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Original Research Article

Cognitive and Functional Decline among Individuals 50 Years of Age or Older in Cambé, Paraná, Brazil: A Population-Based Study

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Key Words
Dementia · Cognitive assessment · Cognitive impairment

Abstract
Aims: To identify the frequency of cognitive and functional decline (CFD) among adults 50 years of age and older by a population-based study. ***Methods:*** Cognitive function was analyzed by the Mini-Mental State Examination, and the functional conditions were based on instrumental activities of daily living (IADL). Cases of CFD included individuals with cognitive decline and 2 or more compromised IADL. ***Results:*** A total of 693 individuals were studied. The frequency of CFD was 16.3%. A low socioeconomic profile was associated with greater CFD independent of gender, age, education, and presence of depression (OR = 2.46; 95% CI: 1.53–3.97). ***Conclusions:*** These data show a high frequency of CFD among adults 50 years and older. Individuals with less education and a lower socioeconomic level exhibited poorer cognitive and functional conditions.

This study was conducted as part of the Postgraduation Program of Public Health, Health Sciences Center, Universidade Estadual de Londrina, Londrina, Brazil.

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Introduction

Neurocognitive disorders represent a significant portion of chronic degenerative diseases and are responsible for increased mortality and health care costs [1]. The number of people with dementia is steadily increasing, especially in developing countries, in which an insufficient number of epidemiological studies have been conducted [2, 3]. Several authors have conducted studies on the prevalence of and factors associated with dementia but have restricted their studies to the elderly population. Although it has been recognized that the onset of dementia occurs earlier in developing countries [4], no epidemiological studies intended to identify cognitive decline in cohorts consisting of individuals who are not considered elderly (less than 60 years old) have been conducted. Moreover, surveys identify established cases of dementia using neurocognitive testing instruments. However, the latest revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) advocates using loss of cognitive functions as a criterion and indicates the necessity of functional impairment in any diagnosis of dementia [5].

One of the leading challenges of the epidemiology of dementia lies in understanding the relationship between dementia and socioeconomic conditions. Poor social conditions have been associated with cognitive impairment, which is commonly explained by limited access to education for poor individuals [6]. In addition, the conceptualization of neurocognitive disorders is difficult to achieve in countries with lower education levels, which may contribute to the overrating of dementia in these populations when cognitive function assessment tools that are dependent on educational standards are used [7]. The Mini-Mental State Examination (MMSE) is the most commonly used tool for identifying dementia, but cutoff points need to be established based on an individual's educational profile [8].

Thus, the present study aims to determine the frequency of cognitive and functional decline (CFD) and its association with educational level and economic status among individuals 50 years of age or older.

Patients and Methods

Study Design and Participants

The present study is part of the 'Cardiovascular diseases in Paraná: mortality, risk profile, drug therapy and complications' (Doenças cardiovasculares no Estado do Paraná: mortalidade, perfil de risco, terapia medicamentosa e complicações) study [9] conducted in 2011 on a representative sample of the noninstitutionalized population 40 years of age or older in a medium-sized city in Southern Brazil. It is a cross-sectional population-based study in which the sample size calculation was based on census data [10] and included 92,888 inhabitants, of whom 30,710 (33.1%) were 40 years of age or older.

Based on the higher prevalence of risk factors and the predominance of residents in the urban area of the study municipality (96%), the sample size was calculated considering an expected participation rate of 50%, a 3% margin of error, and a 95% CI, resulting in a sample size of 1,066 individuals, which was increased by 25% to account for losses, for a total of 1,339 interviews. All census tracts (n = 86) of the urban area were included in the study.

The number of individuals to be interviewed in each sector was calculated based on the number of resident individuals, which was based on (1) the proportional distribution of the population in each sector by gender and age group and (2) the population census data [10]. The present analysis included all individuals 50 years of age or older in this sample, for a total of 704 individuals.

Tools and Procedures

All provisions on guidelines and research standards involving human subjects were followed. Interviews were conducted after providing information about the study objectives and methodologies and a clarification of which ethics committee received and approved the project. After this explanation, respondents who agreed to be interviewed were asked to sign an informed consent form.

The following variables were analyzed:

- Gender
- Age: stratified into two age groups for the analysis, i.e. 50–64 years and 65 years or older
- Educational level: characterized based on the number of years of study, i.e. illiterate (0 years), 1–4 years, 5–8 years, and 9 or more years; individuals who reported being illiterate or having attended 4 or fewer years of school were considered to have a low educational level
- Socioeconomic status: economic classifications were based the criteria of the Brazilian Association of Research Companies [11]; individuals below the 25th percentile were considered to have a low socioeconomic status
- Depression: established based on self-reported information or caregiver information regarding a current diagnosis of depression and/or continuous use of any antidepressant medication
- Basic activities of daily living (BADL): Katz [12] and Lawton [13] Instrumental Activities of Daily Living (IADL) scales; an individual's autonomy was determined for each activity using the following five options: (a) lives alone without difficulty; (b) lives alone with difficulty; (c) lives alone, but needs stimulation/supervision; (d) needs partial assistance, and (e) unable to live alone, needs someone else; if there were any difficulties in performing the activities examined or the alternatives b, c, d, or e were selected, the individuals were classified as having 'compromised capacity'
- Cognitive decline: cognitive function was assessed using the MMSE [14], which is subdivided into questions related to orientation to time, orientation to place, attention and calculation, memory recall, and language; it is measured using a scale ranging from 0 to 30 points; the cutoff score for a classification of cognitive decline was established based on education: illiterate (<19), 1–3 years of education (<23), 4–7 years (<24), and 8 years or more (<28) [15]
- CFD: individuals who presented with cognitive decline (low MMSE score) and at least 2 impaired IADL were considered to have CFD

Statistical Analysis

The statistical analysis was performed with SPSS version 19.0 (SPSS, Chicago, Ill., USA). In the descriptive analysis, categorical data were stratified by gender using the χ^2 test for comparisons between groups. ANOVA was used in the analysis of mean differences of continuous data. Statistical significance was defined as a value of $p < 0.05$.

The analysis of the association between the presence of CFD and the independent variables was performed using a crude analysis and an adjusted analysis using a generalized Poisson linear regression method. For this purpose, CFD was considered the dependent variable, and low socioeconomic status and educational level were considered independent variables. Gender, age range, and presence of depression were used as adjustment variables. The following models of analysis were developed: crude analysis, model A (adjusted for gender and age range), model B (adjusted for gender, age range, socioeconomic status, and education), and model C (adjusted for gender, age range, socioeconomic status, education, and depression). In all analyses, the prevalence ratios and 95% CI were estimated. Associations with a value of $p < 0.05$ in the adjusted analysis were considered statistically significant.

Table 1. Characterization of the study population according to gender

Variable	Total (n = 693)	Men (n = 312)	Women (n = 381)	p value
Mean age (SD)	61.2 (8.1)	60.3 (7.3)	61.8 (8.4)	0.01[a]
Age range				
50–64 years	497 (71.7%)	229 (73.4%)	268 (70.3%)	0.054
≥65 years	196 (28.3%)	83 (26.6%)	113 (29.7%)	
Education				
Illiterate	93 (13.4%)	26 (8.3%)	67 (17.6%)	
1–4 years	348 (50.2%)	161 (51.6%)	187 (49.1%)	
≥5 years	252 (36.4%)	125 (40.1%)	127 (33.3%)	0.001
Low socioeconomic status				
No (>25th percentile)	528 (76.2%)	259 (83.0%)	270 (70.9%)	
Yes (<25th percentile)	164 (23.8%)	53 (17.0%)	111 (29.1%)	<0.001
Depression				
Yes	153 (22.1%)	36 (11.5%)	117 (30.7%)	
No	540 (77.9%)	276 (88.5%)	264 (69.3%)	<0.001
Mean MMSE score (SD)	23.6 (4.0)	24.1 (4.13)	23.2 (4.04)	0.009[a]
Cognitive decline (low MMSE score)				
Yes	312 (45.0%)	131 (42.0%)	181 (47.5%)	0.14
No	381 (55.0%)	181 (58.0%)	200 (52.5%)	
IADL impairments				
None	360 (51.9%)	160 (51.3%)	200 (52.5%)	
≥1	333 (48.1%)	152 (48.7%)	181 (47.5%)	0.382
≥2	216 (31.2%)	105 (33.7%)	111 (29.1%)	0.113
BADL impairments				
None	596 (86.0%)	283 (90.7%)	313 (82.2%)	
≥1	97 (14.0%)	29 (9.3%)	68 (17.8%)	0.019
≥2	40 (5.8%)	11 (3.5%)	29 (7.6%)	0.002
CFD (low MMSE score and ≥2 IADL impairments)				
Yes	113 (16.3%)	50 (16.0%)	63 (16.5%)	
No	580 (83.7%)	262 (84.0%)	318 (83.5%)	

[a] ANOVA.

Results

In total, 704 individuals 50 years of age or older were sampled; however, the analysis was limited to 693 individuals (312 men and 381 women) because the MMSE could not be applied to 11 individuals.

The mean age was 61.2 years, and 28.3% of the subjects were 65 years of age or older. Low educational levels (74.3% between 0 and 4 years) were very prevalent; no significant difference was found between genders. A higher proportion of women (29.1%) were classified as having a low socioeconomic status, resulting in a significant difference between genders (17.0%). Depression was reported by 22.1% of the individuals, the highest proportion of whom were women ($p < 0.001$) (table 1).

The mean MMSE score was 23.6, and impairment in at least 1 BADL or IADL was identified in 14.0 and 48.1% of the individuals, respectively (table 1). Women had nearly twice as many impairments in BADL as men. Approximately one third of the individuals had difficulty in at least 2 IADL; no differences were observed between genders. The overall frequency of CFD in the sample (low MMSE score and 2 or more IADL impairments) was 16.3%; again, no difference was observed between genders (table 2).

Table 2. Multivariate analysis of CFD in relation to socioeconomic status and education

Variable	CFD (low MMSE score and ≥2 IADL impairments)				
	CFD (n = 603)	bivariate analysis: crude, PR (95% CI)	model A: adjusted for age range and gender, PR (95% CI)	model B: adjusted for age range, gender, education, and socioeconomic status	model C: adjusted for age range, gender, education, socioeconomic status, and depression
Age range					
50–64 years	12.1%	1			
≥65 years	27.0%	2.70 (1.78–4.09)**			
Education					
≥5 years	10.0%	1	1	1	1
0–4 years	20.0%	2.25 (1.40–3.62)**	1.82 (1.11–2.97)*	1.42 (0.85–2.40)	1.46 (0.87–2.47)
Socioeconomic status					
>75th percentile	12.3%	1	1	1	1
<25th percentile	29.3%	2.95 (1.93–5.52)**	2.56 (1.60–3.92)**	2.28 (1.42–3.64)*	2.46 (1.53–3.97)**

PR = Prevalence rate. * $p < 0.05$; ** $p < 0.001$.

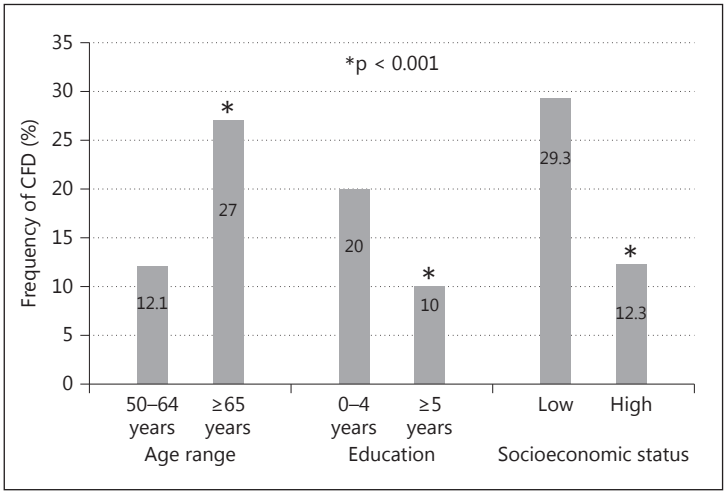

Fig. 1. Frequency of CFD according to age range, education, and socioeconomic status.

Figure 1 shows that the highest prevalence of CFD occurred among individuals 65 years of age or older with low educational levels and worse socioeconomic status. The associations of the frequency of CFD with low educational levels and worse socioeconomic status were significant in the analysis that was adjusted for age and gender. Low socioeconomic status remained associated with CFD in the final multivariate analysis model, which also included the variables education and presence of depression (prevalence rate = 2.46; 95% CI: 1.53–3.97; $p < 0.001$) (table 2).

Discussion

The results show the importance of cognitive impairments in this population. CFD was observed in 16% of the sampled individuals 50 years of age or older, and even among the younger age group (50–64 years), this index was 12%. Low educational levels and a worse

socioeconomic status were positively associated with CFD, but only the socioeconomic variable was independently associated in the multivariate model.

Few studies have examined the presence of cognitive and functional impairments as early as at the age of 50 years. The inclusion of younger age groups is needed to identify preclinical situations associated with neurocognitive and functional disorders. The Baltimore ECA study data showed that people with apathy at the age of 50 years had a higher risk of developing functional impairments over the following 13 years [16]. In addition, Nitrini et al. [4] suggested that dementia starts earlier among populations of developing countries than among those of more developed countries.

Studies on dementia normally examine the later stages of life and focus on diagnosis. If signs of decline are more previously established, patients have greater vulnerability to comorbidities, and preventive measures are no longer effective [17]. In a sense, the early identification of cognitive disorders is necessary to develop not only cognitive performance scales [18] but also cognitive assessments that include different sociocultural profiles, coupled with functional assessments that identify compromised living conditions.

It is difficult to compare the frequencies of CFD observed in this analysis with those obtained by authors who have studied the prevalence of dementia in various senior populations. Our classification of CFD refers to cognitive impairments (low MMSE score) associated with at least 2 impairments in IADL (partial or total). The concept of CFD used in the present study does not necessarily recognize the clinical concept of dementia or more significant neurocognitive disorders, since for this characterization it would have been necessary to exclude other neuropsychiatric disorders that interfere with the functionality of individuals [5].

It is possible that even with cognitive and functional impairments, some people develop compensatory strategies to maintain adequate living conditions [19] and would not be considered as having more significant neurocognitive disorders. Thus, it is possible that the individuals classified as having CFD (16%) in the present study could be clinically grouped with patients with dementia or mild cognitive impairment.

The prevalence of dementia observed in numerous studies varies widely based on sociodemographic and educational profiles and the use of different cognitive and functional assessment instruments. A recognized challenge consists of comparing the frequencies of cognitive disorders according to the various methodologies used [20]. The variation of the prevalence of dementia is 5.1–19% in Brazil [21], 2.1–13.1% in Latin America [4], 6.0–9.6% in the USA [22], and 5.9–9.6% in Europe [20]. The prevalence of mild cognitive impairment can vary from 10 to 20% [23].

The role of the MMSE in assessing cognitive performance has been sufficiently established in the literature [24]. While we recognize that a comprehensive neuropsychological assessment would be more accurate for the diagnosis of mental disorders, the MMSE was deemed an objective measure of cognitive decline. However, cultural adaptations to the instrument need to be established, and cutoff points need to be determined for different educational contexts [8, 25, 26].

In the present analysis, we used different cutoff points for four levels of education [15] to minimize the influence of low educational levels on the MMSE score. Furthermore, the analysis was adjusted for age and gender, and education was included in the multivariate model. In a study in the city of Bagé, Brazil, 34.1% of the seniors (60 years and older) had MMSE scores <23. Although the illiteracy rate in this group was 23.7%, the scoring criteria were used without addressing educational levels [27]. Data from elderly Brazilians in São Paulo (SABE study) showed that 6.9% of the seniors had an MMSE score <13 (regardless of education), and 81% did not have any IADL impairments [28]. In a study involving noninstitutionalized seniors (60 years and older), the prevalence of dementia according to the DSM-IV

was only 2.7%. However, in this group, a clear CFD was present that was not consistent with a dementia diagnosis. The mean MMSE score was 23; 14.6% of the individuals had an MMSE score <17, 19.8% had some IADL impairment, and 7.2% had at least 2 IADL impairments [29].

Cognitive function and functional capacity are commonly associated, but impairments are often observed at different times for each individual. Notably, a strong correlation exists between IADL impairments and cognitive decline, even in patients without dementia [30]. The criteria established by the concept of CFD allow us to discriminate between individuals who, in addition to having low cognitive performance, had difficulties in carrying out daily activities. This group accounted for 16.1% of the study sample and showed a strong association with low educational levels and a lower socioeconomic status, after adjusting for gender and age.

The association between low educational levels and cognitive decline, including among elderly Brazilians, has been consistently observed by several authors [31]. In a multivariate analysis, Herrera et al. [15] showed that educational levels were associated with dementia regardless of age and socioeconomic status. Winter Holz et al. [27] found that cognitive decline (MMSE score <23) was strongly associated with less than 8 years of education. In another sample of Brazilian seniors, education was associated with a lower MMSE score (<13) [32].

Our data show that education did not have a significant association when socioeconomic status and depression were included in the multivariate model. This finding reinforces the significant interference that depression can have in evaluating cognitive and functional impairment [33], suggesting the need to include this comorbidity in the analysis of factors associated with dementia [30]. Understanding the role of education in the frequency of cognitive disorders also depends on the criteria used to define dementia, since less educated individuals could have more difficulty on cognitive tests. Paddick et al. [34] showed distinct differences in the prevalence of dementia in the same population using two different sets of criteria: those of the DSM-IV (6.4%) and those of the 10/66 Dementia Research Group (21.9%). In their analysis, education only showed an association when the 10/66 criteria were used. Other authors in different countries have also observed lower prevalence rates of dementia using the DSM-IV criteria compared to other criteria [35].

The fact that people classified as having worse economic conditions (<25th percentile) have higher frequencies of CFD, independent of gender, age, education, and depression, indicates that socioeconomic status is an important factor, possibly even more important than education, in the epidemiology of cognitive disorders. Some authors have reported results that are consistent with our results, indicating that low economic status is a factor that is independent of education with regard to cognitive decline [27, 30]. Scazufca et al. [36] conducted an important study of dementia in Brazilian seniors (65 years and older) of a low social class and identified low income as being associated with a higher prevalence of dementia; however, in a multivariate analysis, illiteracy was not statistically significant. In a 12-year follow-up study of individuals with cognitive impairment, those with low economic status had a higher risk of developing limitations in activities of daily living [37].

The two factors of social status and education are recognized as determinants of cognitive reserve, which in turn is directly related to the incidence of cognitive disorders [38]. The preservation of cognitive reserve depends on the profile of intellectual activities developed during adulthood, which is influenced by labor and behavioral activities [2]. The study population, despite currently living in an urban area, includes several individuals who have lived most of their adult lives in rural areas, which preferentially includes those with low educational levels and worse socioeconomic status. Contador et al. [39] observed an increased risk of dementia in rural populations and in individuals currently living in urban areas who previously resided in rural areas.

Some of the limitations of the present study should be noted to properly interpret the results. Clinical situations that could compromise an individual's cognitive and functional ability, such as delirium and other neuropsychiatric disorders not associated with dementia, were not included in the study. Furthermore, the identification of clinical complications concomitant with the evaluation and the use of psychoactive drugs could have a negative impact on performance.

In conclusion, despite these limitations, the data highlight the importance of cognitive and functional assessments beginning at 50 years of age and suggest the importance of including early CFD identification strategies using two simple tools and encouraging adaptive attitudes for individuals diagnosed with some type of decline. Confronting this problem will therefore necessarily involve reducing inequalities and implementing measures to promote social equity while preserving quality of life and dignity.

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