Cognitive aftermath of ischemic stroke
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Prediction of life satisfaction fifteen months after stroke: the impact of cognitive abilities and activity restriction

Social Production Functions (SPF) theory describes the engagement in activities as an important mean to obtain well-being. Aims of the present study were to describe the role of cognitive disabilities at three months post-stroke in the restoration of activities after stroke and to examine the predictive value of cognitive disabilities and activity level at three months post-stroke for life satisfaction at fifteen months after stroke. Life satisfaction of 101 community-dwelling, first-ever ischemic stroke patients was assessed at three and fifteen months post-stroke, while patients retrospectively rated life satisfaction before stroke. At the second assessment, life satisfaction of 70 elderly controls was also measured. The results showed that life satisfaction deteriorated from time before stroke to three months post-stroke and remained at this lower level at fifteen months post-stroke. In comparison with control subjects, only male stroke patients reported a significantly lower level of life satisfaction. However, most patients remained relatively satisfied with life.

While physical disabilities at three months after stroke predicted activity level at fifteen months post-stroke, higher reasoning abilities and faster mental speed at three months post-stroke were related to a greater restoration of activities from three to fifteen months post-stroke. Furthermore, activity level, memory functioning and reasoning capacities at three months post-stroke predicted life satisfaction at fifteen months post-stroke. The lower life satisfaction of male patients was explained by the relatively greater sensitivity of male activities after stroke. The present results draw attention to the impact of cognitive functioning on activities and life satisfaction of stroke patients living in the community. This patient group often does not gain access to patient education or cognitive rehabilitation.

Prediction of life satisfaction fifteen months after stroke: the impact of cognitive abilities and activity restriction.
Annemarie Visser-Keizer, Marleen Gerritsen, Betto Deelman, Ina Berg, & Betty Meyboom-de Jong.
Submitted for publication.
Introduction

While early research on outcome after stroke used a dichotomous outcome score of life or death, in recent years more and more attention is paid to the quality of life and well-being of stroke survivors. In its origin, research on quality of life was directed at the evaluation of emotions such as happiness or satisfaction (Wyller et al., 1997). In recent studies, health-related measurements have often been used to assess quality of life after stroke. It has become apparent, though, that poor health does not necessarily mean a low sense of subjective well-being (Albrecht & de Vlieger, 1999, Diener et al., 1999, Brief et al., 1993).

Subjective well-being represents the emotional and cognitive evaluation of one's life, on a global level and on different domains in life (Diener, 1984). Subjective well-being includes the distinct concepts of life satisfaction, optimism, positive and negative affect (Lucas et al., 1996). Well-being is thought to be influenced by relatively stable resources as personality, culture or social class (Diener, Oishi & Lucas, 2003, Schimmack et al., 2002). Life events or daily hassles can cause fluctuations in well-being, but it has been proposed that, in general, people will return to a baseline level (Headey & Wearing, 1992). In most people this baseline shows a tendency towards positive affect or optimism (Diener & Diener, 1996). Recent studies showed that, in the face of illness, a cognitive adaptation can take place by which patients shift to even higher levels of optimism. This cognitive adaptation seems to protect patients from psychological distress (Stieglis et al., 2003; Hagedoorn et al., 2002; Taylor et al., 2000). Some life events, however, have such an impact on life satisfaction, that the level of satisfaction people return to is shifted downwards (Lucas et al., 2004; Lucas et al., 2003). Diener and colleagues (1999), in a review of studies on the impact of health on subjective well-being, concluded that when a disabling condition is severe or entails multiple and chronic problems, it may affect well-being. The impact of one's health on well-being, however, depends on an individual's perception of the illness (Diener et al., 1999).

Until now, the course of life satisfaction after stroke has hardly been studied. While life satisfaction after stroke has been found to be lower than life satisfaction of controls of similar age, almost all studies measured life satisfaction at only one moment after stroke (Carlsson et al., 2003; Clarke et al., 2002; Wyller et al., 1997). The aspects on which stroke patients were less satisfied concerned leisure, sexual, self-care and global satisfaction (Carlsson et al., 2003; Viitanen et al., 1988). In accordance with the idea of a cognitive adaptation, most studies showed that life satisfaction of most stroke patients was fair to good several years after stroke (Viitanen, 1988; King, 1996; Löfgren et al., 1999). Astrom et al. (1992) found that life satisfaction improved from three to twelve months after stroke. However, those stroke patients with poor life satisfaction at one year after stroke, remained dissatisfied for at least two more years.
One of the key elements in the fulfilment of well-being is thought to be the engagement in activities (Csikszentmihalyi, 1997; Steverink et al., 1998). According to the Social Production Functions (SPF) theory, individuals actively try to maximise their psychological well-being by the realization of several lower-order goals (Steverink et al., 1998). Activities are regarded important in providing physical and mental stimulation and opportunities for social interaction. When confronted with sudden illness, such as a stroke, symptoms and functional limitations place constraints on the activities of the patient (Ormel et al., 1997). The patient has to adapt to this situation by finding new activities, perform activities in a different way or place greater value on other goals to obtain well-being. According to SPF-theory, cognitive processes are especially important in these processes of adaptation (Steverink et al., 1998). If someone cannot adapt to or substitute for losses, a more long-term negative effect on well-being is expected.

A great proportion of community-dwelling stroke patients has been found to experience a limitation of activities, and to perform less activities than controls of similar age (Mayo et al., 2002; Labi et al., 1980). The level of instrumental activities, leisure activities and social integration after stroke has been related to life satisfaction in different studies (Kim et al., 1999; Viitanen, 1988; Vestling et al., 2003; Sveen et al., 2004). With regard to the factors that influence the ability to perform activities of daily life, most researchers agree that physical disabilities after stroke have greatest impact (Bernspang et al., 1987; Mercier et al., 2001). In addition, the impact of cognitive disabilities on activities of daily life after stroke is more and more stressed (Gauggel et al., 2000; Filiatrault et al., 1991; Tatemichi et al., 1994; Carter et al., 1988). Patients with impaired global cognitive functioning at three months post-stroke appeared to be less active up to 4 years after stroke than patients with intact global cognitive functioning (Patel et al., 2002). Less research has focused on the impact of distinctive cognitive domains on activities after stroke. So far, poorer attentional and executive functioning have been related to poorer daily functioning after stroke (McDowd et al., 2003; Pohjasvaara et al., 2002).

The first aim of the present study is to describe the course of life satisfaction from time before stroke to three and fifteen months post-stroke in a community based sample. The influence of demographical variables and side of lesion on the course of life satisfaction after stroke will be examined. In literature, no consistent effects have been described with regard to the impact of gender, age or lesion characteristics on life satisfaction after stroke. The final level of life satisfaction at fifteen months post-stroke will be compared to life satisfaction of age-matched controls. Second aim of this study is to analyse the role of post-stroke cognitive functioning in the restoration of activity level from three to fifteen months post-stroke. When patients return home after stroke, they have to adapt to a new situation. The success of this adaptation is expected to be related to the severity of physical disabilities of the patient, but also to the cognitive capability of the patient to compensate for losses. Three important cognitive domains, speed of information
processing, learning capability and problem solving capability will be examined. It is hypothesized that the actual level of activities at three and fifteen months post-stroke will be mainly predicted by the level of physical disability of the patient, while cognitive performance at three months after stroke will be related to gain in activities from three to fifteen months post-stroke. Finally, the impact of cognitive functioning and activity level at three months post-stroke on life satisfaction at fifteen months post-stroke is analysed. SPF-theory describes activities as crucial in obtaining well-being, but the influence of cognitive functioning on well-being remains less clear. Cognitive disabilities can be regarded as constraints or loss of resources which influence the ability to perform or restore activities. In accordance with this idea it can be hypothesized that the influence of cognitive disabilities on life satisfaction will be mediated by the level of activities. On the other hand, because cognitive functions are important in the adaptation process itself, they might be independently related to life satisfaction after stroke.

**Methods**

*Subjects: stroke patients*

First-ever, unilateral, ischemic stroke patients were recruited by 100 general practitioners (GPs) from the northern part of the Netherlands and by the Stroke Unit of the University Hospital in Groningen. Stroke was defined as an acute disruption of blood circulation in the brain with clinically visible symptoms lasting more than 24 hours. Patients with a history of neurological disturbances, psychiatric disturbances or substance abuse were excluded.

A total of 235 patients were recruited of whom 122 met the inclusion criteria, were able and were willing to participate at the interview at T1. Within two weeks, 100 of these patients were assessed neuropsychologically. From the first (T1) to the second interview at fifteen months post-stroke (T2), 21 stroke patients dropped out of the study, so 101 were interviewed twice. Another 20 patients could not take part in the second neuropsychological assessment within the next two weeks. A total of 81 patients were neuropsychologically assessed at T2. See chapter 1 for a more detailed account of patients exclusion and drop-out. Patient drop-out appeared to be related to several variables of interest. Patients included at T1, but not at T2 were older, physically more disabled and less active than patients who stayed in the study. A similar number, but a greater proportion of female than male subjects dropped out. Furthermore, stroke patients who participated at T1, but no longer at T2, performed significantly worse than patients who stayed in the study on measures of reasoning and memory at T1. Drop-out of patients appeared not to be related to side of lesion or total life satisfaction.

All patients approved of the fact that their medical history and lesion characteristics were provided by GP and neurologist. Of the initial number of 122 patients, lateralisation of lesion could be classified for 119 patients on the basis of
all neurological data: 54 had a right hemisphere infarction, 56 a left sided infarction, 4 bilateral lesions and 5 patients had lesions affecting brain stem or cerebellum. Only the patients with left and right hemisphere infarctions were included in the statistical analyses.

Subjects: control subjects

Control subjects were recruited among the population of four general practices from the northern part of the Netherlands. A stratified randomisation procedure was used to match the control subjects to patients on age and gender. Control subjects with a history of psychiatric disturbances, neurological conditions or substance abuse were excluded from the study (n=2). At T1 80 control subjects were interviewed, while 72 controls participated in the first neuropsychological assessment. At the interview at T2 the control group consisted of 70 subjects, 8 subjects had dropped out because they did not want to participate again (n=4), were too busy (n=2) or had moved (n=2). At the second neuropsychological assessment, 64 control subjects were assessed, 6 control subjects did not want to participate in the second neuropsychological assessment. Drop-out of control subjects was not related to any of the investigated variables.

Procedure and measures

The present study was approved of by the Medical Ethical Committee of the University Hospital Groningen. Stroke patients were assessed at three and fifteen months post-stroke at their own place of residence by trained interviewers. Control subjects were also interviewed twice at home with an interval of approximately one year. After signing an informed consent, several questionnaires concerning functional ability, mood and quality of life were administered. Within two weeks after the interview, the cognitive functions of the subjects were assessed using several neuropsychological tests. Only those instruments relevant for the current research questions will be described.

Life satisfaction

Global and domain specific satisfaction with life was measured using the Life Satisfaction Scale (Viitanen, Fugl-Meyer, Bernspang & Fugl-Meyer, 1988). Stroke patients and controls were asked to rate their satisfaction with life in general, leisure, togetherness with friends, togetherness with family, marriage, and sexuality on a numerical scale including "1" for very dissatisfied, "2" for dissatisfied, "3" for rather dissatisfied, "4" for rather satisfied, "5" for satisfied, and "6" for very satisfied. At T1 the satisfaction preceding the stroke (recorded as satisfaction at T0) and at three months after the stroke was rated. At T2, the satisfaction at fifteen months post-stroke was assessed. Controls rated their global and domain specific satisfaction with life at the second interview (T2). Ratings on life domains were summed to a total life satisfaction score (range 7-42). To document the number of satisfied or dissatisfied patients a dichotomy was used for each life domain.
Satisfaction rated rather dissatisfied or lower, were scored as 'dissatisfied'. Reliability of the total satisfaction scale at the time of assessment (T1) (alpha = .81) and satisfaction rated retrospectively (T0) (alpha = .87) proved good in stroke patients.

**Activities**

The instrumental activities of daily life were assessed in stroke patients at T1 and T2 and in controls at T2 with ten items based on the Frenchay Activities Index (FAI) (Holbrook & Skilbeck, 1983). The 15 items of the original FAI can be divided into three subscales, 'domestic activities', 'outdoor activities' and 'leisure activities' (Sveen et al., 1999; Cockburn et al., 1990). In the present study, the subscales 'outdoor activities and 'leisure activities' were used. To improve reliability of the scale, we omitted the item 'gainful work' (Schuling et al., 1993). Ratings of the frequency of the performance of separate activities were used in the statistical analyses, as well as a total activity score (range 0-28).

**Physical disabilities**

The SA-SIP, a 30-item stroke-adapted version of the original Sickness Impact Profile, was used to measure functional impairments of stroke patients (van Straten, de Haan, Limburg, Schuling, Bossuyt & van de Bos, 1997; Bergner, Bobbitt, Carter & Gilson, 1981). The scale was administered to patients at T1 and T2. Principal component analysis with Varimax rotation has shown that a physical disability scale could be formed by adding up the scales Body care and movement, Mobility, Household management and Ambulation (Eigenvalue = 3.6; 44.6 % Explained variance). Only the total score of the physical disabilities scale is used in the present study. Reliability proved to be good for the physical scale (alpha = .91) (van Straten et al., 1997).

**Cognitive functioning**

**Reasoning.** Three out of seven subtests of the SON-R 5½-17 were used to measure reasoning in stroke patients: Categories, Stories and Mosaics (Snijders et al., 1988; Lezak, 1995, Gerritsen, Berg, & Deelman, 2001). In Categories, a measure of abstract reasoning, subjects have to decide which two out of five line drawings belongs to three other drawings. The subtest Stories, a measure of concrete reasoning, requires subjects to arrange a set of pictures into a story with a logical time sequence. Patterns have to be copied using red/white squares in the visuo- spatial subtest Mosaics. Principal component analysis demonstrated that these three subtest measure one underlying factor in stroke patients (Eigenvalue = 2.1, variance explained = 71%). In this selection of subtests, two adaptation were made to the original SON-R 5½-17. All stimulus material in the Categories and Stories was presented vertically instead of horizontally to rule out the effects of neglect as much as possible. Furthermore, time limits of the subtests were prolonged one and a half time. Before the test was administered, sample items were used to ensure that all patients met basic test requirements. Three subjects appeared to lack basic skills
to complete the test. The sum of the three subtests was used for statistical analyses; higher scores indicate better performance.

*Verbal memory.* The Dutch version of the Rey Auditory Verbal Learning Test (AVLT) was used as a measure of explicit memory. In this test, subjects have to learn 15 one-syllable words in five successive trials (Saan & Deelman, 1986). The immediate recall of words in each trail was summed to a total score of correct recalled words. Scores range from 0 to 75, with higher scores indicating better performance.

*Mental speed.* Reaction times were measured using a method developed by van Zomeren (1981). The reaction time was recorded by a computer and is divided into a decision component and a motor component. In this study only the decision times of the two conditions were used. The first is a simple mental speed condition in which subjects react to light stimuli, called *visuomotor* reaction time task. To measure more complex mental speed, a *cognitive* reaction time task was designed (Gerritsen et al., 2003). A computer screen was placed behind the reaction time apparatus on which words (Text-task) or landscapes (Picture-task) emerged. In the Text-task, a category word (e.g. flowers) was presented on the upper half of the screen, while a stimulus word (e.g. rose) appeared in the lower half of the screen. Subjects were required to decide if a word fitted in the category. In the Picture-task, a landscape was presented (e.g. beach) and a picture (e.g. kite) which did or did not fit into the landscape. Previous factor analysis on the reaction time components showed that visuomotor decision times and cognitive decision times formed two separate factors (Gerritsen et al., 2003).

**Statistical analyses**

First, the course of stroke patients' total life satisfaction score from T0 to T2 was analysed using GLM Repeated Measure analysis, followed by post-hoc LSD analyses. Friedman's test for several related variables was used to investigate the course of satisfaction with life domains from T0 to T2. Cochran's Q was used to compare the number of patients dissatisfied with life domains from T0 to T2. To analyse the course of activity level from T1 to T2 in stroke patients, a paired-samples T-test was performed.

Secondly, total life satisfaction and activity level of stroke patients and controls were compared at T2 using independent-samples T-tests. Comparison of patients' and controls' satisfaction with life domains and the frequency of activity per item at T2 was performed by Mann-Whitney U-tests. Chi-square analyses were calculated to compare the number of patients and controls dissatisfied with life domains. Independent-samples t-tests were used to compare cognitive functioning and physical disabilities of stroke patients and controls at T1. Finally, two models concerning the factors influencing activity level and life satisfaction were analysed.
in the stroke group. The prediction of activity level at T1 and T2 and change in activity level from T1 to T2 by cognitive functioning and physical disabilities at T1 was investigated using General Linear Model (GLM)-univariate analyses. GLM-univariate analysis was also used to test the model predicting life satisfaction at T2 by activity level and cognitive functioning at T1. All analyses were performed in SPSS 10.0.

Results

As Table 1 shows, stroke patients and controls did not differ significantly in age, gender, marital status or educational level. Stroke patients were less able to live independently and were less independent in self-care abilities than controls.

Male and female stroke patients did not differ in age, distribution of side of lesion, educational level or level of independence in basic ADL. Female patients were more often single than male patients (male 15% vs. female 46%, \( \chi^2 = 13.6, p < .001 \)). Male and female controls did not differ significantly in age from stroke patients of the same gender.

Table 1: Demographical variables and measures of independence in housing conditions and self-care for patients and controls at T1.

<table>
<thead>
<tr>
<th></th>
<th>Patient (n=110)</th>
<th>Control (n=80)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, M (SD)</td>
<td>66.5 (12.1)</td>
<td>66.3 (11.9)</td>
<td>t=-0.1</td>
</tr>
<tr>
<td>Age, range</td>
<td>39-93</td>
<td>41-89</td>
<td></td>
</tr>
<tr>
<td>Gender, % male</td>
<td>60 %</td>
<td>55 %</td>
<td>( \chi^2 = 0.7 )</td>
</tr>
<tr>
<td>Education#, M (SD)</td>
<td>4.0 (1.5)</td>
<td>3.9 (1.4)</td>
<td>Z=-0.7</td>
</tr>
<tr>
<td>Marital status, % with partner</td>
<td>76 %</td>
<td>74%</td>
<td>( \chi^2 = 0.2 )</td>
</tr>
<tr>
<td>Housing, %</td>
<td></td>
<td></td>
<td>t(\tau)=-2.5*</td>
</tr>
<tr>
<td>independent</td>
<td>82%</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>semi-independent</td>
<td>4%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>institution</td>
<td>14%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Barthel Index, M (SD)</td>
<td>18.0 (3.7)</td>
<td>19.7 (0.8)</td>
<td>t=4.9***</td>
</tr>
</tbody>
</table>

* \( p < .05 \), ** \( p < .01 \), *** \( p < .001 \),
# Classification Verhage, 1964

Course of total life satisfaction of stroke patients

GLM Repeated Measure analysis showed a significant overall change in total life satisfaction from pre-stroke to post-stroke levels (F= 8.1, \( p = .001 \)). Post-hoc tests showed a significant decrease from T0 to T1 (T0: mean= 35.6, sd= 3.7 T1: mean= 33.1, sd= 4.6, F= 16.3, \( p < .001 \)), but no significant difference from T1 to T2 (T1: mean= 33.1, sd= 4.6 T2: mean= 33.4, sd= 4.3, F= 0.2, \( p = .65 \)).
As illustrated in Figure 1, the course of life satisfaction did appear to be different for male and female stroke patients (F= 3.0, p= .05). Male stroke patients showed a significant drop in total life satisfaction from T0 to T1, which was not found in female stroke patients (Gender x Life satisfaction, F= 4.6, p= .04). At T2, female stroke patients reported a significantly higher level of total life satisfaction than male stroke patients (Male mean= 32.6, sd= 4.8, Female mean= 35.1, sd= 3.0, t= -2.5, p= .01). Age, marital status, level of education or side of lesion were neither significantly related to pre- or post-stroke levels of total life satisfaction nor to changes in total life satisfaction.

![Figure 1: Total life satisfaction pre-stroke (T0) and at three (T1) and fifteen months (T2) post-stroke for male and female stroke patients.](image)

**Course of satisfaction with life domains of stroke patients**

Table 2 presents the level of satisfaction with life domains before stroke and at three and fifteen months post-stroke. Stroke patients participating at T1, but no longer at T2 appeared to be less satisfied with self-care (Z= -2.1, p= .03) and sexuality (Z= -1.9, p= .05) at T1 than patients who stayed in the study. Of those patients interviewed twice, satisfaction with life in general ($\chi^2= 18.2, p< .001$), self-care ($\chi^2= 19.6, p< .001$) and leisure ($\chi^2= 26.5, p< .001$) deteriorated significantly from time before stroke to three months post-stroke and remained at a lower level at fifteen months post-stroke. Satisfaction with friends did not only deteriorate from time before stroke to three months post-stroke (Z= -3.2, p<.01) but showed further deterioration from three to fifteen months post-stroke (Z= -2.0, p= .05).

Separate analysis of the course of satisfaction with life domains for male and female patients showed that satisfaction only changed significantly for male patients. For male patients, satisfaction with life in general ($\chi^2= 20.4, p< .001$), self-care ($\chi^2= 17.9, p <.001$), leisure ($\chi^2= 23.8, p< .001$) and togetherness with friends ($\chi^2= 16.8, p< .001$) dropped significantly from time preceding stroke to fifteen
months post-stroke. For female stroke patients, satisfaction with life domains did not change significantly.

Table 2 also provides percentages of patients dissatisfied with life domains. Percentages of patients dissatisfied with the domains self-care (Cochran's Q = 9.7, p = .008), leisure (Cochran's Q = 15.5, p < .001) togetherness with friends (Cochran's Q = 6.2, p = .04) and sexuality (Cochran's Q = 11.5, p = .003) differed significantly from time before stroke to fifteen months post-stroke. Further analysis of the effect of gender showed that percentages dissatisfied with these life domains from T0 to T2 only increased significantly for male stroke patients.

At T1, the highest percentage of patients dissatisfied concerned the domains self-care and leisure (19%), at T2 the domains sexuality (19%) and leisure (16%). At T2, a significantly greater proportion of male stroke was dissatisfied with leisure than female patients (Male 19% vs. Female 3%, χ² = 4.2, p = .04).

Table 2. Level of satisfaction with life domains and percentages dissatisfied (DIS) before stroke (T0) at three (T1) and at fifteen months (T2) post-stroke and level of satisfaction and percentages dissatisfied of control subjects at T2.

<table>
<thead>
<tr>
<th>Satisfaction with</th>
<th>Stroke n T0 M (SD) DIS</th>
<th>T1 M (SD) DIS</th>
<th>T2 M (SD) DIS</th>
<th>Control n T2 M (SD) DIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life in general</td>
<td>74 5.0 (0.8) 4 4.7 (0.9) 8 4.6 (1.0) 11 69 5.0 (0.7) 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td>74 5.1 (0.7) 3 4.4 (1.2) 19 4.6 (1.2) 14 70 5.3 (0.6) 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leisure</td>
<td>74 5.1 (0.7) 1 4.3 (1.2) 19 4.5 (1.2) 16 70 5.1 (0.8) 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Togetherness friends</td>
<td>73 5.0 (0.7) 4 4.7 (0.9) 8 4.5 (1.1) 14 70 4.9 (0.9) 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Togetherness family</td>
<td>66 5.3 (0.5) 0 5.1 (0.7) 2 5.2 (0.6) 2 54 5.4 (0.6) 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marriage</td>
<td>60 5.2 (0.5) 0 5.2 (0.5) 2 5.2 (0.5) 2 52 5.4 (0.9) 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexuality</td>
<td>57 5.0 (0.8) 4 4.8 (1.1) 9 4.6 (1.3) 19 52 4.8 (1.4) 14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course of activity level of stroke patients

Total activity level of stroke patients showed a small and non-significant improvement from T1 to T2 (T1: mean = 15.7, sd = 6.7, T2: mean = 16.7, sd = 6.2, F = 3.7, p = 0.06). Age of stroke patients was not significantly related to activity level at T1, at T2 or to change in activities from T1 to T2. Higher educational level did show a significant correlation with higher activity level at both T1 (rs = .26, p = .01) and T2 (rs = .32, p = .003), but was not significantly related to change in activity level over time.
from T1 to T2. Gender nor side of lesion affected total activity level at T1 or T2 or change in activities from T1 to T2.

**Comparison between stroke patients and controls: life satisfaction at T2**

Stroke patients' level of total life satisfaction at fifteen months post-stroke was significantly lower than life satisfaction of controls (Stroke mean= 33.3, sd= 4.5, Control mean= 36.7, sd= 2.7, t= -5.0, p< .001). While total life satisfaction of male stroke patients at T2 differed significantly from satisfaction of male control subjects (t= 4.8, p< .001), female stroke patients' level of total life satisfaction at T2 did not differ significantly from satisfaction of female control subjects (t= 1.5, p= .14).

Table 2 presents the level of satisfaction with life domains for stroke patients and control subjects at T2. At T2, male stroke patients reported a significantly lower satisfaction than male controls on all domains expect for satisfaction with sexual life. While male patients differed from male controls on six domains, female stroke patients were only significantly less satisfied than female controls on the domains leisure and togetherness with family. At T2, a significantly greater percentage of patients than controls was dissatisfied with self-care ($\chi^2= 10.2$, p= .001) and leisure ($\chi^2= 5.5$, p= .02) than control subjects. A greater percentage of male stroke patients than male controls was dissatisfied with life in general ($\chi^2= 5.8$, p= .02), self-care ($\chi^2= 5.8$, p= .02), leisure ($\chi^2= 6.9$, p= .009) and togetherness with friends ($\chi^2= 8.6$, p= .003). Female patients only differed from female controls in the percentage dissatisfied with self-care ($\chi^2= 4.3$, p= .04).

Total level of life satisfaction of stroke patients retrospectively estimated at time before stroke, did not differ significantly from the total level of life satisfaction of control subjects.

**Comparison between stroke patients and controls: activities at T2**

At T2, total activity level of stroke patients was significantly lower than activity level of control subjects (Control: mean= 20.4, sd= 5.1, Stroke: mean= 16.8, sd= 5.8, t= 4.0, p< .001). In the control group, total activity scores were higher for male compared to female subjects (t= 2.4, p= .02). While total activity score of male stroke patients was significantly lower than male control subjects (t= 4.6, p< .001), female stroke patients did not differ in total activity score from female controls (t= 1.2, p=.22). As to specific activities, table 3 shows that at T2, at group level, patients differed significantly from controls in the frequency of shopping for groceries, social activities, walking, reading books and performed less strenuous tasks in gardening and fixing things than controls.
Table 3: Percentages of stroke patients and controls in highest categories per item and comparison between categorical answers of patients (n=87) and controls (n=70) per item at T2.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Stroke %</th>
<th>Control %</th>
<th>Z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>shopping for groceries, every week</td>
<td>70</td>
<td>87</td>
<td>-3.0**</td>
</tr>
<tr>
<td>social activities, every week</td>
<td>55</td>
<td>81</td>
<td>-3.5***</td>
</tr>
<tr>
<td>walking, every week</td>
<td>48</td>
<td>67</td>
<td>-2.1*</td>
</tr>
<tr>
<td>active leisure activities, every week</td>
<td>76</td>
<td>86</td>
<td>-1.6</td>
</tr>
<tr>
<td>driving a car, every week</td>
<td>51</td>
<td>57</td>
<td>-0.9</td>
</tr>
<tr>
<td>making trips, every week</td>
<td>13</td>
<td>19</td>
<td>-0.5</td>
</tr>
<tr>
<td>gardening, everything needed</td>
<td>32</td>
<td>38</td>
<td>-2.0*</td>
</tr>
<tr>
<td>fixing things, everything needed</td>
<td>24</td>
<td>51</td>
<td>-4.2***</td>
</tr>
<tr>
<td>reading books, 1 or &gt; in 2 weeks</td>
<td>20</td>
<td>29</td>
<td>-3.1**</td>
</tr>
<tr>
<td>watching television, hours each day</td>
<td>4.3</td>
<td>2.6</td>
<td>-1.5</td>
</tr>
</tbody>
</table>

*p<.05; ** p<.01; *** p<.001 (2-tailed).

Comparison between stroke patients and controls: cognitive performance and physical disabilities at T1

Before cognitive and physical disabilities at three months post-stroke will be related to outcome measures at fifteen months after stroke, cognitive functioning and physical status of stroke patients and controls is compared at T1. Table 4 shows that, at three months post-stroke, stroke patients performed worse on all four cognitive domains and were physically more disabled than controls. Within the stroke group, the effect of the demographical variables gender, age and educational level on cognitive performance is analysed at T1. Female stroke patients appeared to have better verbal memory performance than male stroke patients. Next, higher educational level was significantly related to higher performance on all cognitive tests. Higher age was related to lower performance on tests of reasoning, memory and complex mental speed and was associated with greater physical disabilities. With regard to side of lesion, right hemisphere stroke patients were slower on the visuomotor decision task than left hemisphere stroke patients.

Table 4: Independent-samples t-tests on measures of reasoning, memory, mental speed and physical disabilities between stroke patients and controls at T1.

<table>
<thead>
<tr>
<th></th>
<th>Stroke</th>
<th></th>
<th>Control</th>
<th></th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD) n</td>
<td>M (SD) n</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasoning</td>
<td>29.7 (.124) 86</td>
<td>39.0 (13.5)  68</td>
<td>4.4***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>36.8 (10.8)  81</td>
<td>42.5 (10.4)  71</td>
<td>3.3***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple mental speed</td>
<td>.429 (.124)  82</td>
<td>.376 (.054)  71</td>
<td>-3.5**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex mental speed</td>
<td>1.031 (.320) 78</td>
<td>.909 (.299)  71</td>
<td>-2.4*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical disabilities</td>
<td>5.2 (4.6)  110</td>
<td>1.8 (2.1)    79</td>
<td>-6.8***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.05; ** p<.01; *** p<.001 (2-tailed)
**Prediction of activities**

The hypotheses concerning the prediction of activity level and activity gain of stroke patients by early cognitive status and physical disabilities were tested using multiple prediction. Table 5 shows that, as expected, physical disabilities at T1 most strongly predicted activity level at T1 and T2. Less physical disabilities at three months post-stroke were related to higher activity level at both three and fifteen months post-stroke. As hypothesized, better performance on reasoning tests and faster complex cognitive decision times at T1 to T2, but had no additional predictive value of activity levels at T1 or T2. This was also true for visuomotor mental speed, which was the most important variable in predicting gain in activity level from T1 tot T2. In addition, visuomotor mental speed appeared to have predictive value of activity level at T1. Educational level of the patients, that was significantly correlated with activity level in univariate analysis, was subsequently added to the models. It had neither predictive value, nor caused any significant change in the models.

Table 5: Prediction of activity level (FAI) of stroke patients at T1 (n=58), T2 (n=61) and change in activities from T1 to T2 (n=52) by physical disabilities and cognitive functioning at T1.

<table>
<thead>
<tr>
<th>Measures at T1</th>
<th>FAI T1</th>
<th>R²</th>
<th>FAI T1-T2</th>
<th>F</th>
<th>R²</th>
<th>FAI T2</th>
<th>F</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical disabilities</td>
<td>23.7***</td>
<td>.46</td>
<td>0.5</td>
<td>20.1***</td>
<td>.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasoning</td>
<td>3.1</td>
<td>6.7*</td>
<td>.07</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>0.0</td>
<td>2.8</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple mental speed</td>
<td>7.6**</td>
<td>.12</td>
<td>9.4**</td>
<td>.09</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex mental speed</td>
<td>0.0</td>
<td>5.0*</td>
<td>.05</td>
<td>1.0</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected model</td>
<td>14.3***</td>
<td>58</td>
<td>3.5*</td>
<td>.27</td>
<td>8.7***</td>
<td>.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.05; ** p<.01; *** p<.001 (2-tailed).

**Prediction of life satisfaction**

Next, the separate influences of activities and cognitive functioning on total life satisfaction were analysed. Table 6 presents the multivariate prediction of life satisfaction at T2 by activity level and cognitive functioning at T1. The results show that activity level and reasoning abilities at T1 predicted most variance in life satisfaction at T2. Memory functioning at T1 also predicted life satisfaction at T2, while visuomotor and cognitive mental speed at T1 did not appear to be predictive of life satisfaction at T2. At T2 female stroke patients reported higher levels of life satisfaction than male stroke patients. Gender, subsequently added to the GLM-model, neither explained an additional significant proportion of life satisfaction, nor changed the predictive value of activities and cognitive functioning for life satisfaction.
Table 6. Prediction of life satisfaction at T2 by activity level and cognitive functioning at T1 (n=54).

<table>
<thead>
<tr>
<th>Measures T1</th>
<th>Life satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Activities</td>
<td>7.2*</td>
</tr>
<tr>
<td>Reasoning</td>
<td>7.4**</td>
</tr>
<tr>
<td>Memory</td>
<td>4.8*</td>
</tr>
<tr>
<td>Simple mental speed</td>
<td>0.1</td>
</tr>
<tr>
<td>Complex mental speed</td>
<td>0.1</td>
</tr>
<tr>
<td>Corrected model</td>
<td>3.2*</td>
</tr>
</tbody>
</table>

Discussion

Course and level of total life satisfaction after stroke

The present study in a community based sample of stroke patients showed that total life satisfaction deteriorated from time before stroke to three months post-stroke and, at fifteen months post-stroke, remained at a lower level than satisfaction before stroke. Although drop-out of patients from three to fifteen months was not related to total life satisfaction, patients who dropped out from T1 to T2 had significantly lower levels of satisfaction with self-care and sexuality than patients who stayed in the study. Drop-out appeared to be selective and concerned the more disabled patients. The results of the present study might therefore underestimate the impact of disabilities on life satisfaction after stroke. Another limitation of the present study is that satisfaction before stroke had to be rated retrospectively. An argument for a valid measurement, at least on group level, is the fact that pre-stroke levels of satisfaction did not significantly differ from satisfaction of control subjects.

The level and course of life satisfaction in stroke patients was not related to age of the patient, level of education, marital status or the side of stroke. At T2, however, female stroke patients appeared to report a higher level of satisfaction than male stroke patients. Further analysis of the course of life satisfaction showed that a drop in life satisfaction after stroke was only present in male patients. A previous Norwegian study also showed that subjective well-being, which included a measure of satisfaction, was higher in female stroke patients (Wyller, 1998). In contrast, other studies found higher subjective well-being after stroke in male compared to female patients (Wyller, 1997; Diener, 1984).

At fifteen months post-stroke, male stroke patients reported significantly lower life satisfaction than male control subjects while life satisfaction of female stroke patients did not differ significantly from female control subjects. Apparently, the stroke event had such an impact on the lives of male stroke patients that previous levels of satisfaction could not be regained within the first fifteen months post-stroke. This downward shift of the level of life satisfaction has previously been demonstrated in stroke patients, but was also found in subjects who
experienced unemployment and marital transitions (Niemi et al., 1988; Lucas et al., 2004; Lucas et al., 2003). The impact of the loss of a spouse on life satisfaction has been found to be greater in men than women (Chipperfield & Havens, 2001).

Course and level of satisfaction with life domains after stroke

Satisfaction with life in general, self-care, leisure and togetherness with friends deteriorated from time before stroke to three months after stroke and remained at a lower level than pre-stroke satisfaction at fifteen months post-stroke. As was also found in a Scandinavian study, satisfaction with leisure showed greatest deterioration after stroke (Niemi et al., 1988).

Further analysis showed that this downward shift in satisfaction with life domains was only present in male stroke patients. The largest gender difference in the present study was that at fifteen months post-stroke, six times more male stroke patients were dissatisfied with leisure than female patients. An explanation for this difference might be that leisure activities of male stroke patients are more sensitive to the effects of stroke. Sjogren (1982) found that activities of male stroke patients followed traditional gender roles, indicating more outdoor and more straining leisure activities. In the present study, this gender difference in activities was also found in the control group. In the stroke group, male patients did not perform more leisure and outdoor activities than female patients. However, male control subjects performed more frequent and more strenuous activities than male stroke patients, while total activities of female patients did not differ from those of female controls. These findings suggest that male stroke patients might have experienced a greater drop in gender-related outdoor and leisure activities after stroke than female patients.

For both male and female stroke patients, satisfaction with family and marital life did not change after stroke, which is in line with findings from other western stroke studies (Astrom et al., 1992; King, 1996). A high level of satisfaction with family and marital life after stroke might reflect the importance of social interaction with those surrounding the patient. If interaction with others is limited by disabilities after stroke, affection and behavioural confirmation within one's closest relationships might become the most important source to obtain social well-being.

At fifteen months post-stroke, patients' level of satisfaction differed from controls on all domains, except for satisfaction with sexual life. Again, satisfaction of male stroke patients differed from male controls on a greater number of domains than satisfaction of female patients and controls. Fifteen months post-stroke, the highest percentage of stroke patients dissatisfied concerned the domain sexual life (19%), but this percentage appeared to be quite similar in control subjects (14%). In line with findings from Viitanen and colleagues (1988), a greater number of patients than controls were dissatisfied with self-care and leisure. On the other hand, most stroke patients reported a relatively high level of satisfaction with each life domain at fifteen months post-stroke. This finding corresponds to several
other stroke studies and matches the idea that most people will try to maintain an optimistic view of life (Viitanen, 1988; King, 1996; Löfgren et al., 1999; Diener & Diener, 1996). Recent research showed that this ability may not only preserve mental health, but might also protect one's physical health (Stiegelis et al., 2003; Taylor et al., 2000).

**Role of cognitive status in gain of activities after stroke**

In line with other stroke studies, the level of activities of stroke patients remained lower than activity level of control subjects. It was hypothesized that physical disabilities restrict the activities that can ultimately be performed. In addition, cognitive functioning shortly after stroke was thought to be important in the adaptation process to regain outdoor and leisure activities in the first year after stroke. The results mostly confirmed our hypotheses. Physical disabilities at three months post-stroke not only predicted activity level at the same time of measurement, but also proved predictive of activity level at fifteen months post-stroke. Simple mental speed at three months post-stroke also predicted activity level at three months post-stroke. In a group of older adults, mental processing speed was related to the time to complete everyday tasks (Owsley, Sloane, McGwin & Ball, 2002). Stroke patients with a basic slowness in mental speed can be seriously hindered in time-limited leisure and outdoor activities.

On group level, stroke patients showed a small and non-significant improvement in the frequency of activities from three to fifteen months post-stroke. In the present study no measures of the quality of the performance of the activities were included. Cognitive functioning at three months post-stroke appeared to make a small, but significant contribution to changes in activity level. Faster visuomotor and cognitive decision times at three months post-stroke were related to greater recovery of activities within the first fifteen months after stroke. Although mental slowness is one of the most frequently mentioned cognitive changes after stroke, research on processing speed after stroke and its impact on the performance of activities of daily living has been scarce so far (Gerritsen et al., 2003; Visser-Keizer et al., 2002; Hochstenbach et al., 1998). Research on information processing speed in patients with traumatic brain injury indicated that impairments in mental speed should not be regarded in isolation. Information processing speed was related to several other cognitive functions such as attention and working memory (Rios et al., 2004; Chiaravalloti et al., 2003; Spikman et al., 1996).

Reasoning abilities at three months post-stroke also predicted change in activities from three to fifteen months post-stroke. Although physical disabilities restrain the activities one can perform, relatively intact problem solving abilities might help stroke patients to adapt to the circumstances after stroke. Patients with better reasoning capacities might, for example, chose to perform activities in a different way or might be able to shift to less demanding activities. Further inquiry into the way stroke patients perform activities or find alternative activities would be...
highly interesting for future research. A positive relationship between reasoning abilities and activities has been demonstrated in community dwelling elderly and deserves further attention in stroke research (Cockburn, Smith & Wade, 1990).

Life satisfaction, activities and cognitive functioning after stroke

The engagement in activities is regarded as an important mean to obtain well-being (Csikszentmihalyi, 1997; Steverink et al., 1998). After stroke, the performance of activities might be hindered, which poses a threat to the fulfilment of goals to obtain well-being. This assumption based on SPF-theory was confirmed for both male an female stroke patients as activity level at three months post-stroke independently predicted total life satisfaction at fifteen months post-stroke. Within SPF-theory, cognitive disabilities can be regarded as constraints or loss of resources, which can hinder one's activities. It was therefore hypothesized that the relationship between cognitive abilities and life satisfaction would be mediated by level of activities. This hypothesis was partly confirmed for the more basic cognitive measurements of speed of information processing. However, the higher order cognitive functions of memory and reasoning abilities at three months post-stroke predicted life satisfaction at fifteen months post-stroke independently from activity level. These higher order cognitive functions cannot only be seen as restraints for performing activities, but might be regarded as important tools in the adaptation and evaluation process itself (Steverink et al., 1998). Furthermore, the impact of loss of complex cognitive abilities might go beyond the ability to perform activities. Poorer memory functioning and reasoning capabilities could also mean a loss of status or self-confidence, which might directly influence satisfaction with life.

The present results showed that activities and cognitive functioning predicted a quarter of variance in life satisfaction after stroke. This means that a great proportion of life satisfaction is explained by other variables, including personality, culture or social class (Diener, Oishi & Lucas, 2003, Schimmack et al., 2002). For future research, it should be interesting to understand more about the complex interactions between personality characteristics, disabilities after stroke and the adaptation to the consequences of stroke in daily life.

Implications for clinical practice

The present study underlines the importance of activity level and cognition in the subacute phase after stroke in the prediction of life satisfaction in the chronic phase after stroke. Male stroke patients, who generally spend more time in outdoor and active leisure activities than female stroke patients, might be at a relatively greater risk of dissatisfaction with several related life domains. Although physical disabilities restricts one's activities, cognitive functioning in the early phase after stroke appears to contribute to the improvement of leisure and outdoor activities in the first year after stroke. This implies that stroke patients who are physically able to return home after stroke, will not always automatically be able to return to their
activities. Cognitive disabilities, that are not always explicit enough to be noticed during hospitalisation, might become apparent at home. At home, hardly any attention is directed at the education of patients concerning cognitive disabilities and their impact on daily life. Furthermore, these patients generally do not receive professional support or training methods to compensate for cognitive losses. In the last decade, research on the effectiveness of cognitive rehabilitation is growing. The present state of knowledge indicates that cognitive rehabilitation of memory functioning and problem solving abilities directed at everyday situations can be valuable (Cicerone et al., 2000). Further research is needed to support the effectiveness of different programs of cognitive rehabilitation after stroke and to gain more insight into the best timing of cognitive rehabilitation. In adapting these programs to real life activities, gender differences should be taken into account.
References


Prediction of life satisfaction __


