Original Article

A psychometric analysis of the Needs Assessment Checklist (NAC)

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Design: Consecutive series, psychometric validation study.

Objective: To evaluate the psychometric reliability and validity of a clinically focused measure of rehabilitation outcome, known as the Needs Assessment Checklist (NAC).

Setting: Tertiary care, spinal cord injury centre (National Spinal Injuries Centre), Stoke Mandeville Hospital, UK.

Participants: In total, 43 spinal cord injured (SCI) in-patients (38 male and five female). During this study all patients actively participated in a comprehensive, multidisciplinary Goal Planning and Needs Assessment Rehabilitation Programme.

Intervention: Test–retest and concurrent assessment, conducted in one administration, within a week of routine clinical assessment. Reliability analyses were performed examining the NAC's internal consistency, test–retest reliability, and concurrent validity.

Main outcome measures: The NAC is a rehabilitation outcome measure, specifically developed for the SCI population, which is used to assess patient attainment in core rehabilitation areas at mobilisation and prior to discharge. The Spinal Cord Independence Measure (SCIM) and Hospital Anxiety and Depression Scale (HADS) were also employed as comparable benchmark assessment measures with established psychometric properties. Patient comments were gained during this administration, rating the NAC with regard to its usefulness, clarity, and personal relevance.

Results: Reliability analyses yielded high internal consistency coefficients (mean $\alpha = 0.8587$, $SD = 0.918$). All subscales performed above the specified level (0.7). The mean item-internal validity correlation for NAC subscales was 0.5921 ($SD = 0.1411$). Test–retest correlations ranged between 0.694 (Bladder Management) and 0.904 (Skin Management) ($P \leq 0.01$). The mean percentage of agreement between clinical and test–retest assessment over all NAC subscales was 75.5% ($SD = 5.01\%$). Concurrent validity analyses correlating individual subscale scores with SCIM and HADS subscales produced high correlations between 0.850 (Activities of Daily Living with SCIM Self-Care, $P \leq 0.01$) and -0.466 (Psychological Issues with HADS-Depression, $P \leq 0.01$). Significant differences were identified between injury category within NAC subscales; however, this was not consistent. The NAC achieved high patient ratings, attaining mean ratings of seven (out of 10) for usefulness, and eight for its clarity and personal relevance.

Conclusion: The findings of this study indicate that the NAC is a psychometrically reliable and valid clinical measure of rehabilitation outcome.

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Keywords: Needs Assessment Checklist; outcome measurement; spinal cord injury; rehabilitation; psychometric validation

Introduction

The Needs Assessment Checklist (NAC)¹ is a rehabilitation outcome measure, specifically developed for patients with spinal cord injury (SCI). The NAC has

been implemented and developed at the National Spinal Injuries Centre (NSIC) as part of a structured multidisciplinary rehabilitation framework that provides a way of assessing and ensuring that rehabilitation programmes are geared toward each patient's individual needs. The NAC consists of 199 behavioural indicators, assessing patient achievement in nine core areas (sub-

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scales) of rehabilitation in order to provide each individual with the skills they require to maintain their health and quality of life after sustaining SCI. These areas are Activities of Daily Living (ADL), Skin Management, Bladder Management, Bowel Management, Mobility, Wheelchair and Equipment, Community Preparation, Discharge Coordination, and Psychological Issues.

During the development of the NAC, existing measures of client ability, including the Functional Independence Measure (FIM),² the Barthel Index,³ and measures of handicap such as the CHART⁴ were examined for suitability. All of these measures are well established with demonstrated psychometric validity, and have been used extensively in health and rehabilitation care. However, previous research has highlighted that these measures possess floor and ceiling effects, and are insensitive to small differences.⁵ Furthermore, these scales do not state what level of functioning the treatment is expected to produce and consequently, treatment efficacy cannot be measured accurately. Such functional assessment measures (excluding the CHART) also have dominant emphasis on physical restoration. The Catz-Itzkovich Spinal Cord Independence Measure (SCIM Version II)^{6,7} addresses many of these limitations, providing a means of defining and quantifying functional achievement that is sensitive to change, resulting in a scale capable of monitoring function, indicating treatment efficacy, and acting as a guide for the treatment of SCI patients in the domain of disability. This scale is therefore involved in the assessment of the concurrent validity of the NAC in the present study. Owing to the changing characteristics of the SCI population, with the increased survivorship of individuals with high-level SCIs, elevated levels of community residence,⁸ and growing subgroups within this population, such as older adults,⁹ there is great diversity in what constitutes a successful outcome within the SCI population. It has been suggested that the evaluation of individuals based on their functional independence is an assessment limitation. Examining the role of theory in rehabilitation assessment, treatment, and outcomes, Keith and Lipsey¹⁰ emphasise that it is important for rehabilitation medicine to move beyond its preoccupation with scales that rate physical tasks. Consequently, the NAC is an adaptive assessment of both physical and verbal independence. No distinction is made between verbal and physical independence, enabling each patient to have the potential to achieve 100% independence. It is paramount that individuals with a high level of physical disability are able to exert control and articulate their own needs. Even when assistance from others is necessary, this can be incorporated into an individual's life in such a way that optimises independence for the person with SCI.¹¹ The measurement of verbal independence ensures that the NAC is more sensitive to gains that are perceived to be relevant to the individual patient.

As a rehabilitation outcome measure, the NAC has been developed in accordance with a Treatment theory¹⁰

framework. Treatment theory identifies the need for outcome measures that explicitly define problems for the specific population, by specifying the required critical inputs, accounting for the processes that occur in the transformation from input to output, and identifying the important steps needed to produce the desired effects, mode of delivery, and expected outcome. The NAC provides holistic assessment of rehabilitation processes and has been developed via multidisciplinary construction and review, based on the recognition that in order to understand and enhance the quality of life, and other health-related outcomes of SCI individuals, rehabilitation outcome measures must be modified to reflect the experiences and needs of the SCI individual.⁸ This incorporates the assessment of verbal independence, essential healthcare practices (eg skin, bladder, and bowel management), individual care requirements (ie personal assistance), and competency in the ability to sustain community living.

The Needs Assessment has undergone consumer review by the Spinal Injuries Association (SIA), encouraging SCI individuals, and their representative organisations, to be involved in the planning of services. Stallard and Chadwick¹² emphasise the importance of consumer involvement and consultation as a way of aiding the content validity and evaluation of assessment scales. The NAC is also regularly reviewed by the Goal Planning Strategy Group at the NSIC and has been modified throughout its implementation based on current research, multidisciplinary standards of practice, and organisational and legal developments.¹³

As well as being representative of the SCI population, the NAC was also developed in order to facilitate the rehabilitation process and maximise the potential of the rehabilitation environment. Research has demonstrated that active engagement in rehabilitation is one of the best predictors of positive physical and psychological adjustment following discharge,¹⁴ reducing the potential for dependency during prolonged hospitalisation. However, adherence to treatment has remained a problem across the healthcare domain¹⁵ and particularly chronic condition. The NAC provides an assessment of the patient's own perceptions of their independence based on the recommendations of Slade,¹⁶ advocating that assessment measures developed for clinical use should go beyond symptomatology and the behaviour observed by professionals, and incorporate the client's perceptions. Additionally, in a study of interdisciplinary rehabilitation, McGrath *et al*¹⁷ found that by taking client's wishes into account, compliance during rehabilitation was significantly increased.

The NAC has also been utilised effectively in clinical audit. In a review of 82 patients examining rehabilitation outcome at the NSIC, Kennedy and Hamilton¹ found that the Needs Assessment and Goal Planning Programme was successful in establishing greater client independence and that the needs of this patient group are significantly lower after rehabilitation. The Needs Assessment Programme has also been shown to be successful in terms of its usefulness to staff, and in

focusing the different team members on specific goals.¹⁸ Kennedy *et al.*¹⁸ reported that the NAC was found to be a clinically appropriate measure that was popular with team members who reported high satisfaction with its use. In a clinical audit of patient view of the Needs Assessment and Goal Planning Programme,¹⁹ 60% of patients felt that their achievements had been good or very good, while 80% felt that this system was beneficial to their rehabilitation. The NAC has also been used in the study of the rehabilitation gains of subgroups of the SCI population, such as older adults,²⁰ and in the evaluation of the efficacy of the NSIC's specialist seating assessment service.

A comprehensive psychometric analysis has not been performed on the NAC. The internal consistency of each NAC subscale has previously been reported by Kennedy *et al.*²⁰ Reliability analyses performed (using a large series of 316 participants) produced high reliability coefficients for each subscale (mean $\alpha = 0.8307$, $SD = 0.0927$). It has been acknowledged by Kennedy and Hamilton¹ that comprehensive analysis of the NAC's psychometric properties is a necessity. The objective of this study was to evaluate the psychometric validity of the NAC, presenting data regarding this measure's internal consistency, test-retest or rater reliability, item-internal validity, and concurrent validity, and gaining comments from those who undertake the assessment.

Method

Participants

A series of 55 consecutive patients between December 2001 and June 2002, who had recently completed an NAC, were selected for this study. During this time period, 12 (21.8%) patients did not wish to participate, or were unavailable to participate within the defined test-retest period. One patient was not selected for this study because of their limited understanding of English. The final participants consisted of 43 SCI patients (38 male and five female). Of these 43 patients, 28 had recently completed their first NAC (NAC 1) and 15 had recently completed their second (NAC 2). No more than two NACs had therefore been conducted per patient. The mean age of individuals participating in this study was 42.19 years ($SD = 14.6$). This sample consisted of 13.9% of individuals with complete tetraplegia, 37.2% with incomplete tetraplegia, 23.3% with complete paraplegia, and 25.6% with incomplete paraplegia. The most common cause of injury was road traffic accident (51.2%), followed by nontraumatic injury (resulting from progressive medical conditions, eg TB, treatment complications, such as post-epidural or abscesses) (18.6%), falls (16.3%), sports (11.6%), and acts of violence (2.3%). The mean time between date of injury and assessment for patients completing their first NAC was 17.5 weeks ($SD = 13.2$ weeks). The mean time between date of injury and assessment for participants completing a second NAC was 38.6 weeks ($SD = 31.3$).

Additionally, the mean number of days between initial assessment and test-retest assessment was 7.2 ($SD = 2.88$).

Measures

NAC¹ The NAC consists of nine specific SCI rehabilitation domains, each with key indicators of independence and attainment: ADL (29 indicators); Skin Management (14 indicators); Bladder Management (10 indicators); Bowel Management (seven indicators); Mobility (17 indicators); Wheelchair and Equipment (33 indicators); Community Preparation (24 indicators); Discharge Coordination (32 indicators); and Psychological Issues (19 indicators). The NAC was developed to incorporate patient perceptions and each patient rates his/her own level of independence for each task/item by means of an interview, lasting approximately 1 h. Each item receives a score from 0 to 3 (0 = completely dependent; 1 = mostly dependent, 2 = moderately dependent, or 3 = completely independent or not applicable). Item scores for each subscale are totalled and a 'percentage achieved' score is derived, reflecting the patient's level of independence in each rehabilitation area. Thus, for each NAC subscale total scores range between 0 and 100%, with higher NAC scores indicating greater levels of independence. The appendix contains examples of NAC subscale items.

Catz-Itzkovich SCIM (version II)^{6,7} The SCIM is a disability scale, specifically developed in order to assess the capacity of the individual patient with SCI to perform daily tasks. It consists of 18 items divided into three subscales: Self-Care (score range 0–20), Respiration and Sphincter Management (0–40), and Mobility (0–40). The total score ranges between 0 and 100. Higher SCIM scores indicate greater levels of independence. In a study to examine the suitability of the revised SCIM (version II) compared to the original SCIM and FIM, the revised SCIM was applied by paired teams of occupational therapists, physiotherapists, and nurses.⁶ The findings of this study have established the SCIM (version II) as a valid and highly reproducible measure. The frequency of identical scoring by two independent examiners (total agreement) was 80% or above, yielding a test-retest correlation of 0.90–0.96 ($P \leq 0.001$). Total SCIM (version II) scores are also significantly correlated with the FIM ($r = 0.835$, $P \leq 0.001$), establishing this measure's concurrent validity. The SCIM has also been found to be more sensitive than the FIM to changes in function of SCI patients.²¹ In a study comparing the sensitivity of the SCIM and the FIM in SCI subgroups, Catz *et al.*²¹ found that the FIM missed 25–27% of the functional changes detected by the SCIM. Recent RASCH analysis of the revised SCIM²² has also confirmed the validity and reliability of this measure, examining its components in a larger population.

Hospital Anxiety and Depression Scale²³ The Hospital Anxiety and Depression Scale (HADS) is a 14-item scale

developed to provide a brief state measure of anxiety and depression, and detect clinical cases and the severity of anxiety and depression, without contamination of scores by reports of physical symptomatology. Each item is scored from 0 to 3 and total scores range from 0 to 21 for both subscales. Higher scores indicate greater anxiety and depression. The internal consistency for the HADS has been established at 0.93 for anxiety (HADS-A) and 0.90 for depression (HADS-D).²⁴ The HADS' concurrent validity has been assessed by comparison with five-point psychiatric ratings scales of anxiety and depression,²³ where both subscales correlated significantly with these ratings (anxiety = 0.54; depression = 0.79). In a review of 747 identified papers assessing the validity of the HADS, Bjelland *et al*²⁵ reported that the internal consistency of the HADS varied from 0.68 to 0.93 (mean 0.83) for the HADS-A and between 0.67 and 0.90 (mean 0.82) for the HADS-D. Correlations between the HADS and other commonly used questionnaires were in the range 0.49 – 0.83 (mean 0.66). These data indicate good psychometric properties and the HADS has been found to perform well in somatic, psychiatric, and primary-care patients, and in the general population.

Procedure

'Clinical' assessment (routine administration of the NAC used to build profiles of individual patients' needs and for goal planning) was carried out by a representative from the multidisciplinary team, such as the patient's Physiotherapist, Occupation Therapist, Named Nurse or Psychologist. In order to evaluate the consistency of this current 'clinical' assessment utilising the NAC, a 'test-retest' cutoff period of 1 week (after administrative receipt of assessment) was adhered to. After this time point retest assessments were not completed. In one session, a single person (an Assistant Psychologist, not professionally related with the patient) administered the NAC ('test-retest' assessment), HADS, and SCIM. In order to limit errors completing the SCIM with limited patient knowledge, this measure was completed with the assistance of both the patient and nursing staff (with regard to Respiration and Sphincter Management). All staff administering the NAC had been trained in its use via a 1-day training workshop. As an integral part of this study, further comments from patients were also gained during the assessment session. Each participant was asked to rate the NAC (between 0 (not at all) and 10 (extremely)) based on its usefulness, clarity, and personal relevance. Participants were also asked whether they found any aspects of the NAC particularly helpful or unhelpful, and to provide any additional comments. All the assessments used in this study were carried out during the participants' first admission for rehabilitation.

Statistical analyses

Reliability analyses were performed:

Internal consistency reliability: Cronbach's alpha coefficient was employed as an index of internal

consistency reliability. Internal consistency reflects the extent to which each item is measuring the same construct by creating an average of all possible inter-item correlations. To establish the internal consistency of each NAC subscale a correlation of 0.7 or above was required. Alpha coefficients 'if items were deleted' were also computed to determine the impact of individual items on each subscale's internal consistency. Item-internal validity was established by performing a Pearson (two-tailed) *r* correlation between scale items and respective full-scale scores. Item-internal validity can be achieved with a correlation of at least 0.40²⁶ determining the degree to which task, or item, ability reflects patient total ability.

Test-retest reliability: Test-retest reliability of the NAC was computed by correlating clinical NAC subscale scores with test-retest NAC subscale scores. The accepted correlation for this test in order to establish test-retest reliability is 0.7, indicating a modest agreement of just under 50%. The percentage of total agreement between clinical assessment and test-retest assessment was calculated for each NAC subscale. Error frequencies for each subscale were also calculated in order to assess the degree of error within each subscale.

Concurrent validity: Concurrent validity of the NAC's ADL, Bladder and Bowel Management, Mobility, Mood and Psychological Issues Subscales were also computed, correlating ADL, Bladder and Bowel Management, and Mobility with relevant subscales of the SCIM, and psychological subscales with the HADS. Each subscale was standardised (Z-score performed) prior to analysis. The accepted correlation for this test in order to establish concurrent validity is also 0.7 (depending on the existence of a comparable benchmark assessment measure). In order to make the NAC Bladder and Bowel Management subscales more comparable to the SCIM Respiration and Sphincter Management subscale, Bladder and Bowel Management scores were added, computing an overall total, and then correlated. This procedure was also performed to calculate the concurrent validity of the NAC Mood subsection. In this case, both HADS anxiety and depression subscales were added together to provide a more appropriate concurrent measure.

Comparison of subgroup performance

Scale means and standard deviations were computed. Significant differences between sample characteristics such as age, sex, or injury category were identified to ascertain whether each NAC subscale was sensitive to changes, or differences in SCI subgroup ability. NAC 1 and NAC 2 scores were compared by performing an independent samples *t*-test. Univariate ANOVA and multiple comparison *post hoc* Bonferroni's *t*-tests were subsequently performed with NAC 1 and NAC 2 data separately. Comparisons made between NAC 1 and NAC 2 are cross-sectional.

Results

Internal consistency

Reliability analyses performed for each subscale produced a mean alpha coefficient of 0.8587 ($SD = 0.918$) (see Table 1). NAC subscale reliability coefficients ranged between 0.7347 for Psychological Issues and 0.9697 for ADL. Scale alpha after items were consecutively deleted did not significantly improve (by 1 SD) the NAC subscale's internal consistency reliability. Both concurrent measures also yielded high internal consistency coefficients, above the specified level, with this sample (see Table 1). The only subscale not to produce an acceptable alpha level was the SCIM subscale Respiration and Sphincter Management (0.6454).

Item-internal validity was also assessed, correlating individual item scores with a full subscale total (see Table 2). The mean item-internal validity correlation for NAC subscales was 0.5921 ($SD = 0.1411$). Items within each NAC subscale produced significant correlations with the total score in each subscale. However, the item-internal validity mean correlation of two NAC subscales (Community Preparation and Psychological Issues) was below the specified value of 0.4.

Test-retest reliability

The mean test-retest correlation for all the NAC subscales was 0.8238 ($SD = 0.0722$). Test-retest correlations ranged between 0.694 and 0.904 ($P \leq 0.01$) (see Table 3). The only NAC subscale performing below the specified reliability level (0.7) was Bladder Management (0.694); however, this discrepancy was minute.

Table 1 Scale means, standard deviations and internal consistency coefficients of NAC subscales and concurrent measures

Subscale	Number of items	Scale mean	Scale SD	α
ADL	29	59.07	25.88	0.9697
Skin Management	14	25.67	10.54	0.8830
Bladder Management	10	22.81	7.23	0.8356
Bowel Management	7	13.91	6.27	0.8097
Mobility	17	24.28	13.30	0.8729
Wheelchair and Equipment	33	46.09	27.27	0.9527
Community Preparation	24	39.28	12.73	0.7805
Discharge Coordination	32	47.86	25.52	0.9251
Psychological Issues	19	45.49	7.99	0.7347
SCIM				
Self-Care	6	12.63	7.61	0.9608
Respiration and Sphincter Management	4	23.84	10.60	0.6454
Mobility	8	14.02	11.21	0.9288
Full-Scale Score	18	50.49	26.91	0.9227
HADS				
Anxiety	7	5.14	4.32	0.8463
Depression	7	5.51	4.17	0.8122

The mean percentage of agreement between clinical assessment and test-retest assessment over all NAC subscales was 75.7% ($SD = 5.01\%$) (see Figure 1 for subscale-specific agreement and error scores). The percentage of error and degree of inaccuracy between assessments was also computed to determine the NAC's rating reliability. Overall NAC test-retest assessments, 7.8% of responses differed by one point, 3.9% of responses differed by two points, 12.5% of responses differed by three points, and 0.01% of responses differed by four points. Four-point errors are only applicable to the Psychological Issues NAC subscale that utilises a scale of 1–4 within its coping strategies subsection. Error percentages relating to differences of three points are also elevated by individual scales such as Wheelchair and Equipment, Community Preparation, and Discharge Coordination that predominantly utilise a dichotomous scale, scoring items either 0 or 3 (No or Yes/Not Applicable). Individually, mean subscale accuracy percentages between clinical assessment and test-retest assessment ranged between 69.3% (Bowel Management) and 84.6% (Community Preparation) (see Figure 1).

Concurrent validity

Concurrent validity analyses correlating individual NAC subscale scores with SCIM and HADS subscales produced high correlations of between 0.850 (ADL with SCIM Self-Care, $P \leq 0.01$) and -0.466 (Psychological Issues with HADS-D, $P \leq 0.01$) (see Table 4). Correlations with the HADS produced negative correlations because of different interpretations of scale scoring between HADS and NAC.

Comparison of subgroup performance

Analyses were also performed on scale data with regard to identifying significant differences between population subgroups such as gender, age, injury category (level and completeness), and assessment time point (NAC 1 or NAC 2). Independent samples *t*-test comparing group mean scores between first and second NACs identified a significant difference in every subscale ($P \leq 0.01$). Achievement at the second NAC was significantly greater in every subscale. Conducting separate analyses for NAC 1 and 2 data, univariate ANOVA and multiple comparison *post hoc* Bonferroni's *t*-tests identified significant differences between injury category within NAC subscales. A significant difference between injury category was also identified at NAC 2; however, this was found only in the ADL subscale, between incomplete tetraplegia and incomplete paraplegia. Additionally, injury category 'complete tetraplegia' was not represented within NAC 2 data. No other significant differences were identified within NAC subscale, gender or age categories.

Patient ratings of the NAC

The NAC achieved high mean patient ratings, scoring '7' for 'have you found completing the NAC useful?'

Table 2 Item-internal validity: mean Pearson's *r* correlations of NAC scale and item scores

<i>Subscale</i>	<i>Mean r</i>	<i>SD</i>	<i>Minimum r</i>	<i>Maximum r</i>	<i>Number of Items below 0.4 level</i>
ADL	0.741	0.102	0.402**	0.909***	0
Skin Management	0.635	0.160	0.109	0.773***	1
Bladder Management	0.627	0.146	0.286	0.771***	1
Bowel Management	0.803	0.099	0.627***	0.922***	0
Mobility	0.578	0.150	0.235	0.769***	2
Wheelchair and Equipment	0.629	0.115	0.374*	0.788***	2
Community Preparation	0.384	0.218	−0.033	0.807***	13
Discharge Coordination	0.548	0.167	0.188	0.771***	5
Psychological Issues	0.385	0.145	0.162	0.645***	9

***Correlation is significant at the 0.001 level (two-tailed)

**Correlation is significant at the 0.01 level (two-tailed)

*Correlation is significant at the 0.05 level (two-tailed)

and '8' for both 'did you find that the questions made sense?' and 'were they (the questions) relevant to you personally?'

Discussion

These analyses contribute to the demonstration of the NAC as a psychometrically valid and reliable measure of SCI rehabilitation outcome. All NAC subscales produced internal consistency reliability coefficients above the specified level judged acceptable for group comparisons ($\alpha=0.7$), and most subscales (except Community Preparation and Psychological Issues) produced highly desirable reliability coefficients of above 0.8 and 0.9, suggesting that NAC subscales are comprised of homogeneous items. Reliability coefficients presented are consistent with those previously reported.²⁰ The internal consistency of NAC Bladder Management, Community Preparation, and Discharge Coordination subscales was previously higher than reported by this study. These scales may have benefited from a larger sample size representing a higher degree of variance. In this study, Psychological Issues performed better, producing a higher coefficient than previously reported.

Both concurrent measures also yielded high internal consistency coefficients. These results support previous findings reported via extensive analyses conducted on the SCIM, however, with regard to the HADS use with the SCI population, these reliability data are new. The only subscale not to perform above the specified level was the SCIM Respiration and Sphincter Management subscale ($\alpha=0.6454$). However, this was because of a lack of variance relating to the respiration item within this subscale. All patients who participated in this study were able to breathe independently and all received a maximum score (mean = 10, SD = 0), hence 'alpha if item deleted' rose to 0.7261 when this item was eliminated from analyses.

Item-internal validity correlations determining the degree and direction of the relations between individual task ability and overall subscale performance revealed important findings reflecting how each item represents overall ability and changes in subscale performance. Two NAC subscales (Community Preparation and Psychological Issues) produced mean item-internal validity correlations below the specified level (0.4). Characteristically, these subscales contained a high proportion of items that correlated poorly with their subscale total score. These items showed limited variance regardless of the individual's total ability, or stage in rehabilitation. Within Community Preparation, all items within 'Continuing Education' and 'Employment' produced item-internal validity correlations lower than the specified level, questioning these items ability to represent changes in rehabilitation performance, indeed for most participants making immediate plans to return to education was recorded as 'not applicable'. Results regarding the item-internal validity of the Psychological Issues NAC subscale are less surprising as this subscale consists of a 'Coping Strategies' subsection (derived from coping research conducted at the NSIC²⁷), which is considered to represent and measure dispositional coping mechanisms, and has been used as a psychological screening tool incorporated into the NAC. These results also suggest that particular items within subscales may either be readily achieved or never achieved throughout the assessed rehabilitation period (between mobilisation and 6 weeks prior to discharge), questioning these items content validity at this time point. Further investigation regarding this aspect of validity would be beneficial using a larger participant sample.

Test-retest analyses have illustrated the NAC's reliability over time. All NAC subscales performed at the 0.7 specified level and most subscales achieved high correlations of above 0.8 and 0.9. Rating agreement between clinical assessment and test-retest assessment was very acceptable. Furthermore, a high percentage of

Table 3 Test–retest reliability: Pearson's *r* correlations of NAC subscales at two time points

Subscale	Test-retest								
	ADL	Skin Management	Bladder Management	Bowl Management	Mobility	Wheelchair and Equipment	Community Preparation	Discharge Coordination	Psychological Issues
ADL	0.884								
Skin Management		0.904							
Bladder management			0.694						
Bowl Management				0.783					
Mobility					0.883				
Wheelchair and Equipment						0.883			
Community Preparation							0.830		
Discharge Coordination								0.805	
Psychological Issues									0.748

All correlations are significant at the 0.01 level (two-tailed)

Table 4 Concurrent validity: Pearson's *r* correlations of NAC subscales, the SCIM and the HADS

Subscale	SCIM Self-care	SCIM Respiration and Sphincter Management	SCIM Mobility	SCIM Full Scale	HADS-Anxiety	HADS-Depression	HADS (combined scales)
ADL	0.850			0.783			
Bladder and Bowl Management (combined scales)		0.681		0.754			
Mobility			0.691	0.696			
Psychological Issues (mood subsection)					−0.709	−0.633	−0.726
Psychological Issues (Full-Scale)					−0.501	−0.466	−0.523

All correlations are significant at the 0.01 level (two-tailed)

Figure 1 Mean accuracy and degree of error for each NAC subscale.

discrepancies between assessments only differed by one point. Within a 1-week test–retest period the level of agreement between assessment could have been expected to be higher, however, several factors may account for ‘total agreement’ not being observed. A proportion of disagreement can be accounted for by rehabilitation progress. Throughout their rehabilitation, patients receive education and teaching, attend specialist appointments, and details of their discharge become more refined. Consequently, differences in clinical and test–retest NAC scores may represent some of these changes. Additionally, the NAC is a measure of patient perceptions of their own independence and this assessment of independence may be subjective and influenced by other factors. Indeed, by incorporating the patient’s perceptions of their independence, total accuracy may be partially sacrificed in order to facilitate greater treatment adherence. It is also necessary to note that, compared to clinical assessment, test–retest assessment was conducted, to some degree, artificially. The individual conducting assessments had little detailed information regarding each participant’s rehabilitation. Professionals working in rehabilitation draw upon multiple sources of data in the intensive study of individual cases. The NAC endeavours to provide a multidisciplinary appraisal of individual SCI rehabilitation, in which information derived from patient contact and case history is combined with patient perceptions to build up an integrated picture of the individual. Consequently, keyworkers may act as a safeguard, influencing patient responses within the NAC during its administration. In order to enhance the level of agreement between assessment and regulate inconsis-

tencies between patient perceptions, specific criteria for attainment within this measure may need to be specified; stating behaviourally what is required in order to achieve, for example, ‘moderate independence’ in specific tasks.

High correlations with benchmark measures of psychometric reliability and validity (SCIM and HADS) have demonstrated the NAC’s concurrent validity. All correlated subscales produced very acceptable correlations, especially considering that some scales were not directly comparable. Psychological Issues demonstrated the lowest concurrent validity with the HADS. This scale demonstrated a modest correlation; however, this can be attributed to the NAC Psychological Issues subscale measuring a greater number of constructs than mood, also incorporating ‘sexual issues’ and ‘coping strategies’ items within this subscale. This is an acceptable correlation if no suitable concurrent measures are available.²⁸ In this case, the subscale was correlated with a measure of similar, but not identical, variables and can be said to demonstrate ‘construct’ validity (a judgement that the test content pertains to the construct). It is important to note that this study presents psychometric data of previously undeveloped assessment measures in rehabilitation. The NAC Skin Management, Wheelchair and Equipment, Community Preparation, Discharge Coordination, and Psychological Issues subscales are novel within SCI rehabilitation outcome assessment. This has been supported by the author’s inability to identify appropriate concurrent benchmark measures within the literature. The inclusion of some of these novel measures of rehabilitation (Community Preparation, Discharge Coordination,

and Psychological Issues) within the NAC attempt to measure the 'participation' dimension of disablement as defined in the revised draft of the WHO International Classification of Function and Disability (ICIDH-2).²⁹ This is in addition to its existing coverage of the 'activity' dimension (ADL, Skin Management, Bladder and Bowel Management, and Mobility subscales).

The significant difference between NAC 1 and NAC 2 subscale means has contributed to demonstrating the NAC's sensitivity to change. Indeed, The NAC has been developed to facilitate a Goal Planning Rehabilitation Programme at the NSIC and each score reflects small attainable improvements in patient independence. Comparisons of subgroup performance have revealed that significant differences were observed between injury categories, suggesting that the NAC is sensitive to functional changes, or differences in SCI subgroup ability; however, this finding was inconsistent across injury category and NAC time point. It would appear that the difference between injury categories is greater at NAC 1 than NAC 2, by which time the only significant difference was identified within ADL. The NAC includes the measurement of physical and verbal independence relating to task achievement and consequently would not be expected to identify differences between population subgroups. However, it would appear that ability relating to injury category is represented by the NAC. This aspect of this study is limited because of the injury category 'complete tetraplegia' not being represented within NAC 2 data. Owing to inconsistency in the identification of SCI subgroups, interpreting these results is difficult. However, greater differences between injury categories at the first NAC are reflective of the rehabilitation process. The NAC represents a standard of attainment and, regardless of their initial ability, patients are required to fulfil specified rehabilitation targets in order to maintain their health and quality of life post discharge. This study would greatly benefit from analyses utilising a larger participant group that would better represent the broad range of ability that the NAC was developed to measure. It is also suggested that ASIA grading should also be included as a requirement for the Needs Assessment Database. This would provide a more appropriate and meaningful categorisation of functional ability, relating to each individual's motor and sensory control. Analyses could be performed in order to evaluate whether NAC subscales consistently identify differences between the main ASIA groupings (ie comparing A/B/C and D/E). The proposed inclusion of ASIA grading within the NAC would also provide a measure of the 'impairment' aspect of the ICIDH-2,²⁹ which, combined with its attention to the 'activity' and 'participation' dimensions, would result in a scale that aims to provide a broad view of SCI at each stage of the process.

Patient ratings of the NAC also demonstrated that there is a high level of satisfaction with the NAC from those who undertake the assessment, relating to the NAC's usefulness, clarity, and personal relevance. When

asked, 'what did you find most helpful (about completing the NAC)' patients expressed that the NAC had helped them 'to gain a better understanding of their injury and what it involved'. Patients also felt that Goal Planning and Needs Assessment Programme was beneficial to their rehabilitation: identifying needs, setting clear achievable targets, focusing on what could be achieved, and demonstrating patient progress. Patients also commented that the NAC and Goal Planning Programme focused everyone in the support (rehabilitation) team and that the NAC's emphasis on (measurement of) achieving independence was beneficial to them. Other patients felt that the NAC was helpful because of its level of detail. In one case, nonattendance at a patient teaching session was indicated by the NAC and this was later rescheduled for the patient. When asked, 'did you find anything unhelpful about the NAC?' most participants did not find anything unhelpful about the NAC. A small number of patients commented that the Discharge Coordination subscale of the NAC was less relevant to patients of other nationalities and some patients also made suggestions as to how the NAC could be improved.

The findings of this study represent a tradeoff between scientific validity and clinical utility. It is important to remember that the NAC is a 'clinical' assessment of SCI rehabilitation outcome, and that while this measure needs to demonstrate psychometric reliability and validity, it was also developed to facilitate the rehabilitation process as part of an integrated Needs Assessment and Goal Planning Programme. The NAC has been developed via multidisciplinary construction and review, consisting of standards of attainment relating to positive outcome in SCI rehabilitation. The NAC's level of detail and construction enables this measure to successfully respond to changes in clinical context and it is possible that future changes to this measure may undermine the NAC's scientific validity. Although it is an important requirement, it is acknowledged that the psychometric validity of this measure (particularly regarding its higher order psychometric refinement) may be challenged in order to maintain the NAC's clinical utility. Further amendments to the NAC will include important consideration regarding the psychometric reliability and validity of this assessment. The authors plan to conduct Factor Analysis with a larger sample of participants once data have been obtained on 400 individuals. This would further examine how overall patient ability is represented by each item within particular NAC subscales (ie Community Preparation and Psychological Issues) in order to identify any lack of homogeneity generated by discrete items within these subscales. The test-retest reliability of this measure may also be improved by developing specific criteria for attainment for each item/task within this measure, reducing possible ambiguity and enabling consistent judgements to be made using objective standards. Although this measure was specifically developed for SCI, there are many aspects of this assessment that are relevant to physical rehabilitation and disability in

general. Further study may examine the NAC's adaptability to use with other populations and evaluate whether this measure maintains its psychometric validity across physical rehabilitation.

The findings of this study portray the NAC's psychometric reliability and validity, suggesting that the NAC is a highly consistent and replicable clinical assessment of rehabilitation outcome. The NAC has the potential to provide both a broad and specific, finer grained analysis of SCI rehabilitation processes. The NAC and the Needs Assessment Database provides a wealth of information that goes beyond requirements to assess functional capability. Data derived from the NAC can be utilised to provide clinically meaningful information charting patient progress, identifying the topographic features of SCI rehabilitation over time, and providing a detailed analysis of areas within SCI rehabilitation. The NAC facilitates a greater understanding of the SCI population and rehabilitation processes, identifying the salient needs of subgroups within the SCI population,²⁰ and evaluating the efficacy of specific interventions within the treatment process.

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Appendix

Example items from the ADL, Skin Management, Mobility and Psychological Issues, subscales of the NAC.

Key	0 = completely <u>dependent</u> /never does	2 = moderately <u>independent</u> /usually does (or instructs someone to)
	1 = mostly <u>dependent</u> /rarely dose	3 = completely <u>independent</u> /always does (or instructs someone to)

ACTIVITIES OF DAILY LIVING

Food Management

NB: ANSWER ALL QUESTIONS	0	1	2	3	N/A	Comments
Can you (or do you instruct others to)* use feeding utensils?						
Can you (or do you instruct others to)* carry a plate of food on a tray?						
Can you (or do you instruct others to)* pick up a cup/glass?						
Can you (or do you instruct others to)* get a drink?						
Have you been involved in preparing a meal?						

*PLEASE ENSURE TO DELETE AS APPLICABLE

SKIN MANAGEMENT

Skin Checks

NB: ANSWER ALL QUESTIONS	0	1	2	3	N/A	Comments
Do you know how to check your skin with a mirror?						
Do you know what to look for, and where to look?						
Do you carry out this skin checking as instructed?						

MOBILITY

Ambulation (Only applicable to patients with either *INCOMPLETE* or *LOW* lesions who will be walking)

NB: ANSWER ALL QUESTIONS	0	1	2	3	N/A	Comments
Can you walk with a frame?						
Can you walk with any other aids? If so, what?.....						
Can you go up/down stairs?						
Has a video been taken of you walking?						
Do you know how to replace your walking aids, if these are required?						

PSYCHOLOGICAL ISSUES

Mood

Indicate which best describes your feelings **OVER THE PAST WEEK** by ticking one box relating to each of the following eight questions:

1.	DO YOU FEEL SAD? (<i>tick <u>one</u> of the four boxes</i>):										
	Not at this time	3		Sometimes	2		Most of the time	1		Always	0

2.	ARE YOU DISTRESSED? (<i>tick <u>one</u> of the four boxes</i>):										
	Not at this time	3		Sometimes	2		Most of the time	1		Always	0