RESEARCH ARTICLE

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Validation of the Brazilian version of the Apathy Inventory

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Background: Apathy is a frequent neuropsychiatric condition in neurodegenerative disorders, depression, and often in mild cognitive impairment. The Apathy Inventory (AI) is a reliable instrument for improving the accuracy of the apathy diagnosis. The aim was to establish the validity of the Apathy Inventory for the Brazilian community.

Methods: We established the concurrent validity, internal consistency, inter-rater reliability, and the sensitivity and specificity of AI for the Brazilian community in a cohort of 175 individuals with Alzheimer's disease, Parkinson's disease, depression, mild cognitive impairment, and healthy controls. The three dimensions of the AI (emotional blunting, lack of initiative, and lack of interest) were compared with the Apathy domain of the Neuropsychiatric Inventory-Clinician rating scale (NPI-C) in an independent scheme.

Results: The analyses demonstrated high correlation coefficients in AI's individual dimensions and in AI-total score ($F = 0.965$). Concerning the NPI-C/Apathy domain, intra-class correlation coefficients were also high ($F = 0.977$). Concurrent validity was high according to both raters on AI dimensions × NPI-C/Apathy domain and regarding total score (rater 1: rho = 0.956 vs. rater 2: rho = 0.970). The internal consistency of the AI was also high concerning the AI's individual dimensions and total score (rater 1: 0.945 vs. rater 2: 0.958).

Conclusion: We observed high internal consistency, high concurrent validity, and inter-rater reliability of the Apathy Inventory. In addition, we found that its sensitivity and specificity were high. We suggest that the Brazilian version of the Apathy Inventory would be an appropriate instrument to identify the apathy syndrome in Brazilian patients. Copyright © 2013 John Wiley & Sons, Ltd.

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Introduction

Apathy is considered to be a common neuropsychiatric syndrome in neurodegenerative disorders such as Alzheimer's disease (AD), Parkinson's disease (PD), and major depression, and often accompanies various types of mild cognitive impairment (MCI) (Marin *et al.*, 1991; Starkstein *et al.*, 2009). With AD, this condition may begin during the MCI stage, and its prevalence and severity increase as the disease progresses (Apostolova and Cummings, 2008). Furthermore, the prevalence of all neuropsychiatric symptoms increases with the disease's progression. A recent multicenter study reported a significant prevalence elevation of apathy in individuals with AD, from 43.0% to 62.9% during a 4-year follow-up (Gonfrier *et al.*, 2012).

In general, apathy is characterized by a lack of motivation and is clinically manifested by a reduction or loss of initiative associated with goal-directed behavior, a reduction or loss of interest associated with

diminished goal-directed cognition, and emotional blunting, which is a loss or reduction of emotional responses (Robert *et al.*, 2006a, 2006b). Apathy has been found to be related to rapid cognitive ability degeneration, increase in caregivers' or family members' burden, decreasing ability to perform functional daily living activities (Lechowski *et al.*, 2009; Starkstein *et al.*, 2009; Robert *et al.*, 2010), early institutionalization, and increased morbidity and mortality (Aalten *et al.*, 2007; Lyketsos, 2007; Cummings *et al.*, 2008; Gauthier *et al.*, 2010).

Despite controversial results, several studies have shown neurobiological correlates of apathy, using distinct strategies such as brain functional or structural neuroimaging, tractography, biomarkers, and neurotransmitters (Marshall *et al.*, 2006; Monastero *et al.*, 2006; Robert *et al.*, 2006b; Marshall *et al.*, 2007; Bruen *et al.*, 2008; Cacciari *et al.*, 2010; Kim *et al.*, 2011).

The Neuropsychiatric Inventory-Clinician rating scale (NPI-C) developed by de Medeiros *et al.* (2010) is one strategy that, unlike other instruments, includes the clinician's judgment in the apathy assessment. The Apathy Inventory is a reliable method for assessing the emotional, behavioral, and cognitive dimensions, which belong to apathy syndrome (Robert *et al.*, 2002). This instrument includes the caregiver's, the patient's, and the clinician's versions in rating of apathetic symptoms. However, the clinician's assessment is of great importance (Robert *et al.*, 2009) because it helps to improve the accuracy of measuring the patient's suffering while lessening the informant's emotional involvement in describing the severity and frequency of his or her symptoms.

Affective and emotional characteristics of the Brazilian population may influence clinical manifestations of psychopathological disorders, reinforcing the need for an appropriate instrument to assess apathy symptoms.

The aims of this study, therefore, were to establish the concurrent validity, internal consistency, inter-rater reliability, and the sensitivity and specificity indices, of the Apathy Inventory for use in the Brazilian community. We investigated individuals with AD, MCIs, PD, and depression, as well as healthy controls.

Methods

Participants

The cohort of individuals who took part in the present study was composed of 175 subjects recruited from ongoing programs at two public universities: the Institute of Biosciences, Universidade Estadual Paulista, city of Rio Claro, state of São Paulo, Brazil; and the Geriatric Psychiatric Clinic, State University of Campinas, city of Campinas, state of São Paulo, Brazil. Patients with MCI and healthy controls were enrolled as participants in aerobic exercise programs at both locations, which originally were developed for older individuals at the Institute of Biosciences, Universidade Estadual Paulista.

This study was conducted in agreement with the guidelines of the Declaration of Helsinki, and the local ethics committees approved the research. All participants, or their legal representatives when appropriate, signed a consent form.

Patients were not included if they presented with delirium, impairment of motor abilities, or other neuropsychiatric disorders, such as schizophrenia or bipolar depression, whose symptoms could overlap with those of apathy; or if they had recently changed drug prescriptions from their daily routine. Patients without accompanying family members were not included. The patients with PD included in the study presented with mild or moderate levels of the disease and maintained their motor abilities. These criteria were used in order to avoid an overlap between motor retardation related to apathy and hypomimia or bradykinesia, both common clinical signs in PD.

Procedures

Clinical diagnosis and scales. Patients with AD included in the study fulfilled the recommended criteria from the National Institute of Neurological and Communicative Diseases and Stroke-Alzheimer's Disease and Related Disorders Association for probable AD disease (McKhann *et al.*, 1984). The criteria for dementia diagnosis were established according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; APA, 2000). The Mini-Mental State Examination (MMSE) (Folstein *et al.*, 1975) was used to identify cognition levels in all individuals. Additionally, to further ascertain level of severity of approaching cognitive dementia, we used the Questionnaire for Instrumental Daily Living Activities (Pfeffer *et al.*, 1982). The diagnoses of participants were made by a consensus composed by experts on geriatric neuropsychiatry, such as psychiatrists, geriatricians, and neurologists. PD patients were diagnosed according to the United Kingdom Parkinson's Disease Society Brain Bank clinical criteria for idiopathic PD (Hughes *et al.*, 1992). These patients were classified into mild and moderate levels, using the Hoehn and Yahr (1967) scale. These patients did not meet criteria for dementia. Major

depression was carefully diagnosed by a structured clinical interview based on diagnosis criteria for depression, as defined by the DSM-IV-TR (APA, 2000). We assessed the severity of symptoms using the Geriatric Depression Scale (Yesavage *et al.*, 1983). Patients with AD, PD, and major depression were referred to our study by their respective clinicians. Diagnosis of MCI was established according to the following classical criteria (Petersen *et al.*, 1999; Winblad *et al.*, 2004): (a) presence of subjective cognitive complaint, confirmed by an informant such as caregiver or family member; (b) objective cognitive impairment in the cognition assessment; (c) preserved global intellectual function; (d) preserved or minimal impairments in daily living activities; and (e) absence of dementia. We did not divide MCI individuals into different sub-categories. We included all of the MCI individuals in the same group: amnestic, non-amnestic, or multiple domains. In addition, we completed the assessment of individuals with MCI using the Mini-Mental State Examination (Folstein *et al.*, 1975), the Questionnaire for Instrumental Activities (Pfeffer *et al.*, 1982), and with a detailed interview related to instrumental activities. Furthermore, the Geriatric Depression Scale short form (15 items) was used in these patients to exclude potential cognitive impairment related to affective suffering.

In the PD group, we added the Clock Drawing Test (Sunderland *et al.*, 1989) to improve the screening of executive functions. Healthy controls were evaluated by the same procedures that were applied to the individuals with mild cognitive impairment.

Raters considered apathy as a neuropsychiatric syndrome as defined by its particular clinical course, neurobiological correlates, and pattern of psychopharmacological responses (Robert *et al.*, 2006b; Marshall *et al.*, 2007; Bruen *et al.*, 2008; Starkstein *et al.*, 2009; Robert *et al.*, 2010; Kim *et al.*, 2011). For the diagnosis of apathy, raters took into account the criteria established by Robert *et al.* (2009; 2010) and validated by Mulin *et al.* (2011) in clinical practice, as well as PD (Drijgers *et al.*, 2010) and depression (Benoit *et al.*, 2012). These authors determined that the clinical criteria for the diagnosis of apathy comprise three dimensions: (a) loss of or diminished motivation; (b) loss of or diminished goal-directed behavior as evidenced by loss of or diminished self-initiation behavior and goal-directed cognitive activity; and (c) loss of or diminished spontaneous emotional manifestation. In addition, these symptoms cause clinically significant impairment of daily functioning, and they are not exclusively explained by other clinical conditions, sensory or motor disabilities, or substance effects (Robert *et al.*, 2010).

For the purposes of this study, the Apathy Inventory (AI) (Robert *et al.*, 2002, 2010) was translated into the Portuguese language by an expert, who regularly works with neuropsychiatric disorders in AD and other neurodegenerative processes. Another expert, involved in studies of neurodegenerative diseases, but without previous knowledge about the AI, translated the scale back into English. The Apathy domain, a subscale from the NPI-C (de Medeiros *et al.*, 2010), was used to achieve appropriate comparisons with the three dimensions that compose the AI: emotional blunting, lack of initiative, and lack of interest. Raters 1 and 2 completed the AI and the NPI-C/Apathy in an independent scheme, in which one researcher did not know the results of the other.

It was possible for the researcher or clinician to complete a specific domain of the AI and estimate the Apathy domain of the NPI-C. For both instruments, higher scores represent more psychopathological severity.

Statistical analyses. Descriptive analyses of demographic and general clinical data were calculated using means and standard deviations. Intra-class correlations were applied to determine inter-rater reliability; this was determined by comparing the AI's individual items and the total score, as well as the NPI-C/Apathy domain score, between two independent examiners. Inter-rater reliability was determined through two independent interviews, conducted by two examiners with the same caregiver or family member, on the same day. In order to estimate inter-class correlations, two independent raters carried out the evaluations, each independent to the other's results. A two-way analysis of variance was applied to identify differences between scores from the AI and the Apathy domain of the NPI-C, relative to each clinical diagnosis (AD, mild cognitive impairment, PD, depression, and healthy controls). Concurrent validity was estimated by comparing the AI's individual items and total scores with those of the NPI-C/Apathy domain, using Spearman's correlation coefficient. We used Spearman's correlation coefficient because the Kolmogorov–Smirnov test revealed that the data were not normally distributed. Cronbach's alpha coefficient was used to determine the internal consistency and reliability of the AI. To measure sensitivity and specificity of the AI and to produce cutoff points for this scale, we used the receiver operating curve (ROC) analysis. Specifically, we were interested in inter-rater reliability of the AI relative to a "gold standard" of diagnosis criteria for apathy, which has been adopted by international consensus (Robert *et al.*, 2009). This diagnosis is based on loss of or diminished goal-directed behavior, loss of

or diminished goal-directed activity, and loss of or diminished emotion. Data were analyzed using SPSS statistical software, version 20.0, and the level of significance in all analyses was $p < 0.05$.

Results

A total of 175 subjects were enrolled in this study (115 women, 65.7%; 60 men, 34.3%), with a mean age of 71.4 years (42–95 years old) and an educational level of 5.9 years (0–20 years). The sample was divided into five groups: 55 patients with AD, 30 patients with PD, 32 patients with depression, 35 patients with mild cognitive impairment (MCI), and 23 healthy controls. As expected, scores on the MMSE examination differed according to cognitive *status* (AD, 16.8; PD, 26.9; major depression, 24.3; MCI, 25.4; healthy controls, 29.1). In general, values for instrumental activities, as assessed by the Pfeffer Questionnaire, closely followed cognitive performance and were more compromised among patients with AD (17.3 points). Nevertheless, depressed patients had some impairment of instrumental activities (5.7 points). Scores on the Geriatric Depression Scale, as was also expected, were higher among patients with major depression (6.9 points) and, unsurprisingly, were followed by patients with PD (4.0 points). Concerning the diagnostic criteria proposed by Robert *et al.* (2010), apathy was more frequent in the patients with depression ($n = 22$, 68.8%), followed by the patients with AD ($n = 35$, 63.6%) and those with PD ($n = 6$, 20%). The individuals with MCI and the healthy controls had no apathy, although they occasionally presented some apathetic symptoms (Table 1 displays these data).

(a) *Intra-class correlation*

Statistical analyses related to intra-class correlation, involving inter-rater reliability, demonstrated high correlation coefficients in AI-emotional blunting ($F = 0.805$), AI-lack of initiative ($F = 0.881$), and AI-lack of interest ($F = 0.859$). With regard to the AI-total score, the correlation coefficient between raters was also high ($F = 0.965$). Concerning the NPI-C/Apathy domain, intra-class correlation coefficients were also high ($F = 0.977$). These data indicate that, in the AI as well as in the NPI-C/Apathy domain, we found strong inter-rater reliability (Table 2).

(b) *Concurrent validity*

To estimate the concurrent validity concerning the AI versus the NPI-C/Apathy domain, we used Spearman's correlation coefficient. Regarding the AI's individual items, concurrent validity was high according to both raters on AI dimensions such as emotional blunting × NPI-C/Apathy domain (rater 1, rho = 0.849 vs. rater 2, rho = 0.852), lack of initiative × NPI-C/Apathy domain (rater 1, rho = 0.892 vs. rater 2, rho = 0.903), and lack of interest × NPI-C/Apathy domain (rater 1, rho = 0.895 vs. rater 2, rho = 0.932). Additionally, regarding the AI total score, concurrent validity in both raters' assessments was also high (rater1, rho = 0.956 vs. rater 2,

Table 2 Intra-class correlation based on inter-rater reliability relative to the Apathy Inventory and the NPI-C/Apathy domain

Intra-class correlation involving Apathy Inventory and NPI-C/Apathy domain and rater 1 × rater 2 (Spearman's coefficient)	
Apathy Inventory and NPI-C/Apathy domain	Rater 1 × rater 2
Apathy Inventory	
Emotional blunting	0.805
Lack of initiative	0.881
Lack of interest	0.859
Total score	0.965
NPI-C/Apathy domain	0.977

AI, Apathy Inventory; NPI-C, Neuropsychiatric Inventory-Clinician rating scale.

Table 1 Demographic and clinical characteristics and diagnoses

Demographic and clinical characteristics	Alzheimer's	Parkinson's	Depression	MCI	Normal controls
Participants ($N = 175$)	55	30	32	35	23
Women ($n = 115$; 65.7%)					
Men ($n = 60$; 34.3%)					
Age (years)	78.4 (61–95)	66.5 (42–84)	69.7 (55–88)	69.1 (60–86)	67.3 (52–88)
School (years)	5.2 (0-–20)	7.2 (0–15)	4.0 (0–9)	6.1 (0–16)	8.5 (2–20)
MMSE (means)	16.8 (0–27)	26.9 (18–20)	24.3 (16–30)	25.4 (22–27)	29.1 (28–30)
Pfeffer (means)	17.3 (1–30)	0.8 (0–8)	5.7 (0–27)	0.4 (0–6)	0.3 (0–4)
GDS (means)	–	4.0 (0–14)	6.9 (0–15)	1.5 (0–7)	1.2 (0–4)
Apathy diagnosis	35 (63.6%)	6 (20%)	22 (68.8%)	0	0

MCI, Mild Cognitive Impairment; MMSE, Mini-Mental State Examination; GDS, Geriatric Depression Scale.

rho = 0.970). Concerning the evaluations from raters 1 and 2 together, correlation between the AI total score and the NPI-C/Apathy domain was high (rho = 0.963). Table 3 displays these data.

(c) *Internal consistency of Apathy Inventory* (Cronbach's alpha)

On the basis of Cronbach's alpha coefficient, the internal consistency of the AI was high, and inter-rater reliability was also high concerning the AI's individual dimensions such as emotional blunting (rater 1, 0.930 vs. rater 2, 0.962), lack of initiative (rater 1, 0.914 vs. rater 2, 0.924), and lack of interest (rater 1, 0.913 vs. rater 2, 0.924), as well as total scores (rater 1, 0.945 vs. rater 2, 0.958). Table 4 presents these values.

Cronbach's alpha coefficient demonstrated high internal consistency of the AI as well as inter-rater reliability. Furthermore, this analysis provided sufficient support to confirm that the AI can achieve the same assessment of apathy symptoms as does the NPI-C/Apathy domain. According to Cronbach's alpha analysis, the internal consistency of the Apathy Inventory obtained by both raters was high in the three AI dimensions: emotional blunting, lack of initiative, and lack of interest, as well as in the total score. Figures 1–3 display these data.

Sensibility and specificity

The sensitivity and specificity of the AI, with a cutoff of 2.5 points, were 99.2% and 97.3%, respectively; with a cutoff of 3.5, sensitivity was 87.3%, and specificity was 99.5%. These analyses suggest that it is plausible to consider a cutoff point of about 3 as sufficiently high sensitivity and specificity to discriminate case from non-case on the basis of the clinical criteria established by an international consensus (Robert *et al.*, 2009). Figure 4 illustrates these results.

Table 4 Internal consistency of the Apathy Inventory according to raters 1 and 2 (Cronbach's alpha)

Internal consistency of Apathy Inventory (Cronbach's alpha)		
Apathy Inventory	Rater 1	Rater 2
Emotional blunting	0.930	0.962
Lack of initiative	0.914	0.924
Lack of interest	0.913	0.924
Total score	0.945	0.958

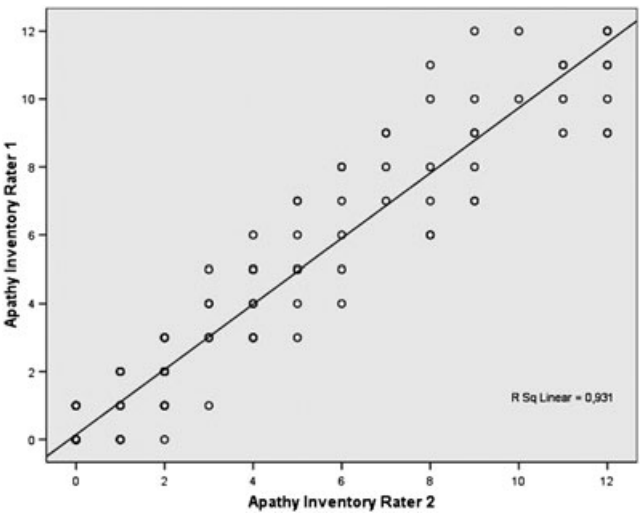

Figure 1 Correlation between raters 1 and 2 concerning the Apathy Inventory (total score).

Discussion

The present study established the internal consistency, concurrent validity, inter-rater reliability, and sensitivity and specificity of the Apathy Inventory in a Brazilian sample composed of patients with AD, PD, older patients with depression, MCI, and healthy subjects. Comparing the AI, which utilized a clinician's assessment

Table 3 Concurrent validity involving AI versus NPI-C/Apathy domain

Correlations between Apathy Inventory and NPI-C/Apathy domain by raters 1 and 2 (Spearman's rho)		
Apathy Inventory	Rater 1	Rater 2
Emotional blunting × NPI-C/Apathy domain	0.849	0.852
Lack of initiative × NPI-C/Apathy domain	0.892	0.903
Lack of interest × NPI-C/Apathy domain	0.895	0.932
Total score × NPI-C/Apathy domain	0.956	0.970
Total correlation (rater 1 + rater 2): AI total score × NPI-C/Apathy domain: 0.963		

AI, Apathy Inventory; NPI-C, Neuropsychiatric Inventory-Clinician rating scale.

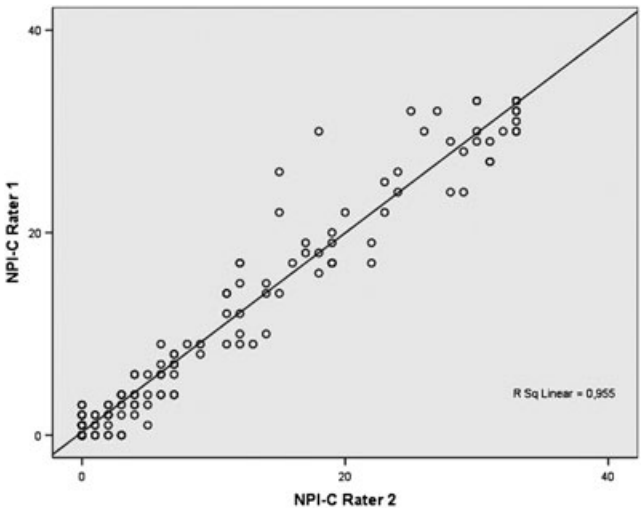

Figure 2 Correlation between raters 1 and 2 concerning the NPI-C/Apathy domain.

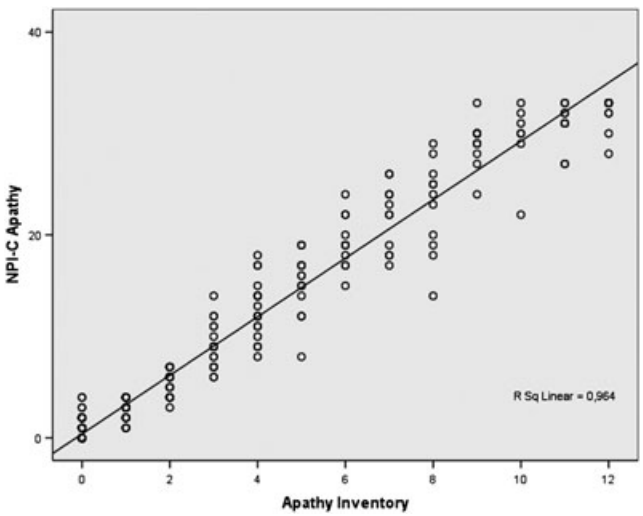

Figure 3 Correlation between Apathy Inventory and NPI-C/Apathy domain in relation to scores from raters 1 and 2 (R^2, R square = 0.964; this value means that one variable explains the other with a certainty of 96.4%).

of symptoms, with the Apathy domain from the NPI-C, which also employed a clinician's assessment of symptoms, we observed high internal consistency of the AI. The three dimensions of the AI strongly correlated to one another, and this correlation also occurred when we considered the AI's total score. We found high concurrent validity of the AI, as this instrument recognized apathy with the same assessment as did the NPI-C/Apathy domain. Furthermore, we observed high inter-rater reliability: the interpretations of the dimensions of

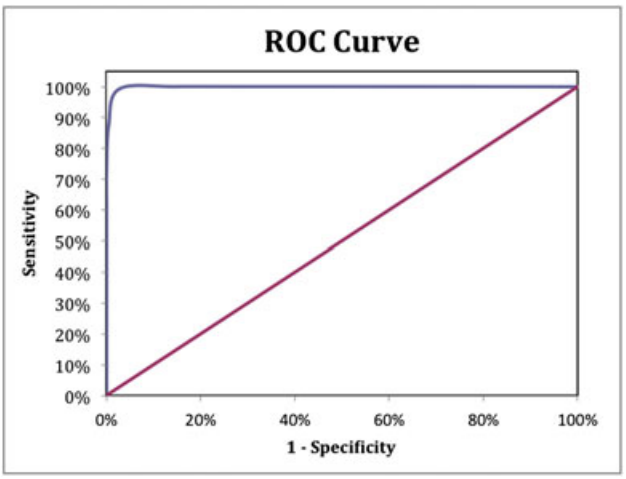

Figure 4 Sensitivity and specificity of AI according to receiver operating curve (ROC) analyses, using 2.5 as a cutoff point.

apathy in the AI, from both raters, were stable. On the basis of the diagnosis criteria for apathy, we found a high frequency of this syndrome in depressive and AD patients, followed by PD patients. The AI revealed high sensitivity and specificity, with a cutoff of 3.0.

Our results support the original validation by Robert *et al.* (2002), who found high total as well as individual dimensional scores on the AI in individuals with AD and major depression and, with a lower frequency, in PD. However, with regard to the MCI patients, we found a notable difference that did not occur in the Robert *et al.* (2002) study: in our study, their score was null. We suspect this is because the MCI individuals from our sample were physically active; they participated in aerobic physical exercise at least three times per week on a regular basis. It seems likely that their lifestyle would contribute to keeping them sufficiently motivated to perform well on the scale.

We investigated PD patients that fall within levels 1 and 2 of the Hoehn and Yahr (1967) classification, which correspond to mild or at least moderate severity of the disease, and we found that 20% of these individuals met the criteria for apathy. Our results are in agreement with a previous study by Aarsland *et al.* (2009), which reported a prevalence of 17% for apathy in the early stage of PD, and with that by Drijgers *et al.* (2010), which found that 17.2% of PD patients without dementia met criteria for diagnosis of apathy. The decision to include only PD patients classified with mild or at least moderate severity of the disease was driven by an attempt to avoid overlapping apathy symptoms and hypomimia, which are common among patients with more severe levels of the disease.

Regarding intra-class correlation, we observed high statistical values in the three dimensions of the AI:

emotional blunting (0.805), lack of initiative (0.881), and lack of interest (0.859); and in the AI total score (0.965). This methodological strategy permitted us to quantify the level to which one rater resembled the other, as well as to measure reliability in relation to scores from each AI dimension and the total score.

Internal consistency was determined by Cronbach's alpha coefficient. This statistical procedure demonstrated that both instruments (AI and NPI-C/Apathy domain) could achieve the same assessment of apathy symptoms, with high internal consistency for the AI and with inter-rater reliability. In the present study, the AI showed high internal consistency for the total score from both raters 1 (0.945) and 2 (0.958), and our results are in agreement with the original version reported by Robert *et al.* (2002), in which the internal consistency for caregiver information was 0.84. When comparing the Brazilian version of the AI with the original version, we found a comparable internal consistency, although we expected a similar level of reliability between both investigations.

Furthermore, our analyses provided sufficient support to confirm that the AI can achieve the same assessment of the apathy symptoms as those reported by the NPI-C/Apathy domain.

We applied the ROC to measure sensitivity and specificity of the AI against the "gold standard" criteria for the diagnosis of apathy, as recommended by an international consensus for neuropsychiatric disorders (Robert *et al.*, 2009). According to the AI cutoff points, mean specificity was likely to be different from mean sensitivity. On the basis of a cutoff point of 2.5, the mean sensitivity was 99.2%, and mean specificity was 97.3%, whereas the cutoff point of 3.5 provided a mean sensitivity of 87.3% and a mean specificity of 99.5%. Results that indicate that sensitivity is lower than specificity suggest that certain patient conditions could be under-reported in the caregiver's and/or clinician's reports. Additionally, our analyses suggest that a cutoff point of 3.0 is a good divisor for identifying case versus non-case in the Brazilian version of the AI.

On the basis of the diagnostic criteria for classifying patients with and without apathy, unsurprisingly, patients with depression and AD presented this syndrome with a high frequency, followed by PD patients. Our results are in agreement with a previous study in which Mulin *et al.* (2011) validated the apathy criteria in clinical practice. In a multicentric investigation, these authors analyzed apathy criteria in several neurodegenerative and psychopathological conditions, including AD, PD, depression, and MCI among others, and observed a high prevalence of apathy particularly in depression, AD, and PD. Depressive psychopathological manifestations could overlap the apathy syndrome, sometimes acting as important confounding factors. Thus, for depression, our results confirm a strong overlap between depressive and apathetic symptoms, as previously reported by other researchers (Mulin *et al.*, 2011; Benoit *et al.*, 2012). Symptoms of apathy and depression considerably overlap; for instance, loss of directed-goal cognitive activity could be related to a diminished interest in leisure activity suggesting apathy syndrome, or they could be related to emotional suffering suggesting depression syndrome Benoit *et al.* (2012).

Considering that affective and emotional manifestations are important characteristics within Brazilian families, which could make it difficult to separate psychopathological manifestations from apathy and depression, the AI represents a useful strategy for confirming the cluster of symptoms from apathy.

Surprisingly, the subjects with MCI from our study did not meet clinical criteria for apathy, unlike those described by Di Iulio *et al.* (2010), who reported a prevalence of 6.9% in amnestic-MCI and 14.7% in subjects with multidomain-MCI. However, it is noteworthy that the subjects with MCI from our study were physically active, regularly participating in an aerobic exercise program. This aspect might have contributed to the absence of apathy symptoms.

Neurobiological correlates involving structural and functional imaging, including diffusion tensor imaging, could contribute to the highlighting of nosological distinctions between apathy and other neuropsychiatric conditions (Benoit *et al.*, 2004; Cacciari *et al.*, 2010; Kim *et al.*, 2011), mediated by fronto-subcortical circuits (Benoit *et al.*, 2004).

Conclusion

The main objective of this study was, ultimately, to validate the Portuguese version of the Apathy Inventory. Apathy is an important and frequent syndrome among patients with AD and other neuropsychiatric conditions and must be properly diagnosed. The Apathy Inventory is a rapid and reliable instrument for assessing the apathy syndrome, which encompasses emotional, cognitive, and behavioral dimensions; this instrument can help the clinician improve the accurate diagnosis of the syndrome. We found high internal consistency of the Apathy Inventory, as well as high concurrent validity; inter-rater reliability was also high. In addition, we found that its sensitivity and specificity were high. These results help to confirm that the Apathy Inventory is an instrument that can easily be applied, over several neuropsychiatric conditions, to assess the apathy

syndrome. Following this validation, we concluded that the Apathy Inventory would be an appropriate instrument to identify the apathy syndrome in Brazilian patients. Whether specific dimensions of apathy—emotional blunting, lack of initiative, and lack of interest—can represent additional clinical markers for the progression of the disease remains an important question.

Key points

- The Apathy Inventory has high internal consistency, high concurrent validity, and high inter-rater reliability.
- The Apathy Inventory revealed high sensitivity and specificity.
- On the basis of the diagnosis criteria for apathy, there was an important frequency of apathy in patients with depression, Alzheimer's disease, and Parkinson's disease.
- The Apathy Inventory seems suitable to identify apathy syndrome among Brazilian people.

Conflict of interest

None declared.

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