



ORIGINAL ARTICLE

Functional profiles derived from the ICF Generic set and the responsiveness and validity of the Generic-6 set's Functioning score among persons after stroke

Johanna JONSDOTTIR *, Thomas BOWMAN, Anna CASIRAGHI,
Marina RAMELLA, Angelo MONTESANO on behalf of the IRCCS FDG-ICF Group*

IRCCS Don Gnocchi Foundation, Milan, Italy

*Members are listed at the end of the paper

*Corresponding author: Johanna Jonsdottir, IRCCS Don Gnocchi Foundation, via Capecelatro 66, 20148 Milan, Italy. E-mail: jjonsdottir@dongnocchi.it

ABSTRACT

BACKGROUND: The International Classification of Functioning, Disability and Health (ICF) parsimonious Generic set can provide identification of functional profiles and recovery after rehabilitation in persons post stroke.

AIM: To explore concurrent validity of the ICF Generic-6 Functioning score with the Barthel Index (BI) and responsiveness after rehabilitation in persons post stroke. Further, the feasibility of applying the ICF Brief Stroke Core set in routine rehabilitation recovery was evaluated.

DESIGN: Prospective study.

SETTING: Inpatient rehabilitation setting.

POPULATION: Persons post stroke.

METHODS: The study included 71 persons post stroke (mean age 66.8 [standard deviation 14.5], mean onset 199.3 [565.3] days, BI score improvement: 17/100), N.=44 acute stroke (<3 months, stroke subacute [SA_group) and N.=27 chronic stroke (>3 months, Stroke chronic [SC_group). The Brief Stroke core set, including the Generic set, was used for classification at admission and at discharge using the five grade qualifiers. The median value of the groups' qualifiers on the Generic set (excluding item 850) was used to form a Functioning score (Generic-6 FS). Responsiveness was assessed with effect sizes (ES) and confidence intervals (CI). The concurrent validity of the Generic-6 FS was explored with the BI as a gold standard using Spearman's correlation coefficient. P was set at 0.05.

RESULTS: The Generic-6 FS proved responsive with ES being moderate for the Generic-6 FS and the BI for the whole group (0.48, CI 0.14-0.82 and 0.67, CI -1.02--0.32 respectively). ES of the Generic-6 FS was significant only for the SA_group (0.62, CI 0.27-0.96. Correlation between the Generic-6 FS and the BI at baseline and discharge were respectively $r=-0.59$ and $r=0.60$, while correlation between change values was lower ($r=0.44$). The Generic-6 FS did not distinguish between the SA_group and the SC_group. Classification with the ICF brief stroke core set was feasible with 89% of the persons being classified both at admission and discharge.

CONCLUSIONS: ICF classification of persons post stroke during rehabilitation recovery was feasible. The Generic-6 FS detected changes in functioning and health in persons recovered for rehabilitation after stroke and distinguished between different recovery rates of persons in the acute and chronic phase after stroke.

(Cite this article as: Jonsdottir J, Bowman T, Casiraghi A, Ramella M, Montesano A; IRCCS FDG-ICF Group. Functional profiles derived from the ICF Generic set and the responsiveness and validity of the Generic-6 set's Functioning score among persons after stroke. Eur J Phys Rehabil Med 2022;58:16-25. DOI: 10.23736/S1973-9087.21.06706-X)

KEY WORDS: Stroke; Rehabilitation; International Classification of Functioning, Disability and Health.

The prevalence and incidence of stroke in the population is very high and is one of the main causes of disability worldwide.¹ The provision of support and adequate rehabilitation is essential to decrease the impact of the initial damage of stroke, maintain residual functionality and recover as much as possible the prior health condition

and functionality of the person. The focus on rehabilitation recovery as a tool to optimize function in persons after stroke is becoming increasingly prominent, with information on functioning an essential component in understanding efficacy of interventions.²⁻⁸ The ICF biopsychosocial approach is recommended by the World Health Organiza-

tion⁹ and the ICF Core Sets for several health conditions, including stroke, are promising as a standardized reporting of functioning of persons with neurological disorders during hospital recovery and over time.¹⁰⁻¹⁵ Further, the ICF Generic set (also called ICF Generic-7 set) was developed for generic use and is included in all ICF core sets. It is comprised of seven ICF categories, that are considered most relevant for classifying function irrespective of health condition or context. It has been suggested that the parsimonious ICF Generic set, and its resultant functioning profiles can provide minimal standard information of impact of recovery and response to rehabilitation.¹⁶⁻¹⁸

Recently attempts have been made to use the ICF core sets to measure changing in function and activities of daily living (ADL) after rehabilitation and to establish a relationship with clinical measures.¹⁹⁻²¹ Results from application of the ICF Generic set in various rehabilitation hospitals in China demonstrated that it was feasible for use in routine clinical practice and that the derived information illustrates levels of functioning across health domains. Results further confirmed that the dimensionality of the domains contained in the ICF generic profile information can be standardized and aggregated into a Functioning score (FS).^{22, 23} A resultant ICF Generic-6 Functioning score (excluding the item regarding remunerative employment (d850)) has been tested for various psychometric properties and found to be a valid tool for the provision of minimal information of functioning across diverse clinical settings and disorders.²⁴ This interesting way of quantifying the qualifiers of functioning and activity lends itself well to a population with stroke where, especially during the first few months, there is an important neurological recovery that can be enhanced with rehabilitation.

Functional independence, traditionally evaluated with the Barthel Index (BI)²⁵ or the Functional Independence measure (FIM),²⁶ is an important goal in stroke recovery.²⁷ While the use of these measures is extensive in the health sector, the use of a parsimonious Generic-6 FS that also takes into account aspects of basic functions and participation is lacking. In this context it would be important to verify how functional independence level relates to a Generic-6 FS derived from the ICF classification applied during rehabilitation recovery. While the concurrent validity of an ICF Generic-6 FS has been verified with the FIM this has not yet been established for the BI.¹¹

Further, it would be important to understand whether the parsimonious ICF Generic-6 FS can characterize persons with stroke and whether it can distinguish among different chronicity levels. In order for the ICF Generic-6 FS to be

valid for use in the clinic it should, ideally, capture rates of neurological recovery in the first subacute stage and beyond when the rate of recovery tends to be much slower and more dependent on rehabilitation being provided.

The aims of this study were to describe the functional profiles from the ICF Generic set and evaluate responsiveness and validity of a Generic-6 FS, in routine clinical recovery of persons with stroke. Further, the feasibility of routinely using the ICF Brief Stroke Core set in an Italian clinical setting was evaluated.

Materials and methods

Study design and settings

This prospective study was conducted from March 2015 and October 2016 in the Don Gnocchi Foundation's Research Institute, Milan, Italy. All persons with stroke recovered in this period for longer than 2 weeks, consenting and firming an informed consent, were classified according to the ICF Brief Stroke Core set at the beginning and end of recovery. The study was approved by the Ethical Committee of the Don Gnocchi Foundation. Standard privacy procedures were followed.

Participants

Eighty adult persons with stroke were recruited consecutively after their admission for rehabilitation. The inclusion criteria were the diagnosis of cerebral stroke and duration of rehabilitation ward stay longer than 2 weeks, while the study excluded persons younger than 18 and persons with cranial trauma or brain tumor.

All participants underwent a multidisciplinary rehabilitation program, which for all included medical care, rehabilitation nursing, physiotherapy, and could include occupational therapy, speech therapy and psychological assessment and support. Data collection was performed according to the principles of the Helsinki Declaration.

Classification and assessment-procedures

Demographic and clinical characteristics were collected from clinical charts. Within three days of admission and before discharge the participants were classified with the "Stroke Brief Core Set" which contains 25 categories from different ICF domain, 9 from Body Functions (b110, b114, b130, b140, b144, b152, b167, b280, b730), 2 from Body Structures (s110, s730), 10 from Activities and Participation (d230, d310, d330, d450, d455, d510, d530, d540, d550, d850) and 3 from Environmental factors (e310,

TABLE I.—*International Classification of Functioning, Disability and Health (ICF), categories contained in the ICF Brief Stroke Core Set. The items of the ICF Generic Set in bold and respective professional roles in the classification are shown in parenthesis.*

ICF categories	Description
b110	Consciousness functions (MD)
b114	Orientation functions (MD)
b130	Energy and drive functions*,** (MD)
b140	Attention functions (CPT, MD)
b144	Memory functions (CPT, MD)
b152	Emotional functions** (MD)
b167	Mental functions of language (ST, MD)
b280	Sensation of pain*,** (MD)
b730	Muscle power functions (PT, MD)
s110	Structure of brain (MD)
s730	Structure of upper extremity (MD)
d230	Carrying out daily routine*,** (RN)
d310	Communicating with - receiving - spoken messages (ST, MD)
d330	Speaking (RN, MD)
d450	Walking*,** (PT)
d455	Moving around*,** (PT)
d510	Washing oneself (RN)
d530	Toileting (RN)
d540	Dressing (OT, RN)
d550	Eating (OT, RN)
d850	Remunerative employment** (MD)
e115	Products and technology for personal use in daily living (OT)
e120	Products and technology for personal indoor and outdoor mobility and transportation (OT)
e310	Immediate family (RN)
e355	Health professionals (MD)
e580	Health services, systems and policies (MD)

*The six (out of seven) items of the Generic set included in the ICF Generic-6 Functioning Score. In parenthesis the respective health professionals that evaluated the various items; **Generic set is evidenced in bold.
MD: medical doctor; OT: occupational therapist; CPT: specialized cognitive physical therapist; PT: physical therapist; RN: registered nurse; ST: speech therapist.

e355, e580). Table I shows the items contained in the Brief Stroke Core Set. The Generic set is part of the Brief Stroke Core set and its 7 items are marked with asterisk.

The validity and reliability of the ICF core set in stroke has been reported in various studies.^{28, 29}

With regard to reliability and validity of the ICF Generic set, interrater reliability and convergent, known group, and predictive validity have already been examined in the hospital setting with item d850 (Remunerative employment) excluded from the analysis resulting in an ICF Generic-6 set. The reliability and validity of the ICF Generic-6 set has been found to be acceptable for heterogeneous patient groups.²⁴

Professionals involved in the classification were department medical doctors (N.=3), nurses (N.=2), physical therapists (N.=4), specialized cognitive physical therapists (N.=1), occupational therapists (N.=2) and speech thera-

pists (N.=2) all of which had been previously trained in using the ICF. Each health professional filled in a pre-established domain of the Brief Stroke Core set at admission and discharge (see Table I for details on each health professionals pre-established domain). Tablet devices with a direct access to a Don Gnocchi-ICF Platform (DG-ICF) were used for the classification according to observation, test values or patient interviews. Each category was assessed using five-grade qualifiers, including 0=no difficulty, 1=mild, 2=moderate, 3=severe, and 4=complete difficulty (Table II). When assigning a qualifier all available information on the patient was considered. If information was missing or not pertinent to the person being classified qualifiers 8 (not specified) and 9 (not applicable) were allowed. For example, a person who had not worked before the stroke, or who was already retired was given a qualifier 9 on item d850 that enquires on remunerative employment. A case manager and supervisor verified the appropriateness of the input data and were available for consultation in case of uncertainties.

The procedure of classification is depicted in Figure 1. Each subject was classified with the Brief Stroke core set and evaluated by the same group of health professionals within a week following admission and before discharge, respectively.

In addition, all participants were evaluated with the BI³⁰ as part of routine care. The main aim of the BI is to establish the degree of independence in various activity domains and its responsiveness has been verified in the rehabilitation setting.³¹ A 10-item BI, scoring 0 to 100 with 5-point increments, was applied, with a total score of 100 points implying full functional independence. Minimal clinically important difference (MCID) for chronic stroke patients has been established as 9.25% of the scale.³²

Statistical analysis

Demographics and clinical characteristics of the whole group and subgroups (subacute or chronic) are presented

TABLE II.—*Descriptions and percentile ranges of International Classification of Functioning, Disability and Health (ICF) qualifiers as specified in the ICF.*

ICF qualifiers	Description	Percentile range (%)
0	No problem none, absent, negligible	0-4
1	Mild problem slight, low	5-24
2	Moderate problem medium, fair	25-49
3	Severe problem high, extreme	50-95
4	Complete problem total	96-100
8	Not specified	/
9	Not applicable	/

as descriptive data. The health condition variable subacute or chronic was defined as <3 months and >3 months respectively (disease duration since the stroke event).³³

The data from the Generic set was presented in a table as percentage of the population having a problem according to qualifiers.³⁴

The Functioning profile was compiled from the Generic sets pre and postrecovery and was presented as heat maps based on the groups median item qualifiers according to Reinhardt *et al.*^{21, 24, 35}

The Functioning Score was derived from treating the ICF Generic set's categories as items and complementing them with ICF as a rating scale. In line with the reasoning of Reinhardt *et al.*, item d850 (Renumerative employment) was not included in the final functioning score since it has been shown to not add any additional information to the score. The functioning score was then calculated as the sum of the items transformed to a scale ranging from 0 to 100, resulting in an ICF Generic set's six item functioning score (ICF-Generic-6 FS).

The Wilcoxon paired *t*-test was used to compare differences in scores of the BI and the Generic-6 FS from admission to discharge and the Mann-Whitney U Test was used to test differences in change scores between subgroups.

For responsiveness, effect sizes (ES) and their confidence intervals (CI) were calculated for the whole group and subgroups from admission to discharge for the Generic-6 FS and the BI, using the Hedge's *g* which gives the size of a treatment effect on a measure. According to Cohen, ES from 0.2-0.49 were considered small, from 0.5 to 0.79 were considered moderate and those equal or larger than 0.8 were considered large.^{36, 37}

The BI was used as gold standard for the evaluation of the concurrent validity of the Generic-6 FS for the whole

group; baseline and discharge scores and the scales' respective changes were analyzed with Spearman's rank correlation coefficient.

Concurrent validity of the Generic-6 FS with the BI was further evaluated as the scales' ability to discriminate between changes in different stroke chronicity, for this correlation in changes from admission to discharge in the Generic-6 FS and the BI were analyzed.

A correlation (*r*) value of less than 0.40 was considered an indication of a low correlation and a value of 0.40–0.79 was considered as moderate correlation.³⁸

The feasibility of using the ICF stroke core set in routine clinical practice was evaluated qualitatively and according to number of patients being classified at admission and discharge.

All statistical analyses were carried out using Statistica with the level of significance set at *P*<0.05.

Data availability

The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

Results

Descriptive demographic and clinical information for the whole sample and subgroups according to stroke chronicity is provided in Table III. Half of the sample was males and most of the sample had a moderate or severe stroke at admission (36 males, mean age 67.2 ± 14.4 years, onset 17.4 ± 20.8 months). The Stroke sub-Acute (SA_group) group was more numerous with 44 persons, while in the Stroke Chronic (SC_group) group there were 27 persons. At baseline the SA_group had a mean onset stroke of almost a month (days 28.5+23.2) while the SC_group had a mean onset of almost 16 months (days 477.8+854.1). The mean length of hospital stay was 55.5+22.4 days, with the SA_group staying 54+17.4 days and the SC_group staying 58+29.0 days on the average.

Responsiveness

The mean BI score at baseline was 53.4+27.1 in the whole group while at discharge it was 71.1+25.5 (Table IV), with a 33% increase from baseline indicating a clinically important and a statistically significant change in functional independence with a moderate effect size (ES=0.67 [CI -1.02 – -0.32], *P*<0.001). When results of subgroups were explored, baseline values were significantly different between the two groups (*t* -3.309, *df* 65, *P*=0.001). At base-

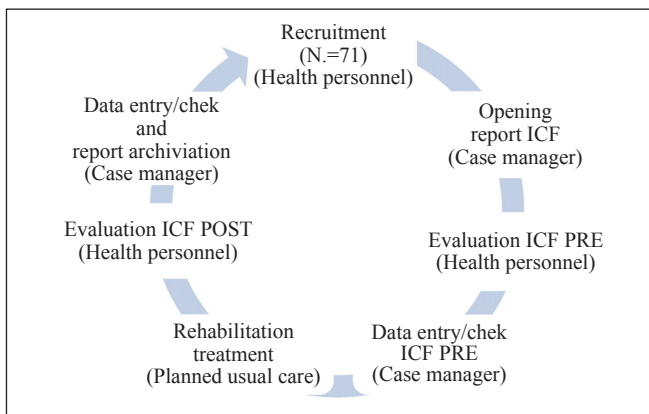


Figure 1.—Study flow chart. The ICF classification procedures.

TABLE III.—Demographics and characteristics of participants.

Variable	Whole group Mean (SD)	SA_group Mean (SD)	SC_group Mean (SD)
Age (years)	66.8 (14.5)	68.6 (14.2)	63.8 (14.5)
Onset (days)	199.3 (565.3)	28.5 (23.2)	477.8 (854.1)
Hospitalization (days)	55.5 (22.4)	54.2 (17.4)	57.7 (29.0)
Sex	N. (%)	N. (%)	N. (%)
Male	36 (52.1)	25 (35.2)	11 (16.9)
Female	35 (47.9)	19 (26.8)	16 (21.1)
Stroke side	N (%)	N (%)	N (%)
Cerebral hemisphere (right)	35 (47.9)	20 (28.2)	15 (21.1)
Cerebral hemisphere (left)	25 (35.2)	17 (23.9)	8 (11.3)
Cerebral hemisphere (right and left)	8 (11.3)	4 (5.6)	4 (5.6)
NS/NA	3 (4.2)	3 (4.2)	0 (0)
Stroke severity*	N. (%)	N. (%)	N. (%)
No-mild	0	0	0
Mild-moderate	4 (5.6)	1 (1.4)	3 (4.2)
Moderate-severe	29 (40.8)	18 (25.4)	11 (15.5)
Severe-complete	36 (50.7)	23 (32.4)	13 (18.3)
Complete	0 (0)	0 (0)	0 (0)
NS/NA	2 (2.8)	2 (2.8)	0 (0)

*Classification based on ICF item s110 Structure of brain Qualifier 1 (Extent of impairment).

SD: standard deviation; N.: number of persons; % percentage of the group; NS/NA: missing information; SA_group: subacute stroke group; SC_group: chronic stroke group.

line the SA_group was less independent in function, with 45.12±7.1 that increased to 66.2±27.6, a clinically important and statistically significant change of 46.8% with a moderate effect size (ES -0.77 [-1.12 – -0.42], P<0.001). The SC_group had a baseline BI of 65.8±22.2 and improved to 78.4±20.3, a clinically important and statistically significant change of 19.1% and a moderate effect size (ES 0.59 [-0.59 – -0.93], P<0.001). In between group analysis demonstrated that change on the BI was significantly higher in the SA_group (t 2.179, df 65, P=0.03).

Regarding the Generic-6 FS, improvement is denoted by a lower score postintervention and a 0 is the best possible. The baseline Generic-6 FS for the whole group was 47.5±18.3 and was reduced to 38.4±19.4 at discharge, a statistically significant improvement of 19.2% with a low effect size (ES 0.48 [0.14-0.82], P<0.001). When results of subgroups were explored, baseline values of the Generic-6

FS were not significantly different between the two groups (t -0.5, df 65, P=0.6). The SA_group had a baseline Generic-6 FS of 46.6±8.4 while at discharge it was improved to 34.7±19.9, a significant improvement of 25.5% with a moderate effect size (ES 0.62 [0.27-0.96], P<0.001). In the SC_group the baseline Generic-6 FS instead was 48.9±18.4 and 43.8±17.7 at discharge, with a significant change of 10.9% and a low non significant effect size (ES 0.28 [-0.06-0.62], P=0.003). In between group analysis demonstrated that the change in Generic-6 FS was significantly higher in the SA_group (t -2.622, df 65, P=0.01).

ICF-Generic-set functional profiles- Domain specifics

Descriptive analysis

Table V demonstrates the percentage of participants having a problem according to qualifiers on the ICF Generic

TABLE IV.—Barthel index and ICF Generic-6 Functioning score (Generic-6 FS) for the whole group and subgroups.

Variable	Group	PRE Mean (SD)	POST Mean (SD)	P value difference	Hedges g (Confidence Interval)
BI	Whole group (N.=67)	53.4 (27.1)	71.1 (25.5)	<0.001	-0.67 (-1.02 – -0.32)
	SA_group (N.=40)	45.1 (27.1)	66.2 (27.6)	<0.001	-0.77 (-1.12 – -0.42)
	SC_group (N.=27)	65.8 (22.2)	78.4 (20.3)	<0.001	-0.59 (-0.59 – -0.93)
Generic-6 FS	Whole group (N.=67)	47.5 (18.3)	38.4 (19.4)	<0.001	0.48 (0.14 – 0.82)
	SA_group (N.=40)	46.6 (18.4)	34.7 (19.9)	<0.001	0.62 (0.27 – 0.96)
	SC_group (N.=27)	48.9 (18.4)	43.8 (17.7)	0.003	0.28 (-0.06 – 0.62)

SD: standard deviation; BI: Barthel Index; SA_group: subacute stroke group; SC_group: chronic stroke group.

set in the whole sample. Most participants had none or mild problems in items of body functions (BF) energy and drive function (b130), emotional functions (b152) and pain functions (b280) with only around 10% of the participants having moderate or severe problems. Regarding activities and participation (A&P), at admission over 50% of participants had a severe or complete problem in carrying out daily routine (item d230), over 60% with walking (d450) while moving around (Item d455) (moving around) was severely or completely problematic for almost 80% of the participants. Similarly, more than 80% of the participants had severe or complete problems with paid occupancy (d280, remunerative employment) or were already at or over the retirement age.

Figure 2 shows a heat map of the ICF Generic set's functioning profiles based on qualifier medians at admission and at discharge of the whole group and subgroups. There was an evident improvement from admission to discharge with the whole group shifting to having no (0) problems in the BF domain at discharge, and moderate (2) limitations in carrying out daily routine (d230) and walking (d450), and only in moving around did they still have severe limitations (d455). Only the complete (4) problem at admission of remunerative employment (d850) does not change, which is not surprising considering the age of the participants and the fact that their employment situation would be unlikely to change during the average 6-8 weeks recovery.

When we looked at the SA and SC groups separately it was evident that at admission the SA_group had mild (1) to complete (4) impairments (BF) and limitations (A&P)

on 5 out of 7 items of the Generic set. They generally had relatively little problems in the BF domain but more severe limitations on items of the A&P domain. Of the items demonstrating problems or limitations all, except the remunerative work (d850), improved by at least one qualifier from admission to discharge.

The SC_group instead had mild to moderate problems in the BF domain and moderate to complete limitations in the A&P domain with improvement by one qualifier only on the pain item (b280) and in gait functions (d450) at discharge.

Concurrent validity Generic-6 Functioning score and Barthel Index

Only 67 patients were included in the analysis of concurrent validity of the ICF Generic-6 FS with the BI (4 patients were excluded from the analysis for missing BI

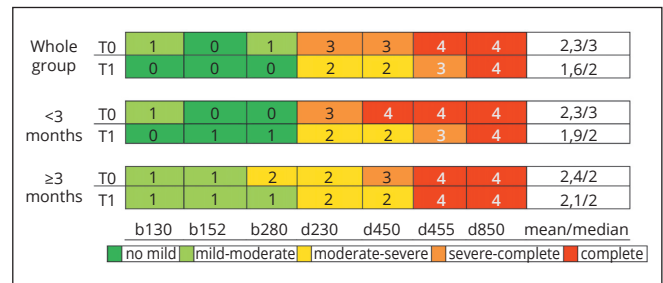


Figure 2.—Heat map of functioning profiles (medians) across groups at admission (T0) and at discharge (T1). b130: energy and drive; b152: emotional functions; b280: sensations of pain; d230: managing daily routine; d450: walking; d455: moving around; d850: remunerative employment.

TABLE V.—Distribution of response options (ICF Generic set) at admission and discharge of all participants.

ICF categories	Time	No Problem N. (%)	Mild Problem N. (%)	Moderate problem N. (%)	Severe problem N. (%)	Complete problem N. (%)	NS/NA N. (%)
b130*	1	32 (45.1)	15 (21.1)	18 (25.4)	5 (7.0)	0 (0.0)	1 (1.4)
	2	38 (53.5)	15 (21.1)	9 (12.7)	7 (9.9)	1 (1.4)	1 (1.4)
b152*	1	36 (50.7)	18 (25.4)	10 (14.1)	5 (7.0)	0 (0.0)	2 (2.8)
	2	36 (50.7)	16 (22.5)	14 (19.7)	3 (4.2)	0 (0.0)	2 (2.8)
b280*	1	35 (49.3)	4 (5.6)	20 (28.2)	9 (12.7)	0 (0.0)	3 (4.2)
	2	43 (60.6)	4 (5.6)	14 (19.7)	7 (9.9)	0 (0.0)	3 (4.2)
d230*	1	8 (11.3)	7 (9.9)	18 (25.4)	24 (33.8)	14 (19.7)	0 (0.0)
	2	12 (16.9)	12 (16.9)	24 (33.08)	14 (19.7)	9 (12.7)	0 (0.0)
d450*	1	6 (8.5)	7 (9.9)	11 (15.5)	12 (16.9)	35 (49.3)	0 (0.0)
	2	14 (19.7)	13 (18.3)	18 (25.4)	11 (15.5)	15 (21.1)	0 (0.0)
d455*	1	2 (2.8)	5 (7.0)	8 (11.3)	12 (16.9)	44 (62.0)	0 (0.0)
	2	3 (4.2)	6 (8.5)	13 (18.3)	16 (22.5)	33 (46.5)	0 (0.0)
d850	1	2 (2.8)	3 (4.2)	5 (7.0)	10 (14.1)	20 (28.2)	31 (42.6)
	2	3 (4.2)	5 (7.0)	5 (7.0)	7 (9.9)	20 (28.2)	31 (42.6)

1: admission; 2: discharge; b130: energy and drive; b152: emotional functions; b280: sensations of pain; d230: managing daily routine; d450: walking; d455: moving around; d850: remunerative employment.
 *items included in the Generic-6 Functioning Score.
 NS/NA: information not specified/information not available.

This document is protected by international copyright laws. No additional reproduction is authorized. It is permitted for personal use to download and save only one file and print only one copy of this Article. It is not permitted to make additional copies (either sporadically or systematically, either printed or electronic) of the Article for any purpose. It is not permitted to distribute the electronic copy of the article through online internet and/or intranet file sharing systems, electronic mailing or any other means which may allow access to the Article. The use of all or any part of the Article for any Commercial Use is not permitted. The production of reprints for personal or commercial use is not permitted. It is not permitted to remove, cover, overlay, obscure, block, or change any copyright notices or terms of use which the Publisher may post on the Article. It is not permitted to frame or use framing techniques to enclose any trademark, logo, or other proprietary information of the Publisher.

data). The ICF Generic-6 FS and the BI were significantly correlated both at admission and at discharge, showing moderate negative correlation (-0.60 pre and -0.59 post, $P=0.01$). A moderate negative significant correlation was also found between change scores of the two tests (-0.44, $P=0.03$) while the change scores were not related to either pre or post scores (Table VI).

Post-hoc power analysis of the Wilcoxon paired t-Test for the differences in scores from admission to discharge with an alpha value equal to 0.05 and total sample size of 67 (for a two-tailed hypothesis) demonstrated an observed power of 0.63 on a 1 tailed test, but 0.51 on a two tailed test.

Feasibility

The feasibility of applying the ICF Brief Core set in clinical care was good. Seventy-one out of 80 original participants concluded both the admission and the discharge ICF classification, with a drop out of 11% due to early dismissals ($N.=6$) or missed classification in the last week ($N.=3$) All five professional health figures and a Case manager participated in the data collection. However, along the way time limitations had to be established as to when data had to be entered into the data base, and similarly the case manager was essential since without his prompting there was a tendency over time to not comply with the classification routine and data entry. Some health professionals did complain of the coding taking away “precious time” and were not enthusiastic about continuing the coding with the same working conditions.

Discussion

This study described the ICF Generic set’s functional profiles of persons recovered post stroke and verified if through the Generic-6 FS it was possible to characterize their overall function. The responsiveness and concurrent validity of the Generic-6 FS were explored.

The Generic-6 FS was moderately responsive to change following rehabilitation and its concurrent validity with

the BI was moderate. Change in the Generic-6 FS was also complimentary to improvements in independence of function measured with the BI and described different rates of functional recovery of persons in the subacute and the chronic phase post stroke.

Level of functional independence of participants

The BI, a well-established measure of functional independence, showed an overall 53 points at baseline indicating participants with “severe” dependency following stroke. At discharge the participants were at 71 points, indicating a shift to a level of being mildly to moderately dependent in daily activities and function after the recovery period.³⁹ The difference from admission to discharge was well over the minimally clinically important difference of 9.25% established for persons with stroke and is similar to that reported by Kwakkel *et al.* following a period of rehabilitation for a population with stroke.³⁹

As could be expected the SA_group was worse at admission, or severely dependent with an average score of 45 on the BI. They increased, however, by 46% to a BI of 66 at discharge, a status similar to the admission value of the more chronic group. This big improvement reflects a spontaneous neurological recovery effect known for the first period after stroke, as well as, a rehabilitation effect.^{33, 39} It is interesting to note that the SC_group, that was on average 16 months post-stroke, also improved by almost 20% giving support to findings of others that have reported improvement in functional independence in chronic stroke patients during rehabilitation recovery. Improvement in A&P domains, such as that measured by the BI, is noted for those that receive rehabilitation and certainly this could benefit their independence and engagement in community activities.⁴⁰⁻⁴²

ICF Generic-6 Functioning score

The Generic-6 FS resulted responsive to rehabilitation. The moderate effect size and overall change of almost 20% in the whole group is in accordance with findings from the study from China²¹ where hospital recovery of a heterogeneous group of patients, including also persons poststroke, resulted in a change of approximately 12 points on the Generic-6 FS. Similarly, our results add to evidence from a study by the same group²⁴ that demonstrated that an interval ICF Generic-6 score was sensitive to change during inpatient rehabilitation treatment with moderate to large effect sizes.

The baseline Generic-6 FS was similar across the SA_

TABLE VI.—*Concurrent validity. Correlations (Pearson’s) between BI and ICF Generic-6 Functioning score (Generic-6 FS) at admission and discharge, and between score changes.*

	Generic-6 FS Pre	Generic-6 FS Post	Generic-6 FS Change
BI Pre	-0.60*	-0.48*	0.15
BI Post	-0.56*	-0.59*	-0.12
BI Change	0.13	-0.12	-0.44*

*Correlation P values <0.05.

BI: Barthel Index.

This document is protected by international copyright laws. No additional reproduction is authorized. It is permitted for personal use to download and save only one file and print only one copy of this Article. It is not permitted to make additional copies (either sporadically or systematically, either printed or electronic) of the Article for any purpose. It is not permitted to distribute the electronic copy of the article through online internet and/or intranet file sharing systems, electronic mailing or any other means which may allow access to the Article. The use of all or any part of the Article for any Commercial Use is not permitted. The production of derivative works from the Article is not permitted. It is not permitted to remove, cover, overlay, obscure, block, or change any copyright notices or terms of use which the Publisher may post on the Article. It is not permitted to frame or use framing techniques to enclose any trademark, logo, or other proprietary information of the Publisher.

group and the SC_group and so the Generic_6 FS did not discriminate between groups of different stroke chronicity. Our participants score⁷ was around 47 and resulted similar to a Generic-6 FS found for mixed diagnostic neurologic groups in the multicenter Chinese study by Reinhardt *et al.*

The Generic-6 FS did prove sensitive to different rates of change in persons post stroke in the subacute and the chronic phase with a significantly bigger change in the SA_group, that improved by near 25% with a moderate ES, while the SC_group score changed little.

The Generic-6 FS was thus sensitive to improvement of functioning during recovery in persons post stroke and it distinguished between recovery rates of stroke populations at a chronicity less than 3 months from the event and one that is in the chronic stage.

Upon closer scrutiny of the heat maps derived from the ICF Generic set the A&P domain appeared more responsive to change than was the BF domain. Not surprisingly a review classifying primary stroke outcomes according to the ICF levels reported that the outcomes most often used were in the A&P domain.⁴¹ The SA_group in general improved in more items than did the SC-group. This may reflect the known increased neuroplasticity in the SA_group and also the fact that a percentage of persons recovered after acute stroke has relatively little damage and so has good potential for recovery of both impairments and activity domains.³³ The persons in the chronic phase after stroke instead were less likely to recover impairments and continued to have limitations in moving around and carrying out activities of daily living. It is interesting to note that regardless of chronicity there were improvements in gait function which may reflect the general emphasis placed on recovery of mobility during rehabilitation.

Concurrent validity of the Generic-6 FS with the BI

The correlation between the Generic-6 FS and the BI was good both at admission and at discharge. The amount of correlation between the measures indicates that they capture some of the same health domains but not all, making both important for describing health and changes in health in response to hospital recovery and rehabilitation.

The change during recovery was moderately correlated in the Generic-6 FS and the BI, in accordance with findings from Kinoshita *et al.*¹¹ that correlated changes on the ICF rehabilitation core set and the FIM in persons with moderate illness after stroke. The FIM and the BI are highly correlated in measuring functional independence in stroke survivors⁴³ while the Generic-6 FS reflects overall functional health, two concepts that probably change

somewhat differently in response to rehabilitation recovery. This further indicates the usefulness of utilizing a Generic-6 FS in addition to measures of independence in assessing improvements after rehabilitation.

Rehabilitation in general is aimed at optimizing a person's functioning both from the perspective of BF domains and A&P domains, with the aim of facilitating physical recovery and lived health in the sense of participation in home and community activities. An overall positive change in both the BI and in the ICF Generic-6 FS after recovery is an important finding since functional independence and functional health have been shown to be predictors of life participation, a domain that should be the ultimate goal of rehabilitation recovery.⁴⁴

Feasibility

The WHO promotes the integration of the ICF as an essential component in national health systems⁴⁵ and so one intention of this work was verifying if the application of the ICF Brief Stroke core set was feasible in routine clinical practice. Health professionals that participated in the classification were those typically involved in the rehabilitation process post stroke in the clinic: medical doctors, nurses, physical, speech and occupational therapists. Practicality of the Brief Stroke core set data collection, including efficiency and compliance, was good among the health professionals. Nonetheless, there were some considerations that had to be revisited along the study timeline, such as time limits for data entry and in general it was necessary to motivate the health professionals to comply with the classification routine. Each professional had his set of items from the ICF Brief Stroke core set to classify that included concepts already evaluated in their routine care, however the extra time needed for giving a qualifier to the concept and inserting it in the data base was not always seen well. The ICF general set, however, has only 7 items and it is possible that inserting qualifiers for these items would be more acceptable in routine care.

General discussion

In view of recommendations of a system-wide ICF implementation in the European health care sector,⁶ this preliminary evidence, from the application of the ICF as a routine classification of persons post stroke, is promising. The ability of the Generic-6 FS to discriminate between different responsiveness rates in two chronicity groups during recovery, gives support to ICF based standardized data collection tools and reporting. There are certainly issues that do have to be addressed, such as training, specific time

dedicated, standardization of item description etc., however, overall, the study results support the inclusion of the ICF generic core set in routine clinical care.

Our findings of the ICF Generic-6 FS being responsive to change in a population post stroke give support to others that have promoted the utility of a Functioning Score derived from six items of the seven item ICF-Generic set²³. The use of an ICF generic set in the health system as one component of outcome evaluation, would allow collection of essential information along the continuum of care, allowing also comparison of the temporal functioning profile of the person along a timeline. This kind of overview of the health status of persons under care is fundamental for standardization of information across the lifetime of disability and across health conditions, across different institutions and across different cultures and countries.

Limitations of the study

There are some limitations to the present study. The health professionals used the ICF standard qualifier system of a 5-point Likert Scale, unlike the more recent studies carried out in the Chinese health care system where a scale of 1 to 10 was used. Further, while Ehrmann *et al.*²³ came to the conclusion that the ICF Generic-6 Set can be used for assessment of functioning in routine clinical practice and that the interval score is sensitive to change, this is only partially true for our results. The Generic-6 FS was not sensitive to change in a group in the chronic phase post stroke. It is possible that the Generic-6 FS is too global or vague to capture smaller changes in function such as those demonstrated by persons in the chronic phase following rehabilitation recovery.

Other limitations are the relatively small number of participants, and the exploratory nature of the observation.

Conclusions

The use of the ICF was feasible in the clinical setting and functioning profiles derived from the ICF Generic set were informative of functional health in a population recovered for rehabilitation post stroke.

The current results indicate the utility of the ICF Generic Set's-6_FS as a metric score of functioning that is valid and sensitive to change. The facility of application and the standardized information on function and health, together with sensitivity to rehabilitation outcome across clinical stroke populations, make it ideal as complementary information that can be shared individually over time and globally across different health settings and countries.

References

1. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. World-wide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. *Lancet Neurol* 2009;8:355–69.
2. Carvalho-Pinto BP, Faria CD. Health, function and disability in stroke patients in the community. *Braz J Phys Ther* 2016;20:355–66.
3. Young J, Forster A. Review of stroke rehabilitation. *BMJ* 2007;334:86–90.
4. Khadilkar A, Phillips K, Jean N, Lamothe C, Milne S, Sarnecka J; Ottawa Panel. Ottawa panel evidence-based clinical practice guidelines for post-stroke rehabilitation. *Top Stroke Rehabil* 2006;13:1–269.
5. National Stroke Foundation. Clinical guidelines for stroke management. Melbourne Australia; 2010.
6. World Health Organization – WHO. International Classification of Functioning, Disability and Health – ICF. Geneva: WHO; 2001.
7. Wade DT, Halligan PW. The biopsychosocial model of illness: a model whose time has come. *Clin Rehabil* 2017;31:995–1004.
8. Leonardi M. Measuring health and disability: supporting policy development. The European MHADIE project. *Disabil Rehabil* 2010;32(Suppl 1):S1–8.
9. Raggi A, Leonardi M, Covelli V, Sattin D, Scaratti C, Schiavolin S, *et al.* The ICF as a framework to collect and interpret data on the extent and variety of disability in neurological conditions. *NeuroRehabilitation* 2015;36:17–22.
10. Paanalaihti M, Berzina G, Lundgren-Nilsson Å, Arndt T, Sunnerhagen KS. Examination of the relevance of the ICF cores set for stroke by comparing with the Stroke Impact Scale. *Disabil Rehabil* 2019;41:508–13.
11. Kinoshita S, Abo M, Okamoto T, Kakuda W, Miyamura K, Kimura I. Responsiveness of the functioning and disability parts of the International Classification of Functioning, Disability, and Health core sets in postacute stroke patients. *Int J Rehabil Res* 2017;40:246–53.
12. Goljar N, Burger H, Vidmar G, Leonardi M, Marincek C. Measuring patterns of disability using the International Classification of Functioning, Disability and Health in the post-acute stroke rehabilitation setting. *J Rehabil Med* 2011;43:590–601.
13. Jonsdottir J, Rainero G, Racca V, Glässel A, Cieza A. Functioning and disability in persons with low back pain. *Disabil Rehabil* 2010;32(Suppl 1):S78–84.
14. Racca V, Spezzaferri R, Modica M, Mazzini P, Jonsdottir J, De Maria R, *et al.* Functioning and disability in ischaemic heart disease. *Disabil Rehabil* 2010;32(Suppl 1):S42–9.
15. Leite HR, Nunes AP, Corrêa CL. Epidemiological profile of stroke survivors registered at the health family strategy of Diamantina, MG. *Arq CiencSaúde*. 2011;15:15–21.
16. Cieza A, Oberhauser C, Bickenbach J, Chatterji S, Stucki G. Towards a minimal generic set of domains of functioning and health. *BMC Public Health* 2014;14:218.
17. Selb M, Gimigliano F, Prodinge B, Stucki G, Pestelli G, Iocco M, *et al.* Toward an International Classification of Functioning, Disability and Health clinical data collection tool: the Italian experience of developing simple, intuitive descriptions of the Rehabilitation Set categories. *Eur J Phys Rehabil Med* 2017;53:290–8.
18. Prodinge B, Reinhardt JD, Selb M, Stucki G, Yan T, Zhang X, *et al.* Towards system-wide implementation of the International Classification of Functioning, Disability and Health (ICF) in routine practice: developing simple, intuitive descriptions of ICF categories in the ICF Generic and Rehabilitation Set. *J Rehabil Med* 2016;48:508–14.
19. Kinoshita S, Abo M, Miyamura K, Okamoto T, Kakuda W, Kimura I, *et al.* Validation of the “Activity and participation” component of ICF Core Sets for stroke patients in Japanese rehabilitation wards. *J Rehabil Med* 2016;48:764–8.
20. Jonsdottir J, Gervasoni E, Meotti M, Montesano A. Efficacy of ICF-based tools in goal setting and the rehabilitation process of people with neurological disorders. Conference Paper. 17th Annual Conference on Rehabilitation in Multiple Sclerosis (RIMS); 2012.

21. Reinhardt JD, Zhang X, Proding B, Ehrmann-Bostan C, Selb M, Stucki G, *et al.* Towards the system-wide implementation of the International Classification of Functioning, Disability, and Health in routine clinical practice: empirical findings of a pilot study from Mainland China. *J Rehabil Med* 2016;48:515–21.
22. Li J, Proding B, Reinhardt JD, Stucki G. Towards the system-wide implementation of the International Classification of Functioning, Disability and Health in routine practice: lessons from a pilot study in China. *J Rehabil Med* 2016;48:502–7.
23. Ehrmann-Bostan C, Proding B, Stucki G, *et al.* ICF Generic Set as new standard for the system wide assessment of functioning in China: multicentre prospective study on metric properties and responsiveness applying item response theory. *BMJ Open* 2018;8: e021696.
24. Liu S, Reinhardt JD, Zhang X, Ehrmann C, Cai W, Proding B, *et al.* System-wide Clinical Assessment of Functioning Based on the International Classification of Functioning, Disability and Health in China: Interrater Reliability, Convergent, Known Group, and Predictive Validity of the ICF Generic-6. *Arch Phys Med Rehabil* 2019;100:1450–1457.e1.
25. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md State Med J* 1965;14:61–5.
26. Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation. *Adv Clin Rehabil* 1987;1:6–18.
27. Silva SM, Corrêa JC, Pereira GS, Corrêa FI. Social participation following a stroke: an assessment in accordance with the international classification of functioning, disability and health. *Disabil Rehabil* 2019;41:879–86.
28. Goljar N, Burger H, Vidmar G, Marincek C, Krizaj J, Chatterji S, *et al.* Functioning and disability in stroke. *Disabil Rehabil* 2010;32(Suppl 1):S50–8.
29. Lemberg I, Kirchberger I, Stucki G, Cieza A. The ICF Core Set for stroke from the perspective of physicians: a worldwide validation study using the Delphi technique. *Eur J Phys Rehabil Med* 2010;46:377–88.
30. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. *J Clin Epidemiol* 1989;42:703–9.
31. Leung SO, Chan CC, Shah S. Development of a Chinese version of the Modified Barthel Index— validity and reliability. *Clin Rehabil* 2007;21:912–22.
32. Hsieh YW, Wang CH, Wu SC, Chen PC, Sheu CF, Hsieh CL. Establishing the minimal clinically important difference of the Barthel Index in stroke patients. *Neurorehabil Neural Repair* 2007;21:233–8.
33. Cramer SC. Treatments to Promote Neural Repair after Stroke. *J Stroke* 2018;20:57–70.
34. Leonardi M, Sattin D, Giovannetti AM, Pagani M, Strazzer S, Villa F, *et al.* Functioning and disability of children and adolescents in a vegetative state and a minimally conscious state: identification of ICF-CY-relevant categories. *Int J Rehabil Res* 2012;35:352–9.
35. Stucki G, Qiu ZY, Li JA. Towards the system-wide implementation of the ICF in rehabilitation in China. *Chin J Rehabil Theory Pract*. 2011;17:5–10.
36. Lenhard W, Lenhard A. (2016). Calculation of Effect Sizes. Retrieved from: https://www.psychometrica.de/effect_size.html. Dettelbach (Germany): Psychometrica.
37. Cohen J. Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum; 1988.
38. Hinkle DE, Wiersma W, Jurs SG. Applied statistics for the behavioural sciences. Second edition. Boston: Houghton Mifflin Co.; 1988, p. 117–21.
39. Kwakkel G, Kollen B, Twisk J. Impact of time on improvement of outcome after stroke. *Stroke* 2006;37:2348–53.
40. Engkasan JP, Ahmad-Fauzi A, Sabirin S, Chai CC, Abdul-Malek IZ, Liguori S, *et al.* Mapping the primary outcomes reported in Cochrane systematic reviews regarding stroke with the International Classification of Functioning, Disability and Health domains: current trend and future recommendations. *Eur J Phys Rehabil Med* 2019;55:378–83.
41. Mudge S, Stott NS. Outcome measures to assess walking ability following stroke: a systematic review of the literature. *Physiotherapy* 2007;93:189–200.
42. van Meijeren-Pont W, Volker G, Vliet Vlieland T, Goossens P. Comparison of the responsiveness of the Utrecht Scale for Evaluation of Rehabilitation (USER) and the Barthel Index in stroke patients. *Clin Rehabil* 2019;33:1672–81.
43. Hsueh IP, Lin JH, Jeng JS, Hsieh CL. Comparison of the psychometric characteristics of the functional independence measure, 5 item Barthel index, and 10 item Barthel index in patients with stroke. *J Neurol Neurosurg Psychiatry* 2002;73:188–90.
44. Westerlind E, Hörsell D, Persson HC. Different predictors after stroke depending on functional dependency at discharge: a 5-year follow up study. *BMC Neurol* 2020;20:263.
45. Stucki G, Zampolini M, Juocevicius A, Negrini S, Christodoulou N. Practice, science and governance in interaction: European effort for the system-wide implementation of the International Classification of Functioning, Disability and Health (ICF) in Physical and Rehabilitation Medicine. *Eur J Phys Rehabil Med* 2017;53:299–307.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Funding.—The study was funded by the Italian Ministry of Health ‘Ricerca Corrente’.

Authors’ contributions.—Johanna Jonsdottir, Thomas Bowman and Angelo Montesano drafted the work and revised it critically for important intellectual content; Johanna Jonsdottir, Thomas Bowman, Angelo Montesano, Anna Casiraghi and Marina Ramella participated in the design of the study, data collection, read and approved the final version of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors read and approved the final version of the manuscript.

Group name.—Members of the group include the following (in alphabetical order): Nadia BRENTAN, Antonio CARACCILO, Matteo MEOTTI, Anna MILO, Laura NEGRI, Marco PASTORE, Laura TETTAMANTI, Chiara VITALI.

History.—Article first published online: September 20, 2021. - Manuscript accepted: September 17, 2021. - Manuscript revised: September 6, 2021. - Manuscript received: November 13, 2020.