Reliability and validity of the brief Dimensional Apathy Scale (b-DAS)

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Abstract

Objective: Apathy is composed of different demotivational subtypes measurable by the Dimensional Apathy Scale (DAS) and can be quickly assessed using the brief DAS (b-DAS). The aim was to determine the reliability and validity of the b-DAS. Method: 53 Amyotrophic Lateral Sclerosis (ALS) patients and 53 of their informants were recruited. Informants completed the b-DAS, the original informant/carer-rated DAS and behavioural interview about the patients (i.e. presence of behaviours such as Apathy/Inertia, Loss of sympathy/empathy). Patients completed measures of depression, anxiety, emotional lability, cognitive functioning and functional disability measures. Results: The b-DAS showed good internal consistency, excellent test-retest reliability, significant positive correlation with the original DAS and no significant correlations with depression, anxiety, emotional lability, cognitive functioning or functional disability measures. Semi-structured behaviour interview showed patients with Apathy/Inertia had significantly higher b-DAS subscale scores and patients with Loss of sympathy/empathy had significantly higher Emotional apathy scores only. Conclusions: The b-DAS is a fast, reliable and valid instrument for screening apathy subtypes independent of physical disability.

Keywords: apathy, validation, assessment, Dimensional Apathy Scale, short form

Introduction

Apathy is the most common behavioural change reported in amyotrophic lateral sclerosis (ALS; Strong et al., 2017), and has been shown to have negative practical impact, such as caregiver burden (Burke, Elamin, Galvin, Hardiman & Pender, 2015), Apathy is a syndrome composed of different subtypes of demotivation (Radakovic & Abrahams, 2018). The Dimensional Apathy Scale (DAS; Radakovic & Abrahams, 2014) is a 24 item measure that can be used to assess Executive apathy (lack of motivation for organisation, planning or attention), Emotional apathy (lack of emotional motivation, indifference or emotional neutrality) and Initiation apathy (lack of motivation for self-generation of thought and or/actions,) independent of motor disability (Radakovic et al., 2016). It has been validated in various neurological and neurodegenerative diseases, such as Parkinson's disease (PD) and dementia (Radakovic, Davenport, Starr & Abrahams, 2018; Radakovic, Starr & Abrahams, 2017a), including ALS (Radakovic et al., 2016), showing differential apathy profiles dependent on neurodegenerative disease. In ALS, Initiation apathy has been found to be characteristic (Radakovic et al., 2016; Santangelo et al., 2019) with distinct overlap with certain types of cognitive dysfunction, specifically the verbal fluency deficit (Radakovic et al., 2017b). Executive and Initiation apathy has been observed in PD, with impact on activities of daily living (Radakovic, et al., 2018) and global apathy over all subtypes supplemented by lower awareness has been observed in dementia, specifically Alzheimer's disease (Radakovic et al., 2017a).

The brief DAS (b-DAS) has recently been developed using item response analysis, a data driven scaling method, wherein the most robust items were selected from the original 24 item informant/carer-rated DAS (Radakovic et al., In Press). This produced the b-

DAS to be completed by informants/caregivers about patients, as a quick and comprehensive informant/carer-rated 9-item scale (with a supplementary awareness deficit/impairment assessment), with apathy subtype specific cutoffs. Given that it is becoming increasingly important to screen for apathy subtypes to determine their impact (Lanctôt et al., 2017) and there is an increasing focus on tailored practical management and non-pharmacological interventions relating to specific apathy profiles (Manera et al., In Press), the b-DAS was developed to be used within a busy clinical setting.

In addition to apathy, cognitive impairment and other behavioural changes are common features in ALS and ALS-Frontotemporal spectrum disorder (Strong et al., 2017) and there are also other non-motor symptoms which can occur, such as depression, anxiety and emotional lability (Fang, Jozsa & Al-Chalabi, 2017). As such, due to the various non-motor symptoms that can occur within ALS, it is important to determine convergent and divergent validity of the b-DAS against other apathy, depression, anxiety and emotional lability measures, while also exploring how this relates to functional disability, cognitive functioning and behaviour change. Therefore, the aim was to determine the reliability and validity of the b-DAS against standardised assessments of other symptoms and a semi-structured interview assessing abnormal behaviours.

Methods

Participants and Procedure

53 ALS patients and 53 of their informants (caregivers/partners/relatives) were recruited for this research study. Participants were recruited from the United Kingdom. All patients were diagnosed using the El Escorial Revised Criteria (Brooks, Miller, Swash

& Munsat, 2000). Ineligibility criteria for the study included severe disability relating to disease progression that would hinder participation, severe diabetes, epilepsy, alcohol/substance- related disorders, or other traumatic or non-traumatic neurological insults (e.g. head injury requiring intensive care hospitalisation, and stroke). All 53 patient-informants dyads undertook the interview below at their homes. Due to patient attrition (for reasons such as death or loss of contact), 43 (of the 53) ALS patient's informants had the b-DAS re-administered approximately 3 months later to determine test-retest reliability.

Ethical approval was obtained from National Health Service (NHS) Research Ethics Committee and all participants gave informed consent under the Declaration of Helsinki.

Measures

Apathy was assessed using the informant/carer-rated b-DAS (Radakovic et al., In Press), a 9 item measure with each item scored on a 4 point Likert (ranging from 0 to 3). It is composed of 3 subscales assessing Executive, Emotional, and Initiation apathy, with the scores ranging from 0 (least apathetic) and the maximum score as 9 (most apathetic) for each subscale. Awareness of apathy subtype is also assessed for each item scored in the upper two points of the Likert Scale with Yes/No question ("Are they aware of this specific difficulty?"). Summed awareness scores (i.e. "No" answers) for each apathy subtype can range from 0 (No Awareness deficit/impairment) to 3 (Severe Awareness deficit/impairment). Validity was assessed against full informant/carer-rated DAS (Radakovic et al., 2016), a 24 item measure with each item scored on a 4 point Likert

composed of the 3 subscales with each score ranging from 0 (least apathetic) to 24 (most apathetic). Due to the overlap of the b-DAS and informant/carer-rated DAS, informants completed the 9 item b-DAS and the remaining 15 items of the 24 item DAS.

Depression was assessed using the 9-item Patient Health Questionnaire (PHQ-9; Löwe, Unützer, Callahan, Perkins & Kroenke, 2004): with each item is scored on a 4 point Likert Scale (ranging from 0 to 3), with the score ranging from 0 (least depressed) to 27 (most depressed).

Anxiety was assessed using the 7-item Generalised Anxiety Disorder questionnaire (GAD-7; Spitzer, Kroenke, Williams & Löwe, 2006): with each item scored on a 4 point Likert Scale (ranging from 0 to 3), with the score ranging from 0 (least anxious) to 21 (most anxious).

Emotional lability was assessed using the 33-item Emotional Lability Questionnaire (ELQ; Newsom-Davis, Abrahams, Goldstein & Leigh, 1999): with three subsections for laughing, smiling and crying. Each subsection has 10 questions scored on a 4 point Likert scale (ranging from 0 to 3) and 1 question scored dichotomously (Yes = 1 and No = 0). The score ranges from 0 (not emotionally labile) to 93 (highly emotionally labile).

Functional disability was assessed using 12-item ALS Functional Rating Scale-Revised (ALSFRS-R; Cedarbaum et al., 1999): with each item scored on a 5 point Likert scale (ranging from 0 to 4), with the score ranging from 0 (maximum disability) to 48 (normal motor function).

Cognitive functioning was assessed using the Edinburgh Cognitive and behavioural ALS Screen (ECAS; Abrahams, Newton, Niven, Foley & Bak, 2014): is a brief 20-minute cognitive screen that assesses ALS specific cognitive domains (language, verbal fluency and executive functioning) and ALS non-specific cognitive domains (memory and visuospatial) with the total score ranging from 0 to 136: lower scores on the cognitive screen indicate cognitive impairment. *Behaviour change* was assessed using the ECAS behaviour interview (Abrahams et al., 2014), which is a semi-structured interview with the informants about the patient to determine changes or impairment in behavioural domains (behavioural disinhibition, apathy/inertia, loss of sympathy/empathy, perseverative, stereotyped or compulsive behaviour, hyperorality/altered food preference and psychosis) with a minimum score of 0 (no behaviour change) and maximum of 5 (most behaviour change).

The b-DAS, informant/carer-rated DAS and ECAS behaviour interview were completed by/administered to the informants about their observations of the patients. The depression, anxiety, emotional lability and functional disability measures were completed by the patients. The ECAS Cognitive screen was administered to the patient by the researcher.

Statistical analysis

R and SPSS were used for analysis. Distribution of data was assessed using Shapiro-Wilk test, which determined the use of non-parametric. Cronbach's Standardised alpha was used to examine internal consistency reliability. Intra-class correlation (ICC) was used to determine test-retest reliability. Correlational (Spearman's Rho) analysis was used to examine psychometric concurrent and discriminant validity against other measures.

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Comparative analysis (Kruskal Wallis Test and/or Mann-Whitney U test) with multiple comparisons correction (Holm method) was further utilised to examine convergent validity of the b-DAS relative to the ECAS behavioural interview domains.

Results

Demographics

Table 1 shows demographic and clinical characteristics of the patients.

Table 1. Clinical and Demographic variables of patients

	ALS Patients (N=53)
Male/Female	44/9
Age (mean, SD)	68.0 (7.5)
Years of Education (mean, SD)	11.3 (1.2)
Disease duration, (median, IQR) months	11 (10)
Site onset % (UL / LL / B / R / M / U)	34.0 / 26.4 / 20.8 / 5.7 / 5.7 / 7.5
ALSFRS-R score (mean, SD)	34.7 (7.7)
ECAS Cognitive score (mean, SD)	107.0 (14.1)
ECAS Behaviour Domain score (median, IQR)	1 (2)
PHQ-9 score (mean, SD)	5.9 (4.6)
GAD-7 score (mean, SD)	3.1 (3.7)
ELQ score (mean, SD)	6.7 (10.7)
Informant/carer-rated DAS Executive (mean, SD)	6.1 (4.8)
Informant/carer-rated DAS Emotional (mean, SD)	8.9 (4.2)
Informant/carer-rated DAS Initiation (mean, SD)	12.1 (5.5)
b-DAS Executive (mean, SD)	2.0 (2.0)
b-DAS Emotional (mean, SD)	2.9 (1.9)
b-DAS Initiation (mean, SD)	4.3 (2.6)

SD = Standard Deviation; IQR = Interquartile Range; UL = Upper limb; LL = Lower limb; B = Bulbar; R = Respiratory; M = Mixed; U = Unknown; ALSFRS-R = ALS Functional Rating Scale-Revised; ECAS = Edinburgh Cognitive and behavioural ALS Screen; PHQ-9 = Patient Health Questionnaire-9; GAD-7 = Generalised Anxiety Disorder questionnaire; ELQ = Emotional Lability Questionnaire; DAS = Dimensional Apathy Scale; b-DAS = Brief DAS

The informants of the patients had a mean age of 62.6 (Standard Deviation = 11.6), 85% were female. The informants were most commonly a spouse/partner (86.8%), followed by daughter/son (5.7%), close friend (3.8%), sibling (1.8%) and parent (1.8%). There were no significant correlations between the b-DAS subscales and age, education or disease duration. Based on b-DAS cutoffs (Radakovic et al., In Press), 34.0% were impaired on Initiation apathy, compared to 17.3% on Emotional apathy and 24.5% on Executive apathy. Additionally, the test-retest participant group (N = 43) did not significantly differ on age and gender distribution from the original participant group (N = 53).

Psychometrics

The Cronbach's Standardised alpha of the b-DAS was found to be 0.81, which was interpreted as good internal consistency reliability. The median interval for test-retest was 100 days (Interquartile Range = 9 days). Test-retest reliability for the b-DAS was excellent (ICC = 0.84).

When examining convergent validity, the b-DAS and the original informant/carer-rated DAS subscales were observed to be significantly positively correlated (Executive $r_s(51) = .87$, $p < .001$; Emotional $r_s(51) = .80$, $p < .001$; Initiation $r_s(51) = .90$, $p < .001$). See Supplementary Table 1 for details.

Figure 1a shows patients that displayed Apathy/Inertia according to the ECAS behaviour interview had higher scores all b-DAS subscales compared to those that did not display apathy (Executive $U = 173.5$, $p < .01$; Emotional $U = 153.3$, $p < .01$; Initiation

U = 143.5, *p* < .01). Additionally, Figure 1b shows patients that displayed Loss of

Sympathy/Empathy were found to have higher scores on only the b-DAS Emotional

subscale compared to those that did not display Loss of Sympathy/Empathy (*U* = 124.5,

p < .05). No differences were observed in relation to the other ECAS behaviour domains,
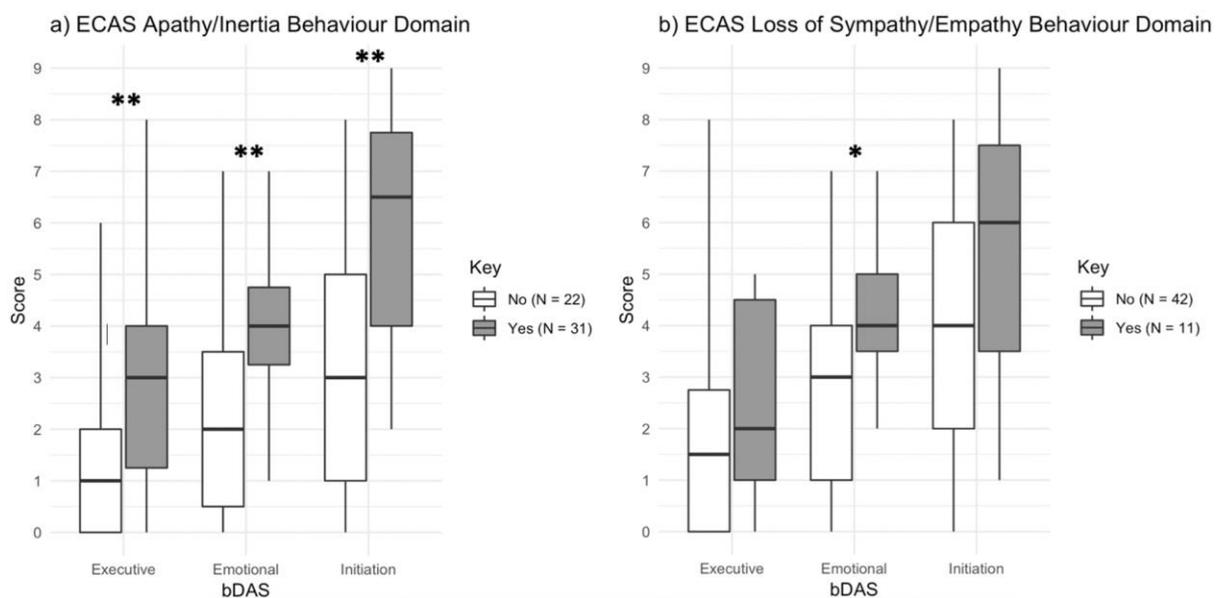
including psychosis.

Figure 1. b-DAS subscale scores for patients with (Yes) and without (No) a) Apathy/Inertia b) Loss of
Sympathy/Empathy on the ECAS behaviour interview.
Whiskers indicate range.   * *p* < .05; ** *p* < .01

In examining discriminant validity, the b-DAS subscales found not to be significantly

correlated with the PHQ-9, the GAD-7 or the ELQ. Further, there was no significant

correlation between the b-DAS and the ALSFRS-R or the ECAS Cognitive Total Score. See

Supplementary Table 2 for details.

On the b-DAS, 37.7% of patients had awareness impairment on one or more subscales. The total b-DAS awareness impairment score was found to be significantly correlated with the ECAS cognitive score (r_s(40) = -.33, p < .05) and the ECAS behaviour domain score (r_s(40) = .50, p < .01).

Discussion

The b-DAS was found to be a reliable and valid screening tool for the assessment of multidimensional apathy in ALS. It is psychometrically robust with good internal consistency and excellent test-retest reliability. When compared to the original informant/carer-rated DAS, this brief screening tool shows excellent content validity, through very strong correlations between the two measures. As the original informant/carer-rated DAS is composed of 24 items, the b-DAS contains the most psychometrically robust items (Radakovic et al., In Press) which may account for variability in association between the two measures. Furthermore, the b-DAS relates well (excellent concurrent validity) to other measures of abnormal behaviour (i.e. Apathy/Inertia and Loss of sympathy/empathy) as assessed by the ECAS semi-structured behaviour interview. The b-DAS was observed to not be significantly related to depression, anxiety and emotional lability (excellent discriminant validity). Of note, while the study demonstrated characteristic Initiation apathy (34.0%) in this ALS patient group, there was still variability of apathy subtype impairments with Executive apathy (24.5%) and Emotional apathy (17.3%). This variability may increase the generalisability of this validation study to other neurodegenerative diseases in which there are different apathy profiles.

In terms of concurrent validity, those with apathy/inertia based on the semi-structured interview scored higher on all subtypes, showing effective measurement of this complex syndrome by the b-DAS. Further, Emotional apathy on b-DAS was also found to relate to loss of sympathy/empathy in the semi-structured interview, providing further validity to this subtype and indicative of the potential overlap between these constructs. Emotional apathy is defined as indifference or emotional neutrality (Radakovic & Abrahams, 2018), which may impact or drive responsiveness to others needs and feelings, and previous research has shown association with emotional recognition deficits and Emotional apathy (Radakovic et al., 2017). Together this may manifest as loss of sympathy or empathy towards family member and/or caregivers.

Further, b-DAS awareness impairments were found to be associated with lower cognitive functioning, as well as more behavioural change. This relationship supports previous assertions that awareness, insight and cognitive functioning may be closely linked to neurodegenerative disease (Rosen, 2011). In ALS with frontotemporal dementia apathy, other behavioural changes and lack of insight (termed anosognosia) are commonly observed (Strong et al., 2017). This suggests that anosognosia for apathy subtypes symptoms is important to assess in such neurodegenerative diseases where dementia might be prominent, as made possible by the b-DAS awareness impairment assessment.

In conclusion, the b-DAS is valid and reliable for quickly assessing symptoms of dimensions of apathy and the patient's awareness of these symptoms. Furthermore, it can be applied within clinical and research contexts for apathy subtype profiling in different neurodegenerative diseases, to better understand the impact this syndrome

has on treatment, wellbeing and burden for people with neurological or neurodegenerative conditions and their families. The b-DAS will allow for objective assessment, and identification of deficits, in terms of real-world clinical impact to be practically addressed.

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Disclosure of interest

The authors report no conflict of interest.

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