J Rehabil Med 2004; Suppl. 44: 56–62

Taylor & Francis
healthsciences

IDENTIFYING THE CONCEPTS CONTAINED IN OUTCOME MEASURES OF CLINICAL TRIALS ON STROKE USING THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH AS A REFERENCE

Szilvia Geyh,[1] Thomas Kurt,[2] Thomas Brockow,[2] Alarcos Cieza,[1] Thomas Ewert,[3] Zaliha Omar[4] and Karl-Ludwig Resch[2]

From the [1]ICF Research Branch, WHO FIC Collaborating Center (DIMDI), IMBK, Ludwig-Maximilians-University, Munich, Germany, [2]Spa Medicine Research Institute, Bad Elster, Germany, [3]Department of Physical Medicine and Rehabilitation, Ludwig-Maximilians-University, Munich, Germany and [4]University of Malaya, Faculty of Medicine, Kuala Lumpur, Malaysia

Objectives: **To systematically identify and quantify the concepts contained in outcome measures in stroke trials using the International Classification of Functioning, Disability and Health (ICF) as a reference.**

Methods: **Randomized controlled trials between 1992 and 2001 were located in MEDLINE and selected according to predefined criteria. Outcome measures were extracted and concepts contained in the outcome measures were linked to the ICF.**

Results: **A random sample of 160 (50%) of 320 eligible studies was included. A total of 148 standardized health status measures were identified. Of 11 283 extracted concepts, 91% could be linked to the ICF. The most used ICF categories for each component were d450 *walking* (70%) for *activities and participation,* b525 *defecation functions* (62%) for *body functions,* and e399 *support and relationships, unspecified* (30%) for *environmental factors*.**

Conclusion: **The ICF provides a useful reference to identify and quantify the concepts contained in outcome measures used in stroke trials. Outcome measurement in stroke refers to an enormous variety of concepts; for comparability of research findings agreement on what should be measured is needed.**

Key words: stroke, cerebrovascular accident, outcome assessment, ICF.

J Rehabil Med 2004; suppl. 44: 56–62

Correspondence address: Alarcos Cieza, Department of Physical Medicine and Rehabilitation, University of Munich, Marchioninistr. 15, DE-81377 Munich, Germany. Tel: +49 89 2180 78216. Fax: +49 89 2180 78230. E-mail: Alarcos.Cieza@med.uni-muenchen.de

INTRODUCTION

Stroke is a frequently occurring condition and a common cause of death and disability. In the USA, each year about 500 000 people experience first stroke (1). Secular trends in stroke mortality show a substantial decline in mortality rates from 79 to 29 deaths per 100 000 population between 1971 and 1994, while the number of stroke survivors increased from 1.5 to 2.4 million from 1973 to 1991 (2). In 2000 estimated 4 700 000 persons with stroke lived in the USA (1). With declining mortality rates and increasing survival it can be assumed that the number of post-stroke patients living with disabilities will rise.

Consequences of stroke on patients' functioning are usually complex and heterogeneous. Stroke has not only an impact on neurological functions, but may also leave survivors dependent in activities of daily living (ADLs) (3) and leads to difficulties in patients' cognitive and mental state (4). In the Auckland Stroke Study, 61% of the patients with stroke reported 6 years after the acute event that they did not fully recover from stroke, and they were found to be at a substantially higher risk of being dependent in basic ADLs than age- and sex-matched controls (5).

Clinical stroke management, but also epidemiological and clinical research, depends on the careful assessment of functioning in patients with stroke. Accordingly, numerous measures exist to assess the wide scope of impact and outcome in stroke. Several reviews provide an overview on these measures to facilitate the selection of appropriate instruments (6–10). Bowling (6) describes various condition-specific measures, e.g. the National Institute of Health Stroke Scale (11), as well as domain-specific instruments, e.g. the Mini-Mental State Examination (12). In more recent reviews (7–9) also generic health status measures used in stroke research are evaluated, for example the SF-36 (13), the EuroQol (14) and the COOP Charts (15).

Wade (10) integrates in his comprehensive review of measurement in neurological conditions instruments into the World Health Organizations' 1980 model of disease consequences (16) and arranges measures according to their content as measures for impairment, disability, or handicap. Wade places great emphasis on the essential principle that the selection of appropriate instruments has to rely on *what* is to be measured, on the concepts contained in the instruments, and should not be primarily guided by the evaluation of their psychometric properties.

Since then, the WHO's framework and classification have

 ISSN 1650–1977
DOI: 10.1080/16501960410015399

been improved and underwent major changes. The new International Classification of Functioning, Disability and Health (ICF) (17) was endorsed by the Word Health Assembly in May 2001 as a reference and a common language of functioning and health. Based on the ICF it is now possible to identify, quantify, and compare the concepts contained in different outcome measures (18).

The objective of this systematic review therefore was to identify and quantify the concepts contained in the outcome measures in randomized controlled trials (RCTs) for interventions on stroke using the ICF as a reference tool. The specific aims were: (i) to determine the frequency of ICF categories linked to the concepts contained within the outcome measures; (ii) to explore differences in the use of ICF categories across different intervention types; and (iii) to examine which standardized health status measures have been applied in patients with stroke and how often.

METHODS

Study design

A systematic review was performed with the following 3 steps: step 1, selection of studies; step 2, outcome measures extraction; and step 3, linkage of the concepts contained within the outcome measures to the corresponding categories of the ICF. All steps were conducted by 2 independent reviewers.

In step 1, selection of studies, RCTs were located in MEDLINE®, Silver Platter, 2001 Edition, by using the highly precise search strategy (sets 1–8) Dickersin's et al. (19). The Dickersin search was then combined with a condition-specific search strategy designed according to the Cochrane Stroke Group MEDLINE® search (20). In addition, the terms "poststroke" or "post-stroke" were included in the second search command to specifically locate rehabilitation trials.

All searches were limited to English articles. The abstracts were checked applying general and condition-specific eligibility criteria. For the selected trials the original study reports were ordered and reviewed applying again the same eligibility criteria. The studies finally included entered step 2 of the review.

A study met general eligibility if the study design was a RCT, the experimental intervention had a therapeutic aim, the study was on human adults, the report was in English, and, if none of the following exclusion criteria were fulfilled: randomized *n* of 1 study, reviews, secondary analyses, psychometric studies, primary prevention studies (healthy population at risk), and mode of action studies. In the case of multiple publications, the paper with the highest impact factor was included.

To identify the appropriate study population, condition-specific eligibility criteria were applied. For the inclusion of a study the diagnosis of ischaemic stroke, haemorrhagic stroke or multi-infarct dementia had to be reported to describe the study population. Studies on populations with transient ischaemic attacks, vascular anomalies of the brain (acquired or inborn), vasculitis of the central nervous system, carotid artery diseases, cerebrovascular trauma (carotid artery, vertebral artery), vascular headaches (e.g. migraine, cluster headache), vascular cognitive impairment other than multi-infarct dementia, and brain ischaemia (e.g. vertebrobasilar insufficiency) were excluded. Furthermore, studies on patients with brain damage due to traumatic, infection, toxic, or metabolic aetiologies, as well as due to brain neoplasm or degenerative diseases were excluded.

In step 2, outcome measures extraction, all types of outcome measures and certain characteristics of the study were extracted including the specific aetiology, chronicity and the type of intervention.

Outcome measures included on the one hand clinical variables, for example haematocrit, internal carotid blood flow, spasticity or walking distance. On the other hand outcome measures also included standardized health status instruments such as questionnaires (e.g. Hospital Anxiety and Depression Scale (21)), rating scales (e.g. Rankin Scale (22)), and standardized tests (e.g. Mini-Mental State Examination (23)). If the items or concepts of a health status measure were not specified in the publication, we attempted to obtain the instrument by reference checking, searches in databases, or books on health status measures (6, 10, 23, 24), e-mail consultation with the developers of the instrument in demand, and internet searches, and then the items were extracted.

In step 3, the concepts contained within the outcome measures were extracted and linked to the most specific ICF category by 2 independent health professionals according to a recently developed set of 10 linking rules (18). Concepts of outcome measures that could not be linked to the ICF were documented and classified in 2 ways: (i) If a concept of an outcome measure was not sufficiently specified to make a decision which ICF category the concept should be linked to, the "not definable" option was chosen (linking rule 9). To give an example, unspecified concepts such as "improvement", "being independent", "physical disability", or "health" were considered not to be definable for linking. (ii) If a concept of an outcome measure was not represented by the ICF, the option "not covered" was chosen (linking rule 10). To give an example, concepts such as "mortality", "pneumonia", "seizures", or "myocardial infarction" were considered not to be covered by the ICF.

Consensus between the 2 health professionals was used to decide which ICF category should be linked to each item or concept. The application of the predefined linking rules has previously been shown to yield high overall agreement between health professionals (91.4% at the second-level of the classification) (18). To resolve disagreements between the 2 health professionals, a third person trained in the linking rules was consulted. In a discussion led by the third person, the 2 health professionals who linked the item stated their pros and cons for the linking of the concept under consideration to a specific ICF category. Based on these statements, the third person made an informed decision.

Additionally, to control the plausibility of the linkage procedure, the concepts of the outcome measures assigned to the same single ICF category were analysed (e.g. the concepts "getting up from chair" (25), "sitting to standing" (26), or "stand up only with someone's help" (27) were linked to the second-level ICF category d410 "changing basic body position").

Analyses

Descriptive statistics were used to examine the frequency of ICF categories linked to the concepts contained in the outcome measures. Large-scale cross-tables generated from an SQL-database (SQL-Server 2000) were thereby analysed. If one and the same ICF category was assigned repeatedly in a study, the category was counted only once.

ICF categories are presented on the second-level of the classification. If a concept of an outcome measure was linked to a third- or fourth-level ICF category, the overlying second-level category was considered. The ICF is organized in a hierarchical scheme, so that the more specific lower-level categories share the attributes of the less specific higher-level category (18). ICF categories with a frequency equal or greater than 10% are shown.

RESULTS

In step 1, 3292 studies were located by the search strategy, 397 studies were preliminarily selected by abstract checking, and 320 studies fulfilled the eligibility criteria by screening the respective original papers. Thereof, a computer-generated random sample of 160 studies (50%) was drawn and included into the review.

The study population consisted in 66 studies (41%) of patients with ischaemic stroke, in 8 studies (5%) the patients suffered a haemorrhage, and in 30 studies (19%) both aetiologies were represented. In the remaining 56 studies (35%) stroke aetiology was not specified. Patients with acute stroke participated in 97 studies (61%), while in 29 (18%) studies patients post-stroke were involved. In 2 studies (1%) the population consisted of

acute and post-stroke patients and in 32 studies (20%) no information was given about the chronicity.

Drug therapy was the most frequently used intervention type with an overall prevalence of 52% (82 studies), including platelet aggregation inhibitors (20%), anticoagulant (16%), calcium channel blocker (16%), thrombolytic (13%), and other medications (35%). Rehabilitative therapies were conducted in 54 studies (34%) including physiotherapy (62%), occupational (11%), speech and language (7%), cognitive (7%) and other (13%) therapies. Combined interventions were applied in 11 studies (7%). Complex treatments applied in different settings (management trials) were investigated in 11 studies (7%), for example stroke unit care compared with general ward care. In 2 trials (1%) surgical intervention was conducted.

In step 2, 148 different standardized health status measures (different versions and subscales of a questionnaire were considered as one and the same questionnaire) were extracted. Twenty-two condition-specific, 120 domain-specific and 6 generic measures were identified. Condition-specific measures covered scales to determine the severity of stroke or the severity of disability following stroke and were used in 52% (83) of studies. The most frequently used condition-specific measure was the Rankin Scale (22) (18%). Domain-specific measures included instruments to assess ADLs, motor functions, various cognitive functions, as well as aspects of mental health, mainly depression and were used in 74% (118) of studies. The most frequently used domain-specific measure was the Barthel Index (28) covering basic activities of daily living. Generic health status measures were used in 14% (22) of the studies; the Nottingham Health Profile (29) was most frequently used (8%). At least 1 standardized health status measure was identified in 150 or 94% of the studies. Type and frequency of the 20 most used health status measures for the different types of study interventions are shown in Table I.

Most often used clinical and physiological outcome measures referred to cardiovascular parameters (e.g. blood pressure, cerebral blood flow, arrhythmia), to muscular functions and mobility (e.g. weakness, spasticity, walking time, range of motion), and laboratory parameters (e.g. haematocrit, partial thromboplastin time). Also variables such as mortality, the occurrence of a recurrent or secondary cerebrovascular accident, and amount or type of care required were frequently reported as study outcomes.

In step 3, a total of 11 283 concepts were extracted from the outcome measures. 10 299 or 91% of concepts could be linked to the ICF, 698 or 6% of concepts were considered not to be sufficiently specified for an assignment to the ICF ("not definable option"), and 286 or 3% of concepts were considered to be not covered by the ICF. A total of 4959 (48%) of the assignable concepts were linked to the component *body functions*, 22 (<1%) to the component *body structures*, 4590 (45%) to the component *activities and participation*, and 728 (7%) to the component *environmental factors*. 80% of the assignable concepts (8250) were contained in standardized health status measures, while 20% (2049) of the concepts were derived from clinical or physiological outcome variables.

The 10 299 assignable concepts contained in the outcome measures were linked to 534 different ICF categories at the second, third and fourth levels of the classification. 275 ICF categories belonged to the ICF component *body functions*,

Table I. *Type and frequency of the 20 most used health status measures in 160 stroke randomized controlled trials for the different types of study intervention*

Outcome measure	Type	All (n = 160)	DT (n = 82)	RT (n = 54)	CT (n = 11)	MT (n = 11)	ST (n = 2)
Barthel Index*	ds	82 (51%)	35 (43%)	30 (56%)	6 (55%)	11 (100%)	
Rankin Scale*	cs	29 (18%)	21 (26%)	3 (6%)	2 (18%)	2 (18%)	1 (50%)
National Institute of Health Stroke Scale	cs	22 (14%)	20 (24%)	2 (4%)			
Functional Independence Measure*	ds	20 (13%)	3 (4%)	17 (31%)			
Mini-Mental State Examination	ds	19 (12%)	10 (12%)	8 (15%)	1 (9%)		
Fugl-Meyer Motor Assessment*	ds	18 (11%)	4 (5%)	12 (22%)		2 (18%)	
Ashworth Scale*	ds	14 (9%)	5 (6%)	7 (13%)	1 (9%)	1 (9%)	
Glasgow Outcome Scale	cs	13 (8%)	12 (15%)		1 (9%)		
Nottingham Health Profile	g	12 (8%)	1 (1%)	7 (13%)	2 (18%)	2 (18%)	
Scandinavian Stroke Scale	cs	10 (6%)	6 (7%)	1 (2%)		3 (27%)	
Frenchay Activities Index	ds	9 (6%)	2 (2%)	4 (7%)	1 (9%)	2 (18%)	
Mathew Scale*	cs	9 (6%)		8 (15%)	1 (9%)		
Hospital Anxiety and Depression Scale*	ds	9 (6%)	9 (11%)				
Nottingham Extended Activities of Daily Living Index*	ds	9 (6%)		6 (11%)		3 (27%)	
General Health Questionnaire*	ds	7 (4%)		5 (9%)	2 (18%)		
Hamilton Rating Scale for Depression*	ds	7 (4%)	6 (7%)		1 (9%)		
Motor Assessment Scale	ds	7 (4%)		7 (13%)			
Motoricity Index*	ds	7 (4%)	2 (2%)	4 (7%)	1 (9%)		
Rivermead Motor Assessment	ds	7 (4%)	1 (1%)	4 (7%)	1 (9%)	1 (9%)	
Sickness Impact Profile*	g	7 (4%)		6 (11%)		1 (9%)	

DT = drug trial; RT = rehabilitation trial; CT = combination trial; MT = management trial; ST = surgical trial; cs = condition-specific; ds = domain-specific; g = generic.
* Different versions or subscales.

Table II. *Frequency of International Classification of Functioning, Disability and Health (ICF)-categories linked to the concepts contained in the outcome measures for the different types of study interventions*

ICF code	ICF category	%All (n = 160)	%DT (n = 82)	%RT (n = 54)	%CT (n = 11)	%MT (n = 11)	%ST (n = 2)
Body functions							
b110	Consciousness functions	45	62	18	45	36	100
b114	Orientation functions	41	36	42	45	72	50
b117	Intellectual functions	11	18	1	18		
b126	Temperament and personality functions	26	30	27	18		
b130	Energy and drive functions	20	18	22	27	27	
b134	Sleep functions	23	18	29	36	27	
b140	Attention functions	13	12	18	9	9	
b144	Memory functions	42	37	48	45	54	
b147	Psychomotor functions	26	24	29	45	9	
b152	Emotional functions	30	20	40	36	36	50
b156	Perceptual functions	36	42	38	27		
b160	Thought functions	23	20	27	36	9	
b164	Higher-level cognitive functions	20	17	29	27		
b167	Mental functions of language	47	54	42	45	27	
b172	Calculation functions	19	13	24	18	45	
b176	Mental function of sequencing complex movements	14	14	18	9		
b210	Seeing functions	28	36	25	18		
b215	Functions of structures adjoining the eye	30	45	9	9	36	50
b240	Sensations associated with hearing and vestibular function	10	13	5	9	9	
b260	Proprioceptive function	15	3	27		54	
b270	Sensory functions related to temperature and other stimuli	11	7	12	27	18	
b279	Additional sensory functions, other specified and unspecified	10	3	18	36		
b280	Sensation of pain	53	62	42	54	45	50
b289	Sensation of pain, other specified and unspecified	17	10	22	36	27	
b320	Articulation functions	19	29	9	18		
b330	Fluency and rhythm of speech functions	10	7	12	18	9	
b410	Heart functions	18	34	1	9		
b415	Blood vessel functions	10	15	3	9		50
b420	Blood pressure functions	17	29	1	18		50
b430	Haematological system functions	14	23	5	9		
b455	Exercise tolerance functions	11	8	18		18	
b510	Ingestion functions	22	29	18	18		
b525	Defecation functions	62	58	62	54	100	50
b535	Sensations associated with the digestive system	16	28	1	18		
b620	Urination functions	56	50	62	45	100	
b710	Mobility of joint functions	21	14	33		36	
b730	Muscle power functions	50	56	40	27	81	50
b735	Muscle tone functions	43	29	57	45	72	100
b750	Motor reflex functions	17	14	24	18	9	
b755	Involuntary movement reaction functions	29	21	40	18	45	
b760	Control of voluntary movement functions	43	43	51	27	27	
b765	Involuntary movement functions	15	14	22		9	
Activities and participation							
d166	Reading	15	6	24	18	45	
d175	Solving problems	10	6	14	18	9	
d177	Making decisions	10	10	7	27		
d230	Carrying out daily routine	23	29	12	27	27	50
d310	Communicating with – receiving – spoken messages	16	28	5			
d330	Speaking	23	32	18		9	
d345	Writing messages	10	4	18		27	
d360	Using communication devices and techniques	11	1	18	18	45	
d410	Changing basic body position	61	45	79	63	100	
d415	Maintaining a body position	34	13	55	27	90	50
d420	Transferring oneself	60	46	72	63	100	50
d430	Lifting and carrying objects	11	2	20	18	36	
d440	Fine hand use	14	1	31	18	27	
d445	Hand and arm use	20	3	38	27	45	
d450	Walking	70	58	83	63	100	50
d455	Moving around	59	46	72	63	100	
d460	Moving around in different locations	10	1	20	18	27	
d465	Moving around using equipment	57	47	66	54	100	
d470	Using transportation	13	3	22	18	45	
d475	Driving	11	3	16	18	45	
d498	Mobility, other specified	28	25	25	36	45	50
d510	Washing oneself	62	51	75	54	100	

Table II. Continued

ICF code	ICF category	%All (n = 160)	%DT (n = 82)	%RT (n = 54)	%CT (n = 11)	%MT (n = 11)	%ST (n = 2)
d520	Caring for body parts	57	50	64	45	100	
d530	Toileting	60	50	70	54	100	
d540	Dressing	61	51	72	54	100	
d550	Eating	60	50	72	54	100	
d560	Drinking	11	3	24	9	9	
d599	Self-care, unspecified	18	26	5	18	18	50
d620	Acquisition of goods and services	16	6	25	18	45	
d630	Preparing meals	23	8	40	18	54	
d640	Doing housework	23	8	42	18	54	
d650	Caring for household objects	16	3	31	18	45	
d710	Basic interpersonal interactions	10	4	14	18	18	
d760	Family relationships	14	6	24	18	27	
d850	Remunerative employment	11	2	22	18	18	50
d920	Recreation and leisure	22	7	37	36	54	
Environmental factors							
e110	Products or substances for personal consumption	15	10	22	18	18	
e120	Products and technology for personal indoor and outdoor mobility and transportation	25	7	48	36	36	
e355	Health professionals	19	26	7	18	18	50
e399	Support and relationships, unspecified	30	28	27	36	45	50
e580	Health services, systems and policies	11	1	14	27	54	

DT = drug trial; RT = rehabilitation trial; CT = combination trial; MT = management trial; ST = surgical trial.

10 belonged to the component *body structures*, 222 to component *activities and participation*, and 27 to the component *environmental factors*.

The concepts contained in the outcome measures were linked to 191 different second-level ICF categories, also including the more specific third-, and fourth-level categories. Of these second-level ICF categories 83 reached a frequency of at least 10% (42 *body functions*, 0 *body structures*, 36 *activities and participation*, 5 *environmental factors*). Most frequently measured *body functions* were b525 *defecation functions* (62%), b620 *urination functions* (56%), and b280 *sensation of pain* (53%). Within the ICF component *activities and participation* the categories d450 *walking* (70%), d510 *washing oneself* (62%), d410 *changing basic body position* (61%), and d540 *dressing* (61%) showed the highest relative frequencies. For *environmental factors* e399 *support and relationships, unspecified* (30%), e120 *products and technology for personal indoor and outdoor mobility and transportation* (25%), and e355 *health professionals* (19%) are the ICF categories most frequently referred to in stroke outcome measures. Table II shows the relative frequency of the most used ICF categories (≥10%) linked to the concepts contained in the outcome measures for the different types of study interventions. Results shown are summarized at the second-level of the classification.

DISCUSSION

Using the ICF as a reference, concepts within the outcome measures used in stroke RCTs were identified and quantified. Most concepts could be linked to the ICF and those that could not be linked were mostly not specified in enough detail for an assignment. Only a small portion of concepts was considered to be "not covered" by the ICF. In these cases the content of the concepts did not lie in the defined universe of the ICF. Such concepts were for example "mortality", but also diagnoses of disease conditions (e.g. "myocardial infarction"), which were often documented as adverse effects of study medication. These concepts of diagnoses can be described by another member of the WHO family of classifications, the International Statistical Classification of Diseases and Related Health Problems (ICD) (30).

The number of different ICF categories resulting from this review reflects the scope of concepts in stroke RCTs outcome measures. There is a large number of 83 different ICF categories that are frequently measured (≥10%). However, there is an even larger variety of rarely measured concepts, linked to 108 different ICF categories (data not shown). This could be explained on the one hand by the heterogeneity of stroke related difficulties in patients' functioning; on the other hand it reveals the need for standardization in stroke outcome measurement.

The frequencies of the ICF categories resulting from this review indicate for the areas of patients' functioning the extent they are regarded as relevant outcomes of stroke interventions from the research perspective. The most frequent ICF categories in the components *body functions* and *activities and participation* were found to map the concepts contained in the Barthel Index (28), that proved to be the most often used outcome measure in stroke trials covering basic aspects of *mobility* (chapter d4), *self-care* (chapter d5), as well as problems in 2 important *body functions* and major indicators of prognosis, *bladder and bowel incontinence* (linked to b525 and b620).

None of the concepts referring to *body structures* was measured with a frequency of at least 10%. Since up till now no treatment could keep the promise of a straight protective or regenerative effect on the damaged brain structure in stroke

patients, it is intelligible that outcome of stroke interventions is seldom described in terms of *body structure*.

Within the ICF component *environmental factors* the category e399 *support and relationships, unspecified* was most often linked to concepts of the identified outcome measures. This category was mainly used to link the concept "requiring help" appearing for example in the Nottingham Health Profile (29), in the Rankin Scale (22), or in the Sickness Impact Profile (27) to indicate the severity of stroke-related disability.

The frequencies of ICF categories showed distinct patterns along with the different types of study interventions. Categories belonging to *activities and participation*, as well as to *environmental factors* were more often addressed in rehabilitation trials, while *body functions* were more often considered in drug trials. This clearly reflects the primary target areas of the specific intervention and the selection of outcome measures according to the study objectives.

Standardized health status measures seem to be more common in studies with rehabilitation type interventions but are also often used in drug trials. Most standardized health status measures were domain-specific instruments. Condition-specific measures were less used, and only a few generic measures were detected, mainly in rehabilitation trials.

The most frequently used outcome measure was the Barthel Index (28), applied in 51% of the examined stroke RCTs, followed by the Rankin Scale (22) (18%), and the National Institutes of Health Stroke Scale (11) (14%). In 2 recent reviews of outcome measurement in randomized stroke trials similar findings are reported (31, 32). Except for the Barthel Index, none of the standardized health status measures was used in a majority of trials, and no single health status instrument could be identified that represents a "standard measure" in stroke.

Results of this systematic review are subject to some methodological limitations, such as the solely use of MEDLINE®, RCTs, studies published in English, and outcome measures available in English. Furthermore, we had drawn a random sample of the eligible studies.

However, our results reflect the "state of the art" with regard to the concepts measured as outcomes in stroke trials over the last decade. The ICF proved to be a valuable reference to identify and quantify the concepts within the outcome measures used in RCTs on stroke interventions. As for the wide variety of outcome concepts measured with a great number of different standardized health status instruments and documented by numerous clinical variables, our findings indicate a need to define and to agree on "what should be measured" in clinical trials to allow for a comparable and comprehensive description of patient populations, their functioning, and health across studies and interventions.

REFERENCES

1. American Heart Association. Heart disease and stroke statistics – 2003 update Dallas: American Heart Association; 2002.
2. Muntner P, Garrett E, Klag MJ, Coresh J. Trends in stroke prevalence between 1973 and 1991 in the US population 25 to 74 years of age. Stroke 2002; 33: 1209–1213.
3. Jorgensen HS, Nakayama H, Raaschou HO, Vive-Larsen J, Stoier M, Olsen TS. Outcome and time course of recovery in stroke. Part I: Outcome. The Copenhagen Stroke Study. Arch Phys Med Rehabil 1995; 76: 399–405.
4. Kase CS, Wolf PA, Kelly-Hayes M, Kannel WB, Beiser A, D'Agostino RB. Intellectual decline after stroke: the Framingham Study. Stroke 1998; 29: 805–812.
5. Hackett ML, Duncan JR, Anderson CS, Broad JB, Bonita R. Health-related quality of life among long-term survivors of stroke: results from the Auckland Stroke Study, 1991–1992. Stroke 2000; 31: 440–447.
6. Bowling A. Measuring disease. A review of disease-specific quality of life measurement scales. Buckingham: Open University Press; 1995.
7. Buck D, Jacoby A, Massey A, Ford G. Evaluation of measures used to assess quality of life after stroke. Stroke 2000; 31: 2004–2010.
8. De Haan R, Aaronson N, Limburg M, Hewer RL, Van Crevel H. Measuring quality of life in stroke. Stroke 1993; 24: 320–327.
9. Golomb BA, Vickrey BG, Hays RD. A review of health-related quality-of-life measures in stroke. Pharmacoecomomics 2001; 19: 155–185.
10. Wade DT. Measurement in neurological rehabilitation. New York: Oxford University Press; 1992.
11. Brott T, Adams HP, Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: a clinical examination scale. Stroke 1989; 20: 864–870.
12. 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: 189–198.
13. Ware JE, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36). I. Conceptual framework and item selection. Med Care 1992; 30: 473–483.
14. EuroQol Group. EuroQol: a new facility for the measurement of health-related quality of life. Health Policy 1990; 16: 199–208.
15. Nelson EC, Wasson J, Kirk J, Keller A, Clark D, Dietrich A, et al. Assessment of function in routine clinical practice: description of the COOP Chart method and preliminary findings. J Chronic Dis 1987; 40 (suppl 1): 55S–63S.
16. World Health Organization. International Classification of Impairments, Disabilities and Handicaps. Geneva: World Health Organization; 1980.
17. World Health Organization. International Classification of Functioning, Disability and Health: ICF. Geneva: World Health Organization; 2001.
18. Cieza A, Brockow T, Ewert T, Amman E, Kollerits B, Chatterji S, et al. Linking health-status measurements to the international classification of functioning, disability and health. J Rehabil Med 2002; 34: 205–210.
19. Dickersin K, Scherer R, Lefebvre C. Identifying relevant studies for systematic reviews. BMJ 1994; 309: 1286–1291.
20. Sandercock P, Anderson C, Bath P, Bereczki D, Candelise L, Chen C, et al. Stroke Group. In: The Cochrane Library, Issue 4, 2003. Chichester, UK: John Wiley & Sons Ltd.
21. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand 1983; 67: 361–370.
22. Rankin J. Cerebral vascular accidents in patients over the age of 60. 2. Prognosis. Scott Med J 1957; 2: 200–215.
23. Lezak M. Neuropsychological assessment. 3rd edn. New York: Oxford University Press; 1995.
24. McDowell I, Newell C. Measuring health. A guide to rating scales and questionnaires. Second edition. New York: Oxford University Press; 1996.
25. Hamilton BB, Granger CV, Sherwin FS, Zielezny M, Tashman JS. A uniform national data system for medical rehabilitation. In: Fuhrer MJ, ed. Rehabilitation outcomes: analysis and measurement. Baltimore: Paul H. Brookes; 1987, p. 137–147.
26. Lincoln N, Leadbitter D. Assessment of motor function in stroke patients. Physiotherapy 1979; 65: 48–51.
27. Bergner M, Bobbitt RA, Kressel S, Pollard WE, Gilson BS, Morris JR. The Sickness Impact Profile: conceptual formulation and

methodology for the development of a health status measure. Int J Health Serv 1976; 6: 393–415.
28. Mahoney FI, Wood OH, Barthel DW. Rehabilitation of chronically ill patients: the influence of complications on the final goal. South Med J 1958; 51: 605–609.
29. Hunt SM, McEwen J, McKenna SP. Measuring health status: a new tool for clinicians and epidemiologists. J R Coll Gen Pract 1985; 35: 185–188.
30. World Health Organization. International statistical classification of diseases and related health problems, 10th revision. Geneva: World Health Organization; 1992.
31. Duncan PW, Jorgensen HS, Wade DT. Outcome measures in acute stroke trials. A systematic review and some recommendations to improve practice. Stroke 2000; 31: 1429–1438.
32. Roberts L, Counsell C. Assessment of clinical outcomes in acute stroke trials. Stroke 1998; 29: 986–991.