

Value of using the international classification of functioning, disability, and health for stroke rehabilitation assessment

A multicenter clinical study

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Abstract

This study aimed to evaluate the efficiency of the International Classification of Functioning, Disability, and Health (ICF) in stroke rehabilitation assessment in China and to identify correlations between the ICF and several commonly used clinical assessment instruments for stroke.

In total, 52 hospitals and 5 premier rehabilitation and neurology research centers participated in this cross-sectional multicenter clinical study. A total of 2822 stroke patients admitted to a neurology or rehabilitation department of a participating medical center between July 2012 and June 2014 were included. The ICF checklist contains 4 parts with 128 two-level items: body functions, body structures, activities and participation, and environmental factors. We analyzed the results of ICF assessments and determined whether correlations existed between the various items of the ICF and several commonly used clinical assessment instruments.

In all but 3 instances, the scores for the ICF-b-body function, ICF-s-body structure-degree of impairment, ICF-s-body structure-impairment location, ICF-d-activity performance, ICF-d-ability performance, ICF-e-facilitator, and ICF-e-barrier correlated significantly ($P < .05$) with the scores for the commonly used clinical assessment instruments.

The ICF checklist is a new rehabilitation assessment instrument that is compatible with commonly used clinical assessment scales for stroke and can be used in combination with these scales.

Abbreviations: FMA-B = Fugl-Meyer assessment of balance function, FMA-M = Fugl-Meyer assessment of motor function, ICF = International Classification of Functioning, Disability, and Health, mBI = modified Barthel Index, MMSE = Mini-Mental State Examination, NIHSS = National Institutes of Health Stroke Scale, SD = standard deviation, SS-QOL = Stroke-Specific Quality of Life, WHO = World Health Organization.

Keywords: assessment, International Classification of Functioning, Disability and Health (ICF), multicenter, rehabilitation, stroke

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1. Introduction

The rehabilitation of patients with stroke is one of the most effective methods for reducing disability. Successful rehabilitation of stroke patients is particularly important because stroke is common globally (e.g., about 2 million people have stroke every year in China), and is one of the leading causes of disability-adjusted life years in both developed and developing countries.^[1,2] Typically during rehabilitation, the assessment of functional status is performed by a number of different observers with various points of view.^[3] It is important that the assessment of stroke recovery not only be limited to nervous system symptoms and functional outcome, but also encompass psychological, physiological, and social function. A “biopsychosocial” model of this type is being increasingly applied in clinical medicine and research, especially in the field of rehabilitation medicine. Disability according to the biopsychosocial approach is defined in terms of conflict between a patient’s health status and needs of the patient’s daily life.^[4] A broad-based recovery assessment of stroke patients should be performed to better formulate individualized stroke recovery treatment plans that can ease the level of disability and enhance quality of life. Various clinical and laboratory variables are also used to predict disability and functioning outcomes in stroke patients, including blood pressure measurements at admission, plasma total cholesterol levels, lower Charlson index scores, frequency of CD4 and CD28 cells as severity markers, and pretreatment with ACE inhibitors, calcium channel blockers, or antiplatelet drugs. Results of such variables may be used in conjunction with stroke scale scores to identify stroke subtypes.^[5,6]

The International Classification of Functioning, Disability and Health (ICF) is a global, general purpose instrument that is the framework used by the World Health Organization (WHO) to gauge health at the individual and group levels.^[7] It is especially noteworthy that the ICF can assess how health conditions can hamper or promote real-life situations in patients’ living environments. In the ICF model, functionality includes the interaction of body structure and function, activity, and participation.^[2] Both personal and environmental factors can act to facilitate or inhibit performance in daily activities and participation in the various aspects of daily life.^[2]

The ICF uses an alphanumeric coding system, which provides a framework to code a wide range of information about health, and uses a standardized common language permitting communication about health and health care across the world in various disciplines and sciences.^[8] Accordingly, the ICF is intended to be used to provide a unified and standard language and framework for the description of health and health-related states. Both a Comprehensive ICF Core Set and a Brief ICF Core Set are available.^[8,9]

Studies of the ICF have been carried out in some countries and the results have indicated that this classification system may be useful to assess disability and functional status.^[10,11] However, no studies of the ICF have been conducted using a large sample. Therefore, we planned to establish a large-sample, multicenter ICF database for stroke, and then evaluate the status of patients with regard to their function, structure, activities, participation, and environmental factors. Our goal for this study was to evaluate the efficiency of the ICF in stroke rehabilitation assessment and identify correlations between the ICF and several commonly used clinical assessment instruments for stroke. We hope that using the ICF will allow patients to be evaluated more

globally and efficiently, which may help to strengthen the applicability of rehabilitation and improve outcomes and quality of life.

2. Patients and methods

2.1. Research design

A multicenter, prospective, cross-sectional study design was used for this investigation. *Multicenter*: This study included data from different areas around China (east, west, south, north, and center). This project was conducted in collaboration with 57 subcenters, which included 52 tertiary A class hospitals and 5 premier rehabilitation and neurology research organizations. The hospital and research organizations were located in different parts of China and all possessed a certain level of research capabilities and were willing to participate in the study as project research partners. *Prospective research*: All the information about the patients was filled in the report forms prospectively once the patients were allowed into the study, and evaluation with the ICF and various clinical assessment scales was performed at that time. *Cross-sectional investigation*: There were no special suggestions or interventions with regard to the treatment of the patients. The intention was to obtain an overall view regarding stroke patients in China.

2.2. Participants

This study was a prospective investigation of stroke inpatients admitted to the neurology or rehabilitation department in hospitals in China between July 2012 and June 2014. We screened consecutive patients who had ischemic or hemorrhagic stroke confirmed by initial CT or MRI, and were aged 18 years or older. The patients had been in the stroke recovery period for ≥ 2 weeks and required rehabilitation. All patients or their legal guardians provided signed informed consent to participate in the study. Patients were excluded from the study if they or their legal guardians decided against participation and did not sign the consent form.

2.3. ICF assessment

2.3.1. ICF categories. Based on the results of discussions by the WHO ICF Core Set Group on Stroke, a total of 128 second-level categories were included in the study: 40 categories from the component body functions, 5 from body structures, 52 from activities and participation, and 31 from environmental factors.^[7,8,12] Body functions are the physiological functions of body systems (including psychological functions), such as consciousness, orientating function, memory function, muscle strength, and so on. Supplementary Table S1, <http://links.lww.com/MD/C576>, presents ICF categories of body functions (denoted as “b”) (ICF-b, 40 items). Body structures are anatomical parts of the body such as organs, limbs, and their components. Supplementary Table S2, <http://links.lww.com/MD/C576>, presents ICF categories of body structure (denoted as “s”) (ICF-s, 5 items). *Activity and participation*: activity is the execution of a task or action by an individual; participation is involvement in a life situation. Supplementary Table S3, <http://links.lww.com/MD/C576>, presents ICF categories of activities and participation (denoted as “d”) (ICF-d, 52 items). Environmental factors were composed of the physical, social, and attitudinal environment in which people live and conduct their lives. Supplementary Table S4, <http://links.lww.com/MD/C576>,

presents ICF categories of environmental factors (denoted as “e”) (ICF-e, 31 items).

The standardization of ICF qualifier: to apply the grading method as 0, 1, 2, 3, and 4 and indicated by “First qualifier,” “Second qualifier,” and “Third qualifier.”

To ensure quality, all personnel who participated in the project received unified training and were able to participate in research for the ICF assessment project only after passing training. The project host, China Rehabilitation Research Center, and the project leadership team, which consisted of representatives from each of the participating units, guided and supervised the research personnel.

2.4. Clinical assessment

The stroke participants were evaluated not only by using the ICF but also by using several clinical assessment instruments: Mini-Mental State Examination (MMSE), Fugl-Meyer assessment of motor function (FMA-M) and balance function (FMA-B), National Institutes of Health Stroke Scale (NIHSS), and modified Barthel Index (mBI).^[13–18] These are the most commonly used clinical scales for stroke patients, and all are clinically approved classic scales. We evaluated and analyzed whether clinical correlations could be found between the ICF and the clinical assessment scales.

2.5. Statistical analysis

Continuous variables are presented as mean and standard deviations (SDs) and categorical variables are presented as counts

Table 1
Baseline characteristics of all enrolled patients.

	Total (N = 2822)
Age, y	59.97 ± 13.79
Height, cm	166.18 ± 17.3
Weight, kg	66.83 ± 18.55
Sex	
Female	891 (22.95%)
Male	1931 (49.74%)
Marriage	
Married	2514 (64.76%)
Unmarried	74 (1.91%)
Widowed	77 (1.98%)
Divorced	21 (0.54%)
Education	
Illiterate	100 (2.58%)
Elementary school	504 (12.98%)
High school	575 (14.81%)
College or above	196 (5.05%)
Occupation	
Civil servant	135 (3.48%)
Professional or technician	138 (3.55%)
Company staff	177 (4.56%)
Corporate manager	73 (1.88%)
Laborer	320 (8.24%)
Peasant	432 (11.13%)
Students	16 (0.41%)
In-service soldier	4 (0.1%)
Self-employed	97 (2.5%)
Small business proprietor	107 (2.76%)
Unemployed	374 (9.63%)
Retired	837 (21.56%)

Data are missing for age, height, weight, marital status, level of education, and occupational classification for 41, 198, 200, 136, 1447, and 112 patients, respectively.

and percentages. Scores of ICF components and clinical assessments are presented as continuous variables. Pearson correlation coefficient analysis was performed to investigate correlations between ICF components and clinical assessments. Multivariate linear regression analysis was performed to detect whether the ICF components were associated with the clinical assessments. Statistical analyses were performed by IBM SPSS statistical software version 22 for Windows (IBM Corp., Armonk, NY), and 2-tailed $P < .05$ indicated statistically significant differences.

3. Results

3.1. Baseline characteristics of patients

The baseline characteristics of the patients are presented in Table 1. A total of 2822 patients (1931 males and 891 females) were enrolled in this study; their mean age was 59.97 years.

3.2. Distribution of ICF components and clinical assessments

The mean scores of the ICF components and clinical assessments are presented in Table 2. The ICF components included ICF-b-body function score, ICF-s-body structure, ICF-d-activity limitations and participation restriction, and ICF-e-environmental factors. The clinical assessments included the MMSE, Fugl-Meyer balance function assessment score, Fugl-Meyer movement function assessment score, NIHSS, and mBI.

3.3. Correlation between ICF components and clinical assessments

The correlations between ICF components and clinical assessments are presented in Table 3. The NIHSS correlated significantly and positively with all ICF components (all $P < .001$). The ICF-b-body function score correlated significantly and negatively with the MMSE, FMA-B, FMA-M, and mBI scores. The ICF-s-body structure-degree of impairment score correlated significantly and negatively with the FMA-B, FMA-M, and mBI scores; no correlation was shown with the MMSE score

Table 2
Distribution of ICF components and clinical assessments among all enrolled patients.

	Total (N = 2822) Mean ± SD
<i>ICF-b-body function score</i>	
First qualifier-total score	42.27 ± 25.55
<i>ICF-s-body structure</i>	
First qualifier-degree of impairment score	4.51 ± 3.79
Second qualifier-nature of impairment score	4.15 ± 5.62
Third qualifier-impairment location score	3.33 ± 2.94
<i>ICF-d-activity limitations and participation restriction</i>	
First qualifier-activity performance score	87.34 ± 42.62
Second qualifier-ability performance score	91.2 ± 45.45
<i>ICF-e-environmental factors</i>	
Facilitator score	45.57 ± 26.98
Barrier score	40.2 ± 29.23
<i>Clinical assessments</i>	
MMSE	19.67 ± 10.05
Fugl-Meyer balance function assessment score	4.26 ± 4.17
Fugl-Meyer movement function assessment score	28.62 ± 27.44
NIHSS	7.82 ± 5.58
Modified Barthel Index	40 ± 24.88

Table 3
Correlation between ICF components and clinical assessments[†].

		MMSE	Fugl–Meyer balance function assessment score	Fugl–Meyer movement function assessment score	NIHSS	Modified Barthel Index
ICF-b-body function score	Pearson γ	-0.486	-0.348	-0.327	0.645	-0.501
	P value	<.001*	<.001*	<.001*	<.001*	<.001*
ICF-s-body structure-degree of impairment score	Pearson γ	-0.008	-0.113	-0.125	0.177	-0.117
	P value	.661	<.001*	<.001*	<.001*	<.001*
ICF-s-body structure-nature of impairment score	Pearson γ	-0.103	-0.137	-0.146	0.14	-0.081
	P value	<.001*	<.001*	<.001*	<.001*	<.001*
ICF-s-body structure-impairment location score	Pearson γ	0.026	-0.046	-0.054	0.113	-0.003
	P value	.166	.015*	.004*	<.001*	.888
ICF-d-activity performance score	Pearson γ	-0.408	-0.396	-0.388	0.571	-0.558
	P value	<.001*	<.001*	<.001*	<.001*	<.001*
ICF-d-ability performance score	Pearson γ	-0.391	-0.396	-0.413	0.508	-0.539
	P value	<.001*	<.001*	<.001*	<.001*	<.001*
ICF-e-facilitator score	Pearson γ	-0.088	-0.057	-0.093	0.127	-0.087
	P value	<.001*	.002	<.001*	<.001*	<.001*
ICF-e-barrier score	Pearson γ	-0.043	-0.078	-0.091	0.067	-0.094
	P value	.023*	<.001*	<.001*	<.001*	<.001*

* $P < .05$ represents significant correlation between ICF components and clinical assessment.

[†] Calculated only for patients with complete information.

($P > .05$). The ICF-s-body structure-nature of impairment score correlated significantly and negatively with the MMSE, FMA-B, FMA-M, and mBI scores. The ICF-s-body structure-impairment location score correlated significantly and negatively with the FMA-B and FMA-M scores; the ICF-s-body structure-impairment location score was not correlated with the MMSE and MBI scores ($P > .05$). The ICF-d-activity performance score and ICF-d-ability performance score correlated significantly and negatively with the MMSE, FMA-B, FMA-M, and mBI scores. The ICF-e-facilitator score correlated significantly and negatively with the MMSE, FMA-B, FMA-M, and mBI scores. The ICF-e-barrier score correlated significantly and negatively with the MMSE, FMA-B, FMA-M, and mBI scores.

3.4. Detecting the ICF components associated with the clinical assessments by multivariate linear regression

The results of multivariate linear regression analysis are presented in Table 4. After adjustment with ICF components,

the mean MMSE score was decreased together with an increased ICF-b-body function score and ICF-s-body structure-nature of impairment score, and increased ICF-d-activity performance score. The mean MMSE score was increased together with an increased ICF-s-body structure-degree of impairment score. After adjusting for ICF components, the mean FMA-B score was decreased together with an increased ICF-b-body function score, ICF-s-body structure-nature of impairment score, ICF-d-activity performance score, and ICF-d-ability performance score, and increased ICF-e-barrier factor score. The mean FMA-B score was increased with an increased ICF-s-body structure-degree of impairment score and ICF-e-facilitator factor score. After adjusting for ICF components, the mean FMA-M score was decreased together with an increased ICF-b-body function score, ICF-s-body structure-nature of impairment score, ICF-d-activity performance score, and ICF-d-ability performance score, and increased ICF-e-barrier factor score. The mean FMA-M score was increased with an increased ICF-e-facilitator factor score. After adjusting for ICF components, the mean NIHSS score was

Table 4
Detection of the ICF components associated with the clinical assessments by multivariate linear regression[†].

	MMSE		Fugl–Meyer balance function assessment score		Fugl–Meyer movement function assessment score		NIHSS		Modified Barthel Index	
	$\beta \pm SE$	P	$\beta \pm SE$	P	$\beta \pm SE$	P	$\beta \pm SE$	P	$\beta \pm SE$	P
	ICF-b-body function score	-0.19 ± 0.01	<.001*	-0.02 ± 0.004	<.001*	-0.06 ± 0.03	.024*	0.12 ± 0.005	<.001*	-0.23 ± 0.02
ICF-s-body structure-degree of impairment score	0.63 ± 0.05	<.001*	0.06 ± 0.02	.013*	0.15 ± 0.16	.334	-0.23 ± 0.03	<.001*	0.52 ± 0.12	<.001*
ICF-s-body structure-nature of impairment score	-0.1 ± 0.03	.001*	-0.03 ± 0.01	.020*	-0.22 ± 0.09	.018*	0.02 ± 0.02	.324	0.19 ± 0.07	.010*
ICF-s-body structure-impairment location score	0.03 ± 0.06	.635	-0.03 ± 0.03	.323	-0.06 ± 0.18	.755	0.18 ± 0.03	<.001*	0.15 ± 0.14	.302
ICF-d-activity performance score	-0.04 ± 0.01	<.001*	-0.02 ± 0.004	<.001*	-0.09 ± 0.02	<.001*	0.05 ± 0.004	<.001*	-0.21 ± 0.02	<.001*
ICF-d-ability performance score	0.004 ± 0.01	.564	-0.01 ± 0.003	.001*	-0.16 ± 0.02	<.001*	-0.02 ± 0.004	<.001*	-0.07 ± 0.02	<.001*
ICF-e-facilitator score	0.01 ± 0.01	.627	0.05 ± 0.01	<.001*	0.17 ± 0.04	<.001*	-0.02 ± 0.01	.002	0.34 ± 0.03	<.001*
ICF-e-barrier score	0.01 ± 0.01	.474	-0.04 ± 0.01	<.001*	-0.13 ± 0.04	.001*	0.01 ± 0.01	.218	-0.26 ± 0.03	<.001*

* $P < 0.05$ represents significantly associated with the clinical assessment.

[†] Calculated only for patients with complete information.

decreased together with an increased ICF-s-body structure-degree of impairment score and ICF-d-ability performance score, and increased ICF-e-facilitator factor score. The mean NIHSS score was increased with an increased ICF-b-body function score, ICF-s-body structure-impairment location score, and ICF-d-activity performance score. After adjusting for ICF components, the mean mBI score was decreased together with an increased ICF-b-body function score, ICF-d-activity performance score, ICF-d-ability performance score, and ICF-e-barrier factor score. The mean mBI score was increased together with an increased ICF-s-body structure-degree of impairment score, ICF-s-body structure-nature of impairment score, and ICF-e-facilitator factor score.

4. Discussion

In this study of 2822 stroke patients, many statistically significant correlations were found between the ICF components and several commonly used clinical assessment scales: MMSE, FMA-M, FMA-B, NIHSS, and mBI. Also, using multivariate linear regression analysis, we detected ICF components that were significantly associated with the clinical assessment scales. Our results suggest that the ICF is a potentially useful rehabilitation assessment instrument for patients with stroke and could be used in combination with clinical assessment scales.

The feasibility and validity of the Comprehensive ICF Core Set was recently evaluated in a study of 208 Chinese patients with stroke.^[1] The outcome measures were based on body function and structure, activity and participation, and environmental factors. The results of the analyses indicated that, in the Chinese clinical setting, it was feasible to use the ICF when certain categories were reduced to account for the special characteristics and cultural attributes of Chinese patients. In a Swedish study, the validity of the Comprehensive ICF Core Set was assessed by obtaining information on the perspective of 22 patients with previous stroke.^[10] These patients were living at home and receiving rehabilitation as outpatients. The investigators found that among the categories from the Comprehensive ICF Core Set for stroke, 69% were confirmed by the patients they studied. In another study of the ICF conducted in China, the researchers sought to assess the effect of rater experience on reliability and validity of the Brief ICF Core Set for stroke.^[9] In that study, raters with ≥ 5 years clinical experience and raters with < 2 years of clinical experience rated the same 149 patients and 78 other patients were rated by novice raters. Results showed that interrater reliability is improved by having clinical experience in rehabilitation of stroke patients. In a case study, the reflective approach using the ICF was found to improve health-related quality of life in a patient with stroke.^[19] The findings in the present study provide additional evidence that the ICF has validity as a stroke rehabilitation assessment instrument and, importantly, our study is the first to use a large sample size to assess the ICF.

Among the major categories of factors of the ICF, environmental factors have attracted the attention of researchers. "Environment" in the ICF refers to the natural, social, and attitudinal factors that shape and steer people's lives. Although these factors are external to individuals, they may have either a passive or active influence on activity performance, activity ability, body function, and body structure of individual members of society. A previous study found that environmental component e120 products and technology for personal indoor and outdoor mobility and transportation are extremely important in improving these aspects of the lives of stroke patients.^[20] That

study included 162 patients aged 18 to 64 years and 202 patients aged ≥ 65 years. The products and technology were found to provide benefits for both the younger and older patients. This finding suggests that relevant government agencies should do more to address the needs of disabled persons when designing and constructing buildings. Furthermore, government and society should include persons with disability from stroke in a special category, and give them necessary policy benefits in areas such as labor and employment services. In a Swedish study of 243 individuals with stroke who lived in the community, personal factors (e.g., age, sex, time since stroke onset) were found to have an effect on the perception of these individuals of their functional status and environmental factors.^[21] In a study carried out in the United States, the researchers categorized environmental factors into 6 separate domains.^[22] They found that 5 of the domains had close correspondence with the ICF environmental factors. Only the domain of economic quality of life did not closely correspond to the ICF environmental factors.

Although stroke assessment scales such as NIHSS and FMA are often used by health professionals to perform quantitative assessment, assessment using the limit values of the ICF generally involves the use of interview software combined information from multiple sources, including self-reports, clinical examinations, clinical records, family members' reports, and so on. Examiners can make clinical judgments and appraisals based on this information from different sources. In addition, various existing stroke scales only assess one or several aspects of patient function and seldom seek to assess participation levels. For instance, the MMSE focuses on cognition and speech, the NIHSS addresses level of awareness, speech, movement, and feeling; the FMA scale chiefly assesses limb function; and the mBI mainly assesses the effect of limb function impairment on the ability to engage in the activities of daily life. Some survival quality scales (e.g., WHO-QOL100 scale and Stroke-Specific Quality of Life [SS-QOL] scale) primarily gauge patients' subjective perceptions concerning their body, psychology, degree of independence, social relationships, environment, and religious beliefs and world view, and emphasize patients' perceptions and individual experience. Furthermore, a correlation analysis of the SS-QOL scale and ICF participation components in a study that included 35 subjects indicated that, while a strong correlation exists between the SS-QOL and the ICF, the ICF emphasizes objective assessments.^[2] Because biopsychosocial models are increasingly important in clinical medicine, broad-based, objective assessments should not only examine levels of function, but also the level of participation and interaction between the patient's condition in the environment. To accomplish this, the ICF uses an integrated biopsychosocial model.

It is noteworthy that using the ICF for patients with acute stroke improves communication and leads to more holistic thinking among staff.^[11] However, there is still only scant evidence on the extent to which the ICF is being used in clinical practice.^[11]

It is not known whether the ICF could completely replace the stroke scales currently in widespread use. The different clinical scales emphasize various specific forms of functional impairment occurring after stroke (such as motor, speech, and cognitive impairments, etc.), and clinical scales addressing specific treatment methods should be used for assessment and comparison as appropriate. The ICF emphasizes rehabilitation as a whole, and its broad perspective enables it to provide effective guidance from different angles at the start of a patient's rehabilitation, which gives it considerable practical value. When the ICF is used

as a rehabilitative assessment scale, comparison of data before and after treatment can be used to determine the effectiveness of stroke treatment or status of stroke progression, and can also be used to perform full-scale assessment of stroke patients' physical functioning, living and participation ability, and influence of environmental factors.^[2] Assessments made using the ICF have the following significance: when a rehabilitation plan is formulated, the ICF's logic can be used to proceed from the specific to the whole, and ensure a more effective start to rehabilitation. The use of the ICF as a stroke rehabilitation patient assessment system in conjunction with existing assessment scales and objective assessment tools can achieve a more comprehensive assessment of patients' functional status. In addition, the assessment results obtained in this manner will have greater practical value, and can be used to provide even more effective rehabilitation.

Furthermore, the ICF also serves as a classification system for health-related functions and disabilities, and is closely connected with the ICD-10, which is also issued by the WHO. The ICD-10 is a health status classification system and an etiological framework, whereas the ICF is a means of classifying functions and disabilities connected with health status. The ICD-10 can provide a "diagnosis," whereas the ICF can offer a supplementary explanation of this diagnosis, and thereby providing richer and more comprehensive information. The use of both the ICD-10 and ICF in tandem can enhance the quality of data.

Studies have been conducted to see if the ICF has additional uses. One study looked into the possibility that the ICF could be used as a screening tool for the risk of falls in patients with stroke.^[23] It was found the ICF provided better accuracy than the Stroke Impact Scale-16. Another study investigated whether a patient education program based on the ICF improved patient education for stroke patients.^[24] No improvement was detected in patient education by basing the education program on the ICF.

One limitation of this study was that the study design was cross-sectional; there were no primary and secondary end points. Another limitation was that the focus was on ICF items and clinical assessments; details of patient demographic data were not obtained.

In summary, the ICF checklist can be used on a broad scale to assess stroke patients' body function, activity and participation ability, and influence of environmental factors. Use of the ICF as an assessment system for stroke rehabilitation patients can be combined with the use of other existing assessment scales and objective assessment tools to gauge functional status more comprehensively. The results of this type of assessment will possess great practical value, and can facilitate even more effective rehabilitation. The biopsychosocial model is increasingly believed to be the most rational medical approach, and use of the ICF as a stroke assessment framework can better reflect and promote this approach. This scale can also facilitate the provision of fairer and more responsive service in the face of the economic restrictions that exist in developing countries.

5. Conclusions

The results of this study show that the ICF is compatible with commonly used clinical assessment scales (MMSE, FMA-B, FMA-M, NIHSS, and mBI), and can be used in combination with these scales. When used in conjunction with clinical scales, the ICF can enable the full-scale assessment of patient function, and facilitate the development of more practical and effective rehabilitation.

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References

- Wang P, Li H, Guo Y, et al. The feasibility and validity of the comprehensive ICF core set for stroke in Chinese clinical settings. *Clin Rehabil* 2014;28:159–71.
- Silva SM, Correa FI, Faria CD, et al. Comparison of quality-of-life instruments for assessing the participation after stroke based on the International Classification of Functioning, Disability and Health (ICF). *Braz J Phys Ther* 2013;17:470–8.
- Saltychev M, Tarvonen-Schroder S, Barlund E, et al. Differences between rehabilitation team, rehabilitants, and significant others in opinions on functioning of subacute stroke survivors: Turku ICF study. *Int J Rehabil Res* 2014;37:229–35.
- Saltychev M, Tarvonen-Schroder S, Eskola M, et al. Selecting an optimal abbreviated ICF set for clinical practice among rehabilitants with subacute stroke: retrospective analysis of patient records. *Int J Rehabil Res* 2013;36:172–7.
- Tuttolomondo A, Di Sciacca R, Di Raimondo D, et al. Effects of clinical and laboratory variables and of pretreatment with cardiovascular drugs in acute ischaemic stroke: a retrospective chart review from the GIFA study. *Int J Carciol* 2011;151:318–22.
- Tuttolomondo a, Pecoraro R, Casuccio a, et al. Peripheral frequency of CD4+ CD28-cells in acute ischemic stroke: relationship with stroke subtype and severity markers. *Medicine* 2015;94:e813.
- World Health Organization. *The International Classification of Functioning, Disability and Health (ICF)*. Geneva: WHO; 2001.
- Geyh S, Cieza A, Schouten J, et al. ICF Core Sets for stroke. *J Rehabil Med* 2004;(44 Suppl.):135–41.
- Chen S, Tao J, Tao Q, et al. Rater experience influences reliability and validity of the Brief International Classification of Functioning, Disability, and Health Core Set for Stroke. *J Rehabil Med* 2016;48:265–72.
- Paanalaihi M, Alt Murphy M, Lundgren-Nilsson A, et al. Validation of the Comprehensive ICF Core Set for Stroke by exploring the patient's perspective on functioning in everyday life: a qualitative study. *International journal of rehabilitation research*. *Int J Rehabil Res* 2014;37:302–10.
- Tempest S, Jefferson R. Engaging with clinicians to implement and evaluate the ICF in neurorehabilitation practice. *NeuroRehabilitation* 2015;36:11–5.
- World Health Organization. *How to Use the ICF: A Practical Manual for Using the International Classification of Functioning, Disability and Health (ICF)*. Exposure Draft for Comment. Geneva: WHO; 2013.
- Folstein MF, Folstein SE, McHugh PR. "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12:189–98.
- Pangman VC, Sloan J, Guse L. An examination of psychometric properties of the mini-mental status examination and the standardized

- mini-mental status examination: implications for clinical practice. *Appl Nurs Res* 2000;13:209–13.
- [15] Fugl-Meyer AR, Jaasko L, Leyman I, et al. The post-stroke hemiplegic patient. a method for evaluation of physical performance. *Scand J Rehabil Med* 1975;7:13–31.
- [16] Brott T, Adams HPJr, Olinger CP, et al. Measurements of acute cerebral infarction: a clinical examination scale. *Stroke* 1989;20:864–70.
- [17] Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md State Med J* 1965;14:61–5.
- [18] Wade DT, Collin C. The Barthel ADL Index: a standard measure of physical disability? *Int Disabil Stud* 1988;10:64–7.
- [19] Kellett D, Mpofu E, Madden R. Reflective action assessment with a prospective clinical problem solving tool in the context of rehabilitation medicine: an illustrative case study. *Disabil Rehabil* 2013;35:1048–54.
- [20] Chang KH, Lin YN, Liao HF, et al. Environmental effects on WHODAS 2.0 among patients with stroke with a focus on ICF category e120. *Qual Life Res* 2014;23:1823–31.
- [21] Berzina G, Paanalahti M, Lundgren-Nilsson A, et al. Exploration of some personal factors with the International Classification of Functioning, Disability and Health core sets for stroke. *J Rehabil Med* 2013;45:609–15.
- [22] Heinemann AW, Magasi S, Hammel J, et al. Environmental factors item development for persons with stroke, traumatic brain injury, and spinal cord injury. *Arch Phys Med Rehabil* 2015;96:589–95.
- [23] Beninato M, Parikh V, Plummer L. Use of the International Classification of Functioning, Disability and Health as a framework for analyzing the Stroke Impact Scale-16 relative to falls. *Physiother Theory Pract* 2014;30:149–56.
- [24] Sabariego C, Barrera AE, Neubert S, et al. Evaluation of an ICF-based patient education programme for stroke patients: a randomized, single-blinded, controlled, multicentre trial of the effects on self-efficacy, life satisfaction and functioning. *Br J Health Psychol* 2013;18:707–28.