Taylor &Francis
health**sciences**

THE NORTHWICK PARK DEPENDENCY SCORE AND ITS RELATIONSHIP TO NURSING HOURS IN NEUROLOGICAL REHABILITATION

Alison Hatfield,[1] Sue Hunt[2] and Derick T. Wade[2]

From the [1]Disablement Services Centre, St Mary's Hospital, Portsmouth and [2]Oxford Centre for Enablement, Oxford, UK

Objective: To evaluate the reliability and validity of the Northwick Park Dependency Score as a measure of nursing dependency.
Subjects: Inpatients in a specialist neurological rehabilitation unit.
Methods: The Northwick Park Dependency Score was measured by 2 assessors and compared with nursing hours. The Barthel ADL Index and the Short Orientation Memory and Concentration test were also compared with the Northwick Park Dependency Score. Time to score the Barthel ADL Index and Northwick Park Dependency Score was recorded. Statistical analysis was carried out using Spearman's Rank Correlation Coefficient.
Results: There was a high correlation between the Northwick Park Dependency Score total scores of the 2 observers (rho = 0.80, $p < 0.005$) and a correlation of rho = 0.87 between the Northwick Park Dependency Score total score and nursing time. There was a high negative correlation between the Northwick Park Dependency Score and the Barthel ADL Index.
Conclusion: The Northwick Park Dependency Score is a valid and reliable way to assess nursing dependency. However, total scores can obscure relevant detail and individual raters differ. The Barthel ADL Index is equally related to nursing dependency.

Key words: Northwick Park Dependency Score, dependency, nursing hours, rehabilitation.

J Rehabil Med 2003; 35: 116–120

Correspondence address: Alison Hatfield, Disablement Services Centre, St Mary's Hospital, Milton Road, Portsmouth PO3 6BR, UK. E-mail: Alison.Hatfield@qmail01.porthosp.swest.nhs.uk

INTRODUCTION

The Northwick Park Dependency Score (NPDS) (1) has been developed as a measure of nursing dependency and, with a set of additional questions (the Northwick Park Care Needs assessment), the assessment of care needs in the community (2). Other measures of dependency exist, such as the Barthel ADL Index (BI) (3) and the Functional Independence Measure (FIM) (4) which also relate to nursing times (5, 6). However, some heavily dependent patients score below the floor of these scales and the NPDS was devised to give a better measure, especially of highly dependent patients with neurological damage.

The NPDS is an ordinal scale. It has a Basic Care Needs (BCN) section with 16 items (maximum score for each ranging between 3 and 5) which summates to a maximum score of 65 and a Special Nursing Needs section with 7 items either scoring 0 or 5. Inter-rater and intra-rater reliability and validity has been evaluated by testing 23 inpatients at a regional rehabilitation unit using 5 senior nurses (1). Inter-rater reliability for the final version 6 was found to be 0.91 for the BCN score and 0.90 for the total NPDS. Intra-rater reliability for the BCN was 0.95 and 0.93 for NPDS. There was a correlation of -0.91 between the BCN section of the NPDS (version 5) and the BI. The Northwick Park Care Needs Assessment has been found to be sensitive to change during rehabilitation and to give a good estimate of care needs in the community (7).

The reliability and validity of the NPDS should be tested using more patients, different raters and in different settings. One such study has found little advantage over the BI in a stroke unit (8). This study investigates reliability and validity (as a measure of nursing input) in another specialist rehabilitation centre. It also assesses utility through measuring the time taken to collect data. The NPDS has been reported to take between 3 and 5 minutes to score depending on the familiarity of the scorer with the patient and the instrument (1).

We aimed to study the validity and reliability of the NPDS as a measure of nursing dependency in a specialist neurological rehabilitation unit, and also to attempt to establish the nature of the link between dependency and cognitive function by comparing the NDPS with an established screening test of cognitive function, the Short Orientation Memory and Concentration Test (SOMC) (9). This is a 7-item questionnaire testing orientation by asking year, month, time of day; concentration by asking the patient to count backwards from 20 to 1 and reciting the months of the year in reverse order; and memory by immediate and delayed recall of a name and address. It is scored positively, subtracting from maximum (for item) for each error. It gives a score of 0–28, with a higher score indicating better cognitive function.

METHODS

The subjects were inpatients in a specialist neurological rehabilitation unit that takes tertiary referrals from many other counties but also provides the acute neurological rehabilitation service to the local population. Patients who have experienced an acute deterioration with any neurological diagnosis are considered for rehabilitation. Details of age, sex and primary diagnosis were recorded. There are 4 parts to this

study with different patient samples. Some patients are in more than one of the samples.

Inter-rater reliability of the NPDS

A senior nurse and a doctor obtained NPDS scores on 22 in-patients (15 men and 7 women) within 7 days of each other by recording the responses to the questions from any of the nurses who were on the patient's nursing team and knew the patient well. Individual nurses did not do the scoring as they were not sufficiently familiar with the scoring system. The age range of this group was 20–69 years, mean (SD) 45.60 (15.30) years; diagnostic categories were 10 head injuries and 11 strokes (7 infarcts, 2 intracerebral haemorrhages, 2 subarachnoid haemorrhages) and 1 patient with cerebral palsy. The mean time between onset of brain injury and admission to the specialist rehabilitation unit for 21 of these patients was 32 weeks, with a range of 7–94 weeks. (The patient with cerebral palsy was not included in this calculation as there was no new neurological lesion.) The 2 raters were blinded to the other's results for the duration of data collection.

Validity—comparison of the NPDS and BI with nursing hours

A senior nurse collected NPDS scores as for the inter-rater reliability study. Nursing hours required in a 24-hour period were recorded by nursing teams for 12 patients (6 men and 6 women) within 7 days of NPDS scores. BI scores were collected at the weekly multidisciplinary meeting. All scores on individual patients were done within 8 days of each other. The mean (SD) age of this group of patients was 45.33 (17.15) years, range 20–69 years. The diagnostic categories comprised 5 with head injury, 5 stroke, 1 with complications arising following meningioma resection and 1 with cerebral palsy.

Validity—comparison of admission NPDS with BI and SOMC

The total NPDS was compared with the BI and SOMC in 20 patients. The BCN was also compared with the BI. This group comprised 11 patients with stroke, 7 with head injury, 1 with cerebral palsy and 1 with residual impairments following resection of a meningioma. The age range of this group of patients was 20–62 years, mean (SD) 41.20 (15.29) years. NPDS scores collected by the senior nurse only were used for this part of the study. The BI score and SOMC score were recorded by the admitting doctor within 7 days of the NPDS score. Patients were scored within the first week of admission and information was collected from the multidisciplinary team for the BI score.

Clinical utility

The time taken to collect individual NPDS scores, when interviewing nurses, and to collect BI scores at the multidisciplinary meeting on 14 patients was recorded by the doctor. The total time for the senior nurse to score all 20 patients on the ward was recorded.

Statistical analysis

Correlation between scores was evaluated using the Spearman Rank Correlation Coefficient. Percentage absolute agreement and agreement
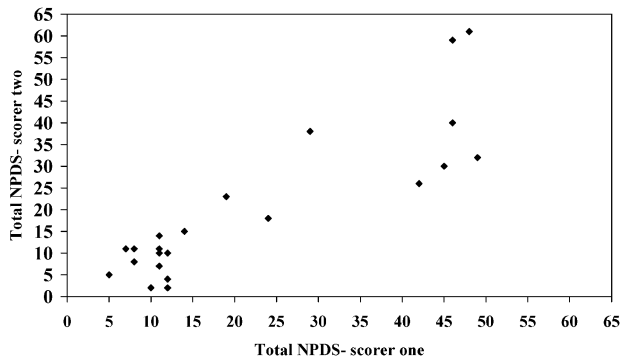

Fig. 1. Correlation between 2 scorers calculating total Northwick Park Dependency Score (NPDS) scores.

Table I. *Inter-rater reliability of the total Northwick Park Dependency Score (NPDS) and Basic Care Needs (BCN)*

Score measured	Rater 1	Rater 2
NPDS (mean (SD))	21.80 (15.70)	19.70 (16.70)
Range	5–49	2–61
Correlation between raters 1 and 2:	0.80 (p < 0.005)	
t value	1.00 (0.5 > p > 0.1)	
BCN (mean (SD))	15.00 (14.80)	13.70 (13.90)
Range	0–40	0–44
Correlation between raters 1 and 2:	0.92 (p < 0.005)	
t value	0.91 (0.5 > p > 0.1)	

±1 point, on the inter-rater reliability study, was calculated for individual items of the BCN and Special Nursing Needs sections. The scores were also plotted on graphs. The significance of the difference between the means of the 2 sets of BCN scores was evaluated using Student's t test (10) to determine whether there was any difference in the 2 sets of scores for the inter-rater reliability study.

RESULTS

Inter-rater reliability of the NPDS

The statistical analysis for this study is illustrated in Table I for the 2 raters. There was absolute agreement for the 2 raters in total NPDS scores on only 3 out of 22 patients. The maximum difference between scores was 17. There was a high correlation between the 2 raters on total NPDS (Fig. 1).

There was complete agreement in 4 of the BCN scores, with a maximum difference of 17. The mean of the differences of BCN scores is 1.27 (SD 6.55). The 95% confidence interval of the difference for *t* with 21 degrees of freedom at $p = 0.005$ is −12.35 to 14.89. Although there is no evidence of bias, the confidence intervals are so wide that it cannot be concluded that the 2 observations are equivalent and a larger study should therefore be considered.

The correlation was much lower for Special Nursing Needs (rho = 0.477). The percentage absolute agreement for individual items of BCN ranged from 55 to 95% and agreement ±1 point from 82 to 100%. The items with least total agreement were communication and safety awareness. For the Special Nursing Needs section percentage absolute agreement was 73–100% with worst agreement for psychological support. The percentage absolute and ±1 point agreement is shown in Table II.

Comparison of NPDS and BI with nursing time

The mean nursing time for each patient was 214 minutes per 24 hours (i.e. more than 3.5 hours; thus this is a highly dependent group of patients (Table III). The correlation between nursing time, total NPDS and the BCN section is shown in Fig. 2.

A negative correlation between nursing time and BI was found, as expected (rho = –0.82, $p < 0.005$) (Fig. 3).

Comparison of NPDS, BI and SOMC

Data on mean, range and standard deviation for this part of the

Table II. *Inter-rater agreement of the Northwick Park Dependency Score (NPDS): item by item analysis for a total of 22 patients*

Item	Absolute agreement no. (%)	±1 point agreement no. (%)
Mobility	15 (68)	18 (82)
Bed transfers	18 (82)	21 (95)
Bladder	21 (95)	21 (95)
Urinary incontinence	18 (82)	22 (100)
Bowels	18 (82)	19 (86)
Faecal incontinence	18 (82)	20 (91)
Washing/grooming	18 (82)	19 (86)
Bathing/showering	13 (59)	20 (91)
Dressing	15 (68)	19 (86)
Eating	13 (59)	22 (100)
Drinking	16 (73)	22 (100)
Enteral feeding	21 (95)	21 (95)
Skin pressure relief	18 (82)	19 (86)
Safety awareness	12 (55)	21 (95)
Communication	12 (55)	19 (86)
Behaviour	14 (64)	18 (82)
Total Basic Care Needs	4 (18)	9 (41)
Tracheostomy	22 (100)	
Wound/sore & dressings	20 (91)	
3+ night interventions	19 (86)	
Psychological support	16 (73)	
Isolation (MRSA)	21 (95)	
Intercurrent medical problem	19 (86)	
Needs one to one specialing	22 (100)	
Total for special care	12 (55)	
Total NPDS	3 (14)	

MRSA = multi-resistant *Staphylococcus aureus*.

Table III. *Comparison of Northwick Park Dependency Score (NPDS), Basic Care Needs (BCN) and Barthel Index (BI) with nursing time* (n = 12)

Score measured	Mean (SD)	Range	Correlation with nursing time
NPDS	34.75 (17.64)	9–62	0.87 $p < 0.005$
BCN	25.58 (16.00)	4–52	0.88 $p < 0.005$
BI	8.42 (5.81)	0–16	−0.82 $p < 0.005$
Nursing time (min/24 h)	214.38 (162.66)	35–498.5	

2 patients who were unable to score on the SOMC predominantly because of aphasia who were less dependent with BCN 8, 22 and NPDS 13, 27.

Clinical utility

The time to score the NPDS by the doctor interviewing nursing staff ranged from 2 minutes 24 seconds to 7 minutes 31 seconds, mean 4 minutes 42 seconds on 14 patients. The mean NPDS in this group of patients was 24.50, range 10–59. Time to score BI on the same patients in the multidisciplinary meeting ranged from 35 to 115 seconds, mean 68 seconds. The mean BI was 10.21, range 0–20. The senior nurse recorded scores for all patients, on the NPDS, usually at one sitting and approximately 1 hour 45 minutes was required to score 20 patients (average 5 minutes 15 seconds per patient). It took longer to score new patients or patients with whom she was not familiar.

study are shown in Table IV. There was a negative correlation between the BI and the NPDS of −0.89 ($p < 0.005$) and between the BI and BCN of −0.95 ($p < 0.005$). There was a weak non-significant correlation between the SOMC and total NPDS: rho = −0.34. The weakness of the relationship is illustrated by reviewing the scores on 4 patients who had an SOMC of 0. These included 2 who had very severe cognitive problems who had high dependency scores: BCN 52, 58 and NPDS 58, 67 and

DISCUSSION

This study provides further information about the NPDS from a separate unit. High inter-rater reliability was found on the total NPDS score. However, there were significant differences found on individual items. Minor differences could be accounted for by a variable amount of assistance being provided by nursing staff. The information given by individual nurses to the scorer
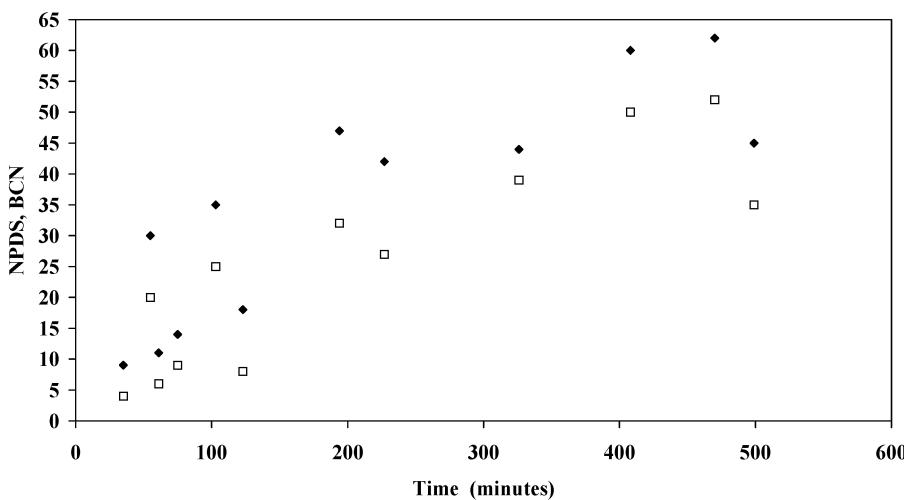

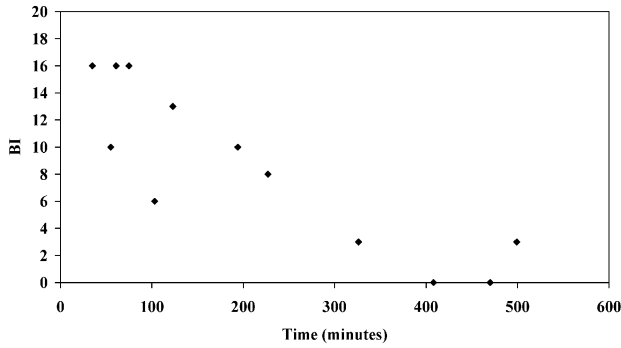Fig. 2. Northwick Park Dependency Score (NPDS) (◆) and Basic Care Needs (□) compared with nursing time.

Fig. 3. Barthel Index (BI) compared with nursing time.

can be affected by their attitudes, culture, training, experience and their perception of patients' abilities. Larger variations seemed to reflect different interpretations of the scoring methods and different knowledge of the patient by the nurse questioned and the scorer who may have influenced the nursing discussion.

Another source of error was a patient being scored for what was done in a therapy session rather than on the ward. Grooming was sometimes rated incorrectly as it was confused with bathing/showering. Two patients were scored differently on having an intercurrent medical problem because the situation had changed over a time interval of 2 days. The largest discrepancy of 17 was because 1 member of staff was not aware of significant improvements in independence that had occurred.

One scorer timed the recording of NPDS scores and although she advised nursing staff that this was not to test them this may have had an influence on the amount of discussion occurring to obtain scores. The senior nurse considered that most patients on the unit, given the complexity of their problems, required psychological support and therefore scored 5 for this on the special needs section.

The correlations between nursing time and NPDS and BI were high and similar. Times were recorded by some nursing staff to the nearest half minute but in practice it is likely to be difficult to record that accurately. It is of note that some patients who have a high physical dependency may have an extremely high dependency in terms of the time required because of impaired but definite ability to communicate and good cognitive function.

The correlation between the NPDS and BI was high but higher for the BCN and BI which would be expected as the BI does not attempt to address special needs. Validity of the BCN section is

Table IV. *Mean, range and standard deviation of Northwick Park Dependency Score (NPDS), Basic Care Needs (BCN), Barthel Index (BI) and Short Orientation Memory Concentration test (SOMC) scores* (n = 20)

Score measured	Mean (SD)	Range
NPDS	30.90 (17.42)	5–67
BCN	21.20 (10.90)	0–52
BI	10.45 (6.53)	0–20
SOMC	14.55 (9.74)	0–28

demonstrated when compared with the BI which has been shown to correlate with dependency. There was a low non-significant correlation between NPDS and SOMC. Cognitive function influences the level of support required but is much more difficult to quantify than basic care.

In our unit the NPDS has proved a valuable tool in the assessment of nursing dependency in the neurological inpatient rehabilitation setting. The score has been used in this unit to allocate patients to give approximately the same total dependency to the 2 nursing teams. However, it is only an aid to the user who also relies heavily on experience in management of case mix of dependent patients. Furthermore the evidence from this and other studies (3, 11, 12) would suggest that the BI may be just as accurate in predicting nursing time required, even in this highly dependent group of patients. Although the NPDS was designed to score below the floor of the BI for the heavily dependent patients the correlations with nursing time were still similar.

This study is limited by the small number of patients particularly when correlation with nursing hours was examined. It would have been clearer if the same patients had been used in all subgroups of the study but this was not possible within the day to day work and patients being admitted and discharged. Comparison of scores needed to be done within a suitable timeframe and if this was not achieved scores had to be discarded. By using 4 patient samples this maximized the numbers available for study. Results should be interpreted using the demographic data described.

Further development or refinement of the scoring system of the NPDS may be useful in improving its accuracy for scoring dependency. We have noted problems in scoring several items. There is no mobility option for "walks with 2 members of staff". In the category "toileting – bladder" having an indwelling catheter or convene scores 1 point. This suggests that nursing dependency and time required are reduced. In reality this may not be the case as bladder washouts and catheter care may be required. Safety awareness, communication and behaviour were often considered difficult to score.

Supervision when eating can be achieved from a distance and more than 1 person can be supervised at the same time, whereas feeding a patient means that a nurse is being utilized for 1 task only. Patient feeding has previously been reported to be very time consuming (13).

In the skin pressure relief item the term "turn" confused staff as they related it to patients who are in bed and require turning. There is no mention of those sitting in wheelchairs and how much assistance they require for skin pressure relief. There is also no mention of air mattresses or wheelchair cushions, which will have an impact on skin pressure relief.

CONCLUSION

The Northwick Park Dependency Scale (NPDS) is a reasonably valid and reliable measure of nursing dependency in a rehabilitation unit. However the Barthel ADL index (BI) is probably

as accurate (or inaccurate). Some patients will always be "outliers". Instructions on some items of the NPDS could be clarified.

REFERENCES

1. Turner-Stokes L, Tonge P, Nyein K, Hunter M, Nielson S, Robinson I. The Northwick Park Dependency Score (NPDS): a measure of nursing dependency in rehabilitation. Clin Rehabil 1998; 12: 304–318.
2. Turner-Stokes L, Nyein K, Halliwell D. The Northwick Park Care Needs Assessment (NPCNA): a directly costable outcome measure in rehabilitation. Clin Rehabil 1999; 13: 253–267.
3. al-Khawaja I, Wade D, Turner F. The BI and its relationship to nursing dependency in rehabilitation. Clin Rehabil 1997; 11: 335–337.
4. Granger CV, Cotter AC, Hamilton BB, Fiedler RC, Hens MM. Functional assessment scales: a study of persons with multiple sclerosis. Arch Phys Med Rehabil 1990; 71: 870–875.
5. Heinemann AW, Kirk P, Hastie BA, Semik P, Hamilton BB, Linacre JM, et al. Relationships between disability measures and nursing effort during medical rehabilitation for patients with traumatic brain and spinal cord injury. Arch Phys Med Rehabil 1997; 78 : 143–149.
6. Disler PB, Roy CW, Smith BP. Predicting hours of care needed. Arch Phys Med Rehabil 1993; 74: 139–43.
7. Nyein K, Turner-Stokes L, Robinson I. The Northwick Park Care Needs Assessment: sensitivity to change during rehabilitation. Clin Rehabil 1999; 13: 482–491.
8. Post MWM, Visser-Meily JMA, Gispen LSF. Measuring nursing needs of stroke patients in clinical rehabilitation: a comparison of validity and sensitivity to change between the Northwick Park Dependency score and the Barthel Index. Clin Rehabil 2002; 16: 182–189.
9. Wade DT, Vergis E. The Short Orientation-Memory-Concentration Test: a study of its reliability and validity. Clin Rehabil 1999; 13: 164–170.
10. Swinscow TDV. Statistics at Square One, Chapter 7: The *t* tests. (1987). London: British Medical Association.
11. Stone SP, Ali B, Auberleek I, Thompsell A, Young A. The Barthel Index in clinical practice: use on a rehabilitation ward for elderly people. Journal of the Royal College of Physicians of London 1994; 28: 419–423.
12. Fortinsky RH, Granger CV, Seltzer GB. The use of functional assessment in understanding home care needs. Medical Care 1981; 19: 489–497.
13. Stride NM. An investigation of the dependence of severely disabled people in a hospital. J Adv Nurs 1988; 13: 556–564.