617	**2.92**	**(1.20 - 7.12)**		
College and above			1				1				1	
Monthly family income (10,000won)												
100 and less	0.73	(0.43 - 1.24)		0.243	1.10	(0.63 - 1.87)		0.733	1.58	(0.86 - 2.93)		
100 to 200	1.30	(0.77 - 2.18)		0.039	1.10	(0.65 - 1.86)		0.996	1.25	(0.69 - 2.30)		
More than 200			1				1				1	
Recurrent stroke	1.22	(0.71 - 2.11)		0.465	**1.88**	**(1.08 - 3.26)**		**0.024**	1.42	(0.78 - 2.59)		
mRS[b]												
Normal to mild			1				1				1	
Moderate to severe	**4.04**	**(2.06 - 7.93)**		**< 0.001**	**8.27**	**(4.03 - 16.96)**		**< 0.001**	**11.60**	**(5.50 - 24.46)**		
Complication after stroke												
Hemiplegia	1.41	(0.87 - 2.28)		0.159	**3.86**	**(2.37 - 6.27)**		**< 0.001**	**5.32**	**(3.06 - 9.28)**		
Dysarthria	**1.88**	**(1.17 - 3.03)**		**0.010**	1.32	(0.81 - 2.15)		0.263	1.16	(0.67 - 1.98)		
Facial palsy	2.76	(0.95 - 8.02)		0.063	**4.85**	**(1.55 - 15.21)**		**0.007**	1.70	(0.53 - 5.42)		
Trouble seeing	**2.86**	**(1.11 - 7.38)**		**0.030**	1.44	(0.52 - 4.00)		0.480	1.97	(0.66 - 5.84)		
Paresthesia	0.86	(0.26 - 2.79)		0.800	2.31	(0.76 - 7.02)		0.140	2.00	(0.48 - 8.23)		
Cognition problem	**5.59**	**(1.61 - 19.38)**		**0.007**	0.65	(0.18 - 2.32)		0.506	1.30	(0.33 - 5.15)		
General weakness	2.46	(0.88 - 6.88)		0.085	**3.19**	**(1.14 - 8.93)**		**0.027**	0.98	(0.24 - 3.93)		
MMS knowledge[c]												
Low	2.15	(0.68 - 6.75)		0.191	2.24	(0.72 - 7.00)		0.164	2.93	(0.87 - 9.86)		

UAC = Understanding and communicating; GAR = Getting around; SCA = Self-care; GAP = Getting along with people; LAC = Life activities; PSO = Participation ir
MMS = Modified Morisky Scale. [a] Adjusted odds ratios (95% confidence interval) from ordinal logistic regression models were estimated using age, sex, living
spouse, education level, family income level, recurrent stroke, mRS, hemiplegia, dysarthria, facial palsy, trouble seeing, paresthesia, cognition problem, genera
weakness, MMS knowledge and MMS motivation. [b] Normal to mild mRS < 3; moderate to severe mRS ≥ 3. [c] Low MMS knowledge (or motivation) < 2; high MI
knowledge (or motivation) ≥ 2.

Variable	UAC			GAR			SCA		
	aOR	(95% CI)	P	aOR	(95% CI)	P	aOR	(95% CI)	
High	1			1			1		
MMS motivation[c]									
Low	3.12	(1.75 - 5.55)	< 0.001	3.22	(1.78 - 5.80)	< 0.001	2.88	(1.52 - 5.46)	
High	1			1		.	1		

UAC = Understanding and communicating; GAR = Getting around; SCA = Self-care; GAP = Getting along with people; LAC = Life activities; PSO = Participation ir
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weakness, MMS knowledge and MMS motivation. [b] Normal to mild mRS < 3; moderate to severe mRS ≥ 3. [c] Low MMS knowledge (or motivation) < 2; high MI
knowledge (or motivation) ≥ 2.

Table 3
Association between WHODAS 2.0 domains and selected variables (continued)

Variable	GAP				LAC				PSO			
	aOR	(95% CI)		P	aOR	(95% CI)		P	aOR	(95% CI)		
Age (years)	1.02	(1.00 - 1.04)		0.051	**1.05**	**(1.03 - 1.07)**		**< 0.001**	1.00	(0.98 - 1.02)		
Sex: female	1.34	(0.85 - 2.11)		0.208	1.42	(0.89 - 2.29)		0.146	1.13	(0.73 - 1.76)		
Living without spouse	0.70	(0.43 - 1.13)		0.141	1.04	(0.64 - 1.70)		0.871	**1.76**	**(1.11 - 2.80)**		
Highest academic qualification												
Elementary school	1.59	(0.74 - 3.40)		0.235	1.28	(0.57 - 2.86)		0.543	1.07	(0.52 - 2.21)		
Middle school	**2.17**	**(1.01 - 4.67)**		**0.048**	**2.23**	**(1.00 - 5.01)**		**0.051**	1.24	(0.60 - 2.58)		
High school	1.58	(0.80 - 3.14)		0.188	1.70	(0.82 - 3.54)		0.155	1.22	(0.65 - 2.30)		
College and above		1				1				1		
Monthly family income (10,000won)												
100 and less	1.34	(0.78 - 2.29)		0.292	**1.77**	**(1.01 - 3.11)**		**0.048**	1.16	(0.69 - 1.97)		
100 to 200	1.20	(0.70 - 2.04)		0.694	1.70	(0.98 - 2.96)		0.899	1.08	(0.64 - 1.83)		
More than 200		1				1				1		
Recurrent stroke	**1.72**	**(1.00 - 2.94)**		**0.049**	1.30	(0.74 - 2.28)		0.367	1.73	(1.00 - 3.01)		
mRS[b]												
Normal to mild		1				1				1		
Moderate to severe	1.03	(0.53 - 2.00)		0.924	**10.17**	**(4.84 - 21.35)**		**< 0.001**	**12.48**	**(5.77 - 27.00)**		
Complication after stroke												
Hemiplegia	**2.72**	**(1.68 - 4.42)**		**< 0.001**	**6.23**	**(3.74 - 10.38)**		**< 0.001**	**3.87**	**(2.38 - 6.28)**		
Dysarthria	**1.82**	**(1.13 - 2.94)**		**0.015**	**1.87**	**(1.14 - 3.06)**		**0.013**	**1.94**	**(1.19 - 3.18)**		
Facial palsy	1.56	(0.53 - 4.62)		0.418	2.36	(0.77 - 7.20)		0.131	1.94	(0.62 - 6.04)		
Trouble seeing	1.61	(0.61 - 4.26)		0.334	2.67	(0.97 - 7.39)		0.058	**5.45**	**(1.93 - 15.41)**		
Paresthesia	1.51	(0.48 - 4.78)		0.485	1.17	(0.32 - 4.25)		0.810	1.53	(0.51 - 4.58)		
Cognition problem	1.93	(0.56 - 6.63)		0.298	2.68	(0.77 - 9.31)		0.122	**6.06**	**(1.62 - 22.58)**		
General weakness	2.28	(0.81 - 6.43)		0.120	1.19	(0.37 - 3.84)		0.777	**3.88**	**(1.38 - 10.92)**		
MMS knowledge												
Low	2.23	(0.72 - 6.93)		0.164	**4.35**	**(1.31 - 14.44)**		**0.016**	2.19	(0.65 - 7.37)		

UAC = Understanding and communicating; GAR = Getting around; SCA = Self-care; GAP = Getting along with people; LAC = Life activities; PSO = Participation ir
MMS = Modified Morisky Scale. [a] Adjusted odds ratios (95% confidence interval) from ordinal logistic regression models were estimated using age, sex, living
spouse, education level, family income level, recurrent stroke, mRS, hemiplegia, dysarthria, facial palsy, trouble seeing, paresthesia, cognition problem, genera
weakness, MMS knowledge and MMS motivation. [b] Normal to mild mRS < 3; moderate to severe mRS ≥ 3. [c] Low MMS knowledge (or motivation) < 2; high MI
knowledge (or motivation) ≥ 2.

Variable	GAP			LAC			PSO		
	aOR	(95% CI)	P	aOR	(95% CI)	P	aOR	(95% CI)	
High	1			1			1		
MMS motivation									
Low	3.83	(2.16 - 6.82)	< 0.001	3.21	(1.76 - 5.82)	< 0.001	2.59	(1.42 - 4.70)	
High	1		.	1		.	1		

UAC = Understanding and communicating; GAR = Getting around; SCA = Self-care; GAP = Getting along with people; LAC = Life activities; PSO = Participation ir MMS = Modified Morisky Scale. [a] Adjusted odds ratios (95% confidence interval) from ordinal logistic regression models were estimated using age, sex, living spouse, education level, family income level, recurrent stroke, mRS, hemiplegia, dysarthria, facial palsy, trouble seeing, paresthesia, cognition problem, genera weakness, MMS knowledge and MMS motivation. [b] Normal to mild mRS < 3; moderate to severe mRS ≥ 3. [c] Low MMS knowledge (or motivation) < 2; high MI knowledge (or motivation) ≥ 2.

Age, mRS, dysarthria, trouble seeing, cognition problem and MMS-motivation were significant positive predictors of the disability of UAC in the model. For every one-year increase on age, the odds of being in more severe category on UAC was 1.03 times higher (p = 0.01). This indicated that a participant aged older was more likely to indicate greater disability of UAC. The odds of being in more severe level on UAC was 4.04 times higher for those who had the level of moderate to severe as compared to those who had the level of normal to mild in mRS (p < 0.001). And the odds of being in more severe level on UAC were 1.88, 2.86 and 5.59 times higher when a participant had the complication in dysarthria, trouble seeing and cognition problem, respectively (p = 0.01; 0.03; 0.007). In addition, the odds of being in more severe level on UAC was 3.12 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-motivation (p < 0.001).

Age, recurrent stroke, mRS, hemiplegia, facial palsy, general weakness and MMS-motivation were significant positive predictors of the disability of GAR in the model. For every one-year increase on age, the odds of being in more severe category on GAR was 1.06 times higher (p < 0.001). This indicated that a participant aged older was more likely to indicate greater disability of GAR. The odds of being in more severe level on GAR was 1.88 times higher for those who experienced recurrent stroke as compared to those who had experienced stroke attack only once (p = 0.024). The odds of being in more severe level on GAR was 8.27 times higher for those who had the level of moderate to severe as compared to those who had the level of normal to mild in mRS (p < 0.001). And the odds of being in a higher level on GAR were 3.86, 4.85 and 3.19 times higher when a participant had the complication in hemiplegia, facial palsy, and general weakness, respectively (p < 0.001; 0.007; 0.027). In addition, the odds of being in more severe level on GAR was 3.22 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-motivation (p < 0.001).

Age, highest academic qualification, mRS, hemiplegia and MMS-motivation were significant positive predictors of the disability of SCA in the model. For every one-year increase on age, the odds of being in more severe category on SCA was 1.07 times higher (p < 0.001). This indicated that a participant aged older was more likely to indicate greater disability of SCA. The odds of being in more severe level on SCA were 2.92 and 2.66 times higher for those who had their highest academic qualification as high and middle school, respectively as compared to those who had college and above (p = 0.018; 0.045). The odds of being in more severe level on SCA was 11.6 times higher for those who had the level of moderate to severe as compared to those who had the level of normal to mild in mRS (p < 0.001). And the odds of being in more severe level on SCA was 5.32 times higher when a participant had the complication in hemiplegia (p < 0.001). In addition, the odds of being in more severe level on SCA was 2.88 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-motivation (p = 0.001).

Highest academic qualification, recurrent stroke, hemiplegia, dysarthria and MMS-motivation were significant positive predictors of the disability of GAP in the model. The odds of being in more severe level on GAP was 2.17 times higher for those who had their highest academic qualification as middle school as compared to those who had college and above (p = 0.048). The odds of being in more severe level on GAP was 1.72 times higher for those who experienced recurrent stroke as compared to those who had experienced stroke attack only once (p = 0.049). And the odds of being in more severe level on GAP were 2.72 and 1.82 times higher when a participant had the complication in hemiplegia, and dysarthria, respectively (p < 0.001; 0.015). In addition, the odds of being in more severe level on GAP was 3.83 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-motivation (p < 0.001).

Age, highest academic qualification, monthly family income, mRS, hemiplegia, dysarthria, MMS-knowledge and MMS-motivation were significant positive predictors of the disability of LAC in the model. For every one-year increase on age, the odds of being in more severe category on LAC was 1.05 times higher (p < 0.001). This indicated that a participant aged older was more likely to indicate greater disability of LAC. The odds of being in more severe level on LAC was 2.23 times higher for those who had their highest academic qualification as middle school as compared to those who had college and above (p = 0.051). The odds of being in more severe level on LAC was 1.77 times higher for those who had their monthly family income as one million and less Korean won as compared to those who had more than two million and less Korean won (p = 0.048). The odds of being in more severe level on LAC was 10.17 times higher for those who had the level of moderate to severe as compared to those who had the level of normal to mild in mRS (p < 0.001). And the odds of being in more severe level on LAC were 6.23 and 1.87 times higher when a participant had the complication in hemiplegia, and dysarthria, respectively (p < 0.001; 0.013). In addition, the odds of being in more severe level on LAC was 4.35 and 3.21 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-knowledge and MMS-motivation, respectively (p = 0.016; <0.001).

Living without spouse, mRS, hemiplegia, dysarthria, trouble seeing, cognition problem, general weakness and MMS-motivation were significant positive predictors of the disability of PSO in the model. For living without spouse, the odds of being in more severe category on PSO was 1.76 times higher ($p = 0.017$). The odds of being in more severe level on PSO was 12.48 times higher for those who had the level of moderate to severe as compared to those who had the level of normal to mild in mRS ($p < 0.001$). And the odds of being in more severe level on PSO were 3.87, 1.94, 5.45, 6.06 and 3.88 times higher when a participant had the complication in hemiplegia, dysarthria, trouble seeing, cognition problem and general weakness, respectively ($p < 0.001$; 0.008; 0.001; 0.007; 0.010). In addition, the odds of being in more severe level on PSO was 2.59 times higher for those who showed low level of adherence to medication as compared to those who showed high in MMS-motivation ($p = 0.002$).

Discussion

To our knowledge, this is the first detailed and nationwide disability prevalence survey on ischemic stroke patients at 1 year after onset in Korea. The study shows that prevalence of disability based on the WHODAS 2.0 is 62.6% which is almost double compared to hemiplegia (33.8%), one of the most common neurological sequelae 1 year after stroke. And the prevalence of severe disability (the WHODAS 2.0 of 50 ~ 100%) is higher in PSO (16.8%) and GAR (11.8%) than in the other domains. It also demonstrates that each domain of disability increases with various associated factors. Particularly, age, recurrent stroke, moderate to severe mRS, hemiplegia and dysarthria are generally related to different domains of disability and low MMS motivation is the only modifiable factor determining the significant association between all six domains of disability after adjustment.

Concerning the personal background, age is associated with disability like as previous studies using WHODAS 2.0 [18–20]. Greater disability tends to increase as age goes higher. The elderly are more vulnerable to age-related comorbidity related with physical health problems [21]. However, even though the adjusted odds of being in a higher category on each domain except SCA is higher (aOR of 1.13 ~ 1.42) for female compared to male, these sex-related differences in WHODAS disability measurements are not significant. A Korean study previously has reported that male elderly stroke patients seem to be more vulnerable to self-care because of Korean tradition of the passive domestic role of male [19]. The Framingham study has reported that female with ischemic stroke is not functionally more disabled than male [21].

PSO is particularly limited by the most variables such as living without spouse, recurrent stroke, moderate to severe mRS, hemiplegia, dysarthria, trouble seeing, cognition problem, general weakness, and low MMS motivation. However, both LAC and GAP are associated only with hemiplegia and dysarthria among seven variables of neurological sequelae. This indicates PSO is not only about getting along with people either not only doing daily life. A prior study considers PSO as most problematic and important because this domain has involved the usage of complex skills and navigation in daily life [20].

Each neurological sequela is associated with different domains of WHODAS 2.0. For example, hemiplegia is associated with five domains except UAC; dysarthria with UAC, GAP, LAC, and PSO; trouble seeing with UAC and PSO; and general weakness with GAR and PSO. Therefore, a tailored support can be shaped such as home visiting, a comprehensive type for hemiplegia, and companion going out, a simpler type for general weakness. It would be reasonable to manage these supports according to periodically assessed HRQoL.

It is of interest and importance that low MMS motivation is significantly associated with all six domains of disability after adjustment (OR of 2.59 ~ 3.83) because this variable is modifiable and essential to prevention from repeating event. Medication adherence is usually known as the proportion of days covered (PDC), the percentage of medication actually taken of the prescribed doses [22], at 1 year after stroke. The Epidemiologic Research Council of the Korean Stroke Society reports a much lower adherence compared to a previous study from the US [23] (75% vs. 91% for lipid-lowering drugs, 74% vs. 91% for antidiabetic drugs, and 82% vs. 92% for antihypertensive drugs) [3]. Moreover, unlike MMS knowledge, MMS motivation is also associated with the adherence to lifestyle modification for risk reduction [24]. Such evidences imply that there is a substantial room of improvement on HRQoL for stroke survivors. It is necessary for stroke survivors to provide with interventions to improve MMS motivation by the specific methods such as a tailored education, computer-based education, mobile phone reminders.

This study has several limitations. Our participants are regarded as persons from higher socioeconomic status in Korean context, as it is likely that the affluent have regular outpatient follow-up at a particular university hospital. Thus, it is possible overall participants demonstrated mild deficits as well as better level of adherence to their medication compared with stroke survivors in the general population. There is also a possibility of selection bias from excluding the stroke survivor 1 year after event due to difficulties in the interview in spite that we tried to ensure stroke survivors with eligibility in the study. In addition, the WHODAS 2.0 covers mainly the activities and participation domains of the ICF, so there has been a need to be addressed for bodily impairments and environmental factors [9]. However, this study choose several bodily impairments related factors to be investigated such as hemiplegia, dysarthria, facial palsy and so on.

Conclusions

Self-perceived disability by the WHODAS 2.0 had almost double the prevalence compared to hemiplegia, one of the most common neurological sequelae 1 year after stroke. Each domain of disability increased with various associated factors. Interventions promoting medical adherence of motivation seem to help high HRQoL in all domains.

Declarations

Authors' contributions

All authors were responsible for the study hypothesis and the analytical methodology. HJL, KK, HKP, GWK, JK, BGK, YHL, HSJ, HL, WKL, and SK played a central role in collecting data from each center. HJL, JM, YKP and JKS performed the statistical analyses. The draft of the manuscript was written by HJL and

JKS. All authors contributed to the discussion as well as the process of review and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because an informed consent was not obtained from the participants during enrollment, but are available from the corresponding author at songj@jejunu.ac.kr on reasonable request.

Ethics approval and consent to participate

The study was approved by the institutional review board of Kangwon National University Hospital.

Consent for publication

Not applicable.

Competing interests

The authors of this paper declare no conflicts of interest.

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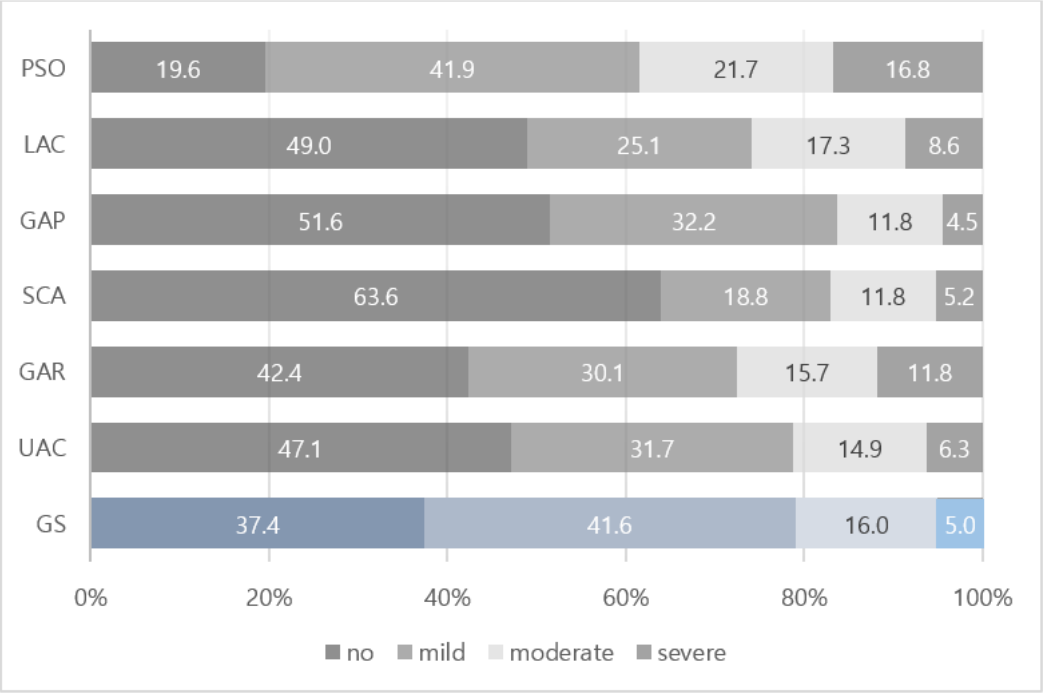
References

1. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, Abraham J, Adair T, Aggarwal R, Ahn SY. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2012;380(9859):2095–128.
2. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, Ezzati M, Shibuya K, Salomon JA, Abdalla S. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2012;380(9859):2197–223.
3. Kim JY, Kang K, Kang J, Koo J, Kim D, Kim BJ, Kim W, Kim E, Kim JG, Kim J. Executive summary of stroke statistics in Korea 2018: a report from the Epidemiology Research Council of the Korean Stroke Society. Journal of stroke. 2019;21(1):42.
4. Yoon J, Oh I, Seo H, Kim E, Gong Y, Ock M, Lim D, Lee WK, Lee Y, Kim D. Disability-adjusted life years for 313 diseases and injuries: the 2012 Korean burden of disease study. J Korean Med Sci. 2016;31(Suppl 2):146.
5. Ali M, Fulton R, Quinn T, Brady M, Steering Committees VISTA, VISTA-Acute:, Lees, Alexandrov KR, Bath A, Bluhmki PM. E: How well do standard stroke outcome measures reflect quality of life? A retrospective analysis of clinical trial data. Stroke. 2013;44(11):3161–5.
6. Kranciukaite D, Rastenyte D. Measurement of quality of life in stroke patients. Medicina. 2006;42(9):709–16.
7. Katzan IL, Thompson NR, Lapin B, Uchino K. Added value of patient-reported outcome measures in stroke clinical practice. Journal of the American Heart Association. 2017;6(7):e005356.
8. King RB. **Quality of life after stroke.** Stroke 1996, 27(9):1467–1472.
9. Üstün TB, Chatterji S, Kostanjsek N, Rehm J, Kennedy C, Epping-Jordan J, Saxena S, Korff Mv, Pull C: **Developing the World Health Organization disability assessment schedule 2.0**. Bull World Health Organ 2010, **88**:815–823.
10. Üstün TB, Kostanjsek N, Chatterji S, Rehm J. Measuring health and disability: Manual for WHO disability assessment schedule WHODAS 2.0:. World Health Organization; 2010.
11. Lee H, Kim D: **Cultural adaptation and reliability testing of Korean version of the World Health Organization Disability Assessment Schedule 2.0**: **12-item versions**. Journal of the Korean Society of Physical Medicine 2011, **6**(4):475–488.

12. Schlote A, Richter M, Wunderlich MT, Poppendick U, Möller C, Wallesch CW: **Use of the WHODAS II with stroke patients and their relatives**: **reliability and inter-rater-reliability**. Rehabilitation 2008, **47**(1):31–38.
13. Kim J, Hwang YH, Kim JT, Choi NC, Kang SY, Cha JK, Ha YS, Shin DI, Kim S, Lim BH. **Establishment of government-initiated comprehensive stroke centers for acute ischemic stroke management in South Korea.** Stroke 2014, 45(8):2391–2396.
14. Lees KR, Bath PM, Schellinger PD, Kerr DM, Fulton R, Hacke W, Matchar D, Sehra R, Toni D. Contemporary outcome measures in acute stroke research: choice of primary outcome measure. Stroke. 2012;43(4):1163–70.
15. Morisky DE, Green LW, Levine DM. **Concurrent and predictive validity of a self-reported measure of medication adherence**. Med Care 1986,:67–74.
16. Case_Management_Society_of_America (CMSA). CMAG: Case manage¬ment adherence guidelines. Guidelines from the Case Management Society of America for improving patient adherence to medication therapies. Version 2.0. June 2006:39–41 Available at: http://www.cmsa.org/portals/0/pdf/CMAG2. pdf.
17. Yoon JS, Kim JM, Shin IS, Yang SJ, Zheng TJ, Lee HY. Development of Korean version of World Health Organization Disability Assessment Schedule II (WHODAS II-K) in community dwelling elders. Journal of Korean Neuropsychiatric Association. 2004;43(1):86–92.
18. Almazán-Isla J, Comín-Comín M, Damián J, Alcalde-Cabero E, Ruiz C, Franco E, Martín G, Larrosa-Montañés LA, de Pedro-Cuesta J, DISCAP-ARAGON Research Group. Analysis of disability using WHODAS 2.0 among the middle-aged and elderly in Cinco Villas. **Spain** Disability health journal. 2014;7(1):78–87.
19. Kwon S, Hong S, Kim E, Kim C, Joa K, Jung H. **Monitoring of functioning status in subjects with chronic stroke in South Korea using WHODAS II.** Annals of rehabilitation medicine 2016, 40(1):111.
20. Bērziņa G, Smilškalne B, Vētra A, Sunnerhagen KS. Living in Latvia after stroke: the association between functional, social and personal factors and the level of self-perceived disability—a cross-sectional study. BMJ open. 2016;6(6):e010327.
21. Kelly-Hayes M, Beiser A, Kase CS, Scaramucci A, D'Agostino RB, Wolf PA. The influence of gender and age on disability following ischemic stroke: the Framingham study. Journal of Stroke Cerebrovascular Diseases. 2003;12(3):119–26.
22. Osterberg L, Blaschke T. Adherence to medication. N Engl J Med. 2005;353(5):487–97.
23. Bushnell CD, Olson DM, Zhao X, Pan W, Zimmer LO, Goldstein LB, Alberts MJ, Fagan SC, Fonarow GC, Johnston SC. Secondary preventive medication persistence and adherence 1 year after stroke. Neurology. 2011;77(12):1182–90.
24. Lee Y, Kim RB, Lee HJ, Kim K, Shin M, Park H, Ahn S, Kim SY, Lee Y, Kim B. Relationships among medication adherence, lifestyle modification, and health-related quality of life in patients with acute myocardial infarction: a cross-sectional study. Health Qual Life Outcomes. 2018;16(1):1–8.

Figures



GS = Global scores; UAC = Understanding and communicating; GAR = Getting around; SCA =Self-care; GAP = Getting along with people; LAC =Life activities; PSO = Participation in society

Figure 1

Distribution of WHODAS global scores by domain