Psychometric evaluation of the Cohen-Mansfield Agitation Inventory in an acute general hospital setting

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Abstract

Objectives: The Cohen-Mansfield Agitation Inventory (CMAI; (Cohen-Mansfield and Kerin, 1986)) is a well-known tool for assessing agitated behaviours in people with dementia who reside in long-term care. No studies have evaluated the psychometric qualities and factor structure of the CMAI in acute general hospitals, a setting where people with demand may become agitated.

Method: Longitudinal study investigating pain, agitation and behavioural problems in 230 people with dementia admitted to acute general hospitals in 2011-2012. CMAI was completed as part of a battery of assessments including PAINAD to measure pain.

Results: A nine-item two-factor model of aggressive and nonaggressive behaviours proved to be the best-fitting measurement model in this sample, (χ^2=96.3, df=26, p<0.001; BIC [Bayesian Information Criterion]=4593.06, CFI [Comparative Fit Index]=0.884, TLI [Tucker Lewis Index]=0.839, RMSEA [Root Mean Square Error of the Approximation]=0.108). Although similar to the original factor structure, the new model resulted in the elimination of item 13 (screaming). Validity was confirmed with the shortened CMAI showing similar associations with pain as the original version of the CMAI, in particular the link between aggressive behaviours and pain.

Conclusion: The factor structure of the CMAI was broadly consistent with the original solution although a large number of items were removed. Scales reflecting physical and verbal aggression were combined to form an Aggressive factor, and physical and verbal nonaggressive behaviours were combined to form the Nonaggressive factor. A shorter, more concise version of the CMAI was developed for use in acute general hospital settings.

Introduction

Dementia is a progressive, neurodegenerative disease characterised by cognitive and physical decline. Challenging behavioural and psychological symptoms (BPSD) are common throughout the moderate and severe stages. Psychological symptoms of dementia include anxiety, depression, paranoia and hallucinations. Behavioural symptoms include physical and verbal aggression, repetitive mannerisms, restlessness and disinhibition (Ware et al., 1990). Increasing numbers of people admitted to acute general hospitals have clinically significant cognitive impairment or dementia (Sampson et al., 2009) and BPSD, in particular aggression, may predict hospital admission (Ware et al., 1990). At any given time in the UK, 6% of people with dementia occupy inpatient beds at acute general hospitals compared with 0.6% of older ageing adults without dementia (Russ et al., 2012). A hospital admission can be a frightening experience for people with dementia (Alzheimer's Society, 2016) and exposes people with dementia to an increased risk of adverse events including an increased risk of mortality, functional decline and a longer length of stay (Watkin et al., 2012, Mukadam and Sampson, 2011). Literature also suggests that the experience of pain is related to behavioural problems, in particular aggressive and agitated behaviours (Ahn and Horgas, 2013).

The Cohen-Mansfield Agitation Inventory (CMAI; (Cohen-Mansfield and Kerin, 1986)) is a 29-item tool (Cohen-Mansfield et al., 1989) developed to assess agitated behaviours of people residing within nursing homes. The utility of the CMAI across different cultures is demonstrated by the translations available (Cohen-Mansfield, 1991). Additionally, the Japanese, Dutch, Korean and Chinese versions of the CMAI have been validated (Schreiner et al., 2000, de Jonghe and Kat, 1996, Suh, 2004, Choy et al., 2001). The CMAI has been shown to have high internal consistency (Finkel et al., 1992) and high test-retest (Koss et al., 1997) and inter-rater reliability over time (Whall et al., 1999, Chrisman et al., 1991). High correlations have been found between the CMAI and other measures of BPSD (Finkel et al., 1992) but the CMAI has been shown to be more sensitive to change when compared with other measures of agitation (Zuidema et al., 2011).

Originally, the CMAI was found to contain three factors: physical aggression, verbal aggression and nonaggressive behaviours (Cohen-Mansfield, 1986, Cohen-Mansfield et al., 1989). Later studies produced a four-factor structure separating the nonaggressive agitated behaviours to reflect physical and verbal behaviour (Cohen-Mansfield, 1991, Rabinowitz et al., 2005). The CMAI has been validated previously using data collected within nursing homes (Cohen-Mansfield, 1986), outpatient clinics in general hospitals (Altunöz et al., 2015) and day centres (Cohen-Mansfield et al., 1995). However, as older ageing adults with cognitive impairment are commonly admitted to acute general

hospitals and interest in research in this area is increasing, it is important to determine if these factor structures are applicable for people assessed during inpatient acute hospital stays. To the best of our knowledge, the measurement properties of the CMAI have not been systematically evaluated within acute general hospitals. Therefore our aim was to explore the factor structure of the CMAI to further validate this tool in a sample of people with dementia during their admission to acute hospital settings.

Method

Participants and Procedure

Detailed methodology for the BePaid study is reported elsewhere (Scott et al., 2011). In summary, patients were recruited as part of a longitudinal study investigating pain, agitation and behavioural problems in people with dementia who were admitted to two acute general hospitals in London, UK (*N*=230). Four trained researchers assessed all patients under the care of geriatricians within 72 hours of admission to an acute general hospital ward from accident and emergency services. All information on patients including medical notes and discussions with family carers and health care professionals was used to assess for pain and BPSD. Patients who fulfilled the following criteria were approached to participate in the study:

- Aged 70 years or above with an unplanned acute medical admission
- Able to give written informed consent or agreement to participate provided by available informal carer or "professional consultee"
- Abbreviated Mental Test Score (AMTS; (Hodkinson, 1972)) of ≤7/10 (routinely measured on admission)

Patients were excluded if they indicated verbally or nonverbally that they did not wish to participate, were moribund, or non-English speaking. To ensure that our study sample had a diagnosis of dementia, the Confusion Assessment Method (CAM; (Inouye et al., 1990)) was used to screen potential participants for delirium. Those who were not delirious were consented or assent was obtained from a carer or professional consultee, and were assessed using the Mini Mental State Examination (MMSE; (Folstein et al., 1975)). Those who scored ≤24 were entered into the study. Patients who initially screened positive for delirium were reassessed 48 hours later and if this resolved, we then completed the MMSE (Folstein et al., 1975). If delirium was persistent, patients were ineligible as we could not establish a clear dementia diagnosis. However, those with delirium who already had a documented specialist dementia diagnosis were eligible. Dementia diagnosis was

confirmed using a structured clinical assessment based on operationalised DSM-IV (American Psychiatric Association., 1994) criteria, comprising cognitive testing (MMSE; (Folstein et al., 1975)), structured case notes review, discussion with family and the clinical team. Data from a sample size of 230 participants were potentially available for analysis.

Ethical approval

Ethical approval was obtained from the Central London Research Ethics Committee 3 (reference: 10/H0716/79).

Measures

Agitation

The Cohen-Mansfield Agitation Inventory (CMAI) is an observer based measure. Each of the 29 items is rated on a 7-point Likert scale ("Never" to "Several times per hour") commonly over the previous two weeks but for the purpose of this study, patients were assessed for the previous 3-5 days. Behaviours include aimless wandering, physical aggression such as hitting and kicking, verbal agitation such as cursing or constant request for attention and hoarding. A total score ranging between 29-203 can be computed, reflecting overall agitation; there are four separate subscales indicating physically nonaggressive behaviours (PNAB; 9 items), physically aggressive behaviours (PAGB; 12 items), verbally nonaggressive behaviours (VNAB; 4 items) and verbally aggressive behaviours (VAGB; 4 items) (Cohen-Mansfield, 1991).

Pain

Pain was measured objectively using the Pain Assessment in Advanced Dementia (PAINAD) Scale (Warden et al., 2003). This observational measure consists of five domains (breathing, negative vocalisations, facial expression, body language, and consolability). Each domain is scored on a severity scale of 0 to 2 points during movement and during rest (maximum score of 10). Scores ≥2 indicate the presence of pain (Zwakhalen et al., 2012).

Statistical Analysis

Items on the CMAI with a prevalence of <5% were excluded. Exploratory factor analysis (EFA) was conducted using STATA (StataCorp, 2013). Oblique Promax rotation was employed as extracted factors were expected to correlate. The number of factors extracted was based on the Kaiser criterion (eigenvalues >1) and the examination of a scree plot. EFA using STATA allows model fit

indices to be evaluated across several factor solutions. Items were removed from the EFA if factor loadings were non-significant or if they loaded significantly but weakly (i.e., <.40) onto more than one factor (Cohen-Mansfield et al., 1989, Rabinowitz et al., 2005). Fit indices were assessed to determine how well the proposed model fitted the sample data. The Chi^2 statistic is used as a measure of fit between the sample covariance and fitted covariance matrices (Byrne, 1998). Although a non-significant Chi^2 is desired, due to the sample size of the current study, a significant Chi^2 is expected based on standard statistical theory of how sample size, power and significance are associated (Cohen, 1992). Therefore, in addition to the Chi^2 statistic several fit indices were evaluated including the Bayesian Information Criterion (BIC), Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI). The model with the lowest BIC is preferred (Raftery) and values >0.95 for the CFI and TLI indicate a reasonable fit (Hu and Bentler, 1999). The Root Mean Square Error of the Approximation (RMSEA) is another fit index which takes into account the error of approximation in the population (Byrne, 1998). RMSEA values <0.06 indicate a good model fit (Hu and Bentler, 1999). Based on previous literature (Ahn and Horgas, 2013) and to validate the measure further, additional analyses were conducted to examine associations between the subscales of the CMAI and pain.

Results

Sample characteristics

We used the first assessment from the longitudinal cohort study, recorded within 72 hours of admission. A total of 230 participants were recruited (117 from Hospital 1; 113 from Hospital 2). The mean and median CMAI scores at baseline were 33 (*SD*=5.5) and 31 (29-35), respectively. The CMAI scores were stable across the study visits. For cohort demographic and clinical information see Table 1.

Table 1 here

Reliability analysis

Cronbach's alpha (α) for the overall CMAI and its subscales, PNAB, PAGB, VNAB and VAGB in the current study were 0.76, 0.42, 0.86, 0.56 and 0.57, respectively. In the current study, the PNAB did not have acceptable reliability with a score <0.5 and the VNAB and VAGB were also below the ideal cut off of 0.70.

Frequency of behaviours

The most commonly reported behaviours from the CMAI included general restlessness (*n*=98;43%), cursing or verbal aggression (*n*=46;20%), pushing (*n*=36;16%), repetitive sentences or questions (*n*=32; 14%), trying to get to a different place (*n*=32; 14%), screaming (*n*=22;10%), hitting (*n*=23;10%), pacing and aimless wandering (*n*=15;7%), constant unwarranted request for attention (*n*=17;7%) and grabbing onto people or things inappropriately (*n*=15;7%). From the 29 behaviours, 19 behaviours did not occur very often (<5%) or did not occur at all in our sample of people in acute settings and thus were excluded from further analyses; complaining and negativism, inappropriate dressing or disrobing, spitting, kicking, scratching, repetitive mannerisms, making strange noises, handling things inappropriately, throwing things, biting, eating or drinking inappropriate substances, intentional falling, hurting self or others, hiding and hoarding things, tearing or destroying property and making verbal or physical sexual advances. The most commonly reported behaviours selected for EFA included general restlessness, cursing or verbal aggression, pushing, repetitive sentences or questions, trying to get to a different place, screaming, hitting, pacing and aimless wandering, constant unwarranted request for attention and grabbing onto people or things inappropriately.

Exploratory Factor Analysis (EFA) of the CMAI

Models extracting two factors were considered based on the indication of the scree plot and using the Kaiser criterion (eigenvalues >1), two eigenvalues were observed to exceed one. The EFA model revealed two factors consisting of 5 items each (a total of 10 items remaining for the scale), however, the fit of the model was poor using standard SEM criteria (χ^2=132.8, df=34, p<.001; BIC=5133.57, CFI=.857, TLI=.810, RMSEA=.112). Using the criteria outlined above, item 13 (screaming) was eliminated from the model due to weak factor loadings (<.40) and double loadings thus limiting interpretation. Although item 1 (pacing and aimless wandering) had weak factor loadings, this item was retained as the loading on Factor 2 was only just below the cut-off criteria (<0.40) and its factor loading on Factor 2 made theoretical sense (the Promax rotated factor solution presented in Table 2). The two-factor solution was re-estimated after excluding item 13. The fit of the final two-factor model was slightly outside of standard SEM limits (χ^2=96.3, df=26, p<.001; BIC=4593.06, CFI=.884, TLI=.839, RMSEA=.108), but was an improvement from the 10-item two-factor solution and thus was chosen for further analysis. As the scores for the original 29-item four-factor solution can be combined to reflect overall agitation, the two factors were combined to test a one-factor EFA model reflecting all types of agitated behaviours. However, the model fit indices for this solution were very poor using standard SEM criteria (χ^2=211.6, df=35, p<.001; BIC=5206.93, CFI=0.744, TLI=0.670, RMSEA=0.148), suggesting that these factors are distinct forms of agitated behaviours.

Table 2 here

The loading pattern of the final two-factor solution was similar to the original solution described by Cohen-Mansfield (Cohen-Mansfield, 1991), but our model combined physically and verbally aggressive behaviours together and nonaggressive physical and verbal behaviours together. The final model consisted of two factors; first factor was labelled "Aggressive behaviours" as it included items such as cursing or verbal aggression, hitting (including self), grabbing onto people or things inappropriately and pushing. The second factor was labelled "Nonaggressive behaviours" as the items referred to the physical and verbal non-aggressive agitated behaviours (pacing and aimless wandering, constant unwarranted request for attention or help, repetitive sentences or questions, trying to get to a different place and general restlessness). Internal reliabilities (α) for the 9-item, two-factor CMAI scales were 0.83 and 0.57.

Intercorrelations with Pain

Intercorrelations between the original 29-item CMAI and PAINAD and also the shortened 9-item CMAI and PAINAD are presented in Table 3. Significant correlations are present between the subscales of the original and new versions of the CMAI. There were significant correlations between the overall CMAI score (based on 29-item version) and PAINAD at rest and during activity. Correlations between the subscales of the original scale CMAI and PAINAD demonstrated significant associations between physically aggressive behaviours and pain during activity and verbally aggressive behaviours correlated both with pain at rest and during activity. Similarly, significant correlations were present between the aggressive agitation subscale of the shortened 9-item version of the CMAI and pain both at rest and during activity.

Table 3 here

Discussion

Findings

We found that in a sample of people with dementia admitted to the acute general hospital, the CMAI measures two types of agitated behaviours, aggressive and nonaggressive. A large number of types of agitation included in the 29-item CMAI were not observed in this sample. Through

exploratory factor analysis, we developed a shortened 9-item modified CMAI scale for further validation and use in acute settings[1].

Out of the 29 items, 19 items were excluded prior to EFA as they were not present or occurred at a rate of less than 5% in our acute setting sample. Several modifications were required to improve the factor structure of the remaining ten items including removal of item 13, screaming, due to low and double factor loadings on both the aggressive and nonaggressive factors. This modification resulted in a shorter 9-item version of the CMAI which included only behaviours seen in people with dementia admitted to an acute general hospital. The new, shortened version of the CMAI was found to be similar to the original factor structure, albeit reducing the model from four factors to two factors and grouping verbally and physically aggressive behaviours and the nonaggressive behaviours together. However, the new shortened two-factor model was the best-fitting measurement model in this sample, suggesting that the aggressive and nonaggressive behaviours are separate forms of agitation and thus should not be combined.

Inter-correlations between the individual sub-scales of the CMAI and pain were very similar in the shorter 9-item version and the original 29-item version. However, this relationship appears to be more prominent between aggressive behaviours and pain compared with that between nonaggressive behaviours and pain, highlighting the distinction between the two types of agitation measured by the CMAI. These findings support previous research on the link between pain and disruptive behaviours, in particular the relationship between aggressive behaviours and pain (Ahn and Horgas, 2013).

Strengths and Limitations

Study limitations include generalizability with regards to ethnicity: a high percentage of the sample were classified as 'white' and female. However, demographics of the current sample are comparable to other studies of people with dementia admitted to acute settings in the UK (Sampson et al., 2009, Goldberg et al., 2011). Although the sample size was relatively large for a clinical study, it was not large enough to conduct an independent EFA and subsequent confirmatory factor analysis (CFA) to confirm the factor structure developed during our EFA. Although ratings of agitated behaviours were partly based on observations of patients in the acute setting, researchers also completed their

[1] Excluded items were: Inappropriate dress or disrobing; Spitting; Kicking; Pushing; Throwing things; Strange noises; Screaming; Biting; Scratching; Intentional falling; Complaining; Negativism; Eating/drinking inappropriate substances; Hurt self or other; Handling things inappropriately; Hiding things; Hoarding things; Tearing things or destroying property; Performing repetitious mannerisms; Making verbal sexual advances; Making physical sexual advances.

ratings based on discussions with family carers and health care professionals. Thus retrospective recall bias is another limitation of this study. Finally, due to the communication problems presented by people with dementia, the PAINAD (Warden et al., 2003) was used as an observational tool of pain. Nevertheless, despite its simplicity, this tool consists of clear and well-defined criteria of behaviours commonly presented by people with dementia during the experience of pain. A recent systematic review of tools assessing symptoms presented by people with dementia has also demonstrated that out of 11 tools assessing pain, PAINAD is one of two measures to have the strongest psychometric properties (Ellis-Smith et al., 2016).

Implications

We have developed the original version of the CMAI by expanding its transferability from a nursing home population to a sample admitted to acute general hospitals. Our study builds on work describing the usefulness of the tool in those attending out-patient clinics (Altunöz et al., 2015). Those people with dementia who present with acute illnesses, are sicker and require admission may experience different levels of distress, pain and agitation. However, further psychometric testing is required in acute settings. Redundant items such as eating or drinking inappropriate substances and hiding and hoarding things which are unlikely to occur in in this environment were removed to produce a more clinically relevant tool. In addition, physically unwell patients with dementia may be more likely to be bed-bound making the prevalence of other behaviours such as wandering lower in this population.

People with dementia may have communication difficulties as the disease progresses and thus may exhibit agitated behaviours to express unmet needs, including pain (Bachino et al., 2001). The relationship between aggressive behaviours and pain emphasises the importance of structured assessment of agitated behaviours using a scale specifically developed for acute general hospital settings. This version of the CMAI is a short and concise measure allowing efficient assessment and monitoring of agitation in people with dementia when admitted to a fast-paced environment like a hospital ward. This may be helpful in developing management strategies for agitation in dementia in acute general hospitals, which, currently, can be quite limited (White et al., 2016) and monitoring response to interventions for the agitation supporting more methodologically robust work in this area.

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Table 1: Patient demographics

	Total cohort *N* (%)
DEMOGRAPHICS	(*N*=230)
Gender	
Female	151 (65.7)
Male	79 (34.3)
Age, years	
75-84	85 (36.9)
85-94	118 (51.3)
95+	27 (11.7)
Ethnicity	
White British	175 (76.1)
Black Caribbean	15 (06.5)
Other	40 (17.4)
Place of Residence	
Home	145 (66.2)
Residential Home	26 (11.9)
Nursing Home	39 (17.8)
Other	09 (04.1)
CLINICAL CHARACTERISTICS	
FAST Score, %	
3-5 (objective functional deficit, difficulties with activities of daily living)	86 (37.4)
6a-6c (help required putting on clothes, toileting or bathing)	39 (16.9)
6d-6e (urinary and faecal incontinence)	74 (32.2)
7a-f (less than 6 words, can no longer walk, sit up, smile, hold up head)	31 (13.5)
CMAI, Median (IQR)	31 (29-35)

Table 2: EFA solution of the CMAI

No.	Item	Factor 1	Factor 2	Communalities
4	Cursing or verbal aggression	**0.48**	0.29	0.42
7	Hitting (including self)	**0.91**	-0.08	0.78
9	Grabbing onto people or things inappropriately	**0.84**	-0.05	0.68
10	Pushing	**0.73**	0.00	0.53
13	*Screaming*†	*0.39*	0.33	0.37
1	*Pacing and aimless wandering*	-0.06	*0.32*	0.09
5	Constant unwarranted request for attention or help	-0.08	**0.61**	0.34
6	Repetitive sentences or questions	-0.20	**0.56**	0.27
16	Trying to get to a different place	0.08	**0.49**	0.27
29	General restlessness	0.02	**0.48**	0.24
	Eigenvalue	2.93	1.05	

Note. †Item 13 was removed due to low and double factor loadings for the final model; Loadings >.40 are shown in bold; Factor labels are: 1 = Aggressive behaviours; 2 = Nonaggressive behaviours

Table 3: Inter correlations between the CMAI and pain (*N* = 230)

29-item CMAI	CMAI total	PNAB	PAGB	VNAB	VAGB
PNAB	.66**				
PAGB	.79**	.21*			
VNAB	.55**	.36**	.13*		
VAGB	.84**	.42**	.67**	.34**	
Pain at rest	.16*	.09	.07	.13	.22**
Pain during activity	.10*	.01	.15*	-.09	.19**
9-item CMAI	Aggressive agitation		Nonaggressive agitation		
Nonaggressive agitation	.33**				
Pain at rest	.16*		.09		
Pain during activity	.20*		-.05		

Note. **p<.001; *p<.05; *PNAB* = physically nonaggressive behaviours; *PAGB* = physically aggressive behaviours; *VNAB* = verbally nonaggressive behaviours; *VAGB* = verbally aggressive behaviours