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TESTING DAILY FUNCTIONS POST-STROKE WITH STANDARDIZED PRACTICAL EQUIPMENT

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ABSTRACT. Two hundred and seven stroke patients were tested with Standardized Practical Equipment (SPE) three months after a stroke. One year after the stroke 183 survivors from this stroke population were tested with the equipment. The SPE test consists of 12 common daily activities, which the patient was asked to perform. The construct validity of SPE was estimated by factor analysis from the results of one-year follow-up. Three factors explained 82% of the variance of the 12 variables of SPE. Factor 1 mainly concerned cognitive factors and co-ordination, Factor 2 construction and hand function and Factor 3 variables that were dependent on mobility and balance. No significant difference was noted between the performance with SPE three months and one year after the stroke among the one-year survivors. There were some differences between men and women; for example the men were more successful in tasks with technical components. The women had more difficulty with some of the tasks involving mobility, such as climbing stairs without support. The Standardized Practical Equipment gave good additive information about the ability of a stroke patient to manage at home and could be used in any set-up.

Key words: cerebrovascular disease, follow-up studies, activities of daily living.

This study was part of a multidisciplinary investigation concerning stroke patients carried out at the University Hospital of Uppsala. One purpose of the main study was to develop testing procedures for measuring the functional capacity after a stroke.

The present study was undertaken to evaluate a test with use of Standardized Practical Equipment (SPE), by which simple daily activities are measured and which can be used together with other functional tests at follow-up examinations after a stroke. Its validity was tested by factor analysis. A further purpose was to find out whether the results obtained with the equipment gave useful information about the functional capacity of a patient post-stroke.

METHOD

Subjects

All acutely ill stroke patients who had been admitted to four general medical wards at the University Hospital in Uppsala during a period of five months in 1984 and eight months in 1985, and who had survived and were tested three months and one year after the stroke, were enrolled in the study. Three months after the stroke 210 patients (75%) had survived and 207 patients (median age 74 years, range 30–96 years; 109 men and 98 women) were tested. At one year 191 (68%) had survived and 183 patients (median age 74, range 30–92; 101 men and 82 women) were tested. At the three-month follow-up three patients declined to participate, and at the one-year follow-up eight patients.

Three-month and one-year follow-ups

All patients were visited by one or two members of the project group three months and one year after the stroke. Most of the patients were visited in their homes, and the others in hospitals for long-term care, at day-care centres or in old people's homes.

At these visits the patients were interviewed with the help of a constructed chart by Hamrin concerning different instrumental activities of daily living, such as household activities, locomotion, psychosocial functions and intellectual activities (2). The primary ADL functions were assessed with the aid of the Activity Index constructed by Hamrin & Wohlin (3). With this Index mental capacity, motor activity (roughly) and six activities of daily living were assessed. The motor functions were evaluated on the basis of a chart, developed by Lindmark (4) within the study for assessment of motor capacity. With the help of the motor chart the motor functions of both sides of the patient were assessed. The domains investigated were ability to perform active movements, coordination, gross mobility, balance, sensation, joint pain and passive range of motion. The results of the interviews and the functional tests have been reported elsewhere (5).

Besides the above-mentioned assessments, the patients were also asked to perform a number of practical tasks with use of the SPE constructed by one of the authors (Törnquist).

Practical functional test with SPE

The Standardized Practical Equipment test included the following practical tasks which the patients were asked to perform. They could use either one or both hands. The important thing was that the patient was able to carry out the task.

1. To open and close the patient's own front door.

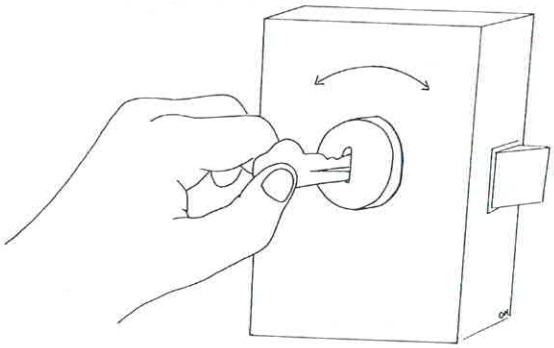


Fig. 1. Task 2, "to insert a key in a keyhole, lock and unlock the door, and then pull the key out of the keyhole", is an example of the tasks that had high factor loadings with Factor 2—construction/hand function.

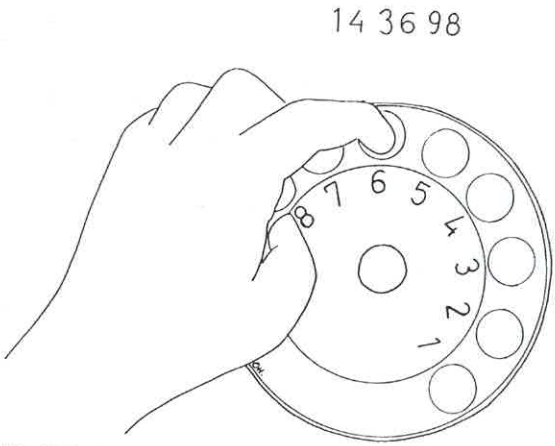


Fig. 2. Task 3, "to dial a particular telephone number", is an example of the tasks that had high factor loadings with Factor 1—cognitive functions/coordination.

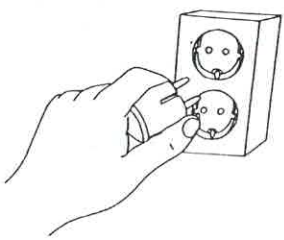
2. To insert a key in a keyhole, lock and unlock the door, and then pull the key out of the keyhole (Fig. 1).
3. To dial a particular telephone number (Fig. 2).
4. To insert a special electric plug into a socket close to the floor (Fig. 3).
5. To switch on and off the light of bedside lamp when lying in bed. If the patient had a lamp of his own beside the bed, he could demonstrate on that instead.
6. To change an electric light bulb in a lamp hanging from above one's head. The lamp holder was held 20 cm above the patient's head.
7. To unscrew and close the lid of a jar and the cap of a bottle.
8. To turn on a tap and fill a pan with five cups of water, put the pan on an electric stove and heat the water.
9. To follow the recommendations on two medicine bottles, open the bottles, take out the right number of pills and put them into the right place in a special compartmented medicine box.
10. To put a pillow into a pillow-case and tie the tapes.
11. To read aloud and show that he understood a short article.
12. To climb up and down stairs without support.

A four-point scale was used for each task: 4 = able to do it without difficulty; 3 = able to do it with slight difficulty, must use some kind of technical aid or do it slowly; 2 = only able to do it with great difficulty, with someone else's help or very slowly, or only able to do some part of the task; 1 = unable to do it.

A manual with more detailed information on how to evaluate each task has been worked out and is obtainable from the authors.

Statistical methods

The SPSS^x program package was used for computing (8). A factor analysis was performed to investigate the construct validity. The added scores of the tasks with the highest factor loadings in three factors obtained with the factor analysis were then correlated with some motor and ADL functions by means of the Spearman rank correlation method. The Wil-



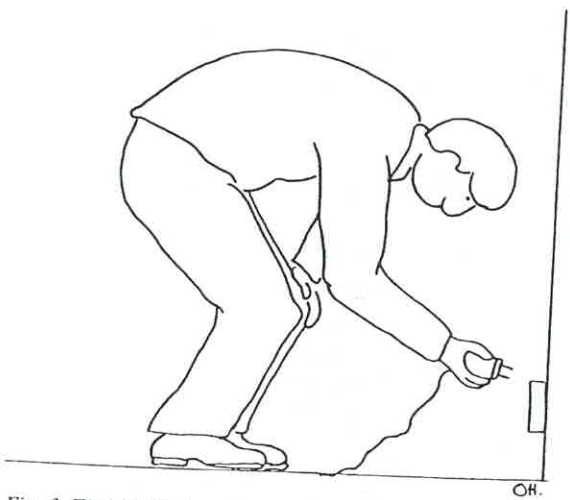


Fig. 3. Task 4, "to insert a special electric plug into socket close to the floor", is an example of the tasks that had high factor loadings with Factor 3—mobility/balance.

Table I. *Age, sex and living conditions of patients who survived three months and one year after the stroke*

	Three months				One year			
	Men		Women		Men		Women	
Number of patients	109		98		101		82	
Median age at the time of the stroke, years	71		77		71		77	
Range, years	30–92		47–96		30–92		47–91	
Living conditions	*N*	%	*N*	%	*N*	%	*N*	%
Alone	23	(21)	27	(28)	21	(21)	23	(28)
With a spouse	59	(54)	35	(36)	60	(59)	36	(44)
Old people's home or service flat	5	(5)	11	(11)	5	(5)	9	(11)
Hospital for long-term care	22	(20)	25	(26)	15	(15)	14	(17)

coxon matched-pairs signed-rank test (9) was used to compare the result at three months with those at one year. The Chi-square method and the Mann-Whitney U test for independent samples (9) were used to determine whether there were any differences in results between men and women.

RESULTS

Table I shows the age, sex and living conditions of the patients three months and one year after the stroke. The women were, on the average, older than the men, and more women lived alone and in old people's homes and hospitals for long-term care. More men lived with their spouses.

Tables II and III show how percentage numbers of men and women who scored 1, 2, 3 or 4 for each task at three months and one year. The tasks that seemed to be most difficult for both sexes were tasks 4 (inserting an electric plug), 6 (changing an electric light bulb), 9 (putting pills into a compartmented medicine box), 11 (reading and understanding an article) and 12 (climbing stairs without support).

The results of the standardized tests with SPE dif-

Table II. *Percental score distribution of patients for each task of the Standardized Practical Equipment test three months after the stroke*

$N = 207$; 109 men and 98 women. Score 1 = unable to perform the task; 2 = only able to perform some part of the task; 3 = able to perform the task with technical aid or do it slowly; 4 = no difficulty in performing the task. Differences between men and women were analysed for significance with the Chi-square test and the *p* values are given

Task	Men, score				Women, score				
	1 (%)	2 (%)	3 (%)	4 (%)	1 (%)	2 (%)	3 (%)	4 (%)	*p* value
1. Open and close front door	10	7	7	76	6	6	11	77	0.639
2. Insert key in keyhole and lock	4	11	15	70	4	9	27	61	0.254
3. Dial telephone number	13	9	11	67	6	7	20	67	0.210
4. Insert electric plug in socket	4	17	23	56	7	28	33	32	0.010
5. Switch on the light in bed position	2	8	7	83	2	4	11	83	0.521
6. Change electric light bulb	3	14	17	66	6	10	27	57	0.225
7. Unscrew lid of bottle and jar	1	7	12	80	2	7	12	78	0.892
8. Heat water on stove	13	3	10	74	5	4	16	76	0.215
9. Put pills into compartmented box	19	13	19	50	12	27	26	35	0.031
10. Put pillow into pillow-case	9	13	16	62	7	5	13	74	0.222
11. Read and understand an article	15	14	20	52	10	15	20	56	0.769
12. Climb stairs without support	17	7	28	49	14	19	33	35	0.050

Table III. *Percental score distribution of patients for each of the tasks of the Standardized Practical Equipment test one year after the stroke*

$N = 183$; 101 men and 82 women. Score 1 = cannot perform the task; 2 = can only perform some part of the task; 3 = can perform the task with technical aid or do it slowly; 4 = no difficulty in performing the task. The difference between men and women was analysed with the Chi-square test and the p values are given

	Men, score				Women, score				
Task	1 (%)	2 (%)	3 (%)	4 (%)	1 (%)	2 (%)	3 (%)	4 (%)	p value
1. Open and close front door	7	12	7	74	4	13	16	67	0.204
2. Insert key in keyhole and lock	4	12	18	66	5	9	22	65	0.809
3. Dial telephone number	9	13	10	68	7	5	24	63	0.027
4. Insert electric plug in socket	7	18	10	65	9	27	29	35	0.000
5. Switch on the light in bed position	4	5	7	84	4	4	7	85	0.977
6. Change electric light bulb	8	13	18	61	2	12	37	49	0.020
7. Unscrew lid of bottle and jar	3	5	13	79	5	5	16	74	0.837
8. Heat water on stove	11	7	10	72	6	13	10	71	0.371
9. Put pills into compartmented box	19	14	17	51	15	15	33	38	0.072
10. Put pillow into pillow-case	10	16	14	60	5	10	13	72	0.296
11. Read and understand an article	17	13	18	53	10	16	16	59	0.504
12. Climb stairs	15	10	30	46	18	21	32	29	0.068

fered in some respects between the sexes. Three months after the stoke the men were significantly better than the women at inserting an electric plug, putting pills into the compartmented medicine box and climbing stairs. One year after the stroke the women were more successful in dialling a telephone number, while the men were significantly better at changing an electric light bulb and inserting an electric plug and were also somewhat more successful in putting pills in the compartmented medicine box and climbing stairs.

The women had significantly greater difficulty in climbing stairs one year after the stroke than at three months ($p<0.02$, Wilcoxon matched-pairs signed-rank test), and in comparison with the men they had deteriorated more in the task of opening and closing the front door ($p<0.03$) between the two test occasions.

From the factor analysis of the results at one year, three factors emerged which explained 82% of the variances of the 12 variables (Table IV). As is evident from the factor loadings in Table IV, in Factor 1 tasks that concerned cognitive functions/coordination had the highest factor loadings, while Factor 2 seemed to have more to do with construction/hand function. In Factor 3 some mobility/balance tasks had the highest factor loadings. In order to compare the performance in the areas covered by each factor, the 12 variables were divided between the three factors so that tasks 11, 3, 9, 8 and 10 were added to Factor 1, tasks 7, 5 and 2 to Factor 2 and tasks 12, 4, 1 and 6 to Factor 3. Neither the men nor the women changed their performance in the areas covered by each factor between the three month and one year follow-up. However, the women scored less in Factor 3 than the men both at three months and at one year ($p<0.01$ and $p<0.02$, respectively, Mann-Whitney U test).

The three factors were highly correlated with the scores obtained with the Activity Index and its different parts, and also with the Lindmark motor assessment score. Concerning the scores of the Activity Index, the highest correlation was found with Factor 1, where the Spearman rank correlation coefficient, r_s, was 0.77 with the total score, 0.75 with its ADL part and 0.66 with the mental capacity part. None of the r_s were lower than 0.62 and all correlations were significant ($p<0.000$, one-tailed test). The correlation coefficients between the results of the motor assessment of the paretic upper extremity and its different parts, on the one hand, and the three factors, on the other, were between 0.66 and 0.72. Concerning the scores for the paretic lower extremity, and for both extremities together, there was particularly high correlation with Factor 3, with r_s of 0.79. The r_s between mobility and Factor 3 was 0.85 and between balance and Factor 3 it was 0.89.

Table IV. *The principal components obtained with factor analysis with three factors and orthogonal (varimax) rotation, of tasks of the Standardized Practical Equipment test*

The scoring was performed on 183 patients who survived one year after the stroke

Task	No.	Factor 1 loadings	Factor 2 loadings	Factor 3 loadings	Communality
Read article	11	0.81	0.18	0.33	0.79
Dial tel. number	3	0.75	0.47	0.27	0.86
Put pills in box	9	0.75	0.29	0.44	0.84
Heat water	8	0.60	0.50	0.47	0.83
Pillow into case	10	0.57	0.57	0.33	0.76
Unscrew lid of jar	7	0.18	0.83	0.35	0.85
Switch on light	5	0.34	0.83	0.19	0.84
Insert key in hole	2	0.58	0.60	0.36	0.82
Climb stairs	12	0.30	0.22	0.86	0.88
Insert el. plug	4	0.49	0.37	0.66	0.81
Open/close door	1	0.45	0.43	0.64	0.80
Change light bulb	6	0.39	0.51	0.59	0.76
Eigenvalue		8.56	0.73	0.55	9.84
Percentage of variance before the rotation		71.3	6.1	4.6	82.0

DISCUSSION

The Standardized Practical Equipment used in this study for measuring some daily procedures of importance in the home situation was simple to apply and required little time (5–15 min). The patients enjoyed the test and found it useful from their point of view.

Aniansson et al. (1) have described equipments for a step test and for upper extremity function tests that is similar to some parts of SPE. Lundgren-Lindquist and Spearling (6) have also studied upper extremity functions with the help of standardized test equipment in laboratory surroundings, in a subsample of a studied population of elderly persons in Gothenburg, Sweden. No validation methods were mentioned in their reports. In a recent publication, Söderback described a more detailed assessment of intellectual functions based on housework, which was tested for its reliability and validity (10), but it seems more complicated and time-consuming than the SPE.

The World Health Organization has initiated the use of a classification related to the consequences of disease—the International Classification of Impairments, Disabilities, and Handicaps (ICIDH) (11). In the classification of Disabilities, the SPE variables can be identified in, for example, "body disposition disabilities" and "dexterity disabilities". The ICIDH uses a severity scale categorisation from 0 (not disabled) to 6 (complete inability). We found the ICIDH too detailed for our study, although some of the disability sections are of great interest regarding post-stroke victims.

Concerning the information given by SPE, with use of factor analysis as a construction validation method, three factors seemed to emerge. *Factor 1* mainly concerned cognitive functions and coordination, while *Factor 2* mainly referred to activities concerning construction and hand function. *Factor 3* included variables for which a certain capacity for mobility and balance was necessary in order to perform the task.

Some differences were found between the sexes in the performance of the 12 tasks of SPE. The men succeeded better in technical tasks, and in tasks concerning mobility and balance. This was in accordance with the findings among healthy elderly persons in other studies (1, 7). One contributory reason for the difference in mobility could have been that the women as an average were six years older.

At our three-month and one-year visits to the stroke patients who took part in the main study, many different tests were performed; these measured mainly ADL function and motor capacity. In our experience a simple and practical test concerning daily procedures of importance for the patient in his or her own surroundings provides very useful additive information concerning the patient's possibility to manage at

home. As a matter of fact we found that patients who did not succeed very well in items such as "opening and closing the front door" (task 1) or "inserting a key in a key-hole" (task 2) were very dependent on others from security aspects, and "dialing a telephone number" (task 3) is also important for the same reason. Items with high factor loadings with Factor 1 showed the patient's ability to organize and follow a process with several steps, which applies to most household tasks. Items regarding construction such as the tasks with high factor loading with Factor 2 often revealed perceptual disturbances. Tasks with high factor loadings with Factor 3 were a useful complement to our motor assessment. For instance, the patient actually had to climb his or her stairs when performing the task (task 12). Many of the tasks also disclosed whether the patient had good vision or not and the possibility of the patient to understand given information. Task 11, "the ability to read and understand a short article", showed whether the patient had communication problems. We do not consider that the SPE should be shortened; all the 12 tasks are needed to give a satisfactory picture of the patient's performance at home.

We conclude that the Standardized Practical Equipment used in this study provides good additional information about the ability of post-stroke patients to manage at home without help and can be used in any set-up, including institutions, without complicated preparatory procedures. We welcome other research groups to test our equipment.

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