# Reliability and validity of the neuropsychiatric inventory-questionnaire using a rasch analysis.

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## Abstract

**Objective: The Neuropsychiatric Inventory-Questionnaire (NPI-Q) is a commonly used measure in clinical work and research. The purpose of this study was to expand on the limited psychometric testing of this measure, and extend testing to include hospitalized older adults.**

**Methods: This was a descriptive study using data from the first 318 dyads in an ongoing cluster randomized clinical trial testing the efficacy of Family-centered Function-focused Care. The NPI-Q, the AD8 Dementia Screening Interview, the Pfeffer Functional Activities Questionnaire, the Clinical Dementia Rating Scale and the Confusion Assessment Method Severity were completed. Rasch analysis was used to evaluate internal consistency, invariance using a DIF analysis, and construct validity based on evidence that the items fit the Rasch measurement model. Hypothesis testing evaluated the association between the NPI-Q and other cognitive and functional measures.**

**Results: The majority of the 318 participants were female (62%), Non-Hispanic (98%), and black (50%) with a mean age of 81.62 (SD=8.43). There was evidence of internal consistency for all subscales (behavior, severity and caregiver distress) and evidence of invariance across race and gender. The items on the NPI-Q fit with each subscale. Hypothesis testing was supported with a significant association between the AD8 and MoCA with behaviors and severity and the AD8 and caregiver distress.**

**Conclusions: The NPI-Q is short, easy to complete, and reliable and valid when used with hospitalized older adults.**

**Keywords**: Behavioral symptoms, Dementia, Rasch analysis, Measurement.

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## Introduction

It is estimated that by 2030 there will 82 million persons living with dementia and this will increase to 152 million by 2050 [1]. Approximately 90% of these individuals will experience Behavioural and Psychological Symptoms of Dementia (BPSD) including aggression, agitation, depression, anxiety, apathy, delusions, hallucinations, restiveness to care, sleep issues, and alterations in appetite and eating behaviour [2,3]. BPSD contribute to negative health outcomes [4,5], a decline in physical functioning [4,5], caregiver burden [6], and inappropriate medication use [7]. Persons living with dementia comprise one fourth of hospitalized older adults and are twice as likely to be hospitalized as those without dementia [8,9]. Three-quarters of hospitalized persons living with dementia display BPSD [10]. These behaviours cause significant distress to family and staff during the hospitalization and are associated with accelerated and lasting functional and cognitive impairment, increased resource consumption, institutionalization, premature death, and care dependency [10-12].

The measurement of behavioural symptoms is generally done by obtaining input from caregivers or via direct observation of the person living with dementia. Direct observation by an objective evaluator, which would be ideal, is not practical as these behaviours can occur at any time and thus twenty-four-hour daily observation would be necessary. There are several measures which have been developed and tested using input from caregivers including the Behavioural Pathology in Alzheimer's Disease Rating Scale [13], the Cornell Scale for Depression in Dementia [14], the Alzheimer's Disease Assessment Scale-Cognitive-Plus [15], the Behavioural and Emotional Activities Manifested in Dementia (BEAM-D) Scale [16], the Cohen-Mansfield Agitation Inventory [17], the Caretaker Obstreperous-Behavior Rating Assessment Scale [18], the Dementia Signs and Symptoms Scale [19] the Neurobehavioral Rating Scale [20], and the Neuropsychiatric Inventory (NPI) [21] among others [22]. Although somewhat similar in terms of content, these measures vary in the period of observation or reporting of information, the number of symptoms addressed and whether or not severity, frequency or impact on caregivers are considered.

One of the most comprehensive and commonly used measures, particularly in research, is the NPI [21]. Prior testing of the NPI provided evidence of reliability and validity [13, 21]. Use of this measure required training and took an extensive period of time and was therefore not practical for clinical work or pragmatic research. In 2000 a briefer assessment, referred to as the Neuropsychiatric Inventory-Questionnaire (NPI-Q) was

developed [23]. This measure includes one item from each of the 12 domains included in the longer NPI. The domains include delusions, hallucinations, agitation/aggression, depression/dysphoria, anxiety, elation/euphoria, apathy/indifference, disinhibition, irritability/lability, motor disturbance, night time behaviours, and appetite/eating. Each behaviour has a simple description and is scored as either present or not present, if present the severity is evaluated as mild, moderate, or severe, and lastly the impact that the behaviour has on the caregiver is assessed (not at all distressing, minimal, mild, moderate, severe, or extremely severe). Initial testing of the NPI-Q [23] was done with 60 older adults in an outpatient setting. The majority of these participants had at least a probable diagnosis of dementia and a mean age of 76 (SD=8). There was support for test-retest reliability among 15 individuals (r=0.80), and evidence of convergent validity based on significant correlations with the full NPI as well as individual items and domains. Moreover, the NPI-Q seemed to identify more behaviours in participants than the full NPI.

Three other studies of community residing older adults were noted to test the reliability and validity of the NPI-Q24-26. Similarly, these studies addressed convergent validity with comparisons with the full NPI. The study by Wong et al. was conducted with a sample of 876 stroke patients with a mean age of 74 (SD=10) and the majority had some evidence of dementia. There was evidence of test-retest reliability based on 20 individuals (r=0.99) and the internal consistency of the measure with an alpha coefficient of 0.76. Correlations between the NPI-Q and NPI were significant for behaviour (r=0.66), severity (r=0.66) and caregiver distress (r=0.58) [24]. In the Rogne study [25], only convergent validity was considered and the sample was small including 25 Norwegian patients. The findings were similar to the other validity studies with evidence of significant correlations between the full NPI and the NPI-Q with regard to behaviour, severity, and caregiver distress. Lastly, the study by Camozzato A, et al. [26]. Tested a Brazilian version of the NPI-Q and demonstrated internal consistency and construct validity.

To expand on the limited psychometric testing of this commonly used measure, and extend use to include hospitalized older adults, the purpose of this study was to evaluate the psychometric properties of the NPI-Q based on Rasch analysis in a hospitalized sample. Rasch analysis has the advantage of evaluating each item comprehensively by considering the linear probabilistic relationship between the person's ability and the difficulty of the item. Fit statistics are provided to indicate how well each item fits to the concept and group of participants in the study. Further, Rasch model testing helps to identify if there are individuals so high or so low in behavioural symptoms that they cannot be differentiated from other individuals. Lastly, a Differential Item Functioning (DIF) analysis can be done to determine if the measure is invariant or if there are items that work differently among different groups of individuals (e.g., males or females). The hypotheses for this study included the following: There would be evidence of (1) internal consistency of the NPI-Q based on item reliability (consistent with an alpha coefficient) and reliability based on evidence that the measure was invariant between males and females and white and black participants; and (2) validity based on item fit, mapping, and hypothesis testing. Specifically, it was hypothesized that controlling for age, gender, race, and delirium there would be a significant association between the NPI-Q and cognition and function among hospitalized persons living with dementia.

## Materials and Methods

### *Design*

This was a descriptive study using data from an ongoing cluster randomized clinical trial (ClinicalTrials.gov identifier: NCT03046121) testing the efficacy of Family-centered Function-focused Care [27]. The study was approved by a University based Institutional Review Board.

### *Setting/Sample*

The first 321 enrolled persons living with dementia and their family caregivers from six medical units in three hospitals were included in this analysis. Eligibility criteria included: age 65 years or older, English or Spanish speaking, screened positive for dementia based on the Montreal Cognitive Assessment (MoCA ≤ 25) [28], had a Dementia Screening Interview (AD8) score of ≥ 2 [29,30], had a diagnosis of very mild to moderate stage dementia as confirmed by a score of 0.5 to 2.0 on the Clinical Dementia Rating Scale (CDR) [31], and had a family caregiver. Older adults were excluded from the study if they had mild cognitive impairment (CDR 0.5 without functional or ADL impairments), any significant neurological condition associated with cognitive impairment other than dementia (e.g., brain tumor), a major acute psychiatric disorder, had no family caregiver to participate, and were enrolled in hospice or living in a nursing home. Data analysis was done with the 318 participants that had complete baseline data.

A total of 1514 older adults were eligible and of these 320 were not approached as the individual was not available (n=36, 11%), was discharged (n=161, 50%), the legally authorized representative could not be reached to complete the consent process (n=105, 33%), or other scheduling issues (n=18, 6%). Of the 1194 approached, 426 (36%) consented, and 392 persons living with dementia (51%) and 386 (37%) caregivers declined. One hundred and five (25%) consented but were not enrolled as they did not meet final eligibility criteria for dementia (n=38, 36%), withdrew from the study (persons living with dementia n=21, 20%; caregiver n=28, 27%), or transferred off the unit (n=17, 16%). A total of 321 dyads were enrolled (27% of those approached) and 318 dyads with complete NPI-Q data were included in this analysis.

### *Measures*

Descriptive data included age, gender, race, ethnicity, co-morbidity, and cognition. Comorbid conditions were based on the Charlson Comorbidity Index [32]. Cognition was evaluated using the Montreal Cognitive Assessment (MoCA) [28] which evaluates executive function, orientation, memory, abstract thinking, and attention. Prior testing of this measure supported the reliability and validity and sensitivity for identifying mild cognitive impairment (90%) and early Alzheimer's disease (100%) as well as specificity (87%) [28].

The AD8 Dementia Screening Interview 29 is a validated brief 2-minute interview to detect dementia by assessing changes in eight cognitive and functional domains. Scores on the AD8 of ≥ 2 are indicative of dementia. Prior testing supported evidence of reliability and validity of the AD8 based on correlations with the Clinical Dementia Rating (CDR) Scale and dementia biomarkers [30]. Functional ability, based on cognition and some instrumental functional activities such as completing finances, was assessed with the Pfeiffer Functional Activities Questionnaire (FAQ) [33]. The FAQ is a reliable and valid 10-item informant-completed survey, used to discriminate MCI from dementia, and is scored such that those with higher scores have more functional impairment [33]. The Clinical Dementia Rating (CDR) scale also considers cognitive and functional ability and helps determine the severity of dementia. Six functional areas are evaluated including memory, orientation, judgment and problem solving, community affairs, home and hobbies, and personal care. Scores range from 0 to 18 with higher scores indicative of greater impairment. Prior research provided evidence of reliability and validity [31].

Delirium severity was based on the Confusion Assessment Method Severity (CAM-S) Short Form [34]. Acute onset and fluctuating course are scored as no (0) or yes (1). Inattention and disorganized thinking are each scored as "absent" (0 points), present in mild form (1 point), or present in severe form (2 points). The fourth item, altered level of consciousness, is scored as alert or normal (0 points), vigilant or lethargic (1 point), and stupor or coma (2 points). Scores range from 0-7, with a higher score indicating greater severity of delirium. The CAM-S Short Form has demonstrated strong psychometric properties and associations with important clinical outcomes including length of stay, functional decline, nursing home placement, and death [34].

The NPI-Q, as described above, is a 12-item, reliable and valid informant-based assessment of neuropsychiatric symptoms [35]. The informant (family caregiver) was asked to respond to items based on whether or not the behaviour was present (range 0 to 12), if present the severity of the behaviour (range 12-36) and lastly how distressing the behaviour was for the caregiver (range 0-60). Across all subscales higher scores are indicative of more behavioural symptoms, greater severity and impact on caregivers.

### *Procedures*

After consent and screening for eligibility, the participants were assessed by trained research staff. Demographic and descriptive information was extracted from the electronic health record, including age, gender, race, ethnicity, and co-morbidity and the MoCA exam was completed. Behavioural and functional assessments were obtained from the family caregivers within 48 hours of admission.

### *Data analysis*

Descriptive statistics were done to describe the sample using SPSS version 24.0 and the Win steps statistical program to complete the Rasch Analysis. Log-10 transformations were done for the NPI-Q outcomes of severity and caregiver distress due to a moderate positive skew. Prior to reliability and validity testing the measure was evaluated to determine if it was unidimensional based on a dimensionality analysis. A principal components (standardized residual) factor plot was obtained and showed that the first factor extracted 1.6 units out of 12 units of NPI-Q residual variance noise, or 13%. This supported the finding that the measure was unidimensional since the first factor explained less than 15% of the variance [36].

### *Reliability testing*

Testing of the internal consistency of the NPI-Q was done using a Rasch measurement model and item reliability [36]. A person separation index, which is the equivalent of internal consistency based on logit values [37,38] was obtained. A minimum value of 0.7 was considered sufficient evidence of internal consistency [38]. In addition to internal consistency, a DIF analysis was done to determine if the measure was reliable when use across different groups [39]. Comparisons were considered between male *vs.* female and white *vs.* black persons living with dementia.

### *Validity testing*

Validity testing was based on construct validity and evidence that the items fit the data and were all consistent with neuropsychiatric symptoms commonly seen in dementia. The Win steps statistical program was used to establish the fit of each item based on INFIT and OUTFIT statistics. INFIT and OUTFIT statistics were considered acceptable if they ranged between 0.4 and 1.6 [40]. An INFIT or OUTFIT value of less than 0.4 suggests that the item may be redundant. An INFIT or OUTFIT value of greater than 1.6 indicates that the item may not be indicative of common neuropsychiatric symptoms [36]. In addition to establishing item fit, item mapping was also considered to determine if the items covered the full scope of BPSD.

Hypothesis testing was done to establish construct validity. It was hypothesized that, controlling for age, gender, race, and delirium there would be a significant association between the NPI-Q and cognition based on the MoCA, the AD8, the CDR, and the FAQ. A linear regression analysis was done and after entering the control variables, a stepwise analysis was used with an entry level of < .05 and a removal level of > 0.10. A significance level of $p < 0.05$ was used in all analyses. The sample was sufficient to assure a reliable model and powered to identify an $R^2$ of .04 [41].

## Results

As shown in Table 1, the majority of the 318 participants were female (62%), non-Hispanic (98%), and black (50%), with remaining representing white (48%) Asian (1%), and mixed race (1%). The mean age was 81.62 (SD=8.43) and they had 3.79 (SD=2.42) comorbidities. As per eligibility they all had dementia with a mean AD8 of 5.95 (SD=1.83), a FAQ of 22.39 (SD=6.86), a MoCA of 10.67 (SD=6.98), and a CDR of 1.26 (SD=0.43) and a CAM-S of 1.46 (SD=1.73). The mean number of behaviours noted on the NPI-Q was 4.36 (SD=2.58), the mean severity score was 7.39 (SD=6.05), and the mean distress score was 9.20 (SD=9.14). Table 2 provides the frequencies of each behaviour among the persons living with dementia

with night time behaviours being the most prevalent at 56% and elation/euphoria being the least prevalent at 7%. There were 18 individuals (6%) that had no evidence of behavioural symptoms and the remaining participants were well distributed demonstrating 1 (8% of participants) to 12 behaviours (.5%) with the majority ranging from 2 to 6 behaviours (65%).

### *Reliability*

With regard to reliability, all three subscales had good item reliability with the NPI-Q subscale for behaviour showing a separation index of 6.66 and a reliability measure of .98. The separation index for the severity subscale was 6.55 with a reliability measure of .98. Lastly, the distress subscale resulted in a separation index of 5.55 and a reliability measure of .97. There was evidence that the measure was invariant when used with males and females as there was no significant difference in responses across all items. With regard to race, there was only a difference with regard to depression such that whites were more often noted to have depressive symptoms than blacks and these symptoms were more likely to be rated as severe. For caregiver distress between blacks and whites there was no evidence of DIF across any of the items.

### *Validity*

As shown in Table 3, all of the items on the NPI-Q fit with the concepts of behavioural symptoms associated with dementia

***Table 1.*** *Descriptive data of hospitalized patient samples(Accepted from Barbara Resnick et al,2021).*

| Variables | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| Patient age | 65 | 105 | 81.62 | 8.43 |
| Comorbidities | 0 | 12 | 3.79 | 2.42 |
| Dementia Screening Interview (AD8) | 2 | 8 | 5.95 | 1.83 |
| Functional Activities Questionnaire (FAQ) | 9 | 33 | 22.39 | 6.86 |
| Clinical Dementia Rating (CDR) | 1 | 2 | 1.26 | .43 |
| Montreal Cognitive Assessment | 0 | 25 | 10.67 | 6.98 |
| Confusion Assessment Method Severity (CAM-S Short Form) | 0 | 7 | 1.46 | 1.73 |
| Barthel Index | 3 | 100 | 60.29 | 27.66 |
| Neuropsychiatric Inventory: Behavior Present | .00 | 12.00 | 4.36 | 2.58 |
| Neuropsychiatric Inventory: Distress | .00 | 44.00 | 9.20 | 9.14 |
| Neuropsychiatric Inventory: Severity | 0 | 30 | 7.39 | 6.05 |
| **Gender** | **--** | **--** | **N** | **%** |
| Male | -- | -- | 123 | 38 |
| Female | -- | -- | 198 | 62 |
| **Race** | | | | |
| White | -- | -- | 155 | 48 |
| Black/Other | -- | -- | 160 | 50 |
| Asian | -- | -- | 3 | 1 |
| Mixed race | -- | -- | 3 | 1 |
| **Ethnicity** | | | | |
| Hispanic | -- | -- | 6 | 2 |
| Non-Hispanic | -- | -- | 315 | 98 |

***Table 2.*** *Frequency of behaviors noted (N=318(Accepted from Barbara Resnick et al,2021).*

| Item | N (%) |
|---|---|
| **Delusions** | |
| Present | 86 (27) |
| Not Present | 232 (72) |
| **Hallucinations** | |
| Present | 62 (19) |
| Not Present | 256 (81) |
| **Agitation/aggression** | |
| Present | 175 (55) |
| Not Present | 143 (45) |
| **Depression/Dysphoria** | |
| Present | 142 (45) |
| Not Present | 176 (55) |
| **Anxiety** | |
| Present | 138 (43) |
| Not Present | 180 (57) |
| **Elation/Euphoria** | |
| Present | 24 (7) |
| Not Present | 294 (93) |
| **Apathy/Indifference** | |
| Present | 126 (40) |
| Not Present | 192 (60) |
| **Disinhibition** | |
| Present | 73 (23) |
| Not Present | 245 (77) |
| **Irritability/lability** | |
| Present | 169 (53) |
| Not Present | 149 (47) |
| **Motor Disturbance** | |
| Present | 70 (22) |
| Not Present | 248 (78) |
| **Night-time Behaviors** | |
| Present | 177 (56) |
| Not Present | 141 (44) |
| **Appetite/Eating** | |
| Present | 145 (46) |
| Not Present | 173 (54) |

for behaviour, severity and caregiver distress. The INFIT and OUTFIT statistics for behavior ranged from .92 to 1.55, for severity the range was .74 to 1.30, and for distress the range was .69 to 1.41. Results for item mapping are shown in Table 4. Results were somewhat similar for the presence of the behavior and severity of behavior with a few differences between the most and least commonly noted behaviours. For the presence of the behavior, the most commonly noted symptom was night time behaviors, followed by agitation/ aggression, irritability/lability, depression, appetite, anxiety, apathy, delusions, disinhibition, motor disturbance, hallucinations, with the least commonly endorsed symptom being elation/euphoria. There were 116 individuals so low in behavioral symptoms that they could not be differentiated. There were no participants that were so high in behavioral symptoms that they could not be differentiated. For severity of the behavior, the most commonly noted symptom was night time behavior, followed by appetite, agitation/aggression, irritability/lability, depression, apathy, anxiety, delusions, motor disturbance, hallucinations, and lastly elation/euphoria. There were 192 individuals that were so low in severity of symptoms that they could not be differentiated and there were none so high in severity that they could not be differentiated.

Mapping was somewhat different for distress of caregivers. The most commonly noted distressing behaviour was agitation/ aggression, followed by depression, anxiety, night time behaviours, apathy, delusions, disinhibition, hallucinations, motor disturbance, and lastly elation/euphoria. There were 250 caregivers that were so low in distress that they could not be differentiated. There were none so high in distress that they could not be differentiated.

As shown in Table 5, controlling for age, gender, race and delirium, there was a significant association between the AD8 and MoCA with behaviour based on the NPI-Q (F change for AD8 was 30.04, p=0.001; and F change for MoCA was 5.05, p=0.03). Combined these variables explained 18% of the variance in behaviour. Those who had better cognition were less likely to have behavioural symptoms. The CDR and FAQ were not associated with behaviours. For severity, after controlling for age, gender, race and delirium, the AD8 and MoCA were associated with severity of behavioural symptoms (F change was 27.91, p=0.001 for the AD8 and F change was 6.65, p=0.01 for the MoCA). Combined these variables explained 17% of the variance in severity of symptoms. Those with better cognition demonstrated less severe symptoms associated with dementia.

***Table 3.*** *Item fit for each subscale in the neuropsychiatric inventory(Accepted from Barbara Resnick et al,2021).*

| Items | Behavior Present | | Severity | | Distress | |
|---|---|---|---|---|---|---|
| | Infit | Outfit | Inpit | Outfit | Infit | Outfit |
| **1. Delusions:** Does the patient have false beliefs, such as thinking that others are stealing from him/her or planning to harm hi/her in some way? | .95 (-.74) | .98 (-.08) | 1.09 (.92) | 1.04 (.32) | 1.13 (1.15) | .97 (-.10) |
| **2. Hallucinations:** Does the patient have hallucinations such as false visions or voices? Does he or she seem to hear or see things that are not present? | 1.00 (-.01) | .92 (-.46) | 1.13 (1.07) | .87 (-.63) | 1.39 (2.61) | 1.00 (.08) |
| **3. Agitation/aggression:** Is the patient resistive to help from others at times, or hard to handle? | .92 (-1.47) | .90 (-1.20) | .84 (-2.46) | .79 (-2.28) | .89 (-1.44) | .85 (-1.85) |
| **4. Depression/Dysphoria:** Does the patient seem sad or say that he/she is depressed? | 1.03 (.65) | 1.02 (.25) | .92 (-1.04) | .97 (-.17) | .91 (-1.08) | .94 (-.38) |
| **5. Anxiety:** Does the patient become upset when separated from you? Does he/she have any other signs of nervousness such as shortness of breath, sighing, being unable to relax or feeling excessively tense? | 1.01 (.19) | .95 (-.56) | .92 (1.04) | .86 (-1.22) | 1.07 (.77) | .97 (-.15) |
| **6. Elation/Euphoria:** Does the patient appear to feel too good or act excessively happy? | 1.12 (.75) | 1.55 (1.50) | 1.23 (1.04) | 1.27 (.92) | 1.20 (.66) | .87 (-.15) |
| **7. Apathy/Indifference:** Does the patient seem less interested in his/her usual activities or in the activities and plans of others? | .98 (-.35) | .90 (-1.18) | 1.08 (.97) | .94 (-.97) | .94 (-.68) | .84 (-1.10) |
| **8. Disinhibition:** Does the patient seem to act impulsively, for example, talking to strangers as if he/she knows them or saying things that may hurt people's feelings? | .95 (-.60) | .81 (-1.38) | 1.07 (.65) | .75 (-1.57) | 1.21 (1.70) | .90 (-.41) |
| **9. Irritability/lability:** Is the patient impatient and cranky? Does he/she have difficulty coping with delays or waiting for planned activities? | .92 (-1.64) | .90 (-1.20) | .71 (-4.52) | .74 (-2.62) | .76 (-3.13) | .69 (-2.43) |
| **10. Motor Disturbance:** Does the patient engage in repetitive activities such as pacing around the house, handling buttons, wrapping string, or doing other things repeatedly? | .98 (-.16) | 1.10 (.69) | 1.16 (1.42) | 1.04 (.28) | 1.05 (.43) | .88 (-.47) |
| **11. Night-time Behaviors:** Does the patient awaken you during the night, rise too early in the morning or take excessive naps during the day? | 1.04 (.79) | 1.03 (.37) | 1.04 (.60) | 1.03 (.37) | .92 (-.96) | .89 (-.73) |
| **12. Appetite/Eating:** Has the patient lost or gained weight or had a change in the type of food h/she likes? | 1.12 (2.35) | 1.28 (3.33) | 1.30 (3.87) | 1.33 (2.95) | 1.23 (2.58) | 1.41 (2.58) |

***Table 4.*** *Item mapping for each subscale (1 is the easiest to endorse or demonstrate and 12 is the hardest to endorse or demonstrate(Accepted from Barbara Resnick et al,2021).*

| Item | Behavior Present | Severity | Distress |
|---|---|---|---|
| **1. Delusions:** Does the patient have false beliefs, such as thinking that others are stealing from him/her or planning to harm hi/her in some way? | 8 | 8 | 4 |
| **2. Hallucinations:** Does the patient have hallucinations such as false visions or voices? Does he or she seem to hear or see things that are not present? | 11 | 11 | 6 |
| **3. Agitation/aggression:** Is the patient resistive to help from others at times, or hard to handle? | 2 | 3 | 1 |
| 4. Depression/Dysphoria: Does the patient seem sad or say that he/she is depressed? | 4 | 5 | 2 |
| **5. Anxiety:** does the patient become upset when separated from you? Does he/she have any other signs of nervousness such as shortness of breath, sighing, being unable to relax or feeling excessively tense? | 6 | 7 | 3 |
| **6. Elation/Euphoria:** Does the patient appear to feel too good or act excessively happy? | 12 | 12 | 7 |
| **7. Apathy/Indifference:** Does the patient seem less interested in his/her usual activities or in the activities and plans of others? | 7 | 6 | 3 |
| **8. Disinhibition:** Does the patient seem to act impulsively, for example, talking to strangers as if he/she knows them or saying things that may hurt people's feelings? | 9 | 10 | 5 |
| **9. Irritability/lability:** Is the patient impatient and cranky? Does he/she have difficulty coping with delays or waiting for planned activities? | 3 | 4 | 2 |
| **10. Motor Disturbance:** Does the patient engage in repetitive activities such as pacing around the house, handling buttons, wrapping string, or doing other things repeatedly? | 10 | 9 | 6 |
| **11. Nightime Behaviors:** Does the patient awaken you during the night, rise too early in the morning or take excessive naps during the day? | 1 | 1 | 3 |
| **12. Appetite/Eating:** Has the patient lost or gained weight or had a change in the type of food he/she likes? | 5 | 2 | 2 |

The CDR and FAQ were likewise not associated with severity of behaviours. For distress, controlling for age, gender, race and delirium there was a significant association between the AD8 with caregiver distress (F change for AD8 was 29.23, p=0.001). Among older adults with better cognition caregivers had less distress. Combined these variables explained 13% of the variance in caregiver distress associated with behavioural symptoms. The MoCA, CDR and FAQ were not associated with distress for caregivers.

## Discussion

The findings from this study provide additional support for the reliability and validity of the NPI-Q for use in hospitalized patients living with dementia. Specifically, this analysis provided evidence that the measure is unidimensional, that there is internal consistency and the item responses are consistent across males and females and black *vs.* white participants with the exception of the presence and severity of depressive symptoms by race. Differences in this item were not surprising given that findings have been inconsistent with some studies reporting that white older adults tend to have more depression than black participants and are more likely to be treated for depression and other studies showed that blacks reported more depressive symptoms [42-46]. These differences may be sample specific [46-50].

Similar to other studies [10-12] in acute care settings, night time disturbances, aggression, and agitation were the most commonly reported neuropsychiatric behaviours, followed by irritability and lability, depression, anxiety, and apathy/indifference. Less commonly noted were delusions, hallucinations, motor disturbances, and disinhibition and the least likely behaviour to be endorsed as present, severe, or distressing was elation or euphoria. In community-based samples, the prevalence of neuropsychiatric symptoms varied based on the type of disease (e.g., vascular dementia, frontal lobe dementia, Alzheimer's disease), who completed the assessment (formal or informal caregivers or other health care providers), severity of disease (mild *vs.* moderate or severe impairment) and sex [51-54]. These prior findings noted that the majority of symptoms seem to be more common in individuals with vascular dementia compared to those with Alzheimer's disease. Specifically, there was more euphoria, apathy, irritability and sleep disturbance in individuals with vascular dementia than those with Alzheimer's disease, and females with Alzheimer's disease tended to have more delusions and disinhibition. In the current study we did not have information about the type of dementia the individual was experiencing. Further it is possible that many of these individuals had mixed dementia [55]. Future research could focus on individuals with different dementia diagnoses to determine if there are differences in responses across the NPI-Q items via a DIF analysis.

In this study there was a large of number of individuals who were so low on behavioural symptoms that they could not be differentiated. It is impossible to know if they simply had no symptoms, if the symptoms were not noticed as could be the case with euphoria, or if symptoms were considered normal and thus not reportable. For example, patients with dementia are frequently described by caregivers to be bored [56,57]. This may not be reported as apathy by the caregiver. Both boredom and apathy present with disinterest in an activity. Boredom however is an emotional state and occurs when the individual is not in a mood to do anything. Conversely, apathy is a neuropsychiatric syndrome focused on loss of motivation not due to emotional distress, intellectual impairment or decreased consciousness [58]. The two concepts overlap and are difficult to differentiate in direct observations of older individuals

***Table 5.*** *Regression analysis of variables associated with behavioral symptoms, severity and caregiver distress (p is significant at < .05(Accepted from Barbara Resnick et al,2021).*

| Variables | Standardized Beta | t | p | F change | p |
|---|---|---|---|---|---|
| **Neuropsychiatric Inventory Questionnaire Behavior** | | | | | |
| AD8 Dementia Screening Interview | .35 | 4.40 | .001 | 30.04 | .001 |
| Montreal Cognitive Assessment | -.05 | -2.25 | .03 | 5.05 | .03 |
| Clinical Dementia Rating Scale | .03 | .52 | .60 | - | - |
| Pfeffer Functional Assessment Questionnaire | .02 | .25 | .80 | - | - |
| **Neuropsychiatric Inventory Questionnaire Severity** | | | | | |
| AD8 Dementia Screening Interview | .23 | 4.11 | .001 | 27.91 | .001 |
| Montreal Cognitive Assessment | -.17 | -2.58 | .01 | 6.65 | .01 |
| Clinical Dementia Rating Scale | .08 | 1.45 | .14 | - | - |
| Pfeffer Functional Assessment Questionnaire | .08 | 1.12 | .26 | - | - |
| **Neuropsychiatric Inventory Questionnaire Caregiver Distress** | | | | | |
| AD8 Dementia Screening Interview | .27 | 4.89 | .001 | 23.92 | .001 |
| Montreal Cognitive Assessment | -.12 | -1.79 | .07 | - | - |
| Clinical Dementia Rating Scale | .06 | 1.08 | .28 | - | - |
| Pfeffer Functional Assessment Questionnaire | .09 | 1.27 | .21 | - | - |

[59]. It may be useful to add boredom as an aspect of apathy when observed by the caregiver. Likewise, helping caregivers understand that paranoia, or fearing that someone is stealing your personal items is consistent with delusional behaviour [60,61], and hoarding things, refusing to take medications, or attempting to inappropriately use the phone to get help and repetitive behaviour may all be indicative of agitation [62,63] may help to more comprehensively identify all behaviours associated with dementia and better differentiate those very low in behavioural symptoms. Further, it may also be helpful to add other neuropsychiatric behaviours to the NPI-Q such as alterations in Circadian rhythm which is often noted when the individual wants to sleep during the day and be up at night or misidentification syndrome which occurs when there is misidentification of oneself, other people, places and objects (e.g., a belief that another residents is one's spouse) and/or dysphoria which manifests by expressing negative concerns like being a burden on family, feeling like a failure, or wishing for death [21,64].

Hypothesis testing was partially support in this study in that the AD8 and MoCA were associated with neuropsychiatric behaviours and severity of behaviours. This is consistent with prior research noting the associations between cognitive status and behavioural symptoms in older adults with dementia [48,65]. There was no association, however, with the measures that focused more on physical *vs.* cognitive function (i.e., CDR and FAQ) or the MoCA with distress of caregivers. The CDR was associated with the NPI-Q in prior research [66] and our findings may be specific to this sample. Domains on the CDR address both physical function such as bathing and dressing as well as instrumental activities of daily such as managing finances. The FAQ focuses more on instrumental activities of daily living. Fewer studies have considered the association between function and behaviour symptoms and those that have reported inconsistent findings with some samples showing a relationship and others not [67,68]. Consequently, the partial support of the stated hypotheses provided sufficient evidence for the construct validity of the NPI-Q.

## Strengths and Limitations

This study was limited in that it included participants from a single state and included only three hospitals. Additional testing with other samples will strengthen support for the reliability and validity of the NPI-Q. Although the sample covered the range of severity of dementia there was no detailed information on the type of dementia which may influence behavioral symptoms. Lastly, responses to questionnaires were based on input from family caregivers and may be influenced by recall bias.

## Conclusion

Despite study limitations the findings from this study provide additional support for the reliability and validity of the NPI-Q, particularly for use with hospitalized older adults. The measure was invariant across sex and race although evaluation across different cultures and types of dementia should be considered in future research. There was a good fit of all items to the measure supporting the validity. However, there may be value to adding other behaviours are not accounted for by the NPI-Q that are relevant to persons living with dementia and their family caregivers. Overall, the NPI-Q is short and easy to complete and can be considered a reliable and valid measure of behavioural symptoms for clinical work and research in hospitalized persons living with dementia.

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