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ORIGINAL RESEARCH

Kessler Foundation Neglect Assessment Process Uniquely Measures Spatial Neglect During Activities of Daily Living

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Abstract

Objectives: To explore the factor structure of the Kessler Foundation Neglect Assessment Process (KF-NAP), and evaluate the prevalence and clinical significance of spatial neglect among stroke survivors.

Design: Inception cohort.

Setting: Inpatient rehabilitation facility (IRF).

Participants: Participants (N = 121) with unilateral brain damage from their first stroke were assessed within 72 hours of admission to an IRF, and 108 were assessed again within 72 hours before IRF discharge.

Interventions: Usual and standard IRF care.

Main Outcome Measures: During each assessment session, occupational therapists measured patients' functions with the KF-NAP, FIM, and Barthel Index (BI).

Results: The KF-NAP showed excellent internal consistency with a single-factor structure. The exploratory factor analysis revealed the KF-NAP to be unique from both the FIM and BI even though all 3 scales were correlated. Symptoms of spatial neglect (KF-NAP>0) were present in 67.8% of the participants at admission and 47.2% at discharge. Participants showing the disorder at IRF admission were hospitalized longer than those showing no symptoms. Among those presenting with symptoms, the regression analysis showed that the KF-NAP scores at admission negatively predicted FIM scores at discharge, after controlling for age, FIM at admission, and length of stay.

Conclusions: The KF-NAP uniquely quantifies symptoms of spatial neglect by measuring functional difficulties that are not captured by the FIM or BI. Using the KF-NAP to measure spatial neglect, we found the disorder persistent after inpatient rehabilitation, and replicated previous findings showing that spatial neglect adversely affects rehabilitation outcome even after prolonged IRF care.

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Spatial neglect is a disorder of spatial attention, affecting perception and mental representation of spatial information, and planning and execution of motor action. It is common after a brain injury such as stroke, occurring in approximately 50% of survivors with right-sided brain damage and 30% of those with left-sided brain damage (table 1).[1-7] Individuals with spatial neglect demonstrate a failure or slowness to respond, orient, or initiate action toward contralesional stimuli.[8] Therefore, spatial neglect disrupts mobility and navigation (walking,[9] wheelchair ambulation,[10] driving),[11] reading,[12] and social interactions.[13] Patients with this disorder have poorer rehabilitation outcomes, experience greater safety risk during hospitalization, and are hospitalized longer as compared with those without spatial neglect.[14,15]

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Table 1 Prevalence of spatial neglect after stroke with unilateral brain damage

Report* (Ordered Chronically)	Neglect Prevalence (Out of a Given Sample Size)		Neglect Assessment	Setting	Country
	Right-Sided Brain Damage	Left-Sided Brain Damage			
Gainotti et al,[1] 1972	42% (n=114)	31% (n=108)	Confrontation examination	Outpatient clinic	Italy
Denes et al,[2] 1982	33% (n=24)	21% (n=24)	Figure copying	Geriatric hospital	Italy
Fullerton et al,[3] 1986	49% (n=88)	25% (n=117)	Postural examination, cancellation tests, drawing	General hospital	Ireland
Stone et al,[4] 1993	82% (n=69)	65% (n=102)	Object pointing, reading, cancellation tests, coin selection, figure copying	General hospital	UK
McGlone et al,[5] 1997	62% (n=71)	31% (n=67)	Figure copying and drawing, line bisection, cancellation tests	General hospital	Canada
Kalra et al,[6] 1997	43% (n=75)	21% (n=70)	Confrontation examination, line bisection, cancellation tests, figure copying and drawing	General hospital	UK
Ringman et al,[7] 2004	43% (n=356)	20% (n=394)	Confrontation examination	Acute care hospital	U.S.
Present study	76% (n=85)	47% (n=36)	KF-NAP	Acute inpatient rehabilitation	U.S.
Overall	51% (N=881)	29% (N=918)			

* Reports were selected for their inclusion of stroke survivors with left-sided brain damage and those with right-sided brain damage.

Conventional detection of spatial neglect uses visual/sensory examination or paper-and-pencil tests. One example is a cancellation task, which requires crossing out all targets (eg, the letter "A") embedded among nontargets (eg, "E" and "Z") on a piece of paper, such as the Bells Test[16] or Star Cancellation.[17] These assessments are widely available in the clinical setting but create 2 challenges: (1) functional performance of daily activities related to spatial neglect is poorly captured, and (2) they may underdiagnose auditory, proprioceptive, or motor-intentional symptoms of spatial neglect.[18] To address these deficiencies, our group developed the Kessler Foundation Neglect Assessment Process (KF-NAP)[19,20] based on the Catherine Bergego Scale (CBS).[21,22] The CBS comprehensively examines functional performance in personal (body surface), peripersonal (within arm's reach), and extrapersonal spaces (beyond arm's reach), as well as performance in perceptual, mental imagery, and motor domains. Thus, the CBS can capture the heterogeneity of spatial neglect and is more sensitive than paper-and-pencil tests[19,23] to problems in activities of daily living (ADL).

We found that additional instructions were needed for reliable CBS administration, and developed the KF-NAP, which provides detailed administration instructions and a scoring chart for the 10 original CBS categories of behavior (fig 1).[19,20] We modified some CBS category labels to better convey the purpose of an observation, to include right-sided neglect symptoms or to shorten the wording. For example, "knowledge of left limbs" on the CBS[22] is revised to "limb awareness" on the KF-NAP. The 2012 version included 1 page of instructions to reduce ambiguity and increase reliability.[19] The *KF-NAP 2014 Manual* provides more detailed scoring and observation information.[20] The examiner is instructed to provide the patients with verbal prompts to initiate or perform certain behavior/actions, such as the following: "I cannot find your reading glasses. Can you tell me where they are?" "Show me how you would put this coat on." "Show me how you wash your face." "Show me how to get to the therapy gym." Clearly, none of the prompts include spatial cues suggesting locations or directions. Even when the patient asks for item(s), the examiner must give a neutral answer. For example, if the patient asks, "Where is the coffee?" during a meal (in the observation category of "eating"), the examiner may answer, "It is on the tray. Can you find it?"

Additionally, the KF-NAP specifies the environment where the observation takes place and observation of left-versus-right asymmetric performance. However, rather than testing functional ability in a specific situation, the KF-NAP emphasizes direct observation of spontaneous behavior and awareness for right-versus-left space during ADL. The main objective is to allow patients to spontaneously explore the environment, move their eyes/head, and initiate actions. It is important that both sides of space are assessed, so that the examiner can compare performance on the right versus left before scoring. Another distinction is that all 10 categories are observed during 1 session, which was not stressed in the original CBS. Depending on the category, patients are rated immediately during or immediately after the observation. Thus, it is based on direct observation rather than summarized impressions from large amounts of behavior.

Standardizing an observational assessment may change its properties. We conducted the present study to demonstrate the psychometric properties of the KF-NAP, its clinical feasibility, and its uniqueness in measuring ADL difficulties specific to spatial neglect. We assessed stroke survivors with unilateral brain damage in an acute inpatient rehabilitation facility (IRF) by using the KF-NAP and 2 common functional outcome measures, the FIM[24] and the Barthel Index (BI).[25] We had 3 objectives: (1) to determine the internal consistency and factor structure of the KF-NAP; (2) to examine whether the KF-NAP uniquely measures

List of abbreviations:

ADL	**activities of daily living**
BI	**Barthel Index**
CBS	**Catherine Bergego Scale**
IQR	**interquartile range**
IRF	**inpatient rehabilitation facility**
KF-NAP	**Kessler Foundation Neglect Assessment Process**

KF-NAP™ Scoring Sheet

Date:_____ Name of Examinee:_____

Time:_____ am/pm Examiner(s):_____

Kessler Foundation Neglect Assessment Process (KF-NAP™)

How to use the Catherine Bergego Scale to assess spatial neglect

	Category	0 no neglect	1 mild neglect	2 moderate neglect	3 severe neglect	NA (provide reasons)
1	Limb awareness					
2	Personal belongings					
3	Dressing					
4	Grooming					
5	Gaze orientation					
6	Auditory attention					
7	Navigation					
8	Collisions					
9	Eating					
10	Cleaning after meal					

Neglected side (circle one): ***left-sided*** spatial neglect; ***right-sided*** spatial neglect

Number of scored categories = _____ Sum of the score = _____ **Final Score =** _____

Neglect severity (circle one)**: Absent** (0); **Mild** (1-10); **Moderate** (11-20); **Severe** (21-30)

See the *KF-NAP™ 2014 Manual* for detailed instructions of each category.

Fig 1 Scoring chart of the KF-NAP (2014 version). Abbreviation: NA, not applicable.

ADL deficits that the FIM or BI does not; and (3) to evaluate the prevalence of spatial neglect and examine how the severity of spatial neglect predicts functional independence at the time of IRF discharge.

Methods

This study was approved by the institutional review boards of the authors' organizations. A consecutive sample of 121 stroke survivors (July 2012 through March 2014) met inclusion criteria, gave informed consent, and completed the first assessment within 72 hours of admission to 3 campuses of an IRF. Inclusion criteria were first stroke, unilateral brain damage, and being an adult (18–99 years of age). Because of unexpected early discharge, 13 participants were not reassessed within 72 hours of IRF discharge. Participating patients had no previous neurologic damage or psychiatric conditions.

Following a certification procedure established in 2012, 2 occupational therapists per IRF campus were trained to use the KF-NAP to competency standards for observing and scoring. They screened patients' eligibility and scheduled and administered both assessment sessions (40–60min per session), during which they measured patients' function with the KF-NAP, FIM, and BI. Occupational therapists were instructed to assess the same patient both at admission and at discharge. However, because of busy clinical duties, it was tolerated when occasionally 1 occupational therapist performed the admission assessment and the other performed the discharge assessment.

Kessler Foundation Neglect Assessment Process

The KF-NAP[19,20] consists of 10 categories: limb awareness, personal belongings, dressing, grooming, gaze orientation, auditory attention, navigation, collisions, eating, and cleaning after meal. Each is scored from 0 to 3, with higher scores indicating more severe neglect. The final score is the sum of all category scores, ranging from 0 to 30. If a category is impossible to score because of the patient's condition (eg, not able to use a wheelchair, eating restrictions), it is not included in the final score. In this case, the final score is calculated by averaging scores in the valid categories: (sum score ÷ number of scored categories) × 10 = final score.[22]

Of the participants, 112 were scored in all KF-NAP categories. Five participants missed 1 category (3 collisions, 1 eating, 1 auditory attention), 3 participants missed 2 categories (2 missed both eating and cleaning after meal, 1 missed both navigation and collisions), and 1 participant missed 3 categories (collisions, eating, cleaning after meal). Of the 108 participants completing the discharge assessment, 104 were scored in all categories: 3 participants missed 2 categories (2 missed both eating and cleaning after meal, 1 missed both navigation and collisions), and 1 participant missed 3 categories (collisions, eating, cleaning after meal). Overall, the following were the most commonly omitted categories, with the omission rates in parentheses (all vs participants with KF-NAP>0): collisions (3.1% vs 5.3%), eating (3.1% vs 5.3%), cleaning after meal (2.6% vs 4.5%), navigation (0.9% vs 1.5%), and auditory attention (0.4% vs 0.8%).

FIM

The FIM[24,26] consists of 18 items assessing the level of independence. The motor domain includes 13 items in the categories of self care, bladder and bowel management, transfers, and mobility; the cognition domain includes 5 items in comprehension, expression, social interaction, problem solving, and memory. Occupational therapists scored each FIM item using the instructions in the *IRF–Patient Assessment Instrument Training Manual*.[27] Each item is scored from 1 to 7, with higher scores indicating better function. Final scores ranged from 18 to 126.

Barthel Index

The BI[25,28] consists of 10 items. The range of scores is different for each item: feeding (0, 5, 10), bathing (0, 5), grooming (0, 5), dressing (0, 5, 10), bowels (0, 5, 10), bladder (0, 5, 10), toilet use (0, 5, 10), transfers—bed to chair and back (0, 5, 10, 15), mobility on level surfaces (0, 5, 10, 15), and stairs (0, 5, 10). The total score is the sum of the 10 items and ranges from 0 to 100, with higher scores indicating better function.

Data analyses

Because all the continuous variables were distributed in a non-normal fashion, we report medians and interquartile ranges (IQRs). All analyses were performed with STATA/SE 12.1.[a]

Objective 1: Reliability and factor structure of KF-NAP

We examined internal consistency with Cronbach alpha among those with admission KF-NAP scores >0 (n=82). In regards to factor structure, the KF-NAP categories were based on the CBS, for which Azouvi et al[23] reported 1 underlying factor, but Goedert et al[18] found 2. To examine the factor structure, we included patients with KF-NAP scores >0 at admission and no missing items (n=73). Following a confirmatory factor analysis in which the previously reported 1- and 2-factor solutions performed similarly (see supplemental appendix S1, available online only at http://www.archives-pmr.org/), we performed an exploratory factor analysis with an oblique promax rotation, because this rotation method is appropriate when latent factors are likely correlated.[29,30] We retained factors with eigenvalues (λ) >1.0 that were not also produced by parallel analysis of random data structures with 50 repetitions.[30,31]

Objective 2: Uniqueness of KF-NAP

Many studies choose FIM or BI as the functional outcome measure because they share similar factor structures.[32] The KF-NAP may capture neglect-specific ADL performance not captured by the FIM or BI. To examine this hypothesis, we performed an exploratory factor analysis with oblique promax rotation, using all items from the KF-NAP, FIM, and BI. We reverse-coded KF-NAP so that higher scores indicate better function on all scales. We used the same factor retention principles as in objective 1.

Objective 3: Prevalence of spatial neglect and its impact on functional outcome at IRF discharge

Some clinicians assume that spatial neglect will resolve completely during inpatient hospitalization. We calculated the percentage of patients with spatial neglect at admission and discharge. Additionally, we examined whether neglect severity at admission predicted rehabilitation outcome (FIM scores) at discharge by using a linear regression analysis, controlling for age, side of stroke, admission FIM, and length of IRF stay.

Results

Of 121 participants (68 women, 53 men; median age, 70y), 36 had a stroke in their left hemisphere, and 85 had a stroke damaging their right hemisphere. Participants were admitted to IRF a median of 6 days poststroke. There was no significant difference in sex ratio, age, handedness, ethnicity, or race between participants who had spatial neglect (KF-NAP>0) and those who had no symptoms (table 2).

Objective 1: Reliability and factor structure of KF-NAP

Cronbach alpha was .96, indicating excellent internal consistency. The factor analysis suggested a 1-factor solution with an eigenvalue of 6.86 (table 3), accounting for 94.0% of the variance. The extracted second factor had an eigenvalue of only .37, and parallel analysis produced a second factor with a greater eigenvalue (λ=.45), suggesting this second factor resulted from noise in the data.

Objective 2: Uniqueness of KF-NAP

The FIM, BI, and KF-NAP were all intercorrelated (table 4), with all Bonferroni-corrected pairwise comparisons reaching significance. However, factor analysis revealed that the KF-NAP accounted for additional variance in patients' performance (11.6%) not captured by the FIM or BI (table 5). The KF-NAP items loaded onto a single factor (factor loadings>.40) that was distinct from 2 other factors containing subsets of FIM and BI items.

Objective 3A: Prevalence of spatial neglect

At IRF admission, 67.8% of participants (n=82) showed symptoms of spatial neglect (table 6), and their median KF-NAP score was 7 (IQR=3–16). Among the 36 participants with left-sided brain damage, 17 had KF-NAP scores >0, suggesting the presence of spatial neglect (median, 5; IQR=2–7). Of the 85 participants with right-sided brain damage, 65 had positive KF-NAP scores (median, 8.9; IQR=3–16). The presence of spatial neglect was more frequent after right-sided than left-sided brain damage (76.5% vs 47.2%; Fisher exact test, $P=.002$). However, side of stroke did not predict severity of spatial neglect (2-sample U test, $P=.138$).

At IRF discharge (see table 6), 47.2% of participants (51/108) showed symptoms of spatial neglect (KF-NAP>0; median, 6; IQR=3–12). Of the 34 patients with left-sided brain damage, 9 were discharged with symptoms of spatial neglect (median KF-NAP, 5; IQR=3–13), as were 42 of the 74 patients with right-sided brain damage (median, 6; IQR=2–11). Presence of spatial neglect remained more frequent after right-sided than left-sided brain damage at IRF discharge (56.8% vs 26.5%; Fisher exact test, $P=.004$), but severity of spatial neglect was again not predicted by side of stroke ($P=.833$).

In patients with spatial neglect at admission (n=74), KF-NAP improved an average of .2 points per day over the hospitalization period, a rate significantly >0 (Kolmogorov-Smirnov test, $P<.001$). There was no difference in KF-NAP improvement between participants with left-sided brain damage and those with right-sided brain damage (U test, $P=.648$).

Objective 3B: Clinical impact of spatial neglect

Those with spatial neglect at admission (ie, KF-NAP>0) had a lower admission FIM than those without neglect (median, 56 vs 82; U test, $P<.001$). The same pattern emerged at IRF discharge (median, 88.5 vs 112; U test, $P<.001$). However, patients with spatial neglect stayed almost 10 days longer in inpatient rehabilitation (see table 2). Thus, the presence of spatial neglect adversely affected rehabilitation outcomes.

We further examined whether the severity of spatial neglect, in addition to its presence, impacted rehabilitation outcomes. Using a

Table 2 Demographic and clinical information of study participants at admission

Characteristics	All N=121	No Spatial Neglect (KF-NAP=0; n=39)	Spatial Neglect Present (KF-NAP>0; n=82)	*P* (Comparison Between Groups)
Sex				
Men	53	16	37	.411*
Women	68	23	45	
Age (y)	70 (61–81)	69 (58–82)	71 (61–80)	.816†
Handedness				
Left	12	4	8	1.000‡
Right	108	35	73	
Ambidextrous	1	0	1	
Ethnicity				
Hispanic	11	6	5	.096*
Non-Hispanic	110	33	77	
Race				
White	78	20	58	.090‡
Black	22	8	14	
Asian	3	2	1	
Other (including those identifying "Hispanic" as race)	17	8	9	
Unknown	1	1	0	
Lesioned hemisphere				
Left	36	19	17	.002*
Right	85	20	65	
Time poststroke (d)	6 (4–9)	5 (4–9)	7 (4–9)	.458†
Length of stay (d)	20 (12–25)	13 (9–18)	22.5 (16–27)	<.001†

NOTE. Values are n, median (IQR), or as otherwise indicated.
* Fisher exact test.
† *U* test.
‡ Freeman-Halton test.

linear regression model, we found that greater neglect severity (KF-NAP score) at admission predicted lower FIM discharge scores (square-root transformed; $b \pm$ SE, $-.033 \pm .015$; 95% confidence interval, $-.063$ to $-.003$; $\beta = -.23$, $P = .033$) after controlling for age, side of stroke, admission FIM, and length of stay. Thus, initial severity of spatial neglect predicted functional independence after inpatient rehabilitation.

Discussion

The KF-NAP provides comprehensive and clear observational methods for assessment and scoring of the CBS,[19,20] measuring patients' symptoms of spatial neglect while performing ADL.[21,22] In the present study, we found excellent internal consistency and a single-factor structure in the KF-NAP, consistent with 1 study[23] but not another,[18] both of which examined the CBS without reporting a standardized assessment process. Thus, the process of the KF-NAP may increase consistency among the observational categories. Most (>94%) of the participants were scored in all KF-NAP categories by occupational therapists, suggesting excellent feasibility of using the assessment within the therapists' clinical routines. Omissions in scoring occurred <5% of time and were likely to involve assessment of collisions, eating, cleaning after meal, navigation, or auditory attention. Since the KF-NAP measures 1 single factor, occasional missing observations should not diminish its validity; we recommend, however, that clinicians observe all categories to optimize its applicability.

Table 3 Rotated factor loading pattern of KF-NAP at admission (n=73)

Categories	Factor 1 (λ=6.86)
Grooming	.77*
Eating	.68*
Dressing	.53†
Auditory attention	.33*
Cleaning after meal	.33*
Personal belongings	.28*
Limb awareness	.25†
Collisions	.25†
Gaze orientation	.07*
Navigation	−.02†

*,† Items loading onto separate factors in the prior study of acute patients using the CBS,[16] without the KF-NAP process.

Table 4 Pairwise Spearman correlation coefficients (ρ) among KF-NAP, mFIM, cFIM, FIM, and BI

	Admission (n=82)				Discharge (n=51)			
Measure	KF-NAP	mFIM	cFIM	FIM	KF-NAP	mFIM	cFIM	FIM
mFIM	−.61				−.65			
cFIM	−.43	.53			−.47	.54		
FIM	−.62	.96	.72		−.65	.98	.68	
BI	−.56	.93	.53	.91	−.58	.90	.49	.88

NOTE. All *P* values <.00001.
Abbreviations: cFIM, cognitive FIM; mFIM, motor FIM.

Table 5 Rotated factor loading pattern of the reverse-coded KF-NAP, FIM, and BI at admission (n=73)

Factor No. (λ) % of Variance	1 (λ=17.99)	2 (λ=3.74)	3 (λ=2.87)
Item	55.5%	11.6%	8.9%
FIM transfers: toilet	1.00*	.07	−.03
FIM transfers: tub, shower	.85*	.06	−.04
FIM toileting	.85*	−.06	−.03
FIM dressing—lower body	.79*	.17	.15
FIM transfers: bed, chair, wheelchair	.67*	.02	−.06
BI toilet use	.62*	.04	.08
BI transfers	.59*	.04	.04
BI mobility	.59*	−.03	.02
FIM stairs	.51*	.01	−.03
BI dressing	.49*	.01	.15
FIM bathing	.48*	−.03	.20
FIM walk/wheelchair	.45*	.00	−.01
KF-NAP gaze orientation	.06	.92*	−.06
KF-NAP navigation	.01	.90*	.08
KF-NAP dressing	.07	.88*	−.01
KF-NAP personal belongings	.05	.88*	−.03
KF-NAP collisions	.02	.76*	−.04
KF-NAP grooming	.11	.75*	.00
KF-NAP eating	−.12	.72*	−.05
KF-NAP limb awareness	−.04	.56*	.03
KF-NAP auditory attention	.04	.54*	.01
KF-NAP cleaning after meals	−.04	.51*	.11
FIM dressing—upper body	.40	.02	.67*
FIM expression	−.01	−.03	.14
FIM grooming	.15	.05	.05
FIM social interaction	.02	.03	.04
FIM problem solving	.07	.05	.04
BI bathing	−.04	.03	.02
BI bowels	.08	−.02	.01
FIM memory	−.01	−.04	.00
FIM bladder management	.14	.02	−.01
BI grooming	.02	−.08	−.03
BI bladder	.04	−.02	−.03

* The factor loading that was the highest and with the value >.40 of a given item.

Importantly, we found that the KF-NAP is different from the FIM or the BI but significantly correlated with them. All these assessment tools help examine deficits during ADL but have different emphasis. The FIM measures burden of care, and the BI measures the assistance that patients need in daily life function. The FIM and BI both measure general functions, which may be affected by spatial neglect, but they do not provide specific information on whether poor functional performance is affected by spatial neglect. The KF-NAP measures patients' awareness of body-environment spatial relations during ADL. Thus, the KF-NAP measures ADL performance deficits that are not captured by the FIM or BI.

Using the KF-NAP score to determine the presence of spatial neglect, we found the prevalence of the disorder to be high: 67.8% at admission and 47.2% at IRF discharge. It is not clear whether the decrease from admission to discharge is due to spontaneous stroke recovery, the effect of rehabilitation therapies, or a combination of the two. However, even after rehabilitation, a large proportion of patients were discharged with symptoms of spatial neglect. The present findings are consistent with reports of patients and caregivers that patients encounter difficulties with everyday tasks and community participation.[33,34] Thus, continued outpatient treatment for people with spatial neglect is desirable.

Lastly, consistent with previous research,[14,15] we found that spatial neglect and its severity are predictive of poor rehabilitation outcomes even after prolonged IRF stays. This has important fiscal and policy implications, in that spatial neglect can seriously hamper motor and functional improvement. Early detection and timely treatment may reduce its impact.

Study limitations

While our findings suggest the potential of using the KF-NAP as part of ADL assessment in clinical settings, there are a few limitations. Occupational therapists performed all the KF-NAP, FIM, and BI assessments in this study. However, in most IRFs, the FIM is assessed by a multidisciplinary team including occupational therapists, physical therapists, speech and language pathologists, and nurses. It is likely that the KF-NAP can also be administered by professionals from different disciplines who receive proper training. A study examining intrarater reliability of examiners from multiple disciplines using the KF-NAP may be warranted.

Another possible limitation is selection bias. It took 21 months to enroll and assess 121 study participants in the hosting IRF system, which admits more than 1200 stroke survivors annually. Patients with multiple strokes and bilateral brain damage were not represented in the study. Occupational therapists also recruited twice as many stroke survivors with right-sided brain damage as with left-sided brain damage. As a result, we were not able to separately examine the psychometric properties of the KF-NAP for left-sided versus right-sided brain damage, because the sample of stroke survivors with left-sided brain damage was too small. Thus, a larger-scale study better representing the stroke population, including equal numbers of stroke survivors with right-sided brain damage and with left-sided brain damage, is needed.

Conclusions

The KF-NAP is a clinically feasible method to observe spatial neglect systematically during ADL. With excellent internal consistency and a single-factor structure, the KF-NAP can be a standard process for measuring spatial neglect using the CBS items. Using the KF-NAP as the measure of spatial neglect, we found that spatial neglect is persistent after inpatient care is completed and adversely affects rehabilitation outcome even after prolonged IRF care.

Supplier

a. StataCorp LP.

Table 6 Prevalence of spatial neglect

	No Neglect	Mild Neglect	Moderate Neglect	Severe Neglect	Presence of Spatial Neglect
KF-NAP score	0	1—10	11—20	21—30	1—30
Admission					
Left-sided brain stroke (n=36)	19 (52.8)	13	1	3	17 (47.2)
Right-sided brain stroke (n=85)	20 (23.5)	35	19	11	65 (76.5)
Total (N=121)	39 (32.2)	48	20	14	82 (67.8)
Discharge					
Left-sided brain stroke (n=34)	25 (73.5)	6	3	0	9 (26.5)
Right-sided brain stroke (n=74)	32 (43.2)	30	10	2	42 (56.8)
Total (N=108)	57 (52.8)	36	13	2	51 (47.2)

NOTE. Values are n (%), n, or as otherwise indicated.

Keywords

Hemispatial neglect; Outcome assessment; Rehabilitation; Symptom assessment

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Supplemental Appendix S1 Confirmatory Factor Analysis for Objective 1

Azouvi et al[1] suggested that the Catherine Bergego Scale (CBS) was a 1-factor—structured scale, and Goedert et al[2] suggested that a 2-factor structure underlies the CBS. Since the Kessler Foundation Neglect Assessment Process (KF-NAP) is a process using the same assessing categories as the CBS, it is important to know whether CBS scores assigned after the KF-NAP assessment process have 1 or 2 underlying factors. Therefore, to confirm whether a 1-factor or 2-factor structure underlies the KF-NAP, we built 2 structural equation models (SEMs) in this confirmatory factor analysis (CFA). The specific models were as follows:

- *Model 1: 1-factor SEM.* One latent factor subserved each of the 10 KF-NAP categories.[1]
- *Model 2: 2-factor SEM.* One latent factor subserved grooming, auditory attention, gaze orientation, personal belongs, eating, and cleaning after meal. The other factor subserved limb awareness, dressing, navigation, and collisions.[2] The covariance between the 2 factors was included in the model.

We performed a preliminary analysis to select the best model fitting the variance-covariance matrix by combining unrestricted, equal, or zero variances with unrestricted, equal, or zero covariances. The result suggested the unstructured variance-covariance matrix (unrestricted variances and covariances) with maximum likelihood estimation be used in the analysis. We included participants without missing data and with positive KF-NAP scores. There was no significant difference between the two models ($\chi_1^2 = .99$, $P = .321$). In addition, both models did not reach 2 of the 3 model-fitting guidelines (supplemental appendix table S1). It is possible that the SEM was not the best method to perform CFA because CFA often assumes independence among observed items.[3] We followed up with exploratory factor analysis and reported the results in the Results section of the article.

Supplemental Appendix Table S1 Model comparison

SEM Model Fit Index	Model 1	Model 2	Recommended Good Fit Guideline[3]
χ^2 (*df*) Model vs saturated	85.90 (35), $P<.001$	84.91 (34), $P<.001$	NA
Root mean squared error of approximation	.141	.143	<.06
Akaike information criterion correction	1452.08	1453.10	NA
Comparative fit index	.924	.924	>.95
Standardized root mean squared residual	.039	.039	<.08
χ^2 (*df*) Model 1 vs model 2	NA	.99 (1), $P=.321$	NA

Abbreviation: NA, not applicable.

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