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ORIGINAL REPORT

SATIS-STROKE: A SATISFACTION MEASURE OF ACTIVITIES AND PARTICIPATION IN THE ACTUAL ENVIRONMENT EXPERIENCED BY PATIENTS WITH CHRONIC STROKE

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Objective: **To develop a satisfaction measure of activities and participation in the actual environment experienced by patients after chronic stroke using the Rasch measurement model.**

Methods: **A 36-item questionnaire based on the International Classification of Functioning, Disability and Health model and existing scales was developed. The questionnaire was submitted to 101 patients (70% men; mean age 63 years) without major intellectual deficits who live in different types of residences (homes and nursing homes). The questionnaire was resubmitted after one month. The patients' responses were analysed separately using RUMM Rasch software to select items presenting an ordered rating scale, sharing the same discrimination, and fitting a unidimensional scale.**

Results: **The final SATIS-Stroke scale consisted of 36 items rated by the patients. The patients reported perceptions over a wider range of measurement with high reliability ($r = 0.94$) and good reproducibility over time (intraclass correlation coefficient = 0.98). The SATIS-Stroke measures are significantly related to age and place of residence.**

Conclusion: **SATIS-Stroke is a functional scale specifically developed to measure satisfaction with activities and participation, providing goal-setting guidelines for treatment planning. Its range and measurement precision are appropriate for clinical practice.**

Key words: stroke, ICF activity, ICF participation, satisfaction, questionnaire, rehabilitation.

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INTRODUCTION

Post-stroke hemiplegia is one of the most prevalent forms of motor disability, occurring in 1% of the population (1). Depending on the severity and the location of the brain lesion, stroke may affect various body functions and structures (body dimension), limit the accomplishment of daily activities (individual dimension) and restrict the subjects' participation in familial and societal life (social dimension) (2). In the past, most instruments were developed to measure either the body dimension or the individual dimension according to a biomedical perspective of health, thus neglecting the social dimension. Optimizing a patient's participation in society has recently become a major goal for the rehabilitation of patients with chronic disorders, including chronic stroke patients.

Participation is defined in the International Classification of Functioning, Disability and Health (ICF) (2), as the patient's involvement in life situations. Participation restrictions represent the problems the patient experiences in the fulfilment of social roles (e.g. being a spouse, parent, worker, or friend) that are regarded as common, considering their age, sex, and the society and culture in which they live. On the contrary, activity is defined as the execution of a task or action by an individual. The activity and participation domains of the ICF have 2 qualifiers: capacity and performance. Capacity refers to an individual's ability to execute activities in a non-actual standardized environment. Performance describes what an individual does in the actual environment in which they are living. Because the actual environment includes a societal context, performance can also be understood as an "involvement in a life situation". Disregarding the social dimension may lead to inappropriate interventions in long-term rehabilitation, especially when patients return to the community (3). In the ICF, activity and participation are expressed through the same list of activities and situations, called items. Several authors (4, 5) have tried to clarify the concept of participation in order to differentiate participation from activity items. Contrary to the activity dimension, participation is not restricted to a limited environment (e.g. the hospital or home) but concerns a wider physical and social environment encompassing all possible life circumstances. Moreover, participation implies that the person is able to control their own life in every life situation, even if they cannot complete the activities themselves (6). Participation is thereby the result of a dynamic and complex interaction between the person (i.e. body functions and structures, capacity to execute activities, and other characteristics such as age, sex, culture, etc.) and their physical and social environment (7). For example, a patient after stroke who is able to move around using a wheelchair (no activity limitation) may be restricted when they want to go to the theatre because there are no ramps into the building (participation restriction).

Several instruments have been developed to measure activities and participation (8) in patients after chronic stroke. These instruments assess the degree of patient performance in activities and life situations, the required assistance, or the experienced

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difficulty. To our knowledge, no instrument actually measures the satisfaction perceived by stroke patients in their experience in activities and life situations, regardless of their degree of performance. Satisfaction corresponds to the person's own perspective on his or her performance in activities and life situations that meet his or her needs and should not necessarily be related to the difficulty in the performing of the activity or the life situation. With a patient-focused approach, it is important to measure satisfaction so that the rehabilitation process meets the needs that are essential to the patient's well-being (9).

Satisfaction is a latent variable concealed within a person in the same manner as pain or anxiety. Satisfaction can be measured by eliciting the patient's perceived satisfaction with life situations using a questionnaire with ordered categories. Such an instrument generates ordinal data that have no metric properties since they rely on counts of potentially unequal units (10–12). Consequently, they are not subject to statistics or mathematical operations such as addition or subtraction (13). Linearity is not obtained when ordinal total scores are used. Linearity implies that the unit of measurement is consistent throughout the scale, so that identical intervals represent the same amount of the variable purported to be measured (11). A linear measure of satisfaction can only be estimated properly from ordinal raw scores according to probabilistic measurement models, the most promising of these being the Rasch model (14). The aim of this study was to develop a Rasch-built questionnaire that measures the satisfaction of adult patients after chronic stroke.

SUBJECTS AND METHODS

Subjects

This study was authorized by the ethics committee of the Université catholique de Louvain, Faculty of Medicine in Brussels, Belgium.

All patients in the present study were older than 18 years and presented with a unilateral hemiplegia subsequent to a stroke that had occurred at least 6 months earlier. Given that the data came from patients' perceptions, only patients showing no major cognitive deficits were selected (≥ 24 out of 30 on the Mini-Mental State Examination) (15). As a result, 101 patients (30 women, 71 men; mean age 63 years) met the inclusion criteria. According to the Hospital Anxiety Depression Scale (16), most of the patients were not depressed. They were asked to report their perceived satisfaction to 1 of 4 occupational therapists who each assessed approximately 25 patients. The 4 occupational therapists did not receive specific training. The sample description is presented in Table I.

Table I. *Sample description (n = 101)*

Characteristics	
Sex, *n*	
Men	71
Women	30
Age, years, mean (range)	63 (25–90)
CVA side, *n*	
Right brain	45
Left brain	56
Delay since stroke, months, mean (range)	52 (5–375)
Residence place, *n*	
Home residence	62
Nursing home residence	39
Social status	
Married	66
Unmarried	35
Depression status, %	
Non-depressed (HADS < 11)	74
Depressed (HADS ≥ 11)	26

HADS: Hospital Anxiety and Depression Scale; CVA: cerebrovascular accident.

Questionnaire development

A large pool of items (271 items) was designed to cover the widest range of stroke patients' activities and life situations. They were selected from the nomenclature of the ICF (2) and from various existing scales (17–19). This pool of items was evaluated by 10 patients after stroke and 10 health professionals who work with patients with chronic stroke. Patients and professionals were asked to appraise the clinical relevance of the activities and life situations.

Eighty-four items were considered clinically relevant by these experts and were included in the experimental version of the SATIS-Stroke questionnaire. The 84 items cover the 9 domains of the ICF: learning and applying knowledge (4 items), general tasks and demands (3 items), communication (10 items), mobility (15 items), self-care (21 items), domestic life (6 items), interpersonal interactions and relationships (11 items), major life areas (4 items), and community, social and civic life (5 items).

Instrument

The experimental version of SATIS-Stroke was given to 101 patients after stroke. For each question, the patients were asked to define their perceived satisfaction with activities and participation on a 4-level scale: Very Dissatisfied (0), Dissatisfied (1), Satisfied (2), or Very Satisfied (3). Activities and situations that were not encountered in the last month or were never performed were scored as "Not Applicable" and were encoded as missing responses. Missing values were observed in 30% of the responses ($n = 8484$) given by all patients ($n = 101$) to all items ($n = 84$).

Procedure

The French version of the questionnaire was presented to patients with chronic stroke in nursing homes or at home. The patients were asked to complete the questionnaire without assistance, except for the first 5 items, which were completed with the assistance of the examiner. The items were presented in a random order to avoid any systematic effect.

The questionnaire was submitted twice to each subject after an interval of 32 days (standard deviation (SD) 10). The first assessment was used to select the items and calibrate the scale. The second assessment was used to verify the test-retest reliability of the final version of the SATIS-Stroke scale.

Data analysis

Patients' responses were analysed using RUMM 2020® Rasch analysis software. For all items, the response categories were analysed according to the rating scale model (20). The Rasch model is a probabilistic model based on the assumption that most satisfied persons have a higher probability of choosing a category reflecting higher satisfaction than less satisfied persons, and vice versa.

The model requires that the probability of choosing any response category to an item depends solely on the patient's satisfaction and the satisfactory level in his activity and life situation (21). In the case of satisfaction measurement, no attribute of the person or item besides satisfaction is theorized to account for the probability of choosing a response. This requirement, called "unidimensionality", is essential for achieving an objective measurement (11, 22). Once the observed responses are found to fit the unidimensionality requirement, the Rasch model can be used to estimate the satisfaction of each subject and the satisfactory level of each item or threshold on a common linear interval scale (14).

Item selection

Starting with 84 items, successive analyses were used to select items that will constitute the final SATIS-Stroke scale. Individual items that did not meet any of the following criteria were eliminated. These criteria are presented in accord with the order of analysis.

Ordered rating scale. The patients were asked to report their perception on a 4-level scale: Very Dissatisfied (0), Dissatisfied (1), Satisfied (2), Very Satisfied (3). If the anticipated order of response categories is verified, subjects with a higher satisfaction should select a higher response to any given item, and subjects selecting a higher response for a given item should demonstrate higher satisfaction. When these conditions are not met, the order of thresholds between successive response categories are reversed, indicating that the rating scale is not used as anticipated for that particular item. Only items having thresholds in the anticipated order were retained.

Items with similar relative threshold locations. Though all items were answered according to the same 4-level rating, the threshold locations (relative to the item location) could vary across items (23, 24). The difference in the relative threshold locations from one item to another complicates the clinical interpretation of scores since a given response has a different relative weight across all items. Therefore, items with relative threshold locations significantly different from the average (Z-test) were removed.

Items fit a unidimensional scale. Chi-squared fit statistics and principal component analysis (PCA) on the residuals were used to detect items that did not satisfy the model requirement of unidimensionality. The total sample was divided into 4 class intervals of increasing satisfaction levels. An item χ^2 fit statistic was computed as the sum of the squared standardized residuals (residuals are the difference between observed and expected responses) of each class interval (22). Items with a p-value lower than 0.05 indicate a threat to the fit requirement and were removed. However, some recent simulation studies have shown that good fit statistics may be reported when the scales are multidimensional. This is why a PCA on the residuals, which gives the percentage of variance attributable to the Rasch factor and the first residual factor, should be undertaken. According to Everett Smith's general approach (25), independent t-tests can be used to compare the estimates for each subject, which derive from the highest positive and negative loadings items (correlated at 0.3 and above with the component) on the first principal component of the residuals. The scale is considered as unidimensional when the percentage of tests outside the range ± 1.96 is less than 5%.

After item selection, the SATIS-Stroke measures (expressed in logits and obtained at the first assessment) were used to test the invariance, validity, and reliability of the final version of the scale, as well as their relationship with demographic and clinical variables.

Scale invariance

The invariance of the SATIS-Stroke scale was tested across different subgroups of patients with chronic stroke. Provided that the data fit the requirement of the Rasch model, the score observed for an item should not be influenced by any factors other than the satisfaction level of the subjects. SATIS-Stroke scale should work similarly for men and women, younger and older patients, etc. If this is not the case, the item is biased or presents "differential functioning". Different item functioning (DIF) was measured by computing a t-test for the difference between the difficulties of each item, estimated separately for 2 subgroups. This procedure is identical to the graphical method reported by Wright & Stone (26) where the relative item difficulties of 2 subgroups are contrasted in an x-y plot using a 95% confidence interval. Six DIF subgroups of patients with chronic stroke were formed based on the following criteria: gender (men vs women), age (≥ 64 years vs < 64 years old, split at the median age), social status (married vs unmarried), place of residence (home residents vs nursing home residents), delay since stroke (≥ 37 months vs < 37 months, split at the median delay), and cerebrovascular accident (CVA) side (left vs right).

Convergent scale validity

The convergent validity was examined by using a Pearson's correlation between SATIS-Stroke (a satisfaction measure) and the Barthel Index (a functional independence measure). Indeed, there is a high probability that patients who are more independent will report a greater satisfaction with activities and participation as well as the converse (27).

Scale reliability

Reliability of internal consistency. An estimate of the scale's internal consistency reliability is available as a Person Separation Index. It was computed as the ratio between the true measured standard deviation (as expressed by the observed standard deviation corrected for measurement error) and the error measure SD. The Person Separation Index allows the number of satisfaction levels that may be statistically distinguished in the sample to be calculated (28).

Test-retest reliability. The test-retest reliability was investigated by comparing the subjects' responses and the satisfactory item hierarchy obtained at the first and the second assessments. To put the measures on the same scale, the adjustment of the origin of both calibrations was obtained by anchoring the items/thresholds of the second calibration at the satisfactory level of the first one. The test-retest reliability of the subjects' responses was determined by an intraclass correlation coefficient (ICC). Moreover, the invariance of the satisfactory item hierarchy across the first and second assessments was also investigated through a DIF test (26).

Relationship of SATIS-Stroke measure to demographic and clinical variables

The relationships between the SATIS-Stroke measures and different demographic (gender, age, social status, type of residence) and clinical (delay since stroke, CVA side) indices were investigated. A Pearson's correlation coefficient was computed for continuous indices and a t-test for nominal indices. A multi-way univariate analysis of variance (ANOVA) was also performed to detect the effects of possible interactions between each of the variable.

Discarded item analysis

An analysis using items that did not fit the model was performed to verify that the discarded items did not represent a new scale.

RESULTS

From the 84-item set, 10 items showed a disordered rating scale, 4 items had relative threshold locations significantly different from the average, and 34 items did not fit a unidimensional scale, leaving a 36-item questionnaire. The results described hereafter refer to the 36-item questionnaire, except the discarded item analysis subsection.

Metric properties

The subjects' measures and the items' threshold distributions are presented in Fig. 1. The satisfaction scale is calibrated in logits (i.e. log-odds units), a probability unit that expresses the natural logarithm of the odds of being satisfied (i.e. the satisfied/unsatisfied probability ratio). At any given satisfaction level, a 1-logit difference between 2 patients indicates that their odds of being satisfied with performance in a given

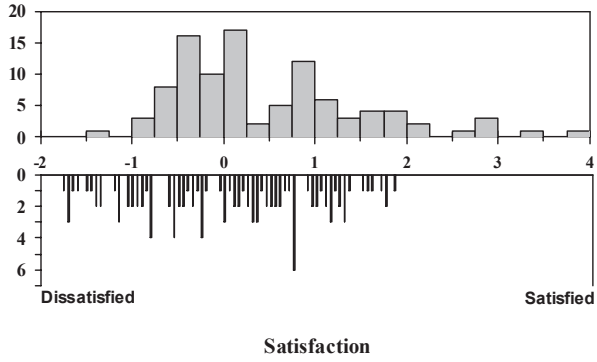

Fig. 1. Satisfaction scale as perceived by adult chronic stroke patients. Top panel: distribution of subjects' measures. Bottom panel: distribution of item thresholds (36 items, 108 thresholds).

activity or life situation are 2.71:1 (i.e. e^1:1), a 2-logit difference indicates 7.4:1 odds (i.e. e^2:1), and so on. The average measure of our sample was 0.41 logits, which indicates that our chronic stroke patients are relatively satisfied with their level of activities and participation. The items are well-targeted on the subjects' measures. The distribution of the items shows few gaps although the range of the scale is narrow (3.66 logits).

The final questionnaire includes 36 items and covers the 9 ICF domains: learning and applying knowledge (1 item), general tasks and demands (1 item), communication (6 items), mobility (6 items), self-care (9 items), domestic life (3 items), interpersonal interactions and relationships (6 items), major life areas (1 item), and community, social and civic life (3 items).

The calibration of the 36-item SATIS-Stroke scale is presented in Table II. The items are sorted, from top to bottom, in order of decreasing satisfactory level. "Moving outside your home in any circumstances" was the item requiring the highest satisfactory level to be performed, while "Listening to and watching television according to your needs" was the item requiring the lowest satisfactory level. Table II reports the standard error (SE) associated with each item (mean: 0.13 logits; range: 0.13–0.16 logits); these values comply with the expectations for most variables (29). The χ^2 (ChiSq) and its probability indicate that all 36 items are consistent with the

Table II. *SATIS-Stroke calibration for chronic stroke patients*

Items		Location logits	SE logits	ChiSq	Probability
1	Moving outside your home in any circumstances	0.81	0.14	3.98	0.41
2	Climbing and going downstairs all stages in your home according to your needs	0.69	0.14	3.57	0.47
3	Using knife, fork and spoon in all circumstances	0.67	0.13	4.40	0.35
4	Having a sexual relationship with somebody	0.63	0.16	5.60	0.23
5	Using coins and banknotes in all circumstances	0.54	0.13	4.60	0.33
6	Participating in spoken exchange of information with your entourage	0.49	0.13	2.47	0.65
7	To supplement administrative documents in all circumstances	0.44	0.14	3.22	0.52
8	Washing your hair according to your needs	0.28	0.13	3.10	0.54
9	Taking a bath or your shower according to your needs	0.26	0.13	1.51	0.83
10	Undressing to use the toilet and redressing in your home or outside of it	0.24	0.13	0.90	0.92
11	Entering and exiting your home according to your needs	0.24	0.13	1.55	0.82
12	Participating in arts and culture (cinema, theatre, etc.)	0.21	0.13	6.01	0.20
13	Reaching objects in your near space	0.17	0.13	3.02	0.55
14	Dressing and undressing in all circumstances and according to your needs	0.16	0.13	3.29	0.51
15	Managing your income in all circumstances	0.10	0.13	5.09	0.28
16	Getting clothes out of the closet	0.10	0.13	1.63	0.80
17	Using storage spaces in your house	0.07	0.14	4.11	0.39
18	Participating in spousal relationships	0.04	0.13	3.67	0.45
19	Ensuring that your rights are respected	0.02	0.13	2.81	0.59
20	Carrying out your personal hygiene according to your needs	–0.01	0.13	5.81	0.21
21	Asking for help in an emergency situation	–0.07	0.13	4.12	0.39
22	Reading and understanding a document in all circumstances	–0.08	0.13	7.70	0.10
23	Moving inside your home	–0.08	0.13	3.83	0.43
24	Managing your pain in all circumstances	–0.13	0.13	2.37	0.67
25	Using the telephone at home according to your needs	–0.30	0.14	1.21	0.88
26	Maintaining emotional relationships	–0.31	0.13	7.77	0.10
27	Expressing oneself to someone	–0.33	0.13	1.16	0.88
28	Having urinary continence in your home and outside of it	–0.33	0.13	4.21	0.38
29	Participating in food and drink preparation in all circumstances	–0.40	0.13	3.13	0.54
30	Opening and closing doors in your home	–0.44	0.14	6.32	0.18
31	Co-operating with your entourage	–0.52	0.13	2.33	0.67
32	Being aware of what surrounds you	–0.57	0.13	5.34	0.25
33	Participating in ceremonies (marriage, gathering family, etc.)	–0.62	0.14	4.53	0.34
34	Choosing appropriate clothes	–0.63	0.14	2.61	0.63
35	Getting feelings across	–0.65	0.14	2.85	0.58
36	Listening to and watching television according to your needs	–0.70	0.14	2.63	0.62

Summary statistics: Person location = 0.498 ; Item – trait interaction = 0.66 ; Reliability indices = 0.94.
SE: standard error; ChiSq: Chi-square.

definition of a unidimensional measure of the satisfaction with activities and participation (Mean ChiSq: 2.82; mean probability: 0.66) (25). The percentage of individual *t*-tests outside the range ±1.96 (95% confidence interval (CI)) was 4%, which would be significant, indicating unidimensionality.

Description of SATIS-Stroke

The definition and use of the SATIS-Stroke scale are depicted in Fig. 2. The top panel shows the distribution of satisfaction measures of chronic stroke patients. Patients reported satisfaction ranged from –1.51 to 4.00 logits.

The bottom panel illustrates the ogival relationship between the finite total raw scores (from 0 to 108) and the infinite satisfaction measures. This relationship is approximately linear between total raw scores of 20 and 90. In this central range, the change in satisfaction corresponding to a non-linear unitary increment in total score is equal to 0.07 logits. Outside of this central range, a unitary progression in the total score accounts for an increasing amount of satisfaction. For instance, an increase of 0.53 logits corresponds to a unitary increment in total score from 1 to 2; this 7-fold difference demonstrates the non-linearity of the total score.

The middle panel shows the expected response to a given item as a function of the underlying satisfaction measure. By comparing the satisfaction of a given stroke patient to the satisfactory level for each item, it is possible to determine the expected score of the patient for the item. For instance, a patient with a total score of 80 (1.06 logits) would be expected to respond "Satisfied" for the 17 first items and "Very Satisfied" for the other items. In contrast, a patient with a total score of 20 (–1.49 logits) has a high probability of responding "Very Dissatisfied" for the 27 first items and "Dissatisfied" for the other items. In our sample, 62% of the patients should be satisfied, or very satisfied with their performance in all listed activities and life situations; 10% of patients should be very satisfied; 1% of patients should be very unsatisfied.

Scale invariance

The invariance of the SATIS-Stroke scale was validated across 6 demographic and clinical subgroups of chronic stroke patients (30). Fig. 3 illustrates the satisfactory level hierarchy of SATIS-Stroke items across the different demographic and clinical patient subgroups. Most of the items were within the 95% confidence interval of the identity line, indicating that the SATIS-Stroke scale can be used to measure satisfaction in chronic stroke patients regardless of their gender, age, social status, place of residence, delay since stroke, and CVA side.

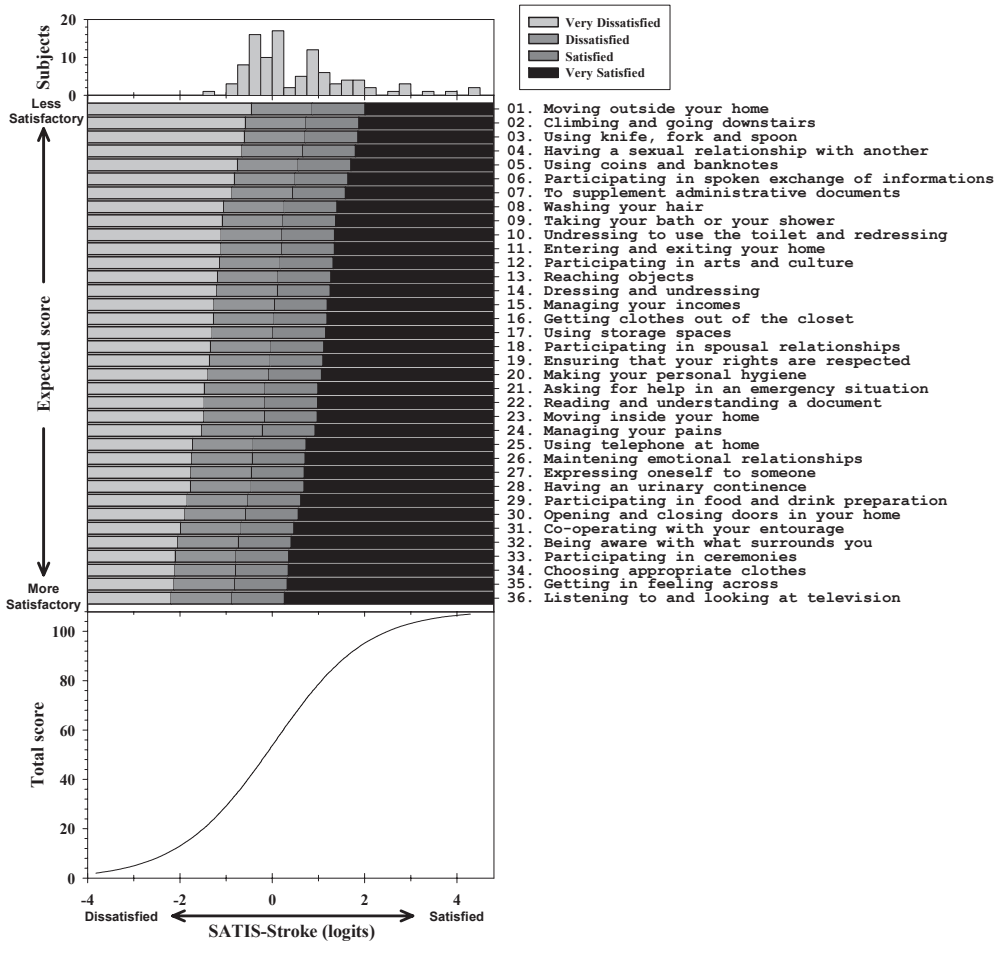

Fig. 2. Top panel: distribution of satisfaction measures of chronic stroke patients. Middle panel: a patient's expected score to each item as a function of the underlying satisfaction measure. A satisfaction measure of zero is by convention set as the average item satisfaction level. Bottom panel: ogival relationship between total score (from 0 to 108 points) and satisfaction measure.

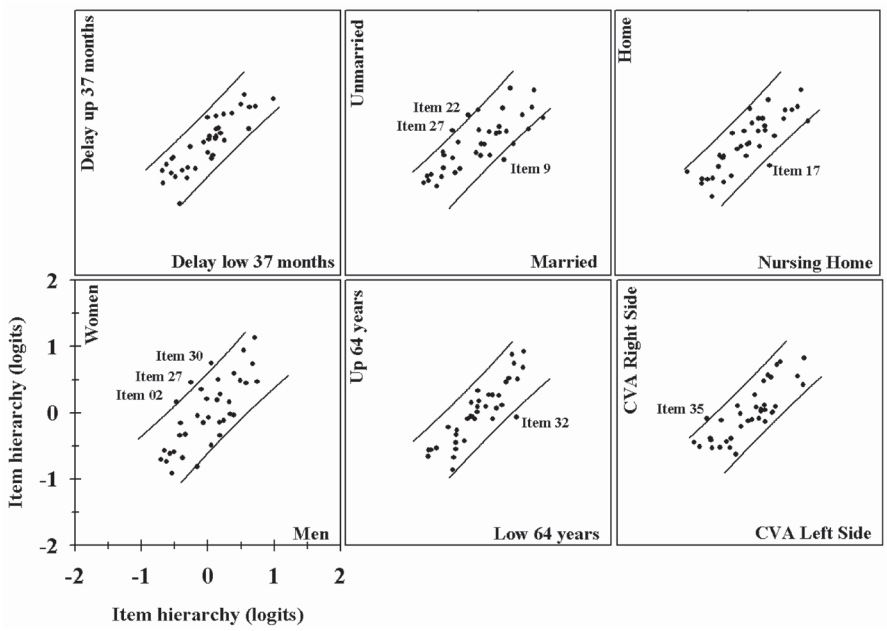

Fig. 3. Differential item functioning plots of the 36 SATIS-Stroke items across 6 demographic and clinical patient subgroups and 95% confidence interval (solid lines) of the ideal invariance. Items requiring the highest satisfaction levels to be involved are plotted in the top right part of the panel. In each plot, items (dots) lying within the control lines have the same satisfaction levels for both subgroups. Outliers are identified by their label.

There are minor exceptions; for instance, "Expressing oneself to someone" (Item 27) was estimated to require a higher satisfaction level for women than for men, "Using storage spaces in your home" (Item 17) appeared to require a lower satisfaction level for home residents than for nursing home residents.

Scale validity

SATIS-Stroke measures were significantly related to the Barthel Index raw scores ($R = 0.74$, $p < 0.05$) confirming that being independent in activities and life situations has an important effect on the satisfaction perceived by the patients.

Scale reliability

A person separation reliability of 0.94 was found for SATIS-Stroke, indicating that the scale allows 6 satisfaction levels to be statistically distinguished in our sample. It appears sufficient to discriminate across patients according to their satisfaction with activities and participation.

The test-retest reliability (interval: 32 days; SD = 10) of the subject measures is presented in Fig. 4. Patients' perceived measures at the first and second assessments were highly correlated (ICC = 0.98, $p < 0.001$). Most of the measures (98%) lie within the 95% confidence interval of the identity line, showing that adult stroke patients tend to estimate their satisfaction over time in a consistent manner. Moreover, the satisfactory level hierarchy of all 36 SATIS-Stroke items was maintained between the first and second assessments, indicating that the scale is invariant across time.

Relationship of SATIS-Stroke measure to demographic and clinical variables

The effects of demographic and clinical variables on SATIS-Stroke measures are presented in Table III. No significant difference in satisfaction measures was observed across gender, social status, and clinical variables (i.e. delay after stroke and CVA side). The place of residence and age were significantly related to SATIS-Stroke measures. Home residents demonstrated a higher satisfaction overall than nursing home residents. Younger patients with chronic stroke were generally more satisfied than older ones. No interaction effect was observed between any of the demographic and clinical variables.

Discarded items analysis

Two *post-hoc* analyses were performed respectively on the 48 removed items and the 34 misfitting items to verify the

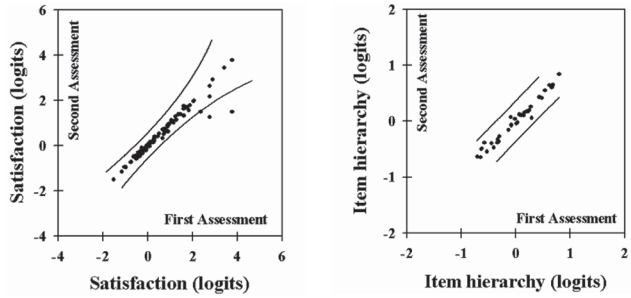

Fig. 4. Left panel: Relationship between the satisfaction with participation measures as perceived by the stroke patients at the first and the second assessment (interval: 32 ±10 days) and 95% confidence interval (solid lines) of the ideal invariance. More satisfied persons are plotted in the top right part of the panel. Patients' measures (dots) lying within the control lines have the same estimated satisfaction at the first and the second assessment. *Right panel:* Differential Item Functioning plot of the item satisfaction level perceived by the stroke patients across time and 95% confidence interval (solid lines) of the ideal invariance. Items requiring the highest satisfaction levels to be involved are plotted in the top right part of the panel. All items (dots) lie within the control lines, indicating that they have the same estimated satisfaction levels at the first and second assessment. CVA: cerebrovascular accident.

Table III. *Relationship of SATIS-Stroke measures to demographic and clinical variables*

Variable	Statistic*	*p*
Gender	0.016	0.874
Age	–0.272	0.006
Social status	0.190	0.057
Residence place	–0.289	0.003
Delay since stroke	0.033	0.744
CVA side	0.149	0.137

*For Spearman's rho.
CVA: cerebrovascular accident.

potential for a second subscale. Neither the 48 removed items nor the 34 misfitting items formed a second valid, reliable (R = 0.53; 0.63), and unidimensional scale (mean ChiSq: 3.92; 2.85 – mean probability: 0.03; 0.07).

DISCUSSION

The purpose of this study was to validate a satisfaction measure of activities and participation in the actual environment experienced by chronic stroke patients using the Rasch measurement model. This measure was calibrated in a sample of 101 stroke patients. From the original pool of 84 items, 36 items were retained for the final SATIS-Stroke questionnaire. The items shared the same ordered rating scale structure, had relative threshold locations similar to the average, and defined a unidimensional and linear scale.

The Rasch model was used to construct the SATIS-Stroke scale. This model facilitated the calibration of SATIS-Stroke activities and life situations so that they could be sorted according to their estimated satisfactory level (Fig. 2) giving clinicians a tool to relate the total score of each patient to the satisfactory level of each item. This tool can help clinicians to establish goal and track the satisfaction level of each patient throughout the rehabilitation process. Furthermore, the Rasch model has the ability to detect discrepancies between the observed score for each item and the expected score given the overall satisfaction measure of the subject. More than simply data quality control, the model can be used to identify idiosyncratic use of the questionnaire.

The Person Separation Reliability of SATIS-Stroke was 0.94, thus showing good precision across the sample. However, the range of the SATIS-Stroke scale was narrow. The precision of a scale is not only determined by the number of items selected in the questionnaire (i.e. the range of the measurement scale) but also by the targeting between the items and the subjects' measures. In our sample, the 36 SATIS-Stroke items covered the whole range of satisfaction. Missing values may affect the accuracy of the estimates obtained by the Rasch model. In the final SATIS-Stroke scale, only 3% of the values were missing from the responses ($n = 3636$) given by all patients ($n = 101$) to all items ($n = 36$). Moreover, the Rasch model is robust for analysing missing values (31, 32), and the proportion of missing values per item is reflected in the item SE. In the present study, the SE associated with the item satisfactory level (mean: 0.41 logits) complied with the expectation for most variables (29).

The observed invariance in the item hierarchy after a delay of approximately one month indicated that the SATIS-Stroke measures were reproducible over time. The invariance of the SATIS-Stroke scale was verified across various demographic and clinical subgroups of chronic stroke patients. The SATIS-Stroke scale can therefore be used to measure satisfaction in chronic stroke patients regardless of their gender, age, social status, place of residence, delay since stroke, and CVA side. Some items presented a minor DIF that did not seem to compromise the clinical application of the questionnaire. All these metric properties give the scale reasonable potential to measure change in satisfaction with activities and life situations.

All aspects of patients' performance in activities and life situations are represented, according to the ICF Core Set for Stroke (33). The areas covered represent key issues for patients with stroke, including mobility, self-care, communication, and interpersonal interactions. The content of the hierarchical scale indicates that the more satisfactory items are predominantly related to communication (4 items) and interpersonal relationships (4 items) while less satisfactory items are predominantly related to mobility (5 items) and self-care (5 items). This suggests that physical limitations and functional dependence may decrease the satisfaction and probably the well-being experienced by the patients in their activities and life situations. This is consistent with the good relationship observed between the Barthel Index and SATIS-Stroke (R = 0.74) indicating that the lower the functional independence, the lower the patient satisfaction level, and inversely.

The average satisfaction of our sample of patients was slightly above the average satisfactory level for the questionnaire. This could be explained by the relatively long delay after stroke (mean: 58 months), which gave patients time to readjust their goals and values in order to find a new way of living as they desired (34). The relatively good mean satisfaction level observed could also arise from the youthfulness of our sample (mean age: 63 years old), and its low depressive symptoms (mean of Hospital Anxiety Depression Scale (16) score: 6.69).

In our sample, a significant relationship was found between SATIS-Stroke and age, confirming previous studies showing a significant link between age and the occurrence of a handicap situations (35, 36). Younger chronic stroke patients were more satisfied than older ones; this may be due to the ability of younger stroke patients to adapt themselves more easily to new life habits imposed by stroke than older ones. Satisfaction level was also significantly lower among nursing home residents than home residents; one possible explanation for this is that in nursing homes residents may feel inclined to resign themselves to a more dependent life, such that their level of satisfaction depends on how nursing assistants meet their needs. In contrast, residents living at home tend more actively to perform activities and life situations with the assistance of their family; this could lead to a better perception of satisfaction by the patient.

The SATIS-Stroke scale was developed to measure the satisfaction of patients who have suffered from a chronic stroke, the most frequent neurological diagnosis of adults who are receiving rehabilitation. The scale focuses on the satisfaction of chronic stroke patients with their performance in activities

and life situations. The exclusion of patients with cognitive deficits and the young average age of our sample may not be representative of all chronic stroke patients.

The metric properties of SATIS-Stroke constitute an encouraging starting point for further investigation. A sample size of 100 patients is an adequate population for the calibration of a well-constructed instrument if it is well-targeted (29, 37). Nevertheless, one must be wise when the sample is split into subgroups such as in the DIF (38). The questionnaire is easy to administer and require little time to complete (15 min). SATIS-Stroke appears, at least in our sample, to be precise enough to discriminate patients' satisfaction levels and, presumably, to capture even subtle satisfaction changes over time. However, future research is required to empirically verify the responsiveness of SATIS-Stroke for evaluating acute and chronic stroke patients. Moreover, we hope that the SATIS-Stroke scale will eventually be applied to evaluate other diseases in adults, with the prospect of building a generic satisfaction measure of activities and participation in the actual environment experienced by adult patients.

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For clinical use of SATIS-Stroke, a website including downloadable scoring sheets and instructions is available (www.rehab-scales.org). Moreover, on-line analyses taking the missing values into account directly convert raw scores into linear satisfaction measures of activities and participation.

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