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Cognitive abilities of institutionalized older persons with depressive symptoms

Habilidades cognitivas de idosos institucionalizados com sintomas depressivos

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ABSTRACT

Objective: To determine the level of association between depressive symptoms and cognitive abilities of institutionalized older adults. **Methods:** This is a cross-sectional study that enrolled 69 older adults, living in a long-term care facility. Investigation of depressive symptoms in all individuals was performed using the geriatric depression scale. Cognitive verbal fluency, digit span forward (DSF) and backward (DSB) tests, and two-minute stationary gait, sit-to-stand test, and six-minute walk test were performed to assess their association with depressive symptoms. **Results:** Depressive symptoms were identified in 35 individuals. Worse cognition and physical performances were associated with the presence of depressive symptoms – Mini-Mental State Examination [t (61) = 2.36; p < 0.05] and Stationary gait test of two minutes [t (53) = 3.12; p < 0.05]. Short-term memory and working memory tests presented worse results in individuals with depressive symptoms (DSF: U = 402.00; p < 0.05 e DSB: U = 341,00; p < 0.05). Older adults with scores below normal in DSF were 5 times more likely to exhibit depressive symptoms. **Conclusion:** The importance of physical, cognitive and social intervention strategies in long-term care facilities for the older adults is highlighted, in order to privilege autonomy. Notably, there is an association between deficits in short-term memory and the presence of depressive symptoms in older adults. Therefore, prospective studies are suggested to investigate the cause-effect relationship of this association with the institutionalization of older adults.

KEYWORDS

Aged, cognition, depressive symptoms, institutionalization, physical fitness.

RESUMO

Objetivo: Determinar o nível de associação entre sintomas depressivos e habilidades cognitivas de idosos institucionalizados. **Métodos:** Trata-se de um estudo transversal que envolveu 69 idosos residentes em uma instituição de longa permanência. A investigação dos sintomas depressivos em todos os indivíduos foi realizada por meio da escala de depressão geriátrica. Os testes cognitivos de fluência verbal, *digit span forward* (DSF) e *backward* (DSB)e os testes físicos de marcha estacionária de dois minutos, de sentar e levantar e o teste de caminhada de seis minutos foram realizados para avaliar sua associação com sintomas depressivos. **Resultados:** Sintomas depressivos foram identificados em 35 indivíduos. Baixos desempenhos cognitivo e físico foram associados à presença de sintomas depressivos – Miniexame do Estado Mental [t (61) = 2,36; p < 0,05] e Teste de marcha estacionária de dois minutos [t (53) = 3,12; p < 0,05]. A memória de curto prazo e os testes de memória operacional mostraram piores resultados em indivíduos com sintomas depressivos (DSF: U = 402,00; p < 0,05 e DSB: U = 341,00; p < 0,05). Idosos com escores abaixo do normal no DSF tiveram 5 vezes mais chance de apresentar sintomas depressivos. **Conclusão:** Destaca-se a importância de estratégias de intervenção físicas, cognitivas e sociais em instituições de longa permanência para idosos, a fim de privilegiar a autonomia. Notavelmente, apresenta-se uma associação entre déficit na capacidade de memória de curto prazo e a presença de sintomas depressivos em adultos mais velhos. Sugerem-se, então, estudos prospectivos que investiguem a relação de causa-efeito dessa associação com a institucionalização de idosos.

PALAVRAS-CHAVE

Idoso, conhecimento, sintomas depressivos, institucionalização, aptidão física.

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INTRODUCTION

Changes resulting from technological advances and health care have been modified the demographics in the world. In four decades, the world population aged 60 or over will increase from approximately 800 million to 2 billion[1]. In line with the global trend, the number of Brazilian older persons grew 18% in 5 years, from 25.4 million in 2012 to over 30 million in 2017[2].

This transition in the age structure has attracted attention to the preservation of functional skills, especially for the older adults, since physical and cognitive impairment are more prevalent in this population than in younger adults, increasing the risk of dependence[3,4]. Thus, aging is understood as a physiological process covered with sociocultural and psychic characteristics, and its approach is complex and interdisciplinary[5]. However, unsuccessful aging affects the functionality, cognition and mood, impairing the quality of life of older adults[6]. The aforementioned factors reduce the quality of life of older adults and increase the prevalence of depression[7].

It should be noted that depression, cognitive and physical impairments have been related to dependency and institutionalization of older adults[8,9]. The prevalence of depression among community-dwelling older adults is in the range of 2% to 10% for patients with minor depression, however, up to 50% of the older adults in nursing homes are depressed[10]. Institutionalization *per se* is a stressor, increasing from two to three times the prevalence of depression in this population[11,12]. Also, cognitive decline is highly prevalent in these populations when compared to community-dwelling older persons[13]. The reasons for a greater cognitive decline among institutionalized older adults are not completely elucidated in the literature, but it is believed that physical and psychological effects of institutionalization, sociodemographic factors, social isolation, reduction or lack of physical activity leading to greater functional impairment, in addition to own depressive symptoms[13-15].

Therefore, along with the increase in life expectancy of individuals, there is the increased necessity of focusing on the healthy aging process[1]. Added to this, is the complexity of the relationship between depression and cognitive decline. Since, despite the different theories as to how this association and its mechanisms happen, research has shown depressive symptoms as predictors of cognitive decline[16-18]. In the present study, we aim to contribute to the discussion by reinforcing the association between depressive symptoms and cognition through the perspective of the neuropsychological cognitive model.

METHODS

Setting and participants

This is a retrospective cross-sectional study performed using the database (https://doi.org/10.6084/m9.figshare.14233928.v1) of larger research performed between 2015 and 2018 in four Brazilian Long-Term Care Facilities – LTCFs (three located in Rio Janeiro city, Rio de Janeiro state, and one located in Montes Claros city, Minas Gerais state). All assessments took place in the afternoon shift with alternating days between neuropsychological and physical tests to avoid measurement bias.

In developing countries, older adults are defined as those aged 60 or older[3-5]. Therefore, for this study participants were of both genders, aged 60 years old or over. The following inclusion criteria were applied: i) being a resident of a LTCF for older adults; ii) to exhibit preserved communication; iii) absence of severe and debilitating lung and heart disease; iv) medical authorization; and v) absence of severe neurological impairment. Participants were excluded if they presented diagnosed depressive disorder according to the DSM-5 (Diagnostic and statistical manual of mental disorders-5) criteria.

Participants in this study were allocated in two groups according to the presence of depressive symptoms (DS) and those with no symptoms (AS). That categorization was made by transforming the numerical variable from the Brazilian version of the Geriatric Depression Scale (GDS)[19] into a categorical one. GDS is a self-report instrument made specifically for screening the occurrence of depressive symptoms in older adults. It consists of thirty questions with binary answers (yes or no). Individuals who achieved a score equal to or greater than 10 were allocated to the DS group[19]. The sensitivity and specificity of GDS 30 were 83% and 57%, respectively, and the test has moderate reliability (kappa = 0.48; p = 0.04)[19].

Cognitive function tests

The Brazilian version of the MMSE was used to quantify global cognition. MMSE consists of 11 items and was used to identify the cognitive level through memory and short-term evocation, temporal and spatial orientation, language and visuospatial skills, calculation, and praxis. The higher the score, the better the cognitive performance, with a maximum of 30 points. Due to the influence of education level on the total MMSE scores, different cut-off points are adopted for different levels of education[20]. In this present study, there was no stratification according to education level since this instrument was only used to characterize the sample. The MMSE test has a reliability coefficient of (R = 0.90), classified as high[21]. According to the Medcal software, the sensitivity of the MMSE was 37% and the specificity was 91%[22].

Verbal Fluency (VF), was used to assess semantic fluency (part of the long-term memory that deals with meanings, symbols, and words) and executive function (analyzed through the loss of initiative, perseverance, or breaking rules)[23-25]. In this test, the subject is asked to evoke the largest number of animals within 60 seconds. To score the VF, count up the total number of animals that the individual is able to say[26]. VF's reliability is 99% classified as high[27]. According to

Medcal software, the sensitivity was 76% and the specificity was 44%[22].

Digit span forward (DSF) and Digit span backward (DSB) were used to assess short-term memory and working memory, respectively[28]. Both tests have high reliability coefficients (Fisher Z = 0.90)[29,30]. In the DSF test participants were asked to recall numeric sequences said by the assessor in the same order. Otherwise, in the DSB the numerical sequence said by the assessor should be repeated in the reverse order by the participants. Each sequence, in both tests, is equivalent to one point and the total score is 14 points. If a participant repeats 6 or more digits in direct order, his/her short-term memory is classified as normal. Meanwhile in the reverse order, if the individual is able to repeat at least 4 digits, his/her working memory is classified as normal[31]. The sensitivity of the DSF was 82% and the specificity was 52%. The DSB sensitivity was 40% and the sensitivity was 93%. Tests performed according to Medcal software[22].

Physical capability

We used the stationary gait test of two minutes (2MST) and the Sit-to-stand Test to assess the physical capability. The first test is an alternative proposal of the six-minute walk test (6MWT) as it has greater feasibility of application in small spaces, such as those made available for the present study. The 2MST evaluates the aerobic endurance of the individual through the number of steps completed in two minutes from the buzzer evaluator. The appropriate minimum knee height should reach a midpoint between the patella and the anteroposterior iliac spine. The total score is recorded by a trained researcher to count how many times the right knee reaches the indicated height. The classification is made according to sex and age, but it is considered as a risk zone less than 65 steps for men and women[32,33]. The Sit-to-stand Test begins with the subject sitting in a chair, feet flat on the floor and arms crossed at chest level. The sound signal evaluator, the participant must get up and sit continuously until a command is given to stop. The maximum number of movements performed in 30 seconds estimates the functional capability of the lower limbs. The classification is made according to sex and age, however, it is considered as a risk zone less than 8 unassisted stands for men and women[33,34]. Thus, these instruments aim to assess aerobic endurance and muscle strength of the lower limbs to determine functional physical capacity.

All instruments, cognitive and physical tests used in the study followed their respective application protocols[20,24-26,31,33,34]. Therefore, all instructions were given to the participants orally. The auditory acuity was established informally and only individuals with preserved communication skills were included in the study. Still, participants requiring orthosis could use it while performing subtasks of the MMSE, minimizing bias. However, it is important to recognize that hearing loss is associated with psychosocial impairments, which can impair autonomy, cause isolation and worsen quality of life, even causing depressive symptoms[35].

Statistical analysis

Based on the reference by Thakur and Blazer (2008)[36], for the calculation of the sample size, we used a 35% prevalence of depressive symptoms in institutionalized older people. A finite population of 309 individuals was considered, the precision of 5%, and the proportion of events of 35%. The sample was estimated at 164 subjects. To perform the calculation the Sample Size Calculator tool from the Australian Bureau of Statistics was used. In addition to those that did not fit the inclusion criteria, added to the difficulties related to conducting research at LTCFs such as the high turnover, deaths, lost information due to the gaps in the medical records, and data loss in testing applications, only 69 individuals were evaluated. Considering our finite population (N = 309) and the percentage of individuals able to be included (22.6%), the estimation is 69 subjects.

Data are presented as mean ± standard deviation for normally distributed variables and as a median (min and max) for variables without normal distribution. The Shapiro-Wilk test was used to determine the normality of the data. Independent T-test and Mann-Whitney test were used to compare the two groups: asymptomatic (AS) and depressive symptoms (DS), as appropriate. A hierarchical binary logistic regression test was performed to verify whether the cognitive variables could predict depressive symptoms since these data were transformed into categorical variables. Since aerobic capacity interferes with depressive symptoms and cognitive functions, this variable was selected as a control. The level of significance was established at $p < 0.05$. All analyses were performed with SPSS® version 21.0.

Ethics statement

This study is a part of two large projects which were approved by the Research Ethics Committee of the *Universidade Federal Fluminense* (protocol 1.287.659/2013) and *Universidade Estadual de Montes Claros* (protocol 2.398.863/2017). For participation in the study, all volunteers signed an informed consent form.

RESULTS

Sixty-nine older adults participated in this present study (Figure 1).

In concern to the occurrence of depressive symptoms, 34 individuals were classified as asymptomatic (AS) and 35 participants showed depressive symptoms (DS). AS group had a score of 5.36 ± 2.13 on GDS, while older adults of the DS group had a value of 17.56 ± 4.08 on GDS. Sociodemographic data are displayed in table 1.

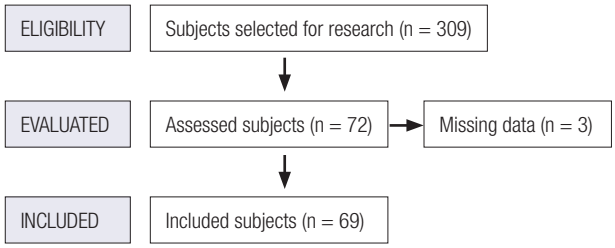

Figure 1. Flowchart of the study selection protocol. Figure created in Mind Manager 2020.

Table 1. Characteristics and cognitive and physical performance in institutionalized asymptomatic (AS) and symptomatic (DS) older adults

Variable	AS (n = 34)	DS (n = 35)	p-value
$GDS_{(score)}$	5.36 ± 2.1	17.56 ± 4.08	<0.01#
$AGE_{(years)}$	81.05 ± 8.01	83.38 ± 7.57	0.22#
BODY $MASS_{(kg)}$	68.98 ± 17.42	68.53 ± 17.03	0.94#
$HEIGHT_{(m)}$	1.56 ± 0.09	1.53 ± 0.07	0.44#
MMSE	20.79 ± 5.27	17.14 ± 7.42	0.02#
DSF	6.00 (1, 10)	4.00 (0, 10)	0.01*
DSB	3.00 (0, 7)	2.00 (0, 7)	<001*
VF	9.59 ± 4.95	8.18 ± 4.71	0.24#
Sit-to-Stand	7.28 ± 2.56	6.04 ± 2.36	0.06#
2MST	38.50 ± 16.67	26.00 ± 12.58	<0.01#

Data presented with mean ± standard deviation (s.d.). #Independent T-test. Data presented with median, minimum and maximum. *U-test. ($p \leq 0.05$).

The homogeneity of ages between groups is especially relevant considering that age can negatively influence the subject's cognitive ability[11,12]. The data obtained through the independent T-test showed a difference between the groups with and without depressive symptoms, according to the results of the MMSE variables [t (61) = 2.36; $p < 0.05$) and 2MST (t (53) = 3.12; $p < 0.05$] shown in table 2. These results demonstrate that older adults with depressive symptoms show worse cognitive and physical performance when compared to those with no symptoms.

Older adults with depressive symptoms showed lower short-term memory and working memory than asymptomatic ones DSF (U = 402.00, $p < 0.05$) and DSB (U = 341.00, $p < 0.05$), indicating a relationship between the outcomes (Table 1).

These outcomes were consolidated according to the results of binary logistic regression performed on cognitive performance and the presence of depressive symptoms. The results pointed that the older adults with scores below normal in DSF (score < 6) are 5 times more likely to have depressive symptoms. However, the other variables showed no significant associations with depressive symptoms. These findings are detailed in table 2.

DISCUSSION

This study evidenced short-term memory as the main cognitive function associated with depressive symptoms. According to the literature, people with major depression may present a deficit in several cognitive processes such as memory, attention, processing speed, and learning, in addition to a negative cognitive bias in the understanding of information[37,38].

Regarding short-term memory, this can be understood by the human capacity to retain a limited amount of information for a short period of time[39]. Working memory, on the other hand, is the combination of sustaining attention and immediate memory that is used to achieve a specific goal and carry out behavior[39]. To differentiate between short-term memory and working memory, it must be understood that working memory is fully active and requires effort when maintaining mental operations for a short period, "working" constantly[40].

About the association between depressive symptoms and cognitive impairment in institutionalized older adults a recent study[12] showed results that corroborating the idea that as higher is the score obtained in the GDS, the greater is the cognitive impairment. In the comparison between the GDS and the Cambridge Cognitive Test, a tool used in the study that also assesses the cognitive performance of the older adults, a negative Pearson correlation (r = -0.471; p = 0.004) was found for the group of older adults considered independent, indicating that as the score of one instrument increases, the other decreases.

It is noteworthy that although the variables working memory and global cognition did not show a significant p-value, these were important to improve the initial model (without independent variables), increasing its predictive power from 50% to 72.2%. These variables were statistically significant before in the association with depressive symptoms in older patients in this study and the literature[11,41,42]. Moreover, aerobic capacity was used as a control variable with significant influence on the model $p < 0.05$. This result

Table 2. Binary logistic regression showing the relationship between cognitive functions and depressive symptoms in institutionalized older adults (Cox & Snell $R^2 = 0.261$; Nagelkerke $R^2 = 0.347$)

Variable	β	WALD	OR	CI95%	p-value
DSF	1.582	4.300	4.86	1.09; 21.69	0.03
DSB	-.586	0.506	0.55	0.11; 2.79	0.47

Aerobic capacity was used as a control covariate: 2MST (OR = 0.93, p = <0,01). The cutoff points of 6 and 4 were used respectively for the DSF and DSB tests[26].

can be explained by a study of 2012[11], also with institutionalized older adults, once an increase in the incidence of depressive symptoms was associated with impaired functional capacity (r = -0.306, p = 0.021), explaining that as one of the elements increases, the other reduces. Another study indicates that physical impairment is a risk factor for depression[42].

It should be noted that, in the context of institutionalization, the older adults are limited by various factors of the LTCFs, such as the rigidity of routine, reduced social functions, the absence of situations that require decision-making, the limitation of the physical space that result in a loss of autonomy and put you in a situation of physical, cognitive and emotional vulnerability[11]. We emphasize that being an older adult is different in developed and developing countrie[43] and that the prevalence of depression varies due to cultural factors and assessment methods. However, in Brazil, studies claim that among institutionalized older persons, the prevalence of depression is approximately 50% (48.7% and 45.7%)[44,45], following the trend of developed countries like the United States of America[46].

The aging process is natural and inevitable, causing several structural, functional, social, and psychic changes, resulting from the interaction of several intrinsic and extrinsic factors. Understanding these changes in cognitive functions, which are related to depressive symptoms, can be useful in preventing depressive symptoms by monitoring cognitive impairment, resulting in greater longevity, quality of life, and less burden to public coffers[12]. Regarding physical performance, this should be understood within a context of functionality and autonomy, since its decline may be associated with the onset of depressive symptoms[11]. Likewise, considering better mental health should also be considered with the absence or minimization of depressive symptoms can promote an improvement in physical and cognitive ability[47,48].

When it comes to the older population, depression is under-diagnosed and under-treated, either because its symptoms permeate neurodegenerative diseases, making a differential diagnosis difficult, or because its symptoms are considered part of unsuccessful aging[49]. Consequently, with the progressive enhancement in the population aging and the risk of depression, this issue will become a public health problem. The problem is added that with the increase in aging, there is an increase in the institutionalization of this part of society[12], and studies have already addressed that compared to older adults in the community, those who live in LTCF have a higher prevalence of depressive symptoms, cognitive impairments, and functional deficits[11,41,49].

Although the association between depression and cognitive decline is well established in the literature, it is not clear whether cognitive decline is a risk factor for depression, a symptom of it, or a consequence of risk factors that are shared between both[34]. Many studies point to depression as a risk factor for dementia[50-52], however, 20% of subjects with dementia develop depression[53]. Additionally, the cognitive neuropsychological model of depression assumes that the negative affective bias plays a central role in the onset and maintenance of depression[54,55]. In order to collaborate in this matter, even a major depressive episode remission, deficits in selective attention, working memory, and long-term memory remain[56]. Therefore, it is important to consider both pathophysiological pathways and their clinical implications for better treatment guidance.

In this sense, this study aimed to promote a better understanding of the possible associations of depressive symptoms and cognitive ability being controlled by aerobic capacity. This is a reaffirmation study to increase the range of evidence in this line of studies. This association between low short-term memory and depressive symptoms may occur via hippocampal atrophy[57]. Memories that carry a relationship with the hippocampus are the most affected in depressed patients as they undergo changes mediated by stress, decreased neurogenesis, and neurodegeneration[58]. Considering the classic segmentation of the hippocampus which is – CA1-CA4, dentate gyrus, subiculum, molecular layer, and tail – these substructures present a reduction in volume, mainly in the left lateral region, with the exception of the molecular layer, which presents an increase[57]. Such findings confirm the importance of CA1-CA4 and dentate regions, which are important circuits for the functions of pattern separation and completion and neurogenesis[57]. Thus, the atrophy of these regions in depression may be associated with impaired short-term memory. However, as such mechanisms were not investigated in the present study, we should interpret this as a speculation.

In this sense, the study by Wan et al., which investigated deviations in subregions of the hippocampus in older adults with cognitive frailty, corroborates with our findings. This is because cognitive frailty is related to changes in brain structure that negatively impact physical capacity and cognitive skills. Study results show that, in comparison with a group of healthy older adults and a group with cognitive frailty, those with cognitive frailty had six hippocampal subregions with less volume, four on the left and two on the right, namely the left presubiculum, parasubiculum, molecular layer of the HP, and HATA, and the right CA1 and presubiculum. Such subregions are associated with functions such as cognitive processing (information input and output capacity), visuospatial function, memory, fear regulation (situational learning and emotional memory) and hippocampal circuitry function and cognitive behavior. Thus, this more severe atrophy in the brain parenchyma and a reduction in the total number of white matter fibers in the group of older adults with cognitive frailty may indicate the pathway of association between low short-term memory, depressive symptoms and lower physical abilities[59].

Limitations include the lack of sociodemographic data and the loss of anthropometric data[37], but without prejudice to the reliability of the results. The lack of stratification of the MMSE requires a cautious interpretation of the results. Some included individuals were diagnosed with depression according to the physician in each LTCF. However, none validated criteria (e. g. DSM-5) was used as an instrument to provide the diagnosis. Thus, these persons were not excluded from the sample, probably limiting our results. About the limitations surrounding the Brazilian LTCFs, most are philanthropic and do not have sufficient human resources to manage services and information, causing limitations in conducting research at these institutions. Thus, the results of this study cannot be generalized, once the planned sample was not reached, once a large number of older adults were excluded due to the incapacities to be evaluated. Still, considering the heterogeneity of issues that vary among the older adults aged 60, 80, or more, a multidimensional approach that considers the peculiarities of each age group is necessary to guide both diagnosis and treatment in order to offer a more appropriate care plan for the situations that concern each older person in these periods[60]. Also, the lack of specific data regarding medication intake is added as a limitation of this study, since several medications can cause physical and cognitive side effects, which could be a confounding factor in our findings.

Finally, a prospective study investigating the incidence of depression and cognitive impairment in institutionalized older adults should be performed, since in this research we do not intend to establish whether institutionalization is what favors such declines or if people with previous commitments are more hospitalized. However, it is pointed out that there is a need to intensify the care provided by the LTCFs so that they favor the autonomy of the older adults through cognitive, physical, and social stimulation.

CONCLUSION

The present study demonstrated that short-term memory and working memory would be associated with the development of depressive symptoms in institutionalized older adults. The results indicate the importance of seeking intervention strategies in these institutions aimed at strengthening these capabilities, especially concerning short-term memory, whose deficit would be associated with an approximately 5 times greater risk to present depressive symptoms.

INDIVIDUAL CONTRIBUTIONS

Laís Francielle Francisca Felício – Formulated the research question, elaborated the study, carried it out, analyzed the data and wrote the article.

Renato Sobral Monteiro-Junior – Formulated the research question, prepared the study, carried it out, analyzed the data and reviewed the article.

Luana Lemos Leão – Analyzed the statistical data and revised the language.

Eric Hudson Evangelista e Souza – Helped in the statistical design of the study and in carrying out the statistical analysis.

Frederico Sander Mansur Machado – Formulated the research question, analyzed the data and revised the article.

Jerson Laks – Assisted in the writing of the article and critically reviewed its intellectual content.

Andrea Camaz Deslandes – Assisted in the writing of the article and critically revised its intellectual content.

Alfredo Maurício Batista de Paula – Assisted in the writing of the article and critically reviewed its intellectual content.

DISCLOSURE OF CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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