# Accuracy of Functional Performance in Healthy Elderly Subjects, with Mild Cognitive Impairment and Alzheimer's Disease

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## Abstract

It is challenging to establish the continuum of cognitive and functional decline in normal to pathological aging. In this transition is the Mild Cognitive Impairment (MCI), defined by subtle impairment in cognition and functionality. When functional impairment increases, it meets the criteria for dementia. Thus, it is essential to determine an accurate diagnosis from the functional evaluation. The aim of this study was to compare functional performance through direct versus indirect assessments, verify the relationship between them, and evaluate the accuracy of it within the control group, MCI and Alzheimer's disease (AD) patients. Ninety subjects ($n = 27$ controls, $n = 35$ MCI and $n = 28$ AD) participated in the study. We used the Activities of the Daily Living Questionnaire (ADL-Q) and the Direct Assessment of Functional Status (DAFS-R). MANCOVA was performed to compare the direct functional performance, and ROC curves were used to verify the diagnostic accuracy of the scales among groups. The performance of the direct assessment showed differences between the controls and MCI, and between MCI and AD subjects. Both scales showed differences between MCI and AD, and DAFS-R showed differences between controls and MCI. Thus, DAFS-R demonstrated better accuracy of functional performance in these groups.

**Keywords**: Functional performance, Aging, Mild Cognitive Impairment, Alzheimer's disease.

# Acurácia do Desempenho Funcional em Idosos Saudáveis, com Comprometimento Cognitivo Leve e Doença de Alzheimer

## Resumo

Estabelecer o *continuum* de declínio cognitivo e funcional no envelhecimento normal para o patológico é desafiador. Nesta transição está o Comprometimento Cognitivo Leve (CCL), definido por prejuízo sutil na cognição e funcionalidade. Quando o prejuízo funcional aumenta preenche critérios para demência. Assim, determinar a acurácia diagnóstica da avaliação funcional é imprescindível. Com isso o objetivo foi comparar o desempenho funcional através da avaliação direta *versus* indireta e avaliar a acurácia do desempenho destas avaliações entre controles, pacientes com CCL e com doença de Alzheimer (DA). Participaram 90 indivíduos (*n*=27 controles, *n*=35 pacientes com CCL e *n*=28 com DA). Foram utilizadas a *Activities of Daily Living Questionnaire* (ADL-Q) e a *Direct Assessment of Functional Status* (DAFS-R). Foram realizadas MANCOVA para comparar o desempenho funcional direto entre os participantes e curvas ROC para verificar a acurácia diagnóstica das escalas entre os grupos. O desempenho da avaliação direta demonstrou diferenciar controles de CCL e CCL de DA. Ambas as escalas mostraram diferenciar CCL e DA, e a DAFS-R controles de CCL. Assim, a DAFS-R evidenciou melhor acurácia do desempenho funcional nestes grupos.

**Palavras-chave**: Desempenho funcional, envelhecimento, Comprometimento Cognitivo Leve, doença de Alzheimer.

# Precisión del Rendimiento Funcional en Personas Mayores Sanas, con Deterioro Cognitivo Leve y Enfermedad de Alzheimer

## Resumen

Establecer el deterioro cognitivo y funcional en el envejecimiento normal y de la enfermedad es desafiador. Esta transición es el Deterioro Cognitivo Leve (DCL), definido por deterioro sutil en la cognición y la funcionalidad. Cuando aumenta el deterioro funcional cumple con los criterios para la demencia. Por lo tanto, para determinar la exactitud diagnóstica de evaluación funcional es esencial. Por lo tanto, el objetivo fue comparar el rendimiento funcional a través de directa frente a la evaluación indirecta, verificar la relación de estas actuaciones, evaluar la exactitud de los resultados de estas evaluaciones entre los controles, los pacientes con DCL y enfermedad de Alzheimer (EA). Participaron 90 sujetos (*n* = 27 controles, *n* = 35 pacientes DCL y *n* = 28 EA). Se utilizaron *Activities of Daily Living Questionnaire* (ADL-Q) y *Direct Assessment of Functional Status* (DAFS-R). Se realizaron MANCOVA para comparar el rendimiento funcional directo entre los participantes y las curvas ROC para verificar la precisión diagnóstica de las escalas entre los grupos. El rendimiento de la evaluación directa mostró diferenciar los controles de DCL, y DCL de EA. Ambas escalas mostraron diferenciar DCL y EA, y DAFS-R controles de DCL. Por lo tanto, DAFS-R mostró una mejor precisión del rendimiento funcional en estos grupos.

**Palabras clave**: Rendimiento funcional, envejecimiento, Deterioro Cognitivo Leve, enfermedad de Alzheimer.

Dementia caused by Alzheimer's disease (AD) has insidious onset and may lead to months or years of cognitive and functional decline (Albert et al., 2011; McKhann et al., 2011). The distinction between normal and pathological aging is difficult to define, since it is characterized as a possible continuum. In this evolution, we highlight Mild Cognitive Impairment (MCI), in which cognitive impairments are already present, but with a subtle impact on daily life, af-

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fecting more complex activities of the individual without impairing their level of independence (Albert et al., 2011). Given this difficult definition between healthy and pathological aging, the diagnostic accuracy of direct *versus* indirect functional assessments is essential.

The onset of AD and MCI symptoms is presented by cognitive deficits, and can be amnestic or non-amnestic (Petersen et al., 2009). In non-domestic frameworks, deficits can be of language, attention, perception, agnosia, social cognition and/or executive functions, such as alteration of reasoning, planning, cognitive flexibility, inhibitory control, working memory, judgment, and problem solving (American Psychiatric Association [APA], 2014; McKhann et al., 2011). Due to cognitive impairment, the patient may present complaints from the outset when performing previously habitual tasks such as preparing meals, paying bills, and shopping (Frota et al., 2011).

One study demonstrated that people with MCI are 6.7 times more likely to develop AD than healthy elderly individuals (Boyle, Wilson, Aggarwal, Tang, & Bennett, 2006). Elderly patients with MCI suffer a decrease in cognitive functioning at a faster rate than normal-aging individuals (Boyle et al., 2006). While MCI diagnostic criteria show functional preservation, studies suggest that patients with MCI may suffer with the complexity of daily living activities (DLA), such as coping with finances and skills related to purchases (Pereira, Oliveira, Diniz, Forlenza, & Yassuda, 2010). Although in AD the impairment of DLA is greater than in patients with MCI (Marshall et al., 2011), there may be impairment in the daily functioning of the elderly with MCI when compared to their own previous performances (Farias et al., 2006).

Functional performance is the main differentiator between AD and MCI. The elderly with MCI, based on the diagnostic criteria, can, at most, present subtle impairment in more complex and / or instrumental daily activities (Albert et al., 2011; Teng, Becker, Woo, Cummings, & Lu, 2010; Marshall et al., 2011). These complex functional activities include the ability to prepare a meal, perform housework, deal with finances, and administer medication. On the other hand, basic daily life activities that include self-care and the ability to perform personal hygiene, sphincter control and proper feeding are preserved (Chaves et al., 2011).

Functional evaluation is important for the diagnostic differentiation between early dementia and MCI. This evaluation can be indirect or direct. The indirect assessment is carried out through the report of an observer, using tools like scales and questionnaires. The direct assessment happens through observing and examining functional performance based on the simulation of daily life activities, in an ecological way (Lima-Silva et al., 2014; Pereira, Oliveira, et al., 2010). Both in clinical practice and in research the observer, or informant, is the main source of data, and he or she may underestimate or overestimate the patient's actual functional decline. This is because they are susceptible to biases caused by frames of humor, personality, negative feelings, physical fatigue, or informant burnout (Pereira, Oliveira, et al., 2010; Novelli, Nitrini, & Caramelli, 2010). In addition, a direct assessment of performance in daily activities, in contrast to an assessment made by an informant, allows for better accuracy in the differentiation between healthy elderly, MCI and AD (Goldberg et al., 2010).

Performing a direct functional evaluation gains more relevancy when we consider that more and more elderly adults are living alone (Brazilian Institute of Geography and Statistics [IBGE], 2008; Department of Health and Human Services [DHHS], 2002). For this reason, they do not usually have a family member or caregiver who is present in your routine and might observe their functional impairments. This type of functional evaluation is necessary to avoid possible risks to these elderly adults.

Several scales and questionnaires were developed for the evaluation of basic and complex daily activities in individuals with dementia (Johnson, Barion, Rademaker, Rehkemper, & Weintraub, 2004). In Brazil, some instruments for the indirect functional evaluation are validated and recommended for use in the diagnosis of dementia in AD (Chaves et al., 2011). They

are: Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE; Bustamante et al., 2003; Jorm & Jacomb, 1989; Sanchez & Lourenço, 2009); Disability Assessment for Dementia (DAD; Bahia et al., 2010; Gauthier et al., 1994); Activities of the Daily Living Questionnaire (ADL-Q; Johnson et al., 2004); and Bayer's Scale of Daily Life Activities (B-ADL; Folquitto et al., 2007; Hindmarch, Lehfeld, de Jongh, & Erzigkeit, 1998; Mapi Research Institute, 1999).

The Activities of the Daily Living Questionnaire (ADL-Q) is a scale that evaluates both basic and complex (or instrumental) activities and is performed with family members or caregivers of elderly adults with suspicion of dementia (Medeiros & Guerra, 2009). It evaluates six domains: self-care, social interaction, organization, planning, and social participation. The patient is observed by another person. Therefore, this assessment depends on an observer's report (Johnson et al., 2004). The only study found to evaluate patients with MCI and AD using ADL-Q demonstrated a high test-retest reliability and good accuracy to detect a mild decline, as well as the more severe symptoms of disease progression (Johnson et al., 2004).

The Performance-Based Skills Assessment (Goldberg et al., 2010) and the Direct Assessment of Functional Status (DAFS) are considered direct functional assessments, and are applied to patients with complaints and suspicion of dementia (Loewenstein et al., 1989). DAFS was developed to evaluate a variety of functional abilities, both basic and complex, required for independent living in elderly adult patients with and without cognitive impairment. The main objective of DAFS is to perform a closer assessment of the actual daily performance of older adults (Loewenstein et al., 1989; Zanetti, Frisoni, Rozzini, Bianchetti, & Trabucchi, 1998).

The DAFS evaluates six domains: temporal orientation, communication, ability to handle money and shopping, personal hygiene, and ability to dress and feed independently (Pereira, Oliveira, et al., 2010). The validation of DAFS-R for Brazilian culture was performed through a sample of healthy elderly, MCI and AD patients. In this study, a significant difference was

observed in AD patients in relation to healthy elderly and MCI, showing lower performance in orientation, communication skills and time perception. Dressing skills, personal hygiene and feeding presented lower relationships compared to the other subcategories. This may have occurred because the tasks involved in these domains are performed automatically, so these tasks may have limited abilities to differentiate these groups from older adults. The DAFS has great accuracy in discriminating the healthy elderly of patients with AD (Loewenstein et al., 1989) and also differentiates elderly with MCI from healthy elderly people (Pereira, Oliveira, et al., 2010).

Therefore, it can be observed that the direct evaluation of the functional performance presented good discriminative power among healthy elderly adults, patients with MCI and patients with AD (Pereira, Oliveira, et al., 2010). However, in the validation study for Brazil was no specific concern to include only patients with mild stage dementia. The inclusion of patients in more advanced stages of dementia allows for greater differentiation between the groups. Furthermore, we did not find a study that performed an evaluation of the accuracy of functional domains of direct evaluation. Our study also had as objectives to evaluate the accuracy of the total scores of direct and indirect evaluations among elderly adults with MCI, with AD and controls; and the accuracy of the domains of direct evaluation between controls *versus* MCI and MCI *versus* AD, in domains that demonstrate difference in performances between these groups.

## Method

### Participants

The sample was composed by 90 elderly adults, divided into three groups: $n = 27$ controls, $n = 35$ patients with MCI and $n = 28$ patients with mild AD. The following inclusion / exclusion criteria were used for the different groups: elderly control adults, elderly adults with MCI and elderly adults with AD. Inclusion criteria for all groups: individuals with 55 years of age or older and had at least one full year of formal edu-

cation. MCI patients had to meet the diagnostic criteria for Mild Cognitive Impairment (Winblad et al., 2004); individuals with AD had to meet the current criteria for Alzheimer's disease (Frota et al., 2011). Only patients with a history of concomitant vascular disease were included as possible AD. Patients with AD had to present a mild severity stage assessed by the Clinical Dementia Rating Scale (CDR) = 1 (Chaves et al., 2007; Hughes, Berg, Danziger, Coben, & Martin, 1982) and Mini State Examination Mental (MMSE)> 14 points (Reisberg et al., 2011), or MMSE> 14 and ADL-Q <66 points (Medeiros & Guerra, 2009).

Participants with sensory disturbances (auditory and / or visual) without correction were excluded for all groups. The following were also excluded: patients with current or previous history of alcohol abuse, illicit drugs, and aphasic symptoms that would make evaluation impossible. For the control group and the MCI, participants with a history of current neurological or psychiatric conditions were excluded, as well as those with presence of current depressive symptoms, greater than or equal to mild (GDS≤6) for controls and greater than mild for MCI, evaluated by the Geriatric Depression Scale (GDS-15) - (Almeida & Almeida, 1999; Yesavage et al., 1983); MMSE≤22, if education between 1 and 5 years, MMSE≤23, if education between 6 and 11 years, MMSE≤24, if education ≥ 12 years (Chaves, & Izquierdo, 1992; Folstein, Folstein, & McHugh, 1975; Kochhann, Varela, Lisboa, & Chaves, 2010). For the control group, participants with an intellectual level equal to or lower than the borderline level examined by the WASI scale were also excluded (Trentini, Yates, & Heck, 2014; Wechsler, 1999).

The initial study sample consisted of 123 individuals; of these, 18 patients were excluded because they presented moderate to severe dementia, five because they presented cognitive impairment due to another neurological disease other than AD (e.g. Parkinson's disease, TBI, alcoholic dementia), nine because of their current psychiatric disorder, and one subject for presenting borderline IQ.

## Ethical Aspects and Procedures

The present study was carried out as part of a bigger project approved by the Research Ethics Committee of the Pontifical Catholic University of Rio Grande do Sul (PUCRS), number 657.955 / 14 and by the Ethics Committee of the Clinics Hospital of Porto Alegre (*Hospital de Clínicas de Porto Alegre* [HCPA]), number 14-0368. Patients were selected from the Dementia Outpatient Clinic of the HCPA. We also reached out to patients via television, radio and Internet. All participants signed and received a copy of the Term of Informed Consent. All elderly adult participants and their relatives / caregivers were evaluated individually in quiet rooms and free of external stimuli. The evaluation was composed of two sessions of approximately two hours each, following the same order of the instruments for all participants. The CDR scale was not applied during this study, because it is routinely used in the care of patients from the HCPA Dementia Outpatient Clinic. All medical records were assessed, and only patients with a diagnosis of AD dementia with a stage classified as mild (CDR = 1) were invited to participate in the study.

## Instruments

The instruments were divided between sample characterization instruments and functional evaluation instruments.

**Characterization Instruments**. The sociocultural questionnaire and health aspects for elderly adults is a semi-structured questionnaire that includes questions about gender; age; education (years); frequency of reading and writing habits through scores: everyday (4 points), weekly (3 points), monthly (2 points), rarely (1 point) and never (zero points), with a total score of 28 points; use of medications; description of the onset and progression of forgetfulness symptoms; or functional impairment. It also evaluates the socioeconomic level according to the rules of the, Brazilian Criteria of Economic Classification, provided by the Brazilian Association of Research Companies (ABEP, 2014), considering the strata A (45 to 100 points), B1 (38 to

44 points), B2 (29 to 37 points), C1 (23 to 28 points), C2 (17 to 22 points) and SD (0 to 16 points), among other clinical and sociodemographic variables.

The other instruments are included in the sample description and were used for the evaluation of the inclusion and exclusion criteria of the participants. In addition, all participants underwent a broad neuropsychological evaluation of verbal and visual episodic memory, semantic memory, prospective memory, working memory, assessment of verbal and visuomotor initiation and inhibition capacity, verbal fluency, and comprehension (Fransen et al., in press).

## Functional Evaluation Instruments

*The Activities of Daily Living Questionnaire* (ADL-Q; Johnson et al., 2004; Medeiros & Guerra, 2009) is an instrument that evaluates the routine functioning of the patient through information provided by a family member or caregiver. It allows to evaluate basic and instrumental daily life activities (domains of self-care, interaction, intellectual activity, organization / planning, social participation and feeding). The total score varies from 0 to 100. Classification is as follows: from 0 to 33: no losses or slight losses; from 34 to 66: moderate losses; and over 66 serious losses. The adapted version for Brazil presented good reliability through Cronbach's alpha of 0.759 (Medeiros, & Guerra, 2009).

*The Direct Assessment of Functional Status - Revised* (DAFS-R; Loewenstein et al., 1989; Pereira, Oliveira, et al., 2010) is an instrument based on simulations of basic and instrumental daily life activities of the elderly adult in which the participant must perform activities similar to his or her routine. The DAFS-R is an abbreviated version that evaluates seven different domains of functional abilities. The total score ranges from 0 to 105, the higher the score, the better the performance. The domains evaluated are temporal orientation (16 points); skills needed for communication (14 points); dealing with finances (32 points); buying skills (20 points); skills needed to pack / dress (13 points) and eat domain (10 points). The adapted version for Brazil presented good sensitivity = 0.995 and specificity = 0.995 to identify MCI and DA (Pereira, Yassuda, et al., 2010).

## Data Analysis

We used Statistical Package for the Social Sciences (SPSS), version 17.0, for data analysis. The variables analyzed did not present a normal distribution. Thus, we performed the non-parametric Kruskal Wallis test and the Chi-square to characterize the sample. After that, we conducted a MANCOVA, controlling for age and education, the frequency of reading and writing habits, and the socioeconomic level score, to verify the direct functional performance of the participants in the groups (Control *versus* MCI and MCI *versus* AD), including the overall score and domains. A Spearman correlation analysis was performed between ADL-Q and DAFS-R in order to verify the possible association between them. Finally, to check the diagnostic accuracy of the functional scales in ADL-Q and DAFS-R between the controls *versus* MCI and MCI *versus* AD group, we implemented receiver operating characteristic (ROC) curves. For all analyses, differences with significance level $p \leq .05$ were considered significant.

## Results

The sociodemographic and clinical data of the sample can be observed in Table 1. There was no difference in gender distribution. In the other variables, it can be observed that the patients with AD were older, had less education, had lower economic class score, less reading and writing habits, and greater cognitive impairment.

In the MANCOVA analyses to verify the direct functional performance of the participants in the groups (control *versus* MCI and MCI *versus* AD), including the general and domains score, only the general score and the domain of money skills differentiated controls of MCI. The MCI group had lower scores than the control group. In the comparison between MCI and AD, both general score and domains differentiated these

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**Table 1**
**Socio-Demographic and Clinical Data**

| Variables | Controls (*n*=27) | MCI (*n*=35) | AD (*n*=28) | *p* | *Post-Hoc* analysis |
|---|---|---|---|---|---|
| Age (*m±sd*) | 68.07±5.57 | 69.34±7.04 | 75.07±6.65 | **.001** | C,MCI<AD |
| Education (*m±sd*) | 14.19±5.57 | 10.26±4.60 | 6.71±5.16 | **<.001** | C>MCI>AD |
| Socioeconomic level (*m±sd*) | 36.08±12.17 | 32.34±10.14 | 27.93±6.76 | **.038** | C>AD |
| Frequency of reading and writing score (*m±sd*) | 16.22±4.91 | 11.97±6.35 | 5.79±4.22 | **<.001** | C>MCI>AD |
| MMSE (*m±sd*) | 28.41±2.39 | 26.11±3.47 | 21.04±4.01 | **<.001** | C>MCI>A |
| GDS-15 (*m±sd*) | 1.59±1.86 | 2.06±2.26 | 4.96±3.46 | **<.001** | C,MCI<AD |
| Female gender - *n*(%) | 20(74.1) | 25(71.4) | 22(78.6) | .811 | – |

*Note. p≤.05 is considered significant. MMSE = Mini Mental State Examination; GDS-15 = Geriatric Depression Scale; C = Controls; MCI = Mild Cognitive Impairment; AD = dementia of Alzheimer's disease. In bold is highlighted the values with significant difference.*

**Table 2**
**Comparison of Direct Functional Performance between Groups**

| Variables | Controls X MCI | | | MCI X AD | | |
|---|---|---|---|---|---|---|
| | *F* | *p* | *n² partial* | *F* | *p* | *n² partial* |
| Temporal orientation | 1.045 | .311 | 0.019 | 29.748 | **<.001** | 0.347 |
| Skills needs for comunication | 0.041 | .840 | 0.001 | 4.400 | **.040** | 0.073 |
| Dealing with finances | 6.076 | **.017** | 0.099 | 15.774 | **<.001** | 0.220 |
| Buying skills | 0.957 | .332 | 0.170 | 13.906 | **<.001** | 0.199 |
| Skills needs for pack/dress | 0.037 | .848 | 0.001 | 8.088 | **.006** | 0.126 |
| Eat domain | – | – | – | 2.007 | .162 | 0.035 |
| DAFS-R geral score | 4.747 | **.034** | 0.079 | 27.910 | **<.001** | 0.333 |

*Note. p≤.05 is considered significant. DAFS-R= Direct Assessment of Functional Status - Revised; MCI = Mild Cognitive Impairment; AD = dementia of Alzheimer's disease. In bold is highlighted the values with significant difference.*

groups, and the AD group had lower scores than the MCI group, except for the eat domain, in which there were no differences between the groups (Table 2).

Spearman's correlation analysis showed that the total DAFS-R score and the total ADL-Q score had a strong and negative association (rho = -0.743, *p* <.001). Thus, Table 3 shows the best cut-off points observed, maintaining the balance between sensitivity and specificity for the

indirect and direct functional evaluation scales. It can be observed that both scales have greater accuracy between the MCI and AD groups. However, DAFS-R showed better accuracy in differentiating MCI from controls than ADL-Q. For the DAFS-R scale, accuracy analyses were also performed for the domains that showed a difference in performance between controls *versus* MCI and MCI *versus* AD in the MANCOVA analysis.

**Table 3**
**Cut-Off Points of DAFS – R and ADL – Q**

| Groups | Domains | Cut-off points | Area on the curve | Sensitivity | Specificity |
|---|---|---|---|---|---|
| | DAFS – R | | | | |
| Controls *versus* MCI | Geral score | 91 | 0.726 | 68 | 63 |
| | Dealing with finances | 26 | 0.744 | 68 | 66 |
| | Geral score | 70 | 0.905 | 89 | 83 |
| | Temporal orientation | 13 | 0.916 | 89 | 77 |
| MCI *versus* AD | Skills needs for comunication | 10 | 0.792 | 78 | 71 |
| | Dealing with finances | 19 | 0.871 | 89 | 77 |
| | Buying skills | 11 | 0.848 | 89 | 77 |
| | Skills needs for pack/dress | 12 | 0.758 | 71 | 68 |
| | ADL – Q | | | | |
| Controls *versus* MCI | Geral score | 1 | 0.653 | 66 | 59 |
| MCI *versus* AD | Geral score | 21 | 0.977 | 93 | 91 |

*Note.* $p \leq .05$ is considered significant. ADL-Q = Activities of Daily Living Questionnaire; DAFS-R= Direct Assessment of Functional Status - Revised; MCI = Mild Cognitive Impairment; AD = dementia of Alzheimer's disease.

## Discussion

The aim of the study was to compare the accuracy of the direct assessment scores by DAFS and indirect ADL-Q scores among elderly adults with MCI, with AD and controls, and to ascertain the accuracy of the domains of direct evaluation between Controls *versus* MCI and MCI *versus* DA. The comparison of the performance of the direct evaluation represented by the DAFS instrument, controlling the sociodemographic variables, showed that the total score differentiates controls from MCI and MCI from AD. However, although almost all domains differ between the MCI and AD groups, it can only be observed that money skills differentiated the MCI and control groups. This result indicates that coping skills may be the first sign of decline in the very subtle functionality that is already present in MCI frameworks. This

suggests that individuals with MCI have an increased risk of developing dementia (Boyle et al., 2006), precisely because they already begin to show small declines in instrumental abilities that they did not previously have.

The evaluation by the DAFS, in addition to having differentiated MCI from controls, replicating previous studies (Pereira, Yassuda, et al., 2010; Puente, Terry, Faraco, Brown, & Miller, 2014) also presented excellent accuracy to differentiate MCI from AD. Moreover, it can be observed that the direct evaluation of the functionality presents better accuracy than an indirect evaluation. This is probably due to capturing more information about the overall severity of dementia (Farias, Harrell, Neumann, & Houtz, 2003).

In addition, the results are in agreement with literature that shows differences of control group from MCI in the domain of money skills (Pereira,

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Oliveira, et al., 2010; Razani et al., 2011); however, the study by Pereira, Oliveira, et al. (2010) found a difference in purchasing skills. Yet, it is worth mentioning that this study used as an exclusion criterion scores lower than 10 points in the MMSE and included AD patients with mild or moderate stages; in comparison with the present study which excluded patients with MMSE lower than 15 points and only included AD patients at a mild stage. Thus, the objective of the present study was to enable the differentiation between controls and MCI and between MCI and AD, in order to more accurately evaluate the functional decline present in the frames of cognitive neurodegeneration.

Studies have shown that elderly adults with AD showed greater losses in the domains of financial skills, shopping, temporal orientation and communication skills in relation to the healthy elderly and MCI (Goldberg et al., 2010; Pereira, Oliveira, et al., 2010). The findings showed similar results by direct evaluation: older adults with AD presented worse performance than patients with MCI in the total score and in all domains, except for the alimentary domain. Regarding the differentiation between MCI and controls, only the DAFS differentiated these elderly adults. Thus, this type of direct functional evaluation proves to be important for the differentiation of these pathologies.

The perceived advantage in directly patient-based information is that they are free of possible distortions by the caregiver's assessment and of possible underestimation and overestimation of their functionality (Goldberg et al., 2010; Ready, Ott, & Grace, 2004). They are not susceptible to biases caused by humor, personality or burnout of informants (Pereira, Oliveira, et al., 2010). In addition, elderly adults who reside alone may not have a reliable informant because they do not have an adequate contact frequency that allows an accurate report of functional performance, so they do not have a family member who is in their routine to observe the functional impairments. One study showed that caregivers who spent less than 20 hours per week with older adults were inclined to make at least one judgment error (Loewenstein et al., 2001), which emphasizes the need for direct functional evaluation in elderly people living alone.

According to the DHHS (2002), older adults have the desire to maintain independence and reside alone. With increasing life expectation, the percentage of elderly individuals living alone increases proportionally (DHHS, 2002; IBGE, 2008). Thus, due to the progressive increase of the elderly living alone there is a need for a direct functional evaluation, enabling better monitoring and early diagnosis in order to provide adequate treatment for dementia.

One limitation was the inclusion of the ADL-Q scale in the main objective of the study. This was because the scale belonged to the instruments that evaluated the inclusion criteria for the sample (helping in the differentiation between MCI and AD), but at the same time it was performed as an indirect evaluation accuracy criterion: functionality. However, this was done because no article with ADL-Q cut-off points was found. The validation study of the ADL-Q scale demonstrated that it is a sensitive tool to the detection of mild decline as well as more serious damage to disease progression (Johnson et al., 2004). Still, this study did not include control group and MCI in its sample (Johnson et al., 2004). In the present study, although ADL-Q demonstrated good accuracy to discriminate MCI and AD, it did not discriminate for differentiation between control and MCI elderly adults. It is important to highlight that the ADL-Q and DAFS scores are opposites, that is, a better performance in the ADL-Q will yield a score close to or equal to zero. In the DAFS, on the other hand, a score of zero indicates poor performance. This aspect implies to have little or almost no variability in the score of the ADL-Q scale between controls and MCI. In general, this is a characteristic of scales that evaluate functionality through an informant's report.

Thus, it can be concluded that direct evaluation of the functional performance of patients presents a better diagnostic accuracy between elderly control adults and MCI and between elderly with MCI and AD. This type of instrument proves to be indispensable in the evaluation of elderly people who do not have

informants or who do not have a reliable report. The importance of its use also in the context of public health is emphasized, with the objective of increasing the diagnostic accuracy. However, studies that investigate the functional levels for each MCI subtype are recommended. In addition, longitudinal studies are suggested to evaluate the functional continuum of the subgroups that were evaluated in the present study.

## Authors' Contributions

Substantial contribution in the concept and design of the study: Natalia Lemos Fransen, Rochele Paz Fonseca, Renata kochhann.

Contribution to data collection: Natalia Lemos Fransen, Maila Holz, Andressa Pereira.

Contribution to data analysis and interpretation: Natalia Lemos Fransen, Maila Holz, Andressa Pereira, Renata kochhann.

Contribution to manuscript preparation: Natalia Lemos Fransen, Maila Holz, Andressa Pereira, Renata kochhann.

Contribution to critical revision, adding intelectual content: Rochele Paz Fonseca.

## Conflicts of interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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