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The criterion-related validity of the Northwick Park Dependency Score as a generic nursing dependency instrument for different rehabilitation patient groups

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Objective: To investigate the criterion or concurrent validity of the Northwick Park Dependency Score (NPDS) for determining nursing dependence in different rehabilitation groups, with the Barthel Index (BI) and the Care Dependency Scale (CDS).

Design: Cross-sectional study.

Setting: Centre for Rehabilitation of the University Medical Center Groningen, The Netherlands.

Subjects: Patients after stroke, spinal cord injury, multitrauma, head injury, amputation, rheumatoid arthritis, diabetes mellitus, lung diseases, tuberculosis and coronary artery disease. One hundred and fifty-four patients were included.

Measures: The Northwick Park Dependency Score (NPDS), the Barthel Index (BI) and the Care Dependency Scale (CDS).

Results: The correlation (ρ) between the NPDS and the BI for all groups was -0.87 ; $R^2 = 0.76$ ($n = 154$). Per patient group ρ varied from -0.70 ($R^2 = 0.49$) to -0.93 ($R^2 = 0.86$). The overall correlation between the NPDS and CDS was larger than the criterion of $\rho = 0.60$ ($r = -0.74$; $R^2 = 0.55$) but was < 0.60 in the rheumatoid arthritis and tuberculosis group. The overall correlation between BI and CDS exceeded the criterion ($r = 0.75$; $R^2 = 0.56$).

Conclusions: The NPDS is a generic nursing dependency instrument that can be used as a valid measure across various patient groups in rehabilitation.

Introduction

Care dependency scales provide data that can be used to determine quality management, to describe the cost of nursing care, and as a management tool for personal planning.^{1–3} These dependency scales were developed for both acute and chronic care settings.^{4,5} However, none of these instruments

include more specific rehabilitation nursing needs, such as time taken to supervise and encourage patients to take care of themselves.^{3,6} A more rehabilitation-specific nursing dependence scale was developed by Turner-Stokes and colleagues: the Northwick Park Dependency Score (NPDS). The NPDS was designed for application in neurological rehabilitation³ and its validity was tested in patient groups with severe and complex disability arising from brain injury or stroke.^{2,6,7} However, a rehabilitation centre not only cares for neurological patients. Therefore, a generic rehabilitation nursing dependency instrument

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may be relevant for other patient populations in rehabilitation. Although we could not locate studies in which the criterion validity or concurrent validity of the NPDS for other disease groups was examined, the NPDS has sufficient psychometric qualities.^{3,7,8} The Barthel Index (BI) is known as a valid, reliable and simple measure of activities of daily living (ADL)^{3,9,10} and is a widely used and accepted measure of ADL. The Care Dependency Scale (CDS) provides a framework for assessing the care dependency status of institutionalized patients and comprises 15 basic needs.^{11–13} The CDS has good psychometric properties.^{12–17} In the current study the BI was used as the reference measure or external criterion for the NPDS and CDS.^{3,13}

The purpose of the present study was to determine the performance of the NPDS as a measure of nursing dependency across different rehabilitation patient groups. In order to test the concurrent or criterion validity of the NPDS, the following hypotheses were tested:

- 1) In the total sample and in disease groups, the correlation between the NPDS and the BI exceeds the generally accepted criterion¹⁸ of $r \geq 0.60$.
- 2) In the total sample and in disease groups, the correlation between the NPDS and the CDS exceeds the general criterion of $r \geq 0.60$.

Methods

The current study was performed at the Department of Rehabilitation of the University Medical Centre Groningen (UMCG) in a multicentre study with the Medical Centre Leeuwarden in the Netherlands. At the UMCG, patients are treated after stroke, spinal cord injury, multiple trauma, head injury and amputation. Apart from these rehabilitation patient groups, there is also rehabilitation treatment for the chronically ill, for example patients suffering from rheumatoid arthritis, diabetes mellitus, lung disease, tuberculosis and coronary artery disease.

The design of the study is cross-sectional. Ethical approval was obtained from the local

research ethics committee of the Medical Centre Leeuwarden. In line with this approval, permission was obtained from the health care authorities of the UMCG.¹³

A quota sampling method was applied and patients were randomly selected and assessed after informed consent: within each stratum (wards) a quota of 10 eligible patients were selected from the hospital database and randomly assigned to the raters during one week. If the length of stay had not been long enough to give the co-ordinating nurse the opportunity to become thoroughly conversant with a patient's health status, that patient was not included. This sampling procedure was performed three times to obtain a reasonable sample size: in week 23, week 29 and week 35 of 2004. The co-ordinating nurse was informed about the study and raters were trained in using the scales.

Northwick Park Dependency Score (NPDS)

The NPDS consists of two domains of needs, namely the 'Basic care needs' (BCN) and the 'Special nursing needs' (SNN). The BCN section reflects information needed to predict care needs and is therefore mainly determined by the number of helpers needed (at the level of supervision or physical help) and by the time taken to complete each task. The BCN consists of 16 items. The scale of each item varies between 3 and 5 depending on the number of possibilities (for example, washing and grooming may require two helpers while drinking requires only one) which summates to a maximum of 65. The SNN section comprises seven items reflecting needs for nursing care specific to the therapeutic environment and each item is associated with a substantial workload. Items are assessed as dichotomous variables with a score of either 0 or 5 with a maximum score of 35.⁶ The total composite NPDS score ranges between 0 and 100.

Barthel Index (BI)

The 10-item BI contains the following questions concerning dependency in ADL: feeding, moving from wheelchair to bed and returning, personal hygiene, getting on and off toilet, bathing self, walking, ascending and descending stairs, dressing and controlling bowels and bladder.¹⁹ The BI is sensitive enough to detect treatment-related

change^{3,20} and has been widely used and tested in a broad range of chronically ill patient groups. Therefore the BI is used as a reference measure for other ADL measures and as the benchmark for evaluating new ADL rating scales.^{3,13} The total composite BI score ranges between 0 and 20.

Care Dependency Scale

The Care Dependency Scale (CDS) is originally a Dutch scale. It has been used internationally and its psychometric properties have been evaluated in several studies.¹²⁻¹⁷ Originally this scale was developed in geriatric and mentally disabled care, but there is also a hospital version of the instrument, which was used in this study. This version contains 15 items: eating and drinking, incontinence, body posture, mobility, day and night pattern, getting dressed and undressed, body temperature, hygiene, avoidance of danger, communication, contact with others, sense of rules and values, daily activities, recreational activities, learning activities. Scores range from 15 to 75 and higher scores indicate a higher level of care dependency. Statistical analysis was performed using SPSS version 12.0.1.²¹

The criterion-related validity of the NPDS was studied within each patient group by linear associations (Spearman's correlation coefficient ρ for associations with the ordinal NPDS and Pearson's r for interval scales) and linearly explained variance R^2 between the NPDS and two other validated care dependency measures, namely the BI^{9,19,22} and the CDS.¹³ Correlation coefficients ≥ 0.60 are considered to be high in this study.¹⁸

Results

The study sample was composed of 154 patients with the following diagnoses: stroke ($N=29$), diabetes mellitus ($N=12$), head injury ($N=8$), amputation ($N=11$), spinal cord injury ($N=17$), multitrauma ($N=9$), lung diseases ($N=21$), rheumatoid arthritis ($N=20$), tuberculosis ($N=19$) and coronary artery disease ($N=8$). The study included 82 women with a mean age of 61 years (SD 16, range 23-90) and 72 men with a mean age of 54 years (SD 17, range 20-84). Table 1 shows the number of patients that were included across disease groups and the overall results on the NPDS, BI and CDS. The mean scores of the NPDS ranged from 5.9 to 26.9, means of the BI ranged from 7.3 to 17.6 and the CDS from 53.8 to 76.9. The mean scores on the NPDS, BI and CDS scales among the complete sample ($N=154$) were 13.6, 14.1 and 62.8, respectively.

Hypotheses 1 and 2 were addressed by determining the correlation between the NPDS and both the BI and CDS. Table 2 shows the results per disease group and the overall sample's correlation. The overall correlation between the NPDS and the BI for the total sample exceeded the criterion of $\rho=0.60$ ($\rho_{\text{NPDS-BI}} = -0.87$; $R^2=0.76$). Within each of the disease groups $\rho_{\text{NPDS-BI}}$ varied from -0.93 ($R^2=0.86$) to -0.70 ($R^2=0.49$) and exceeded the criterion. The overall correlation between the NPDS and CDS was larger than the criterion ($\rho = -0.74$; $R^2=0.55$). Except for the rheumatoid arthritis and tuberculosis patients ρ exceeded the criterion of

Table 1 Number of patients per disease, mean scores and standard deviations (SD) of the NPDS, BI and CDS

Disease	N	NPDS Mean (SD)	BI Mean (SD)	CDS Mean (SD)
Stroke	29	13.7 (10.7)	14.3 (4.9)	59.8 (12.8)
Diabetes mellitus	12	5.9 (8.5)	16.9 (4.8)	70.0 (10.2)
Head injury	8	20.0 (8.6)	12.0 (5.3)	55.9 (8.0)
Amputation	11	8.6 (7.5)	15.8 (3.4)	76.2 (5.4)
Spinal cord injury	17	26.9 (13.1)	7.3 (4.9)	53.8 (11.1)
Lung diseases	21	6.9 (6.9)	16.8 (4.1)	65.9 (9.9)
Rheumatoid arthritis	20	18.3 (8.6)	11.8 (4.2)	59.2 (10.8)
Tuberculosis	19	9.8 (9.7)	16.8 (4.1)	62.4 (9.2)
Heart diseases	8	9.2 (4.9)	17.6 (2.0)	76.9 (3.0)
Multitrauma	9	16.1 (8.5)	11.9 (5.3)	58.9 (9.9)
Total	154	13.6 (11.1)	14.1 (5.3)	62.8 (11.9)

NPDS, Northwick Park Dependency Score; BI, Barthel Index; CDS, Care Dependency Scale.

0.60. Furthermore, the overall correlation between BI and CDS exceeded the criterion of 0.60 ($r = 0.75$; $R^2 = 0.56$); however, only in the head injury group was the correlation between the BI and CDS below $r \geq 0.60$.

Discussion

Although this study provides evidence for the criterion validity of the NPDS, there were disease groups that did not confirm the criterion of $r = 0.60$. The correlations of the NPDS with the BI and CDS were high in this study and, consequently, the percentage of explained variances (R^2) was also high. The use of R^2 was preferred since the fact that the coefficient r does not deviate from zero due to chance fluctuation in this study was appraised as irrelevant information although all correlation coefficients were statistically significant. In three subgroups of patients the criterion of $r = 0.60$ was not confirmed: in the rheumatoid arthritis group the correlation between the NPDS and the CDS was too low, and in the head injury patients the correlation between the BI and the CDS did not exceed the criterion. We have calculated the mean groups correlation for NPDS–BI, NPDS–CDS and BI–CDS and these coefficients were 0.81, 0.75 and 0.72, respectively. We may conclude that the mean correlations of

the NPDS with BI and CDS were higher than the correlation between BI and CDS. The percentage of explained variance of NPDS–BI is significantly higher ($R^2 = 0.66$) compared with the other linear association between NPDS–CDS ($R^2 = 0.56$).

The analysis with subgroups with small sample sizes in this study (with a number of observations ranging from 8 to 12) may have affected the results due to low statistical power. Considering the more diverse patient groups and the larger number of patients, the results of this study are comparable with the results from Post *et al.*³ It may be interesting to investigate which disease-specific aspects of care are associated with nursing care dependency, for example, the more educational or counselling aspects of care.

However, other studies with small samples yielded identical results when compared with the current study.⁸ A Dutch study among 91 stroke patients yielded a correlation of -0.92 between the NPDS and the BI. In the current study, similar results are shown with a correlation of -0.87 , among 29 stroke patients as well as among the total sample of 154 patients from 10 different patient groups.³ The fact that the NPDS was validated in neurological rehabilitation and used in this study among other disease groups may have affected the reliability and validity of the measure's outcome. However, the NPDS scores were associated with the BI – the most valid

Table 2 Correlation coefficients r (ho) per disease group between the measures (NPDS–BI, NPDS–CDS, BI–CDS) with percentage explained variance (R^2).

Disease	NPDS–BI		NPDS–CDS		BI–CDS	
	ρ	R^2	ρ	R^2	r	R^2
Stroke	–0.87	0.76	–0.75	0.56	0.81	0.66
Diabetes mellitus	–0.93	0.86	–0.89	0.79	0.69	0.48
Head injury	–0.74	0.55	–0.60	0.36	0.53	0.28
Amputation	–0.81	0.66	–0.81	0.66	0.68	0.46
Spinal cord injury	–0.86	0.74	–0.80	0.64	0.76	0.58
Lung diseases	–0.87	0.76	–0.84	0.71	0.76	0.58
Rheumatoid arthritis	–0.70	0.49	–0.59	0.35	0.87	0.76
Tuberculosis	–0.76	0.58	–0.52	0.27	0.66	0.44
Heart diseases	–0.70	0.49	–0.87	0.76	0.74	0.55
Multitrauma	–0.79	0.62	–0.89	0.79	0.75	0.56
Total	–0.87	0.76	–0.74	0.55	0.75	0.56

NPDS, Northwick Park Dependency Score; BI, Barthel Index; CDS, Care Dependency Scale.

Clinical messages

- The Northwick Park Dependency Score can be used as a generic care dependency instrument for various rehabilitation patient groups.
- The Barthel ADL index gives the same information in its total score, although the detail from individual items may be less.

criterion – which indicates sufficient evidence for the criterion or concurrent validity of the NPDS. Furthermore, with the NPDS and the concurrent measures (BI and CDS) statistically significant differences were consistently detected between spinal cord and other disease groups and between the lung diseases and rheumatoid arthritis patient groups. These differences were consistently associated with large or medium effect sizes as indicators of clinically relevant differences.

As in earlier studies concerning the NPDS,^{3,6} the correlation between the NPDS and the BI was high and therefore it may be questioned whether the outcome of the BI discriminates from that of the NPDS, and is not a less time-consuming instrument than the NPDS. In other words, what is the added value of the NPDS? Nurses in the Post *et al.* study found the NPDS more comprehensive than the BI. They came to the conclusion that the NPDS gave more insight into the nature of the care that is provided. In relation to the practice of rehabilitation nursing care, it can also be argued that the more specific NPDS questionnaire makes clear which aspect of care takes up the most time and personnel. Through this knowledge, managers are able to analyse these specific aspects of care and can choose to intervene by investigating the efficiency of the care that is given and whether more or fewer personnel are needed.

This study obviously has some limitations. Selection bias may have affected the results as the patients, although randomly selected, were included when their period of stay was sufficiently long to give the nurses an accurate and complete overview of their health status. Furthermore, a more serious threat to the internal validity of this study may be that the assessment of patients with

the NPDS, BI and CDS was performed by the same health professional. Finally, the disease groups have small numbers of patients and are recruited from the UMCG and the Medical Centre Leeuwarden, which may not be representative for all rehabilitation patients in the Netherlands. On the other hand, the results of this study show generally consistent results for all patient groups, which may be an important indicator of the validity of the NPDS. Finally, this study shows that the NPDS is a general care dependency instrument based on its criterion validity that may be used across several patient groups in rehabilitation clinics. The results of this study indicate that the NPDS measures what it purports to measure.

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