The role of education on the association between disability and depressive symptoms among community-dwelling older adults: Evidence from Frailty in Brazilian Older People (Fibra) study

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ABSTRACT

Objectives: To explore whether higher socioeconomic status attenuates the effects of depressive symptoms on disability among older adults.

Methods: We conducted a cross-sectional study based on 596 older adults, aged 65 and over, from a large city (Belo Horizonte) in Brazil. Disability was defined as limitation in activities such as Basic Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL). Covariates were age, comorbidities, Body Mass Index (BMI) and grip strength. Statistical analyses were based on Ordinal Logistic Regression and calculated separately for men and women.

Results: Elderly women with disability and higher education levels have similar prevalence of depressive symptoms compared to those without disability (17.9% and 16.1%, respectively), but lower compared to those disabled with lower education (37.2%). A positive gradient trend was observed for depressive symptoms across disability categories among women (OR = 2.61; 95% CI 1.52, 4.48). However, these patterns were not observed among men.

Conclusion: A higher level of education attenuates odds of depressive symptoms in elderly women with disability but does not eliminate it. Therefore, screening for depressive symptoms in low-educated elderly women is important in order to identify them and start early prevention care for target risk population and decrease the disability expenses for health services.

1. Introduction

The demographic ageing of the population in Brazil, as in other undeveloped countries, has been occurring quickly (National Health Services, 2011). The number of people aged 65 and over is projected to grow from an estimated 524 million in 2010 to around 1.5 billion worldwide in 2050 (National Health Services, 2011). One of the recognized aims to achieve successful ageing is to maintain high functioning levels (Organização Mundial de Saúde, 2003). According to the Brazilian National Health Survey (Ministério da Saúde, 2013), 6.8% of older Brazilian adults have basic Activities of Daily Living (ADL) disability and 17.3% have Instrumental Activities of Daily Living (IADL) disability.

Studies report an inverse gradient in the association between socioeconomic status (SES) and disability (i.e. difficulty in carrying out

ADL) (Andrade et al., 2015; Fillenbaum et al., 2013; Leite et al., 2013; Lima-Costa, Facchini, Matos, & Macinko, 2012; Lima-Costa, Oliveira, MacInko, & Marmot, 2012; Lima-Costa, Mambrini, Peixoto, Malta, & Macinko, 2016; Lima-Costa, Oliveira et al., 2012; 2012b; Lima & Lima, 2014), and for SES and depressive symptoms (Lima-Costa, Oliveira et al., 2012; 2012b) among Brazilians, in the sense that the economically better off experience higher functioning levels and less depressive symptoms. For instance, depressive symptoms account for 8.31% of disability-adjusted life-year (DALY) and there is a gradient of DALY across regions with different concentration of assets, with higher rates, 209 per 1000 inhabitants, among the poorest (Northeast region) (Leite et al., 2013). Moreover, depressive symptoms are strongly associated with disability among those living in poorer areas of Brazil (Gomes et al., 2014; Silva, Scazufca, & Menezes, 2013). Therefore, tracking socioeconomic inequalities in health is important for understanding

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how inequalities are related to disability and guide health policies specifically to groups in need.

Despite researches published previously have found inequalities in disability in ADL and depressive symptoms among older adults in Brazil (Fillenbaum et al., 2013; Leite et al., 2013; Lima-Costa, Oliveira et al., 2012,2012b; Lima-Costa et al., 2016, 2012a,2012b; Lima & Lima, 2014), none has yet considered the SES as a modifying factor, i.e. a factor that attenuates the effect of one aspect when disability, for example, is present. One study conducted in England explored this condition and found heterogeneous effects of depressive symptoms on disability across wealth categories (Torres, Lima-Costa, Marmot, & Oliveira, 2016). The understanding of these effects is important because depressive symptoms are hypothesized to lead to disability by influencing health-damaging behaviors, psychological and physiological systems (Stringhini et al., 2012), and higher SES have the potential to attenuate these effects due to lower stress levels accumulated over the course of life (Matthews & Gallo, 2011). Therefore, the aim of this study is to explore whether higher SES diminishes the effect of depressive symptoms on disability, mensured by difficulty in carrying out ADL and IADL, among older adults living in a large city in Brazil.

2. Methods

2.1. Study and sample

This is a cross-sectional study based on the Frailty in Brazilian Older People (Fibra) Study. Fibra is a multicenter study conducted in different cities in Brazil, including Belo Horizonte (Fibra-BH). Belo Horizonte is the capital of Minas Gerais state, in Southeast Brazil, with an estimated population in 2017 of nearly 2.5 million inhabitants according to official Brazilian data (Brazilian Institute of Geography and Statistics - IBGE). The Fibra sample details are described elsewhere (Silva, Neri, Ferrioli, Lourenco, & Dias, 2016). Briefly, the sample size in each city was estimated to achieve 50% of a certain characteristic, according to the population size of the city. Based on this calculation, sample size for cities with more than one million inhabitants (such as Belo Horizonte) require a minimum of 601 older adults, with a sample error of 4%. It was a two-stage cluster sample: (1) first, the census tracts of the IBGE were randomly selected; and (2) according to the older adult population size in the selected census tracts, we set a minimum number of interviews in each census tracts. All households of selected streets were visited and we included all participants that agreed to take part in the study.

The inclusion criteria were being 65 years and over and living in the community. The exclusion criteria were Mini-Mental State Examination (MMSE) (Brucki, Nitrini, Caramelli, Bertolucci, & Okamoto, 2003) score lower than 17 (i.e. sugestion of cognitive impairment), serious stroke sequel, serious Parkinson's disease, using a wheelchair and being bedridden, following recommendations of Ferrucci et al. (2004). Data was collected from December 2008 to December 2009 by interviewers trained previously.

2.2. Study variables

The study's dependent variable was disability.According to The International Classification of Functioning, Disability and Health (ICF) (Organização Mundial de Saúde, 2003), one of the domains of disability encompasses performance limitation in activities. In the current study, performance limitation in activity was measured by self-reported limitations considering Basic ADL and IADL. Although ADL and IADL refer to different domains of activity (personal care and domestic life, respectively), both are classified as the same component, and has been used together (Ferreira, César, Camargos, Lima-Costa, & Proietti, 2010; Torres et al., 2016). For ADL we used the Portuguese validated version of Katz index (Lino, Pereira, Camacho, Ribeiro Filho, & Buksman, 2008), that includes activities such as eating, toileting and dressing. For

IADL we included seven activities: preparing a meal, shopping for groceries, making telephone calls, taking medications, doing work around the house, managing money and taking public transport or taxis. Disability was defined as having any difficulty in one or more activities, including ADL and IADL (activity limitation).

To create order between categories, we split those with disability into two categories, according to education level. In Brazil, formal education is organized into first level (1–8 years of school), second level (9–11 years), and higher. In this analysis, given the distribution among our sample, we categorized education into two groups according to the total number of years of education: 0–8 years (lower education) and ≥ 9 years (higher education). Then, we joined disability and education into three groups: (1) without disability (reference category); (2) with disability and higher education; and (3) with disability and lower education. The objective was to create a grade of categories. Our hypothesis is that higher education would attenuate deleterious effect of disability by accumulating less stress levels over the course of life (Matthews & Gallo, 2011) but not the less than not having disability.

The independent target variable in this study was depressive symptoms. We used the Portuguese validated version of Geriatric Depressive Scale-15 (GDS-15) (Almeida & Almeida, 1999), a 15-item scale with questions about depressive symptoms experienced during the week before the Fibra-BH interview. A dichotomous variable distinguishing between those with and without depressive symptoms was derived, considering the validated cut-off point of more than five depressive symptoms for being classified with depressive symptoms in elderly outpatients (Paradela, Lourenço, & Veras, 2005). Among older Brazilian adults, it has 0.81 sensitivity and 0.71 specificity, decreasing misclassification bias; the area under the Receiver Operator Characteristic curve was 0.85 (95% CI: 0.79–0.91) (Paradela et al., 2005).

Potential confounders included in this analysis were age (continuous), number of comorbidities, Body Mass Index (BMI) and grip strength. The number of comorbidities was assessed by self-reported doctor diagnosed chronic diseases, including diabetes, cancer, stroke, arthritis, lung disease, high blood pressure, angina and heart attack, previously described as being associated with disability. The number of comorbidities was categorized into none, one and two or more. BMI was measured objectively using a calibrated scale for weigh and a measuring tape for height. Grip strength was assessed by a Jamar hydraulic Hand dynamometer® for the dominant hand with the elbow was flexed at 90 degrees and the shoulder at 0 degrees of flexion. A mean of three sets was used.

2.3. Statistical analysis

Univariate analysis was conducted using Pearson's chi-square test for categorical variables and ANOVA or *t*-test for continuous variables. We used Ordinal Logistic Regression to estimate the odds ratio (OR) and their 95% confidence intervals to assess the association of depressive symptoms across disability categories. This type of regression has increased its use in epidemiological studies. It has been used in analysis in which the dependent variable has an established category order (Abreu, Siqueira, & Caiaffa, 2009). We ran the Ordinal Logistic Regression to test if there is an order across categories of disability (without disability – reference category, disability and higher education and disability and lower education). The premise of parallelism of OR was tested by the Wald test. All study variables fit this premise. Multivariate analysis was performed using sequential models. Firstly, we estimated the association between depressive symptoms and disability categories by adjusting for age and secondly, we added the number of comorbidities, followed by BMI and grip strength. All analyses were performed using STATA 14.0 (Stata Corp LLP, College Station, TX), considering the sampling parameters (individual weight and household clustering of individuals). We considered men and women separately in the analyses once the effect of sex might be not evident in the multivariate model (Noh, Kwon, Park, Oh, & Kim, 2016).

Table 1

Characteristics of the participants according to disability status – the Fibra-BH (2008–2009).

Variables	Total	Disability[*]		P value
		No	Yes	
Depressive Symptoms, (%)	21.8	15.7	29.7	< 0.001[**]
Education, (%)				0.57
≥ 9 years	23.7	24.6	22.4	
0-8 years	75.3	75.4	77.6	
Sex (Women), (%)	66.3	62.6	71.0	0.01[**]
Age (years), mean (SD)	74.3	73.0	76.1	< 0.001[**]
	(6.4)	(5.5)	(7.1)	
Number of comorbidities, (%)				0.01[**]
None	26.7	31.5	20.5	
1	26.9	29.4	23.6	
2 +	46.5	39.2	56.0	
Body Mass Index (BMI), mean (SD)	27.1	27.0	27.2	0.54
	(5.1)	(4.8)	(5.5)	
Grip strength, mean (SD)	22.9	25.1	20.0	< 0.001[**]
	(9.2)	(9.4)	(8.1)	
N total	**596**	**337**	**259**	

Note: estimated percentages, considering the sampling parameters.

Number of interviewees, not including corrections according to sampling parameters.

[*] Considering ADL (Katz index) and IADL (preparing a meal, shopping for groceries, making telephone calls, taking medications, doing work around the house, managing money and taking public transport or cab).

[**] Statistically significant values (p < 0.05).

2.4. Ethics approval and informed consent

All participants gave written informed consent. The Fibra-BH has been approved by the Federal University Ethics Committee (Etic n. 187/07).

3. Results

Of 606 Fibra-BH participants in Belo Horizonte, 596 (98.3%) had complete information about study variables and were included in the current analysis. Characteristics of the study population by disability are showed in Table 1. The mean age of participants was 74.3 years (SD = 6.4), with a majority of females (66.3%). Prevalence of depressive symptoms was 21.8%, and the majority of participants (46.5%) had two or more chronic conditions. With the exception of education and BMI, all study variables were associated with disability in the univariate analysis (p < 0.05).

Table 3

Multivariate Ordinal Logistic Regression analyses of factors associated with disability and education of 596 older adults in Belo Horizonte by sex – the Fibra-BH (2008–2009).

Variables	Disability categories[a] in Men		Disability categories[a] in Women	
	OR	95% CI	OR[b]	95% CI
Depressive Symptoms (vs no)	1.20	0.50; 2.91	2.61	1.52; 4.48[**]
Age	1.00	0.94; 1.06	1.09	1.05; 1.13[**]
Number of comorbidities (vs none)				
1	1.30	0.43; 3.86	1.29	0.68; 2.46
2 +	2.89	1.36; 6.15[**]	1.56	0.74; 3.79
Body Mass Index (BMI)	0.95	0.85; 1.06	1.04	1.01; 1.08[*]
Grip strength	0.94	0.91;0.97[**]	0.94	0.89; 0.99[*]

95%CI: 95% confidence intervals; OR: adds ratio.

[a] Without disability (reference), disability and higher education and disability and lower education. Considering ADL (Katz index) and IADL (preparing a meal, shopping for groceries, making telephone calls, taking medications, doing work around the house, managing money and taking public transport or cab).

[b] Estimated by Ordinal Logistic Regression.

[*] p < 0.05.

[**] p < 0.01.

Table 2 shows the distribution of studying variables according to disability categories by sex. We did not observe a gradient of depressive symptoms across disability categories among men. Higher-educated women with disability have similar prevalence of depressive symptoms (17.9%) compared to those without disability (16.1%), but lower than lower-educated disabled (37.2%). Similar results were found to age among women and for grip strength among men and women.

Table 3 shows results of the multivariable analyses of the association between depressive symptoms and disability categories by sex. Among men, we can observe a grade for two or more chronic diseases (OR = 2.89; 95% CI 1.36, 6.15) and grip strength (OR = 0.94; 95% CI 0.91, 0.97). On the other hand, among women, a grade was observed for depressive symptoms (OR = 2.61; 95% CI 1.52, 4.48), as well as for age, BMI and grip strength.

In order to visualize how the relationship between disability and depressive symptoms changed according to education level among women (our main results), we fitted a logistic regression of having disability to estimate the predicted probability of disability considering the effects of education and depressive symptoms, and plotted the
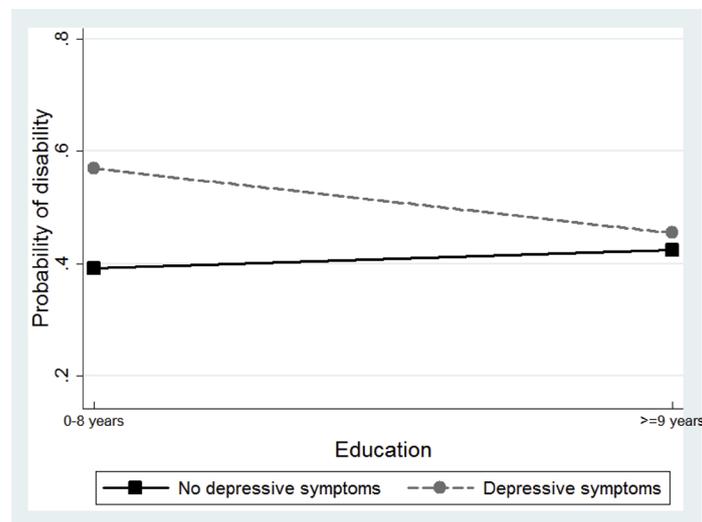
Table 2

Characteristics according to disability categories in 596 men and women, the Fibra-BH (2008–2009).

Variables	Men				Women			
	Without disability	Disability[a]		P value	Without disability	Disability[a]		P value
		≥ 9 years	0-8 years			≥ 9 years	0-8 years	
Depressive Symptoms, (%)	15.1	5.3	26.8	0.05	16.1	17.9	37.2[*]	< 0.001
Age (years), mean (SD)	74.3 (5.7)	74.5 (7.5)	75.7 (6.6)	0.37	72.1 (5.3)	76.4 (6.7)[*]	76.4 (7.3)[*]	< 0.001
Number of comorbidities, (%)				0.05				0.20
None	42.9	36.8	28.6		24.6	20.5	15.2	
1	30.2	21.1	21.4		28.9	20.5	25.5	
2 +	27.0	42.1	50.0		46.5	59.0	52.4	
Body Mass Index, mean (SD)	25.8 (4.1)	25.3 (4.8)	24.5 (3.5)	0.16	27.7 (5.1)	26.8 (4.3)	28.7 (6.0)	0.09
Grip strength, mean (SD)	32.5 (9.2)	30.0 (8.3)	26.4 (8.6)[*]	< 0.001	20.7 (6.2)	15.4 (5.4)[*]	17.5 (5.6)[*]	< 0.001
N total	**126**	**19**	**56**		**211**	**39**	**145**	

Note: estimated percentages, considering the sampling parameters.

Number of interviewees, not including corrections according to sampling parameters.

[a] Considering ADL (Katz index) and IADL (preparing a meal, shopping for groceries, making telephone calls, taking medications, doing work around the house, managing money and taking public transport or cab).

[*] Statically significant difference compared to without disability group.

Fig. 1. Expected probability of limitations in one or more basic Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) by education, according to presence of depressive symptoms among women. Belo Horizonte – Brazil, the Fibra-BH (2008–2009).

results. It shows a higher effect of depressive symptoms on disability when the education level is low (Fig. 1).

4. Discussion

Our main findings showed a clear gradient across disability (without/with) and education (higher/lower) categories for depressive symptoms in later life among women, with better levels of functioning among those who had less depressive symptoms and higher education. When education is lower, depressive symptoms lead to significantly higher odds of disability.

Current evidence on socioeconomic inequalities in Brazil corroborate with our findings for disability (Andrade et al., 2015; Fillenbaum et al., 2013; Hosseinpoor et al., 2013; Leite et al., 2013; Lima-Costa, Oliveira et al., 2012,2012b; Lima & Lima, 2014; Mitra, Posarac, & Vick, 2013) and depressive symptoms (Fillenbaum et al., 2013; Lima-Costa, Oliveira et al., 2012; 2012b). Moreover, we added that lower education levels strengthen the association between disability and depressive symptoms. Previous studies that reported adjusted coefficients by education might represent merely the average coefficients across the education categories rather than its actual meaning. It was not only that disability and depressive symptoms increase among the lower educated. When either disability or depressive symptoms are present among the lower educated, the likelihood of depressive symptoms and disability, respectively, increases considerably. Therefore, when physicians are screening for depressive symptoms among people with low education levels and they find positive results, it is important to implement preventive care for disability and vice versa, people with disability should be considered at risk of depressive symptoms and treated accordingly

In contrast with results showed in England (Torres et al., 2016), we found that disabled older adults with higher education levels have similar prevalence of depressive symptoms compared to those without disability for men and women. Therefore, higher education might alleviate the negative effects of depressive symptoms on disability. It is well known that depressive symptoms are an important aspect when investigating disability in elderly men and women and that this association appears to be bidirectional (Chen et al., 2012; Yang & George, 2005). The "vascular hypothesis" proposes that frontal lobe [the same area in charge of executive function (Schillerstrom, Royall, & Palmer, 2008)] cerebrovascular disease causes mood changes in later life. However, our findings highlight that the physiologic pathways may not totally explain the relationship between disability and depressive

symptoms. Other pathways such as psychological, behavioral and social context should be considered.

Some factors may be considered to explain the link between the association of lower education with disability and depressive symptoms among women. Firstly, inequalities in ADL disability are concentrated among the poorest older Brazilian adults [Concentration index: −0.145 (95%CI −0.194, −0.097)], and socioeconomic factors, such as own education, explain 92.2% of this index (Andrade et al., 2015). People, mainly women, with lower education have limited employment opportunities, which in turn restrict their human capital accumulation. Considering that disability requires additional expenditures for the individual, such as healthcare, transportation, assistive devices, personal assistance, and house adaptation (Mitra et al., 2013), the material lack and its consequential frustration may lead to depressive symptoms. Furthermore, lower education may increase the likelihood that depressive symptoms result in activity limitation, considering that there are a limited healthcare and rehabilitation services for those lower-educated older adults, or more barriers for them to overcome in order to access the services that are available (Mitra et al., 2013). On the other hand, poorer areas have limited safe spaces to congregate (social integration) and to be physically active, two important preventive practices for disability and depressive symptoms (Mendes De Leon & Rajan, 2014). Moreover, those subjective aspects appear to be more important among women than men (Torres et al., 2016). Women experience more depressive symptoms than men and this phenomenon may be mediated by differences in perceived social support, sense of control and self-esteem by gender (Noh et al., 2016). And finally, more deprived people may experience less social support when they are in need (Vonneilich et al., 2012) and have consequently poorer health.

This study has some strength and limitations. The main strength is the methodology and selected sample rigor that ensures its internal validity and the results generalization to community-dwelling older adults living in Belo Horizonte. Our results interpretation may takes into account the cross-sectional design, which does not permit the establishment of temporal relations between education, disability and depressive symptoms. However, education is a parameter of socioeconomic status commonly achieved during adulthood that exhibits few changes among older adults. Therefore, it is likely to have occurred before the health variables. But the bidirectionality reported for depressive symptoms and disability (Chen et al., 2012; Yang & George, 2005) is limited for establishing temporality for those health variables. Another limitation is that we did not include the use of antidepressant

medication as a covariate because this information was not avaliable. The use of this type of medication might alleviate depressive symptoms, decreasing their prevalence. Although, the prevalence found in the current study is similar to those found in other Brazilian cities (Gomes et al., 2014; Silva et al., 2013). Yet, GDS-15 is an instrument for screaning purposes, but not diagnosis purposes. However, higher scores (more than 5) are strongly suggestive of depression and it is a wide-spread instrument for measuring depressive symptoms in population-based studies (Gomes et al., 2014; Silva et al., 2013).

5. Conclusions

Based on our findings, we conclude that lower education level and depressive symptoms together might increase disability odds among women. Therefore, health professionals should be aware of the importance of screening for depressive symptoms in lower-educated older adult populations in order to start an early prevention care for target risk population and decrease the disability expenses for health services as well as screening for disability.

Conflict of interest statement

We, Juliana Lustosa Torres, Silvia Lanziotti Azevedo da Silva, and Lygia Paccini Lustosa declare that there is no conflict of interest regarding any financial and personal relationships with other people or organisations that could inappropriately influence (bias) their work.

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