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Factors associated with functional disability of elderly in Brazil: a multilevel analysis

ABSTRACT

OBJECTIVE: To analyze the influence of demographic, socioeconomic, health, and contextual factors of the Brazilian federation units on the functional disability of the elderly.

METHODS: Cross-sectional study based on data from the 2003 PNAD (Brazilian National Household Survey), of IBGE (Brazilian Institute of Geography and Statistics) and Ipea (Institute of Applied Economic Research). The sample was composed of 33,515 individuals aged 60 years and older. The dependent variable was functional disability, measured by difficulty in climbing slopes or stairs. The independent variables were divided into two levels: individual (demographic, socioeconomic and health-related characteristics) and contextual (Gini Index and Gross Domestic Product per capita by Brazilian state in 2000). A multinomial and multilevel logistic regression model was utilized in order to estimate the effect of the independent variables on the functional disability of the elderly.

RESULTS: Functional disability was associated with demographic, socioeconomic and health factors. At the individual level, sex, level of schooling, income, occupation, self-perception of health and chronic diseases were the factors that were most strongly related to functional disability. At the contextual level, income inequality proved to exert an important influence.

CONCLUSIONS: Self-perception of health is the factor that is most strongly related to the functional disability of the elderly in Brazil, followed by chronic diseases. Sex, occupation, level of schooling and income are also highly associated with it. Actions that approach the main factors associated with functional disability can contribute significantly to the well-being and quality of life of the elderly.

DESCRIPTORS: Aged. Frail Elderly. Functional Capacity. Socioeconomic Factors. Multilevel Analysis. Cross-Sectional Studies. Health of the Elderly. Quality of Life.

INTRODUCTION

Brazil has been undergoing a quick and sharp process of aging and extension of the population's longevity. With the acceleration of this process, there is an increase in the prevalence of chronic-degenerative diseases and of functional disability.¹

Functional disability can be defined by the individual's difficulty or need of help concerning the execution of basic or more complex daily tasks that are necessary for an independent life in the community, like, for example, mobility-related tasks.² Although the presence of chronic diseases is important, their

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Received: 2/4/2009

Approved: 12/4/2009

Article available from www.scielo.br/rsp

functional consequences have implications that are more visible and perceptible to the elderly, since functional loss causes greater vulnerability and dependence in old age.¹²

The functional disability of the elderly can be determined by activities of daily living (ADL), by instrumental activities of daily living (IADL) and by physical mobility.²

Individual factors have been viewed as responsible for the functional disability process. Previous studies have shown that functional decline is related to demographic, socioeconomic and health factors.^{1,4,5,6} However, few studies in Brazil focus on the relationship of the determinants of functional disability among the elderly.^{8,19,24}

At the contextual level, socioeconomic conditions can explain regional variations and the great diversity of the levels of health and functional disability among the elderly. Income inequality can cause contextual or extra-individual effects on the social environment that affect health. To Porell & Miltiades²¹ (2002), the impact of adverse socioeconomic conditions on individuals' health is higher in regions with highly unequal income distribution. According to Kaplan et al¹³ (1996), high income inequality measured in the national, state or community level is associated with worse population's health.

Brazil is among the countries with the highest degrees of social inequality. A study using data from *Pesquisa Nacional por Amostra de Domicílios* (PNAD - Brazilian National Household Survey) indicated that the functional capacity of the elderly is strongly influenced by the socioeconomic situation.¹⁵ It is likely that individuals living in areas with better socioeconomic conditions have greater access to medical goods and services and, consequently, are capable of maintaining good health conditions and functional capacity over time.²¹ Nevertheless, there are no studies in Brazil that investigate the relations between socioeconomic inequalities at the level of federation units (states and the Federal District), important geographic spaces for application of public policies, and functional disability of the elderly.

The aim of the present study was to analyze the influence of demographic, socioeconomic, health and contextual factors of the federation units on the functional disability of the elderly.

METHODS

Cross-sectional study based on data from PNAD-2003, from *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography

and Statistics)^b and *Instituto de Pesquisa Econômica Aplicada* (IPEA – Institute of Applied Economic Research).^b In 1998, PNAD included in its questionnaire a health supplement whose information should be collected every five years, and 2003 was the most recent available information.

The present study included individuals aged 60 years or older, whose data were obtained by PNAD by means of home interviews. Overall, 1,527 elderly people who did not answer the questions regarding the study's variables were excluded. The studied sample was composed of 33,515 elderly individuals.

The dependent variable was functional disability. To measure it, the physical mobility variable "ability to climb slopes or stairs" was used, considered a robust indicator of future functional decline among the elderly.¹² In addition, the choice of the physical mobility indicator to the detriment of the ADL derives from its capacity to detect an early stage of functional losses, enabling the discrimination of disability in the community.¹⁷ The interviewee answered the following question: "Do you usually have difficulty in climbing slopes or stairs?" Four categories were used in the functional disability classification: does not have difficulty, has low level of difficulty, has high level of difficulty and cannot do it.

The independent variables were subdivided into two levels: individual and contextual. At the individual level, the variables were classified into three blocks: demographic, socioeconomic, and health. The demographic variables were: age (considered as continuous because capacity loss has a direct relationship to aging), sex, family arrangement (lives alone and lives with someone), race/color (white, black and mixed ethnicity) and household situation (urban and rural). In PNAD, individuals classify themselves in terms of race/color as: white, black, yellow, mixed ethnicity and indigenous. Indigenous individuals, yellow ones and those who did not declare their race/color were excluded because the relative frequency was below 1%. The socioeconomic variables were: level of schooling, (no schooling, 1-4, 5-8, 9-11 and 12 years of schooling or more), monthly family income (lower than one minimum salary, one to three, three to five, five to ten and ten or more) and occupation (occupied and unoccupied). Minimum salary refers to the value it had on April 2003 (R\$240.00). The included health variables were: self-perception of health (very good, good, regular, poor and extremely poor), self-reported presence of arthritis/rheumatism, cancer, hypertension, diabetes, bronchitis/asthma, heart disease, chronic renal failure, depression, spinal column problems, tuberculosis, tendinitis/tenosynovitis and cirrhosis

^a Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional por Amostras de Domicílio 2003 – Available in CD-ROM.

^b Instituto de Pesquisa Econômica Aplicada. [internet] [cited 2008 Apr 21] Available from: <http://www.ipeadata.gov.br/ipeaweb.dll/ipeadata?65370046>

(dichotomized into yes and no), hospitalizations in the last 12 months (yes and no) and affiliation to a private health plan (yes and no).

The independent contextual variables that were included were: Gini Index^b and Gross Domestic Product (GDP)^c per capita by federation unit (FU) in 2000.

According to Pinheiro & Torres²⁰ (2006), individuals living in the same FU are more similar concerning health problems when compared to those living in another FU, because they are submitted to the same context (socioeconomic conditions, cultural factors, among others). Thus, inside the FU, observations would not be independent and there would be violation of the presuppositions of the traditional regression models. In light of the fact that the data structure is hierarchical and the response variable has four categories, to estimate the association between functional disability and the demographic, socioeconomic and health variables, the multilevel multinomial logistic regression model was employed, with the first level represented by the individuals, and the second, by the FU.⁹

Initially, a univariate multinomial logistic regression analysis was carried out with the variables of the individual level. The statistically significant variables ($p < 0.25$) in the univariate regression analysis were selected for multivariate analysis. In the multivariate analysis, the variables of the individual level were included first, followed by the variables of the contextual level with the fixed coefficients. The evaluation of the effect of the contextual variables on functional disability was carried out through the analysis of the statistical significance ($p \leq 0.05$) of its coefficient and through the reduction in the random effect variance, in comparison with the model that has only the individuals' characteristics.

The results of the final model (individual and contextual variables) were interpreted in probabilities, calculated for each statistically significant variable ($p \leq 0.05$), and the other variables were centered on the mean.²³ The software MLwiN was used for data analysis.²²

RESULTS

The elderly individuals' age varied from 60 to 106 years (Table 1), and the mean and median ages were 69.8 and 68 years, respectively ($SD = 7.7$). The population was predominantly female (56.1%) and 87.1% of the elderly lived with someone; 84.2% lived in urban areas; 55.7% referred to their color as white; 37.8% did not have any schooling; 37.5% earned from one to three minimum salaries; 32.8% were occupied. As for health aspects, 35% perceived their health as

good; 12.7% reported hospitalization in the last 12 months and 28% had a private health plan. Arterial hypertension was the most frequent chronic disease (48.9%), followed by spinal column problems (36.8%), arthritis/rheumatism (28.5%), heart disease (17.4%) and diabetes (12.9%) (Table 1).

The estimates of the coefficients of the fixed and random effects of the models with the variables of the individual level and final model are in Table 2. The model with the individual level variables showed that part of the variability in the probability of the elderly individual to have low level of difficulty, high level of difficulty and not being able to climb slopes or stairs was explained by the level of the FU ($\sigma_j^2 = 0.054; 0.091; 0.150; p < 0.05$; respectively).

After controlling the factors of the contextual level, there was reduction of 13%, 36.3% and 36.7% in the random effect variance, which continued to be statistically different from zero for the three categories of the dependent variable, indicating that there still was variability in the contextual level, which might be reduced with the additional inclusion of variables of this level in the model. The inclusion of the contextual variables in the model did not cause important modifications in the estimates of the coefficients of the individual variables.

The interpretation of the final model was carried out in terms of probabilities (Table 3). The probability of the individual to be able to climb slopes or stairs decreased as age increased (0.60 at 60 years of age and 0.24 at 85 years) and increased in the category cannot do it (0.04 at 60 years of age and 0.21 at 85 years). The female sex showed higher probability to have high level of difficulty (0.21) and not to be able to do it (0.09) compared to men (0.15 and 0.07, respectively). The probability of the elderly who lived with someone to fail in the execution of the activity was higher compared to those who lived alone (0.08 and 0.06, respectively). As for the household situation, the elderly who lived in the rural area presented higher probability to fail to do it compared to those living in the urban area (0.10 and 0.08, respectively). Having black and mixed (black and white) skin color reduced the probability of the elderly to fail to climb slopes or stairs (0.07). As for level of schooling and income, as the levels increased, the probability of the elderly individuals to be able to carry out the activity increased. Income lower than one minimum salary increased the probability of failure in the accomplishment of the activity (0.09). The occupied elderly individuals had lower probability to present high level of difficulty (0.15) in relation to the unoccupied individuals. The unoccupied individuals, in turn, presented high probability (0.11) of failure, compared to the occupied ones (0.04).

^c Instituto Brasileiro de Geografia e Estatística. Produto interno bruto dos municípios: 1999-2002 [internet]. Rio de Janeiro, 2005 (Contas nacionais, 14). [cited 2008 Apr 23] Available from: <http://www.ibge.gov.br/home/estatistica/economia/pibmunicipios/2002/pibmunic2002.pdf>

Concerning the health indicators, the elderly who self-perceived their health as poor (0.25) and extremely poor (0.43) had much higher propensity to fail in carrying out the activity. Regarding chronic diseases, the absence of spinal column problems increased the probability (0.49) of success in the accomplishment of the activity. Those suffering from arthritis, diabetes, bronchitis, hypertension, heart disease, chronic renal failure, depression and tuberculosis presented increased probability to have high level of difficulty (probabilities of 0.24; 0.21; 0.27; 0.20; 0.25; 0.22; 0.21; 0.32; respectively) compared to individuals without those diseases (probabilities of 0.16; 0.18; 0.18; 0.17; 0.17; 0.18; 0.18; respectively). The presence of cancer increased the probability to fail to accomplish the activity (0.11) compared to those who did not suffer from it (0.08). Tendinitis and cirrhosis did not have a statistically significant association. In the case of occurrence of hospitalizations in the last 12 months, the elderly had high probability of high level of difficulty (0.22) and of failure in climbing slopes or stairs (0.15) compared to those who were not hospitalized (0.18 and 0.07, respectively). Elderly individuals who owned a health plan had lower probability to present high level of difficulty (0.16) in accomplishing the activity compared to those who did not have a health plan (0.19).

In relation to the contextual variables, the Gini Index in 2000 presented a statistically significant association with the functional disability of the elderly. The elderly who lived in FU with greater levels of economic inequality presented higher probabilities to have high level of difficulty (0.21) or to fail (0.09) to climb slopes or stairs compared to the elderly who lived in States with lower economic disadvantages (0.16 and 0.07, respectively). The GDP in 2000 did not show a statistically significant effect on the functional disability of the elderly.

Table 4 presents the probabilities for the sex variable categories, taking into account different levels of the random effect on the category having high level of difficulty. In areas located in the mean, the probability of a woman to present high level of difficulty proved to be 45% higher compared to that of men (0.214/0.147). However, this probability may increase considerably if we compare women living in areas located two SD above the mean with men living in areas located two SD below the mean (218%). Due to the overlap, the probability to present high level of difficulty may be higher among men if we compare, for example, men living in FU two SD above the mean (0.218) with women living in FU located two SD below the mean (0.144).

DISCUSSION

The multinomial logistic regression model enabled to disaggregate functional capacity into more than two categories.¹ Some aspects, however, limit the use of these models. Firstly, functional disability might be understood

Table 1. Relative distribution (%) of demographic, socio-economic and health characteristics of the elderly. Brazil, 2003. (n = 33,515)

Variable	n	%
Sex		
Male	14715	43.9
Female	18800	56.1
Family arrangement		
Lives alone	4323	12.9
Lives with someone	29192	87.1
Household situation		
Rural	5307	15.8
Urban	28208	84.2
Race/skin color		
White	18675	55.7
Black	2385	7.1
Mixed-ethnicity	12455	37.2
Level of schooling (years of study)		
No schooling	12655	37.8
1 to 4	12456	37.2
5 to 8	4210	12.6
9 to 11	2510	7.5
12+	1684	5.0
Income		
< 1 MS	4343	13.0
1 to 3 MS	12580	37.5
3 to 5 MS	6949	20.7
5 to 10 MS	5471	16.3
10 or more MS	4172	12.4
Occupation		
Unoccupied	22508	67.2
Occupied	11007	32.8
Self-perception of health		
Very good	2534	7.6
Good	11732	35.0
Regular	14561	43.4
Poor	3813	11.4
Extremely poor	875	2.6
Spinal column problems		
Presence of arthritis	12339	36.8
Presence of cancer	9557	28.5
Presence of diabetes	701	2.1
Presence of bronchitis/asthma	4338	12.9
Presence of hypertension	2275	6.8
Presence of heart disease	16375	48.9
Chronic renal failure	5826	17.4
Presence of depression	1440	4.3
Presence of tuberculosis	3271	9.8
Presence of tendinitis	139	0.4
Presence of cirrhosis	1657	4.9
Hospitalization in the last 12 months	98	0.3
Affiliation to health plan	4272	12.7
	9376	28.0

Source: PNAD (National Household Survey), 2003.
MS: Minimum Salary

as ordered and the risk might be estimated in relation to the immediately previous category. Nevertheless, even though an underlying order exists, the comparison between types of disability and full capacity allows to assess the effect of the several variables, having the same baseline for comparison, which makes sense because, ideally, all the elderly might be capable. Another

important aspect of the modeling process was the utilization of multilevel models, which allowed to estimate more accurately the parameters associated with the individual and contextual variables simultaneously.

At the individual level, the results indicate that functional disability was highly associated with sex. Elderly

Table 2. Estimates of the fixed and random coefficients of the multilevel multinomial logistic regression models for the functional disability of the elderly. Brazil, 2003.

Variable	Model with variables of the individual level			Final model (variables of the individual and contextual levels)		
	Has low level of difficulty	Has high level of difficulty	Cannot do it	Has low level of difficulty	Has high level of difficulty	Cannot do it
Intercept	-4.802*	-7.651*	-11.020*	-6.764*	-11.49*	-14.831*
Age	0.043*	0.070*	0.107*	0.043*	0.070*	0.107*
Sex						
Male	0.000	0.000	0.000	0.000	0.000	0.000
Female	0.413*	0.647*	0.572*	0.413*	0.648*	0.571*
Family Arrangement						
Lives alone	0.000	0.000	0.000	0.000	0.000	0.000
Lives with someone	0.003	0.078	0.435*	0.002	0.075	0.431*
Household Situation						
Rural	0.000	0.000	0.000	0.000	0.000	0.000
Urban	-0.093*	-0.039	-0.323*	-0.093*	-0.041	-0.324*
Race/skin color						
White	0.000	0.000	0.000	0.000	0.000	0.000
Black	-0.025	-0.055	-0.211*	-0.030	-0.063	-0.223*
Mixed-ethnicity	-0.106*	-0.125*	-0.162*	-0.114*	-0.138*	-0.181*
Level of schooling (years of study)						
No schooling	0.000	0.000	0.000	0.000	0.000	0.000
1 to 4	-0.157*	-0.281*	-0.391*	-0.154*	-0.278*	-0.386*
5 to 8	-0.306*	-0.527*	-0.728*	-0.305*	-0.526*	-0.725*
9 to 11	-0.264*	-0.605*	-0.732*	-0.265*	-0.608*	-0.735*
12+	-0.462*	-0.611*	-1.076*	-0.464*	-0.614*	-1.081*
Income						
< 1 MS	0.000	0.000	0.000	0.000	0.000	0.000
1 to 3 MS	-0.037	-0.207*	-0.154	-0.036	-0.205*	-0.151
3 to 5 MS	-0.104	-0.229*	-0.316*	-0.102	-0.226*	-0.313*
5 to 10 MS	-0.173*	-0.409*	-0.462*	-0.171*	-0.405*	-0.455*
10 or more MS	-0.223*	-0.440*	-0.388*	-0.221*	-0.44*	-0.383*
Occupation						
Unoccupied	0.000	0.000	0.000	0.000	0.000	0.000
Occupied	-0.354*	-0.563*	-1.198*	-0.355*	-0.563*	-1.200*
Self-perception of health						
Very good	0.000	0.000	0.000	0.000	0.000	0.000
Good	0.626*	0.656*	0.886*	0.626*	0.655*	0.886*
Regular	1.297*	1.849*	2.153*	1.296*	1.847*	2.151*
Poor	1.628*	2.890*	3.831*	1.626*	2.885*	3.826*
Extremely Poor	1.661*	3.157*	4.749*	1.660*	3.152*	4.744*

To be continued

Table 2 continuation

Variable	Model with variables of the individual level			Final model (variables of the individual and contextual levels)		
	Has low level of difficulty	Has high level of difficulty	Cannot do it	Has low level of difficulty	Has high level of difficulty	Cannot do it
Spinal column problems ^a	0.374*	0.394*	0.139*	0.374*	0.396*	0.141*
Presence of arthritis ^a	0.488*	0.710*	0.587*	0.488*	0.708*	0.584*
Presence of cancer ^a	-0.047	0.041	0.312*	-0.044	0.045	0.319*
Presence of diabetes ^a	0.152*	0.275*	0.269*	0.153*	0.275*	0.269*
Presence of bronchitis/asthma ^a	0.440*	0.745*	0.579*	0.443*	0.749*	0.584*
Presence of hypertension ^a	0.266*	0.348*	0.247*	0.267*	0.349*	0.247*
Presence of heart disease ^a	0.375*	0.713*	0.576*	0.377*	0.716*	0.582*
Chronic renal failure ^a	0.209*	0.403*	0.550*	0.210*	0.405*	0.556*
Presence of depression ^a	0.186*	0.340*	0.646*	0.188*	0.343*	0.651*
Presence of tuberculosis ^a	0.517	0.960*	-0.022	0.517	0.961*	-0.02
Presence of tendinitis ^a	0.056	0.088	0.128	0.056	0.091	0.13
Presence of cirrhosis ^a	0.110	0.452	0.594	0.111	0.455	0.595
Hospitalization in the last 12 months ^a	0.215*	0.447*	1.009*	0.216*	0.448*	1.01*
Affiliation to health plan ^a	-0.079	-0.285*	-0.331*	-0.078	-0.284*	-0.331*
Gini Index in 2000				0.03	0.059*	0.061*
Gross Domestic Product (GDP) in 2000				0.006	0.017	-0.007
Random effect	0.054*	0.091*	0.150*	0.047*	0.058*	0.095*

Fontsource: PNAD (National Household Survey) 2003; IBGE (Brazilian Institute of Geography and Statistics) 2000; Institute of Applied Economic Research 2000

* $p \leq 0.05$

^a Reference group = no (0.000)

MS: Minimum salary

women had higher probability to present higher functional loss than men. These results corroborate those found by Giacomini et al⁸ (2008). Some hypotheses might explain this difference. The first one is associated with women's longer survival. The second refers to the higher prevalence of non-fatal incapacitating conditions among women. The third hypothesis would be the women's ability to report a higher number of health conditions compared to men of the same age.¹⁸

The present study showed that aging increased the probability of the elderly to present functional disability, in agreement with previous studies.^{11,16}

Black and mixed (black and white) race/color was a protective factor of functional disability, contradicting the findings of Guralnik & Kaplan¹⁰ (1989) in the USA. It is possible that black and mixed ethnicity elderly individuals in our study were healthier compared to whites, given that those with worse health conditions may have experienced higher mortality rates. It is important to remember that in Brazil, race/color is directly associated with the individual's socioeconomic situation.

Living in urban areas was a protective factor for functional disability, contradicting results found by Parahyba et al¹⁹ (2005) in Brazil. It is likely that the elderly who live in urban areas present better life conditions, greater availability and access to prevention and primary or specialized medical assistance services.

Living with someone was a determinant factor for functional disability. Elderly individuals who live with someone are more likely not to be able to climb slopes or stairs compared to those who live alone. Our findings corroborate those of Rosa et al²⁴ (2003), suggesting that elderly people who live alone are probably healthier and more independent.

The higher the level of schooling and income, the lower the probability of the elderly person to report a worse functional capacity, which confirms previous findings.^{4,15} Schooling brings diverse advantages to health because it influences psychosocial and behavioral factors.⁷ Elderly individuals with higher level of schooling are less likely to be exposed to the risk factors for diseases and to submit themselves to inadequate working conditions. Higher level of schooling favors

Table 3. Probabilities for the functional disability of the elderly. Brazil, 2003.

Variable	Can do it	Has low level of difficulty	Has high level of difficulty	Cannot do it
Age (years)				
60	0.60	0.24	0.12	0.04
65	0.53	0.26	0.15	0.05
70	0.46	0.28	0.18	0.08
75	0.38	0.29	0.22	0.11
80	0.31	0.29	0.25	0.16
85	0.24	0.28	0.28	0.21
Sex				
Male	0.53	0.25	0.15	0.07
Female	0.41	0.29	0.21	0.09
Family arrangement				
Lives alone	0.48	0.29	0.18	0.06
Lives with someone	0.46	0.28	0.18	0.08
Household situation				
Rural	0.44	0.28	0.18	0.10
Urban	0.47	0.28	0.18	0.08
Race/skin color				
White	0.45	0.28	0.19	0.08
Black	0.46	0.28	0.18	0.07
Mixed-ethnicity	0.48	0.27	0.18	0.07
Level of Schooling (years of study)				
No schooling	0.41	0.28	0.21	0.10
1 to 4	0.47	0.28	0.18	0.08
5 to 8	0.52	0.26	0.16	0.06
9 to 11	0.52	0.28	0.14	0.06
12+	0.56	0.24	0.15	0.05
Income				
< 1 MS	0.42	0.28	0.21	0.09
1 to 3 MS	0.45	0.28	0.18	0.08
3 to 5 MS	0.46	0.28	0.19	0.07
5 to 10 MS	0.49	0.27	0.17	0.07
10 or more MS	0.50	0.26	0.16	0.07
Occupation				
Unoccupied	0.42	0.28	0.20	0.11
Occupied	0.55	0.26	0.15	0.04
Self-perception of health				
Very good	0.75	0.16	0.07	0.02
Good	0.60	0.25	0.11	0.04
Regular	0.38	0.30	0.23	0.09
Poor	0.20	0.22	0.33	0.25
Extremely poor	0.13	0.15	0.29	0.43
Spinal column problems				
No	0.49	0.26	0.17	0.08
Yes	0.41	0.31	0.21	0.08
Presence of arthritis				
No	0.50	0.26	0.16	0.07
Yes	0.36	0.31	0.24	0.09

To be continued

Table 3 continuation

Variable	Can do it	Has low level of difficulty	Has high level of difficulty	Cannot do it
Presence of cancer				
No	0.46	0.28	0.18	0.08
Yes	0.45	0.26	0.19	0.11
Presence of diabetes				
No	0.47	0.28	0.18	0.08
Yes	0.42	0.29	0.21	0.09
Presence of bronchitis/asthma				
No	0.47	0.27	0.18	0.08
Yes	0.33	0.30	0.27	0.10
Presence of hypertension				
No	0.50	0.26	0.17	0.08
Yes	0.42	0.29	0.20	0.08
Presence of heart disease				
No	0.48	0.27	0.17	0.07
Yes	0.36	0.29	0.25	0.10
Chronic renal failure				
No	0.46	0.28	0.18	0.08
Yes	0.38	0.28	0.22	0.11
Presence of depression				
No	0.47	0.28	0.18	0.08
Yes	0.39	0.28	0.21	0.12
Presence of tuberculosis				
No	0.46	0.28	0.18	0.08
Yes	0.31	0.31	0.32	0.05
Hospitalization in the last 12 months				
No	0.47	0.28	0.18	0.07
Yes	0.37	0.27	0.22	0.15
Affiliation to a health plan				
No	0.45	0.28	0.19	0.08
Yes	0.49	0.28	0.16	0.07
Gini Index in 2000				
Percentile 25	0.50	0.27	0.16	0.07
Percentile 50	0.48	0.27	0.17	0.08
Percentile 75	0.42	0.28	0.21	0.09

Sources: PNAD (National Household Survey) 2003; IBGE (Brazilian Institute of Geography and Statistics) 2000; Institute of Applied Economic Research) 2000

MS: Minimum salary

the access to: information, lifestyle modifications, adoption of healthy habits and visits to healthcare services.²⁵ Probably, poorer elderly individuals attend the healthcare services less frequently, and have less access to treatments and medicines. Occupation also exerts a protective effect. The occupied elderly person is less likely to present worse functional capacity. These results are in agreement with those reported by Cheng et al⁶ (2002) in which occupied elderly individuals present few difficulties in activities of daily living when compared to those who do not work. It is reasonable to suppose that elderly people who work are more independent and healthier.

Concerning their self-perception of health, the probability of an increase in the dependence degree was higher for the elderly who rated their health as poor, confirming previous findings.¹⁴

Chronic diseases had a strong influence on the functional capacity of the elderly. Alves et al¹ (2007) investigated the influence of chronic diseases on the functional capacity of the inhabitants of the municipality of São Paulo, southeast of Brazil, in 2000, observing that the chronic conditions had a significant influence on functional dependence and that heart disease, pulmonary disease, hypertension and arthropathy presented the greatest effects.

Table 4. Probabilities of an elderly individual to have high level of difficulty in climbing slopes or stairs, by sex and random effect levels. Brazil, 2003.

Sex	Random effects ^a				
	-2SD	-1SD	Mean	1SD	2SD
Male	0.096	0.119	0.147	0.180	0.218
Female	0.144	0.176	0.214	0.257	0.305

^a Random effect levels: 2 standard deviations below the mean, 1 standard deviation below the mean, mean, 1 standard deviation above the mean, 2 standard deviations above the mean

As for hospitalizations, the associations that were found coincided with those of the study carried out by Boyd et al⁵ (2005), in which the elderly became more vulnerable to functional decline and dependence after hospitalization.

An important relationship was observed between affiliation to health plan and functional disability. The elderly affiliated to health plans had lower probability to fail to climb slopes or stairs. Although we have not found studies on the relationship between health plan and functional disability of the elderly, it is probable that individuals with health plan attend the healthcare services more frequently and present higher adherence to treatments, which contribute to improve their functional capacity.

The results showed an effect of the income inequality of the FU on the functional disability of the elderly, even when controlled by the average income level (GDP). Although there are many studies about the relationship between income inequality and health status, this kind of investigation is still rare in Brazil. The main results indicate lack of relationship between income inequality and health status. However, Noronha^d (2005) found that the individuals who live in unequal places have smaller chances of being healthy. This effect would express the characteristics associated with the context in which the individual is inserted rather than shortage of material resources or the lower purchasing power of poorer individuals.

Other findings of the present study show that the elderly who live in more unequal states have higher probability to present functional loss. The mechanisms through which income inequality affects functional disability in Brazil can be explained taking into account the particularities of the Brazilian reality. The country presents one of the worst income distributions in the world and is characterized by the presence of individual and regional inequalities, which defines, on one side, richer cities and regions, with socioeconomic and health indicators that are similar to those of more developed economies, and on the other side, very poor cities and regions, like those observed in the FU of the North and Northeast of Brazil. The presence of these inequities

results in unequal distribution of resources across the cities and, consequently, unequal access to goods and services that are important to the level of health of the individual and of the population, such as healthcare services, education and basic sanitation.³

The investigation of the relationship between functional disability and individual and contextual factors related to the economic situation is relevant, due to the deep socioeconomic disparities observed among individuals and among states. We did not find in the Brazilian literature any references to studies about this kind of analysis that assesses the effect of income inequality on functional disability in the FU, and also analyzes the characteristics of the individuals and of the context, considering the hierarchic structure of the data.

Even after controlling through variables of the contextual level, we verified the existence of a variability that still needs to be explained. Thus, future research could investigate other important aspects of the contextual level related to functional disability of the elderly in Brazil.

As for the study's limitations, the few works about multilevel analysis and functional disability in the international literature, the lack of studies in Brazil, the difference concerning the context variables used in the analysis hindered the comparison between the present findings. Another limitation refers to the cross-sectional design, which prevented causal inferences.

The identification of factors associated with the functional disability of the elderly provides relevant elements for prevention and intervention measures and is fundamental in the present society. The study suggests that policies focusing on the reduction in social and economic inequalities should be encouraged, like for example: guaranteeing education in the early phases of life and the permanence of the elderly in the labor market. Finally, the present study strengthens the importance of strategies targeted at the maintenance of health and of a life without disability, with preventive actions and the organization of the health system so as to meet the real needs of this portion of the population, which is the one that has the highest growth rate in Brazil. Thus, the individuals would be able to age in a healthier way, living their additional years of life with higher quality.

^d Noronha KVMS. A relação entre o estado de saúde e a desigualdade de renda no Brasil [doctoral thesis]. Belo Horizonte: Centro de Desenvolvimento e Planejamento Regional da Universidade Federal de Minas Gerais; 2005.

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