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한국판 수정된 노팅엄 감각평가의 신뢰도 타당도 연구

Translation and Validation of the Korean Version Revised Nottingham Sensory Assessment

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요약

본 연구의 목적은 수정된 노팅엄 감각평가(rNSA)를 한국판으로 번역하고 검증하는 것이었다. 수정된 rNSA를 한국어로 번역하기 위해 번안/역번안 과정을 사용하여 단면 연구가 수행되었고, 한국판 rNSA의 유효성을 조사하기 위하여 평가자간 및 평가자내 신뢰도, 내적일관성 및 동시타당도를 조사하였다. 한국판 rNSA는 평가자간 신뢰도(r=0.92-1.00), 평가자내 신뢰도(r=0.93-1.00)로 높은 신뢰도를 확인하였고, 한국판 Fugl Meyer의 감각항목과의 유의한 상관관계(r=0.96)를 확인하였다. 한국판 rNSA의 내적일치도에 대한 Cronbach 값은 0.73-0.90의 범위이고, 한국판 Fugl Meyer의 감각항목의 Cronbach 값은 0.70-0.88의 범위였다. 이 결과로, 한국판 rNSA의 신뢰도 및 타당도를 확인하였으며, 임상환경에서 뇌졸중 이후 감각기능을 평가하는 것이 가능할 수 있다고 생각한다.

■ 중심어 : | 재활 | 감각평가 | 번안 | 타당도 | 뇌졸중 |

Abstract

The aim of this study was to translate and validate the revised Nottingham Sensory Assessment(rNSA) in Republic of Korea. A cross-sectional study was conducted to translate the rNSA into Korean using a modified forward/backward translation procedure. Inter-rater and intra-rater reliability, internal consistency, and concurrent validity were investigated to validate the Korean version rNSA. The Korean version rNSA showed excellent inter-rater reliability (r=0.92-1.00) and intra-rater reliability (r=0.93-1.00). Significant correlations were found between sensory assessment results of the Korean version of the rNSA and the Korean Fugl Meyer Assessment Sensory subscales (r=0.96). The Cronbach α value of internal consistency of Korean version rNSA was ranged from 0.73 to 0.90, the value of K-FMA-S was ranged from 0.70 to 0.88. In these results, psychometric properties of the Korean version of the rNSA achieved the standard level and can be feasible in clinical practice to assess sensory function following stroke in Republic of Korea.

■ keyword : | Rehabilitation | Sensory Assessment | Translation | Validation | Stroke |

I. Introduction

Somatic sensation enables humans to engage with the world in a safe and meaningful way. It supports a spectrum of skills that underlie participation in numerous areas of occupation,

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from detecting dangerous levels of heat to knowing where one's body is in space[1]. Somatosensory deficits are a common symptom after stroke occurring in about 50-80% of stroke survivors[2]. These sensory deficits can dramatically impact a person's ability to function and live safely and independently[3]. Studies suggest that sensory impairment is related to motor impairment after stroke[4]. In addition, Lima et al. found that somatosensory impairments induced by stroke affected activities of daily living[5]. Many stroke survivors experience somatosensory deficits in the Republic of Korea and there is currently no "gold standard" reliable standardized assessment commonly used by clinicians.

Clinicians working with stroke survivors report that they use sensory assessments on a regular basis and find them important for clinical practice[6]. Information gained from sensory assessments is important for the entire therapeutic process: diagnosis, prognosis, client and caregiver education, and intervention planning[7]. Sensory impairment can occur in both left and right hemispheric patients due to stroke[8]. It follows that being able to determine the extent and severity of sensory deficits in stroke survivors allows for more informed treatment and may potentially lead to better client outcomes. The American Occupational Therapy Association (AOTA) strongly recommends that occupational therapists use appropriate, evidence-based measures during the evaluation and intervention processes as much as possible in order to guide effective clinical decision-making. However, there are a limited number of standardized sensory measures available, and most possess low clinical utility and have not been found to be reliable or valid[9].

Standardized assessment tools for testing somatosensory function in stroke patients include the Rivermead Assessment of Somatosensory Performance, the Hand Active Sensation Test, Fugl Meyer Assessment Sensory subscales (FMA-S) and the revised Nottingham Sensory Assessment (rNSA)[10]. The Rivermead Assessment of Somatosensory Performance has good inter-rater and intra-rater reliability in hemiplegia patients; however, its main disadvantage is the need for expensive commercial equipment. The Hand Active Sensation Test, a measure of haptic performance of hand, evaluates the sense of weight and texture of objects in hemiplegia patients and has strong test-retest reliability, but it does not evaluate sense of temperature or stereognosis of the hand[8][11]. The FMA-S have high inter-rater reliability and internal consistency in proprioception, and light touch of the upper and lower extremities. Also, The validity and responsiveness of the FMA-S have been established at different post-stroke stages of recovery. but reliability of light touch items are minimal to moderate[12].

The NSA is an established standardized multimodal assessment used with patients post-stroke in other countries[13]. The NSA was first developed in the U.K. In 1991 as a comprehensive sensory evaluation tool, and includes the following test items: Light Touch, Temperature, Pinprick, Pressure, Tactile Localization, Bilateral Simultaneous Touch, Stereognosis, Proprioception, and Two-Point Discrimination. Unfortunately, using Cohen's kappa (K) coefficients, the assessment was found to have a wide range of inter-rater reliability (K = .01 to K = .89)[5]. After 1998, test

items were revised and the scale was shortened by reducing testing of the unaffected limb to light touch, temperature, and kinesthetic sensation only[6]. A hierarchy of items was identified so that testing could be terminated if no impairments were detected in the distal portion of the limb. One of significant advantages of rNSA over other sensory assessment tools is that only inexpensive equipments are required and the assessment includes both the upper and lower extremities.

The rNSA has not been used in the Republic of Korea. One possible reason for the nonuse of the rNSA in the Republic of Korea could be that there are unique differences in language and culture between U.K. and the Republic of Korea. These facts are significant enough to potentially cause Korean occupational therapists and patients to misunderstand some of the test items, which may reduce the reliability and validity of the rNSA when used in the Republic of Korea.

The purpose of the current study was to translate the rNSA into Korean with cultural adaptation and to validate its reliability and validity in hemiparetic patients after stroke.

II. Materials and Methods

1. Subjects

Ethical approval was granted by the Institutional Review Board on Human Subjects Research and Ethics Committees, Soonchunhyang University, Cheonan, Korea(No. : 1040875-201412-BM-044). To test the validity and reliability of the K-rNSA, thirty participants were recruited from St. Vincent's hospital in Suwon city of the Republic of Korea from January 5 to January 19, 2015. All participants were assessed after giving written informed consent.

Stroke patients were selected if they were hemiplegic patients, aged 18 years or older, and had been diagnosed with a stroke within the previous six months. Patients with diagnosed diabetes, peripheral nerve disease, sensory problems from other diseases, aphasia, or cognitive impairments were excluded from the study.

Demographic data and impairment levels are summarized in [Table 1]. There were thirty hemiparetic participants with a mean age of 55.7 (±16.1) years and a maximum age of 80 years. Patients were divided by stroke type: 15 patients had a hemorrhagic stroke (50%), 13 patients had an ischemic stroke (43.3%), and two patients had other types of stroke (6.7%). Sixteen patients had lesions in the cerebral cortex (53.4%), seven patients had lesions in the subcortex (23.3%), four patients had brainstem lesions (13.3%), two patients had mixed lesion (6.7%), and one patient had a lesion in cerebellum (3.3%). The mean time since stroke was 3.9 months (±1.9) on average. Thirteen patients had right hemiparesis (43.3%) and 17 patients had left hemiparesis (56.7%). The average score of Korean-Mini Mental State Examination (K-MMSE) was 25.2 (±3.2), and Korean-Modified Barthel Index (K-MBI) score was 63.3 (±26.3).

Table 1. Demographics of the stroke patient cohort (N=30)

Variables	Mean ± SD	
Age (years)	55.7±16.1	
Gender (M/F)	15 (50%) / 15 (50%)	
Type of Stroke	Hemorrhage	15 (50%)
	Infarction	13 (43.3%)
	Others	2 (6.7%)
Onset period (months)	3.9±1.9	

Site of stroke lesion	Cerebral(cortex)	16 (53.4%)
	Cerebral(subcortex)	7 (23.3%)
	Brainstem	4 (13.3%)
	Mixed	2 (6.7%)
	Cerebellum	1 (3.3%)
Affected side (Rt./Lt.)	13 (43.3%) / 17 (56.7%)	
K-MMSE	25.2±3.2	
K-MBI	63.3±26.3	

2. Procedures

This study applied translation with cultural adaptation and backward translation, and psychometric evaluation.

2.1 Translation and cultural adaptation process

After approval from the author of the original version, Korean translation of the rNSA was performed by an occupational therapy student and one occupational therapist with over 5 years clinical experience. Another occupational therapist with over 5 years clinical experience checked for the appropriateness of terminology, comprehension of the assessment, and if the translation was written in a clear and natural manner. The occupational therapist who involved in revision described the revised contents with the original contents and sent the revision to the authors of this article and then rNSA was completed for the first draft of Korean version of revised Nottingham Sensory Assessment(K-rNSA).

Following the Korean translation and cultural adaptations, one bilingual speaker(English and Korean) who had lived in an English speaking country for more than five years, performed a backward translation to verify the Korean translation. Also another bilingual speaker (English and Korean) who had lived in an English speaking country for more than five years and had more than three years of clinical experience in occupational therapy verified the contents. The revised materials were sent back to the authors. After incorporating these revisions, rNSA finalized in Korean.

3. Assessments

The current study included two test sessions over the course of two weeks. Each test session repeated three times at once. During the first week, two raters separately performed the K-rNSA and K-FMA-S on all patients. After one week, the raters re-assessed the K-rNSA. The concurrent validity and internal consistency was then analyzed.

3.1 Korean version of revised Nottingham Sensory Assessment(K-rNSA)

The K-rNSA assesses tactile sense, proprioception, and stereognosis of the head, trunk, shoulder, elbow, wrist, hand, knee, ankle, and foot. The tactile sense category has detailed items like pressure sense, temperature sense, and tactile localization etc. Scores are as follows: 0 indicates no sense, 1 indicates impaired sense, and 2 indicates normal sense. The proprioception category assesses segmental direction and position during active movement of the participant's limbs and is scored as follows: 0 indicates no sense, 1 indicates that the patient only perceives localization, 2 indicates that the patient perceives movement, but only over a 10° range, and 3 indicates that the patient perceives movement under 10° (however, this category does not assess proprioception of the head, trunk or foot). The stereognosis category includes 11 items and is scored as follows: 0 indicates no sense, 1 indicates impaired sense, and 2 indicates normal sense. Assessment items included: a filament(green) for light touch, tubes(cold, hot)

for temperature test, powder for tactile sense, 50, 100, and 500 won coins, a ballpoint pen, a pencil, a comb, scissors, a sponge, fabric, and cup for stereognosis.

3.2 Korean version of Fugl Meyer Assessment(K-FMA)

One of the most widely recognized and clinically relevant measures of body function impairment after stroke is the Fugl-Meyer assessment(FMA)[14]. It is consisted of 5 domains (motor, sensory, balance, range of motion, joint pain). The inter-rater agreement of the total score of the Fugl Meyer Assessment Sensory subscales(FMA-S) was excellent, with an intraclass correlation coefficient of 0.93[6]. The Cronbach's alphas of the FMA-S at four time points after stroke ranged from 0.94 to 0.98, indicating excellent internal consistency.

A study of translation and verification on the K-FMA-S showed both good inter-rater reliability (ICC=0.992, 95% CI=0.987-0.995) and test-retest reliability (ICC=0.883, 95% CI=0.798-0.932)[15].

4. Statistical analysis

The data were entered into statistical package for social sciences (SPSS) 20.0 for windows at the completion of the trials. The descriptive analysis of the numerical and categorical variables of the sample was done. Inter-rater reliability and intra-rater reliability were analyzed by intraclass correlation coefficients(ICCs). Internal consistency was computed by the Cronbach α. To evaluate concurrent validity, spearman correlation coefficients were calculated by using total data for the sensory categories of the K-FMA and K-rNSA. The significance level was set at 0.01 for all statistical analyses.

Ⅲ. Results

1. Inter-rater reliability

The inter-rater reliability of all the K-rNSA test items were in strong agreement ranged from 0.92 to 1.00[Table 2]. All items were statistically significant($p<0.01$). The greatest value was Ballpoint pen, Comb, Scissors, and Sponge.

2. Intra-rater reliability

The intra-rater reliability analysis included 18 variables, which all demonstrated high reliability (0.92-1.00) and were all statistically significant [Table 3]($p<0.01$).

3. Internal consistency

Cronbach α was analyzed for each sensory subscale of K-rNSA and K-FMA-S. Estimated corrected item-total correlation value of Cronbach α was ranged from 0.73 to 0.90[Table 4]. Additionally, the value of K-FMA-S was lower than K-rNSA and ranged from 0.70 to 0.88[Table 5].

4. Concurrent validity

To test the concurrent validity of the K-rNSA, spearman correlation coefficient was analyzed between the results of K-rNSA and K-FMA-S. There was a strong correlation between the total score of the K-FMA-S the K-rNSA. The result was 0.96 and was statistically significant at the 0.01 level[Table 6].

Table 2. Inter-rater reliability and intra-class correlation coefficients

Item	ICCs	95% Confidence interval
Light touch	0.96*	0.92-0.98
Pressure	0.95*	0.90-0.97
Pinprick	0.97*	0.94-0.98
Temperature	0.96*	0.93-0.98
Tactile localization	0.94*	0.88-0.97
Bilateral simultaneous touch	0.95*	0.91-0.98
Proprioception	0.98*	0.95-0.99
Coin (₩10)	0.98*	0.97-0.99
Coin (₩100)	0.93*	0.86-0.96
Coin (₩500)	0.92*	0.83-0.96
Ballpoint pen	1.00*	1.00
Pencil	0.99*	0.98-0.99
Comb	1.00*	1.00
Scissors	1.00*	1.00
Sponge	1.00*	1.00
Fabric	0.99*	0.98-0.99
Cup	0.99*	0.98-0.99
Glass	1.00*	1.00

*p<.01

Table 3. Intra-rater reliability and intra-class correlation coefficients

Item		ICCs	95% Confidence interval
Light touch		0.98*	0.95-0.99
Pressure		0.95*	0.91-0.98
Pinprick		0.97*	0.94-0.98
Temperature		0.95*	0.89-0.97
Tactile localization		0.96*	0.92-0.98
Bilateral simultaneous touch		0.92*	0.84-0.96
Proprioception		0.96*	0.92-0.98
Stereognosis	Coin (10-won)	0.97*	0.95-0.98
	Coin (100-won)	0.95*	0.91-0.98
	Coin (500-won)	0.99*	0.97-0.99
	Ballpoint pen	0.98*	0.96-0.99
	Pencil	0.96*	0.91-0.98
	Comb	1.00*	1.00
	Scissors	1.00*	1.00
	Sponge	1.00*	1.00
	Fabric	0.99*	0.98-0.99
	Cup	0.99*	0.98-0.99
	Glass	0.98*	0.96-0.99

*p<.01

Table 4. Internal consistency for K-rNSA

Item	Corrected item-total correlation	Alpha if item deleted
Light touch	0.90	0.93
Temperature	0.83	0.94
Pain	0.86	0.94
Pressure	0.90	0.94
Localization	0.90	0.93
Bilateral stimulation	0.90	0.93
Proprioception	0.73	0.94
Streognosis	0.80	0.96

Table 5. Internal consistency for K-FMA-S

Item	Corrected item-total correlation	Alpha if item deleted
Light touch Upper	0.81	0.85
Proprioception Upper	0.87	0.80
Light touch Lower	0.70	0.88
Proprioception Lower	0.88	0.80

Table 6. Spearman correlation between K-rNSA and K-FMA-S

Spearman's rho		K-FMA	p-values
	K-rNSA	0.96	<0.01

Ⅳ. Discussion

The present study translated rNSA into Korean, and analyzed the inter-rater and intra-rater reliability, internal consistency, and concurrent validity of the K-rNSA using thirty Korean stroke patients. The research team followed the frequently used multi-step approach to improve translation quality[16].

In the K-rNSA, 2-p, 10-p, and 50-p coins were changed to 10-won, 100-won, and 500-won coins, respectively. Neither occupational therapists nor study participants reported any issues in terms of administration when K-rNSA was being assessed with study participants.

Intra-rater and inter-rater reliability were

analyzed in this study to confirm reliability of the K-rNSA. Based on the 95% confident interval of the Intraclass correlation coefficients estimate, values less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively[17]. The results found the intraclass correlation coefficient was 0.92-1.00 suggesting excellent reliability.

A maximum Cronbach alpha value of 0.90 has been recommended[18]. All items was correlated with the total to a good degree. “Recent study could not confirm the internal consistency of K-FMA-S. In this study, between K-FMA-S and K-rNSA was confirmed the internal consistency. The Cronbach α was ranged from 0.73 to 0.90 in K-rNSA, the K-FMA-S was 0.70 to 0.88, indicating that K-rNSA had a higher internal consistency”[15].

The efficiency of the K-rNSA as a sensory assessment was evaluated by comparison with the K-FMA-S, which resulted in an ICC of 0.963. From the results, the authors concluded that the K-rNSA demonstrates strong reliability and validity for the majority of the subtests, indicating acceptability for use in clinical practice.

The purpose of applying K-FMA-S to compare validity is that it is useful clinically and has high reliability and validity. Rivermead Assessment of Somatosensory Performance also has high reliability and validity, but has a disadvantage in that it is somewhat expensive to be applied clinically. In the previous study, the validity between rNSA and FMA-S was compared, and this study was used as the most similar evaluation tool[5][20].

Also there were other similar results about reliability and validity in other countries. Hornsveld et al. in Netherlands used 18 patients with intracranial disabilities for reliability testing using the Erasmus MC modifications of the Nottingham Sensory Assessment(EmNSA)[19]. The intra-rater reliability of the tactile sensations, sharp-blunt discrimination and the proprioception items of the EmNSA were generally good to excellent for both raters with a range of weighted kappa coefficients between 0.58 and 1.00. Likewise the inter-rater reliabilities of these items were predominantly good to excellent with a range of weighted kappa coefficients between 0.46 and 1.00[19]. Gaubert and Mockett found that the majority of subjects (n = 13) were found to have impaired stereognosis on their affected side. And a good level of reliability was found for the majority of items(n = 32), with kappa values being rated as substantial or higher for most of the objects tested(Gaubert & Mockett, 2000). Wu et al.(2016) in Taiwan studied to establish the concurrent validity(n=147). Correlation coefficients(0.79-0.95) were good to excellent between the rNSA and the FMA-S[19]. The rNSA proprioception measure was a predictor for the FMA-S[20].

This was the first study to investigate the reliability and validity of the K-rNSA. These findings may support the use of the K-rNSA by clinicians and researchers as a comprehensive measure to evaluate somatosensory impairments in people with stroke.

A few limitations of the study warrant consideration. 1) The validity of translation study experts may be deteriorated. In future studies, it is necessary to use the Delphi method to increase the validity of the tools. 2) The purpose of K-rNSA was to identify sensory

problems after stroke, and this study was intended to confirm reliability and validity, including all lesions, because it could affect sensory damage in several lesions due to stroke. Although this study was conducted with a small number of subjects, it was not possible to generalize, but it is thought that follow-up studies will be needed with a large number of subjects. 3) The time since stroke varied between patients, who were anywhere from the acute stage to the subacute stage post-stroke, which warrants an equivalence test to determine potential differences.

Therfore, We think K-rNSA achieved the standard level and can be feasible in clinical practice to assess sensory function following stroke in Republic of Korea.

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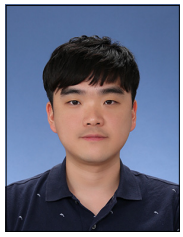

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