

# Stroke Unit Treatment Improves Long-term Quality of Life

## A Randomized Controlled Trial

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**Background and Purpose**—We have previously shown that treatment of acute stroke patients in the combined acute and rehabilitation stroke unit in our hospital improves survival and functional outcome compared with treatment in general wards. The primary aim of the present trial was to examine whether the treatment in our stroke unit had an effect on different aspects of quality of life (QoL) for stroke patients 5 years after the onset of stroke.

**Methods**—In a randomized controlled trial, 110 patients with symptoms and signs of an acute stroke were allocated to the stroke unit and 110 to general wards. No significant differences existed in baseline characteristics between the two groups. The patients alive after 5 years were assessed by the Nottingham Health Profile (NHP) and the Frenchay Activities Index (FAI), which were the scales used as primary outcome measures for QoL. As secondary outcome measures we used a global score for the NHP and a simple visual analogue scale (VAS).

**Results**—After 5 years, 45 of the patients treated in the stroke unit and 32 of those treated in general wards were alive. All surviving patients were assessed by the FAI. Thirty-seven (82.2%) of the stroke unit patients and 25 (78.1%) of the general wards patients were assessed by the NHP; 38 (84.4%) and 28 (87.5%), respectively, were assessed by the VAS. Patients treated in the stroke unit had a higher score on the FAI ( $P=0.0142$ ). Assessment with the NHP showed better results in the stroke unit group for the dimensions of energy ( $P=0.0323$ ), physical mobility ( $P=0.0415$ ), emotional reactions ( $P=0.0290$ ), social isolation ( $P=0.0089$ ), and sleep ( $P=0.0436$ ), although there was no difference in pain ( $P=0.3186$ ). The global NHP score and VAS score also showed significantly better results in the stroke unit group (NHP,  $P<0.01$ ; VAS,  $P<0.001$ ). Patients who were independent in activities of daily living had significantly better QoL assessed by these scales than patients who were dependent.

**Conclusions**—Our study shows for the first time that stroke unit care improves different aspects of long-term QoL for stroke patients. (*Stroke*. 1998;29:895-899.)

**Key Words:** quality of life ■ stroke ■ stroke unit

Several trials have shown better outcome for stroke patients treated in stroke units compared with stroke patients treated in general wards.<sup>1-9</sup> Meta-analysis of all available randomized controlled trials has shown that care of stroke patients in stroke units reduces mortality, institutionalization, and dependency.<sup>10,11</sup> QoL after a stroke is probably just as important as the functional level.<sup>12</sup> For a complete evaluation of the effects of stroke unit care, is it necessary also to look at the effects on QoL and particularly the long-term effects on QoL. It is probably impossible to measure a person's "real" QoL. However, several attempts have been made to define QoL. Some have placed an emphasis on life satisfaction<sup>13</sup> and others on health-related subjective experience<sup>14</sup> or psychosocial and physical well-being.<sup>15</sup> Others have just asked what the patients themselves think about their QoL.<sup>16,17</sup> No single generally accepted method for assessment of QoL exists, but most researchers today seem to adopt a multidimensional approach to QoL assessment.<sup>12,18</sup> In this trial we have used different scales and

methods commonly used with stroke patients for assessment of QoL. In accordance with the present knowledge about QoL assessments, they probably reflect important dimensions of QoL.<sup>12,19</sup>

The primary aim of the present study was to test the hypothesis that treatment of patients with acute stroke in a stroke unit improves different aspects of long-term QoL compared with patients treated in general wards. Secondly, we wanted to examine whether there was a correlation between functional level assessed by the BI<sup>20</sup> and the different outcomes of QoL.

### Subjects and Methods

The stroke unit, located in the Department of Medicine in our hospital, is a combined acute and rehabilitation unit. For management of acute stroke, we have constructed an acute treatment program for stroke that includes standardized diagnostic evaluation, observation, acute treatment, mobilization, and rehabilitation. Our team approach to nursing and rehabilitation emphasizes patient and family participation. Functional training and a modified motor

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### Selected Abbreviations and Acronyms

|                                  |
|----------------------------------|
| ADL = activities of daily living |
| BI = Barthel Index               |
| FAI = Frenchay Activities Index  |
| NHP = Nottingham Health Profile  |
| QoL = quality of life            |
| VAS = visual analogue scale      |

relearning program are the basic rehabilitation approaches. Details about the program have been published previously.<sup>9</sup>

On admission, patients with symptoms and signs of acute stroke were randomly allocated to treatment in the stroke unit (n=110) and treatment in general wards (n=110). Patients in deep coma on admission, patients with subarachnoid hemorrhage, and patients living in nursing homes before onset of stroke were excluded before randomization. Otherwise, the patients represented an unselected hospitalized stroke population. Details about the inclusion criteria and the study design have previously been described.<sup>9</sup> There were no differences in baseline characteristics, and the distribution of stroke diagnosis was similar in the two groups.<sup>9</sup> The maximum period for treatment in the stroke unit was 42 days (average, 16 days). It was only during this period that differences in treatment and care were present. For both groups, the family physicians were responsible for further treatment and follow-up after the first 6 weeks.

We have previously shown a positive effect of our treatment program in the stroke unit during the first year after the stroke.<sup>9</sup> Recently, we have also shown that the treatment increases survival and functional outcome after a 5-year follow-up.<sup>21</sup> In the present study, all surviving patients were reassessed 5 years  $\pm$  3 months after the onset of stroke. All assessments were performed by an assessor blinded to the protocol who did not know whether the patients had been treated in the stroke unit or the general wards. The following scales were used in the assessments: for evaluation of ADL, the BI;<sup>20</sup> for primary outcomes of QoL, part I of the NHP,<sup>22</sup> and the FAI.<sup>23</sup> NHP part I consists of 6 components (energy, pain, emotional reaction, social isolation, physical mobility, and sleep), with the scores in each component weighted using the Thurstone method of paired comparison to give a score of 0 to 100.<sup>24</sup> The FAI was developed for use in stroke patients. It consists of 15 items, and we used the version with the scoring 1, 2, 3, or 4 for each item, which give a maximum score of 60.<sup>23</sup> The FAI measures lifestyle in terms of more complex physical activities and social functioning. Although this scale does not assess as many dimensions as other QoL scales, it has been regarded as one that provides information about QoL.<sup>12</sup>

As a measure of secondary outcome we calculated a total or global score for the NHP part I in two different ways. We used the methods developed by O'Brien and coworkers,<sup>25</sup> whose object was to obtain a single score between 0 and 100 (where a higher score denotes better health status or better QoL).<sup>25</sup> Part I consists of 38 statements. The first method for calculation was simply to use the proportion (in percent) of the total of the 38 statements to which an affirmative answer was given and subtract this from 100. Thus, affirming 25% of the statements would yield a global score of 75 ( $100 - 25 = 75$ ) of the possible 100. The second method for calculation of a global score was to use the differential weights for statements within each dimension, giving equal weight to each dimension. A third method for a global score exists but was not used in our assessments.<sup>25</sup> Details about the calculations of a global score of the NHP have been presented earlier.<sup>25</sup>

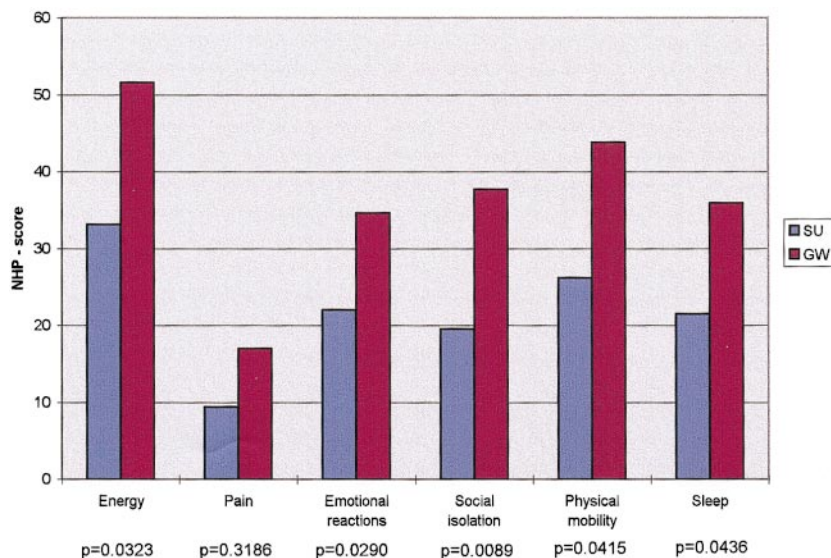
As a measure of secondary outcome we also used a VAS. Our VAS for QoL was a 100-mm-long line with the term "worst possible QoL" at one end of the line and the term "best possible QoL" at the other. We calculated the distance in millimeters from the end of the line where the term "worst possible QoL" was located to the mark the patient had put on the line. Such a simple VAS has been validated for depression.<sup>26,27</sup> An approach similar to that in our trial has been used before in a stroke trial,<sup>16</sup> but because the VAS for QoL has not been validated, the VAS in this trial was regarded only as a secondary end point.

Differences between groups in the scores on different dimensions of the NHP and the total NHP score and the FAI scale were analyzed by the Mann-Whitney test. The same test was used for the differences in the total NHP score and differences on the VAS. The FAI score was also analyzed at a cut point of 30, and the  $\chi^2$  test was used to analyze the differences in proportions of patients with a score of  $\geq 30$  versus a score of  $< 30$ .

Finally, we also analyzed the degree of correlation between the BI and the FAI, the BI and the NHP global score, and the BI and the VAS. A nonparametric correlation coefficient, the Spearman  $\rho$ , was used in these analyses. We have in previous results from this trial<sup>21</sup> performed analysis by the BI with a cut point of 95, in which we defined patients with a BI score of  $\geq 95$  as independent in ADL and patients with a score of  $< 95$  as dependent. We have now also examined whether differences exist within each treatment group in the scores of the global NHP, FAI, and VAS related to a BI score of  $\geq 95$  versus  $< 95$ . The Mann-Whitney test was used in the latter analyses.

## Results

After 5 years, 45 stroke unit patients and 32 general wards patients were alive.<sup>21</sup> Of these, 37 (82.2%) of those from the



**Figure 1.** Bar graph showing results of the NHP 5 years after stroke for patients treated in the stroke unit (SU; blue bars) and patients treated in general wards (GW; red bars).

**TABLE 1. The Mean/Median Scores and Proportion of Patients With a Score of ≥30 on FAI for Stroke Unit and General Wards Patients Assessed 5 Years After Stroke**

| FAI Score                                       | Stroke Unit | General Wards | P      |
|---|-------------|---------------|--------|
| FAI (mean/median)                               | 34.2/36     | 27.2/20.5     | 0.0142 |
| Number and proportion* of patients with FAI ≥30 | 29 (64.4%)  | 13 (40.6%)    | 0.036  |

\*Percentages were calculated from patients alive after 5 years: in the stroke unit (SU) group, 45 patients; in the general wards (GW) group, 32 patients.

stroke unit and 25 (78.1%) from the general wards were assessed with the NHP. Severe aphasia and mental impairment were the main reasons for missing assessments, because a minimum of communication ability and cognitive function are necessary for assessment with this scale. The results of the NHP are shown in Figure 1. Significant differences in favor of the stroke unit were present for the dimensions of energy ( $P=0.0323$ ), emotional reactions ( $P=0.0290$ ), social isolation ( $P=0.0089$ ), physical mobility ( $P=0.0415$ ), and sleep ( $P=0.0436$ ), while there was no difference in the category of pain ( $P=0.3186$ ).

Table 1 shows that the stroke unit group had a significantly higher score on the FAI ( $P=0.0142$ ). The proportion of patients with an FAI score of  $\geq 30$  was also significantly higher in this group ( $P=0.036$ ). As a secondary outcome measure, we calculated a total score for NHP in two ways; Table 2 shows that the stroke unit group had a significantly higher global NHP score with both methods of calculation ( $P=0.0086$  and  $P=0.0092$ ). Figure 2 shows the results of the VAS for QoL before and after the stroke. The QoL was similar in the two groups before the stroke, when we used the patients' own judgment recorded 5 years later. Five years after the stroke the QoL appeared to be significantly better in the stroke unit than in the general wards group when we used the VAS results as an indication of QoL (Figure 2). The VAS result (in millimeters from the end of the line reading "Worst Possible QoL") was (mean/median) 72.8/77 in the stroke unit group and 50.7/50 in the general wards group ( $P=0.0002$ ). In the stroke unit group 38 (84.4%) of the patients were assessed by the VAS, whereas the number was 28 (87.5%) in the general wards group.

Table 3 shows the correlations assessed by the Spearman  $\rho$  between BI and the different QoL scales. For both groups a very high correlation was present between the BI and FAI ( $\rho=0.81$  for the stroke unit group and  $\rho=0.89$  for the general wards group).

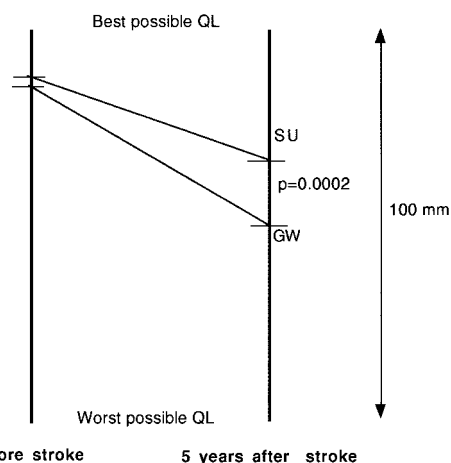
Substantial and significant correlations ( $P<0.01$ ) also existed in both groups between BI and NHP global scores and

**TABLE 2. Nottingham Health Profile Global Scores for Stroke Unit and General Wards Patients**

| NHP Global Score | SU (n=37*) | GW (n=25†) | P      |
|------------------|------------|------------|--------|
| Method A         | 77.7       | 63.1       | 0.0086 |
| Method B         | 78.0       | 63.3       | 0.0092 |

\*Thirty-seven (82.2%) of the surviving patients were assessed in the stroke unit (SU) group.

†Twenty-five (78.1%) of the surviving patients were assessed in the general wards (GW) group.



**Figure 2.** Results of the VAS (mean values) for patients treated in the stroke unit (SU) and patients treated in general wards (GW) before stroke and 5 years after stroke. Both assessments were made 5 years after stroke.

BI and VAS scores, but the correlations were not as strong as the correlation between BI and FAI scores.

Patients from both groups independent in ADL ( $BI \geq 95$ ) had a significantly higher degree of social activities (assessed by the FAI) and a higher global QoL (assessed by a global score of the NHP) than patients dependent in ADL ( $BI < 95$ ; Table 4). In Table 4, only method A is presented for the calculation of a global score of the NHP, because the results between method A and method B were almost identical. Independent patients from both groups had a significantly higher score on the VAS than those who were dependent. The difference was most pronounced for patients in the general wards group (Table 4).

### Discussion

The primary outcomes measures in this trial (NHP and FAI) showed that the stroke unit group had better function in dimensions that are generally accepted as important aspects of QoL. The NHP is often regarded as a measure of general perceived health status,<sup>19</sup> but the profile has been used in several stroke trials as a measurement of QoL.<sup>7,28,29</sup> The reliability and validity are quite high, just as high as on other scales of QoL measurements.<sup>12,19,28,30,31</sup> With significantly fewer problems for the stroke unit group in the domains of energy, emotional reactions, social isolation, physical mobility, and sleep, the results on the NHP strongly indicate a better QoL in that group than in the general wards group. Because of communication problems, approximately 20% of

**TABLE 3. Correlations (Spearman  $\rho$ ) Between the BI and FAI, Methods A and B for Calculation of an NHP Global Score, and a VAS for QoL**

| Barthel Index | Barthel Index | FAI   | NHP      |          |       |
|---------------|---------------|-------|----------|----------|-------|
|               |               |       | Method A | Method B | VAS   |
| SU            | 1             | 0.81† | 0.49*    | 0.48*    | 0.46* |
| GW            | 1             | 0.89† | 0.68†    | 0.64*    | 0.63* |

\* $P<0.01$ ; † $P<0.001$ .

**TABLE 4. Mean and Median Scores on the FAI, NHP Global Score, and VAS for Patients With BI  $\geq$ 95 and for Patients With BI  $<$ 95 in the Stroke Unit and General Wards Groups**

|               | FAI |             | NHP Global Score |             | VAS |             |
|---------------|-----|-------------|------------------|-------------|-----|-------------|
|               | n   | Mean/Median | n                | Mean/Median | n   | Mean/Median |
| Stroke unit   |     |             |                  |             |     |             |
| BI $\geq$ 95  | 26  | 42.1/43.0‡  | 25               | 81.8/84.2*  | 25  | 77.7/79.0*  |
| BI $<$ 95     | 19  | 23.5/22.0   | 12               | 69.3/71.1   | 13  | 64.4/69.0   |
| General wards |     |             |                  |             |     |             |
| BI $\geq$ 95  | 9   | 42.6/43.0‡  | 9                | 77.5/84.2†  | 9   | 64.2/62.0*  |
| BI $<$ 95     | 23  | 21.3/18.0   | 16               | 55.1/51.3   | 19  | 44.3/39.0   |

Patients with BI  $<$ 95 and  $\geq$ 95 were compared within each treatment group; n indicates the number of patients assessed with each scale. (For FAI all surviving patients were assessed; for NHP and VAS, some patients could not be assessed.)

\* $P < 0.05$ ; † $P < 0.001$ ; ‡ $P < 0.001$ .

the patients could not be assessed with the NHP. To obtain information about all patients, we also used the FAI as a measure of primary outcome (the strength of the FAI is that it is possible to assess all the stroke patients).<sup>22</sup> The FAI has often been used in assessment of stroke patients.<sup>12,23,32,33</sup> Although the FAI does not assess as many dimensions of QoL as other scales, the higher FAI scores for stroke unit patients is an indication of a more active social life in that group than in the general wards group (Table 1).

The NHP total score is not validated, and the methods of a global score for QoL may be discussed.<sup>25</sup> Care must be taken when interpreting the results of such a total score, but the global NHP shows the same difference in favor of the stroke unit group as the single dimensions. Such a global score might therefore reflect some type of global assessment of QoL.

The VAS for QoL is an attempt to use the patients' own ratings as a QoL measure. It is a common view that such a single-item QoL measure is, in itself, not very reliable or valid.<sup>12</sup> On the other hand, the patient is probably the best expert to assess his or her own QoL, and some trials have used a VAS for QoL assessment.<sup>16</sup> The VAS results in our trial indicate that the patients' own ratings of QoL were in favor of the stroke unit group.

Previous results from our stroke unit trial have shown that patients treated in the unit had higher BI scores than patients treated in general wards.<sup>9,21</sup> As shown in Table 3, there was a high correlation between the BI and FAI scores. It is difficult for elderly dependent patients to participate in social activities, and other investigators have observed a similar relationship between the BI and FAI.<sup>34</sup> The correlations between the BI and VAS and the BI and global NHP were not as evident, but there was a significant correlation. Other investigators<sup>16</sup> have also shown that such a VAS is influenced by functional performance. Trials in stroke patients that focus on correlations between the BI and a global NHP have not previously been performed.

Table 4 shows that independent patients (BI  $\geq$ 95) had a higher score on the global NHP and the VAS. These results support the results from the correlation analysis and add evidence to the view that independence in ADL is important

for patients and their QoL. Other trials have also shown that patients with dependency or physical disability have lower QoL, as assessed by different QoL scales.<sup>16,28,35</sup> QoL has several dimensions, and there are results which clearly show that patients with a maximum score on the BI may have severe problems with other aspects of QoL.<sup>36</sup> ADL function probably should never be the primary goal in treatment and rehabilitation of stroke patients; from the results of our trial, however, independence in ADL appears to be an important means to a better long-term QoL.

All assessments in this trial were performed by an assessor blinded to the protocol who did not know where the patients had been treated, so we have no reason to believe that the assessments were biased in favor of the stroke unit group. The better outcome in this group was probably a consequence of the initial management in the unit, because the differences in treatment in this trial were limited to the first 6 weeks. The average stay in the stroke unit was 16 days, so it was in fact during these 16 days that the main differences in treatment occurred.

We have carefully examined the information and records about the treatment of every patient. In the period after discharge from hospital and up to 5 years, we found no significant differences in treatment, rehabilitation, medical or psychological support, or follow-up between the two groups.

Therefore, a standardized systematic treatment and rehabilitation program in a stroke unit during the acute stage of stroke seems to improve patients' long-term QoL. Some of the better QoL may be explained by the higher BI scores achieved in the stroke unit group. However, it seems that group differences in QoL are even greater than the differences in BI score. In our stroke unit, we strongly emphasize psychological support; we work closely with all patients to determine their abilities for improvement and to encourage them to return to an active life despite their impairment and disability. With such an approach, we believe that our stroke unit enhances the psychological and social aspects that are important domains of QoL.

Our trial and our experience are from a combined acute and rehabilitation stroke unit in which we have combined some of the elements of acute treatment from an intensive care stroke



unit with elements of a rehabilitation stroke unit.<sup>9,21</sup> In an intensive care unit the important aspects of early rehabilitation may often be reduced or delayed, and in a rehabilitation unit the acute medical aspects will not be present. Thus, our combined model is in our opinion the only one that provides a complete treatment package for acute stroke patients. However, more research is needed to prove that this model is superior to other stroke unit models.

In summary, previous results from our combined acute and rehabilitation stroke unit have shown that this model of stroke unit care improves short- and long-term outcome for stroke patients with regard to functional level, mortality, and institutionalization.<sup>9,21</sup> With the results of the present trial we have for the first time shown that stroke unit care also improves dimensions that are regarded as important for QoL. We conclude that treatment in a combined acute and rehabilitation unit improves long-term QoL compared with treatment in general wards. The results support the evidence of the effectiveness of stroke units, particularly the effectiveness of the combined acute and rehabilitation unit model.

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### References

- Garraway WM, Akthar AJ, Hockey L, Presscott RJ. Management of acute stroke in the elderly: preliminary results of a controlled trial. *BMJ*. 1980; 280:1040-1044.
- Strand T, Asplund K, Eriksson S, Hegg E, Lithner F, Wester PO. A non-intensive stroke unit reduces functional disability and the need for long-term hospitalization. *Stroke*. 1985;16:29-34.
- Stevens RS, Ambler NR, Warren MD. A randomised controlled trial of a stroke rehabilitation ward. *Age Ageing*. 1984;13:65-75.
- Kalra L, Dale P, Crome P. Improving stroke rehabilitation: a controlled study. *Stroke*. 1993;24:1462-1467.
- Kaste M, Palomaki H, Sarna S. Where and how should elderly stroke patients be treated? A randomized trial. *Stroke*. 1995;26:249-253.
- Aitken PD, Rodgers H, French JM, Bates D, James OFW. General medical or geriatric unit care for acute stroke? A controlled trial. *Age Ageing*. 1993;22(suppl 2):4-5.
- Juby LC, Lincoln NB, Berman P. The effect of a stroke rehabilitation unit on functional and psychological outcome: a randomised controlled trial. *Cerebrovasc Dis*. 1996;6:106-110.
- Jørgensen HS, Nakayama H, Raaschou HO, Larsen K, Hubbe P, Skyhøj Olsen T. The effect of a stroke unit: reductions in mortality, discharge rate to nursing home, length of hospital stay, and cost. *Stroke*. 1995;26: 1178-1182.
- Indredavik B, Bakke F, Solberg R, Rokseth R, Håheim LL, Holme I. Benefit of a stroke unit: a randomized controlled trial. *Stroke*. 1991;22: 1026-1031.
- Langhorne P, Williams BO, Gilchrist W, Howie K. Do stroke units save lives? *Lancet*. 1993;342:395-398.
- The Stroke Unit Trialists' Collaboration. Collaborative systematic review of the randomised trials of organised inpatient (stroke unit) care after stroke. *BMJ*. 1997;314:1151-1159.
- de Haan R, Aaronsen N, Limburg M, Langton H, Hoyer R, Van Crevel H. Measuring quality of life in stroke. *Stroke*. 1993;24:320-327.
- Hörnquist JO. The concept quality of life. *Scand J Soc Med*. 1982;10: 57-61.
- Guyatt GH, Jaeschke R. Measurements in clinical trials: choosing the appropriate approach. In: Spiker B, ed. *Quality of Life Assessments in Clinical Trials*. New York, NY: Raven Press Publishers; 1990:37-46.
- Wenger NK, Mattson ME, Furberg CD, Elinson J. Preface to Wenger NK, Mattson ME, Furberg CD, Elinson J, eds. *Assessment of Quality of Life in Clinical Trials of Cardiovascular Therapies*. Washington, DC: Le Hacq; 1984:xi-xv.
- Ahlsjø B, Britton M, Murray V, Theorell T. Disablement and quality of life after stroke. *Stroke*. 1984;15:886-890.
- Aaronsen NK. Quality of life assessments in clinical trials: methodological issues. *Control Clin Trials*. 1989;10:195S-208S.
- Aaronsen NK. Quality of life: What is it? How should it be measured? *Oncology*. 1988;2:69-74.
- Walker SR, Rosser RM, eds. *Quality of Life Assessment: Key Issues in the 1990s*. Dordrecht, Netherlands: Kluwer Academic Publishers; 1993.
- Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md Med J*. 1965;14:61-65.
- Indredavik B, Slørdahl SA, Bakke F, Rokseth R, Håheim LL. Stroke unit treatment: long-term effects. *Stroke*. 1997;28:1861-1866.
- Hunt SM, McKenna SP, McEwen J. The Nottingham Health Profile Users Manual. Rev ed. Manchester, England: Galen Research & Consultancy; 1991.
- Holbrook M, Skilbeck CE. An activities index for use with stroke patients. *Age Ageing*. 1983;12:166-170.
- Thurstone LL. *The Measurement of Values*. Chicago, Ill: University of Chicago Press; 1959.
- O'Brien BJ, Buxton MJ, Ferguson BA. Measuring the effectiveness of heart transplantation programmes: quality of life data and their relationship to survival analysis. *J Chronic Dis*. 1987;40(suppl 1):137S-153S.
- Folstein MF, Luria R. Reliability, validity and clinical application of the visual analogue mood scale. *Psychol Med*. 1973;3:479-486.
- Folstein MF, Maiberger R, McHugh PR. Mood disorder as a specific complication of stroke. *J Neurol Neurosurg Psychiatry*. 1977;40: 1018-1020.
- Ebrahim S, Barer D, Nouri F. Use of the Nottingham Health Profile with patients after a stroke. *J Epidemiol Community Health*. 1986;40:166-169.
- Johansson K, Lindgren I, Widner H, Wiklund I, Johansson BB. Can sensory stimulation improve the functional outcome in stroke patients? *Neurology*. 1993;43:2189-2192.
- Hunt SM, McKenna SP, McEwen J, Backett EM, Williams J, Papp E. A quantitative approach to perceived health status: a validation study. *J Epidemiol Community Health*. 1980;34:281-286.
- Hunt SM, McKenna SP, Williams J. Reliability of a population survey tool for measuring perceived health problems: a study of patients with osteoarthritis. *J Epidemiol Community Health*. 1981;35:297-300.
- Wade DT, Legh-Smith J, Langton H, Hoyer R. Social activities after stroke: measurement and natural history using the Frenchay Activities Index. *Int Rehabil Med*. 1985;7:176-181.
- Wyller TB, Sween U, Bautz Holter E. The Frenchay Activities Index in stroke patients: agreement between scores by patients and by relatives. *Disabil Rehabil*. 1996;18:454-459.
- Wilkinson PR, Wolfe CDA, Warburton FG, Rudd AG, Howard RS, Ross-Russell RW, Beech RR. A long-term follow-up of stroke patients. *Stroke*. 1997;28:507-512.
- Anderson C, Laubscher S, Burns R. Validation of the Short Form 36 (SF-36) Health Survey Questionnaire among stroke patients. *Stroke*. 1996;27:1812-1816.
- Duncan PW, Samsa GP, Weinberger M, Goldstein LB, Bonito A, Witter DM, Enarson C, Matchar D. Health status of individuals with mild stroke. *Stroke*. 1997;28:740-745.