

# Determinant factors of functional status among the oldest old

## Fatores determinantes da capacidade funcional em idosos longevos

Silvana L. Nogueira<sup>1</sup>, Rita C. L. Ribeiro<sup>1</sup>, Lina E. F. P. L. Rosado<sup>1</sup>, Sylvia C. C. Franceschini<sup>1</sup>, Andréia Q. Ribeiro<sup>1</sup>, Eveline T. Pereira<sup>2</sup>

### Abstract

**Background:** The fastest-growing age group in Brazil and around the world is the oldest-old group (aged 80 and over). Among these individuals, the prevalence of disability and morbidity is higher than in other groups. **Objectives:** To investigate the influence of socioeconomic, demographic, biological, health, nutritional, and social factors, as well as perceived health, on the functional status of the oldest old. **Methods:** This was a cross-sectional population-based study in which the data were collected by means of questionnaires and anthropometric measurements. The functional status was evaluated according to the model developed by Andreotti and Okuma (1999). Univariate and multivariate analyses were used. **Results:** The independent factors associated with worse functional status were: age 85 years and over (OR=2.91), female gender (OR=0.69), continuous use of five or more medications (OR=2.67), no visits to friends and/or relatives at least once a week (OR=11.91), and worse perceived health relative to peers (OR=4.40). **Conclusions:** The results suggest that functional status is associated with a complex web of multidimensional factors. Thus, it is important to develop programs related to the factors that are susceptible to intervention in order to provide a better quality of life to the oldest old.

**Key words:** functional status; daily activities; older adult; logistical models; aging; older adult health.

### Resumo

**Contextualização:** A faixa etária que mais cresce no Brasil e no mundo é a de idosos com 80 anos e mais. Entre esses indivíduos, a prevalência de incapacidades e morbidades é maior que em outros grupos. **Objetivos:** Investigar a influência de fatores socioeconômicos, demográficos, biológicos e de saúde, nutricionais, de relações sociais, além da auto-avaliação da saúde sobre a capacidade funcional de idosos longevos (80 anos e mais). **Métodos:** Trata-se de um estudo transversal, de base populacional, em que os dados foram obtidos por meio de questionários e medidas antropométricas. A capacidade funcional foi avaliada utilizando-se o modelo desenvolvido por Andreotti e Okuma (1999). Foram realizadas análises univariada e multivariada. **Resultados:** Os fatores independentes associados à pior capacidade funcional foram: ter 85 anos e mais (OR=2,91), ser do gênero feminino (OR=0,69), fazer uso contínuo de cinco ou mais medicamentos (OR=2,67), não visitar parentes e/ou amigos pelo menos uma vez por semana (OR=11,91) e considerar a própria saúde pior que a de seus pares (OR=4,40). **Conclusões:** Os resultados sugerem que a capacidade funcional está associada a uma complexa rede de fatores multidimensionais, sendo importante o desenvolvimento de ações relacionadas àqueles fatores que são passíveis de intervenção, visando propiciar melhores condições de saúde e qualidade de vida a esses indivíduos.

**Palavras-chave:** capacidade funcional; atividades cotidianas; idoso; modelos logísticos; envelhecimento; saúde do idoso.

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<sup>1</sup> Department of Nutrition and Health, Universidade Federal de Viçosa (UFV), Viçosa (MG), Brazil

<sup>2</sup> Department of Physical Education, UFV

Correspondence to: Silvana Lopes Nogueira, Av. José Maria dos Santos, nº 345, Centro, CEP 36.550-000, Coimbra (MG), Brazil, e-mail: sillnogueira@yahoo.com.br

## Introduction

The increase in longevity is a global phenomenon, and the fastest growing age group in the world is the oldest-old group, aged 80 and over<sup>1</sup>. In 1980, this group numbered 591,000 individuals in Brazil, and it is estimated that, by 2050, this number will reach 13.8 million. This represents an increase of 2,226%, while the total population will increase 81.6% and the older adult population 436% in the same period<sup>2</sup>.

This phenomenon outlines a series of social, cultural and epidemiological implications due to the greater prevalence of morbidity and disability in this age group. Nevertheless, there are few studies on the oldest old to provide knowledge of the health conditions of this segment of the Brazilian population<sup>3,4</sup>. Among the studies on aging, morbidity is one of the main health indicators analyzed. Few studies have assessed functional status and autonomy, despite the fact that these indicators are often more important than morbidity as they are directly related to quality of life<sup>5</sup>.

Functional status refers to the individual's ability to live independently and to relate to their environment. Loss of functional status is associated with increased risk of institutionalization and falls<sup>6</sup> and, in some studies on the oldest old, it was considered an independent risk factor for mortality<sup>7,8</sup>. Numerous studies have shown an association between aging and higher risks of functional dependence<sup>9-12</sup>, as well as a high prevalence of functional disability or limited functional ability in the older adult population<sup>13-16</sup>. These studies highlight that the added years of life should be accompanied by quality of life and should be free from the high cost of dependence. The decline in functional status may also be associated with a number of multidimensional factors that interact to determine this status in older adults<sup>17-19</sup>. Early detection of these factors can help prevent functional dependence in this group.

The above arguments demonstrate the importance of research on the determinants of functional status in older adults, considering the possibility of intervention and prevention measures by healthcare professionals (e.g. physical therapists) and through public policy planning. Thus, the present study aimed to determine the factors associated with functional status in the oldest old, taking into account socioeconomic, demographic, health, nutritional, and social dimensions.

## Methods

This was a cross-sectional population-based study on the oldest old (80 years and over) carried out in São Geraldo, MG, Brazil, between February and May 2008. The town of

São Geraldo is among the 20 municipalities of the state of Minas Gerais with the highest percentage of older adults. It also has the highest rate of oldest old in its county. The study was approved by the Human Research Ethics Committee of Universidade Federal de Viçosa (UFV), Viçosa (MG), Brasil (protocol no. 058/2007).

The sample included 129 non-institutionalized oldest-old participants of both genders, which represents 96.3% of the total population of that age group living in the urban area of São Geraldo. The participants were contacted based on records kept by the Family Health Program (FHP), and all of them signed an informed consent form. Screening for dementia was conducted by searching FHP records and by taking reports from the caregivers. Although in some cases the questions were answered by the caregivers, and it is believed that this has not compromised the validity of the results.

Prior to the data collection, a pilot study was carried out to train the interviewers and adjust the assessment tools. The questionnaire with the variables of interest was administered by the interviewers. The main researcher took the anthropometric measurements and administered the questionnaires to evaluate functional status (FS) and social relations. Data collection was carried out at the participant's home, and most of the participants answered the questionnaires alone, but in the presence of a caregiver. In 12.4% of the cases, the answers were supplied by the caregiver because the participant was unable to do so.

Based on the anthropometric measures of weight and height, the body mass index (BMI) was calculated using the formula: weight/height<sup>2</sup>. For the diagnosis of nutritional status, the cut-off points proposed by Lipschitz<sup>20</sup> were used. This author classifies BMI values lower than 22 kg/m<sup>2</sup> as underweight, values between 22 kg/m<sup>2</sup> and 27 kg/m<sup>2</sup> as normal, and values above 27 kg/m<sup>2</sup> as overweight. Waist circumference (WC) was measured during the normal expiratory movement at the midpoint between the last rib and the iliac crest, with the individual in the standing position. The cut-off points recommended by the World Health Organization<sup>21</sup> were adopted. The WC was not measured in the participants who were unable to stand, and their height was estimated by measuring knee height and using the equation proposed by Nahas<sup>22</sup>. There was a sample loss of 9.3% for these measures.

Besides the anthropometric measures described, the questionnaire consisted of the following groups of variables:

- **Socioeconomic and demographic characteristics:** gender, age, educational level, marital status, income, history, and time of residence in rural areas<sup>23</sup>.
- **Biological and health variables:** use of health services and medications, self-rated vision and hearing, occurrence

of falls in the three months prior to the study, and self-reported morbidities, grouped according to the International Classification of Diseases (ICD)<sup>24</sup>. The information on continuous medications was confirmed by checking the labels. Polypharmacy was defined as the simultaneous use of five or more medications<sup>25</sup>.

- **Social relations:** visiting friends and/or relatives at least once a week, taking part in social programs, being part of a religious group, and attending social events.
- **Perceived health:** self-rated health and health relative to peers.

Statistical analyses were performed using Epi Info 6.04 and STATA 7.0 and consisted of univariate and multivariate data analysis. FS was considered the dependent variable. To evaluate FS, we used a model developed by Andreotti and Okuma<sup>26</sup>, which includes 40 questions (worth 4 points each) on activities of daily living (ADLs) and instrumental activities of daily living (IADLs). According to the total score, the participants were classified as having very poor, poor, regular, good or very good FS. For data analysis, the participants were grouped into two categories: those with very poor, poor and regular FS (worse functional status) and those with good and very good FS (better functional status).

For the univariate analysis, the Chi-Square test and Fisher's exact test were carried out, and the association measure selected was odds ratio (OR). According to the results of the univariate analysis, the variables associated with the dependent variable with a *p* value <0.20 were selected for multivariate modeling. The multivariate analysis was performed by means of multiple logistic regressions using a hierarchical selection model.

The construction of models was based on the theoretical model proposed by Victora et al.<sup>27</sup>, in which the variables were grouped into blocks according to the order of influence on functional status. Thus, the more distal variables served as adjustment factors for the hierarchically inferior blocks and were maintained in the other models, even if their statistical significance was not preserved. As demonstrated in Appendix 1, the socioeconomic and demographic variables were considered distal determinants; the biological, health and social variables were considered intermediate determinants; and the self-reported health variables were considered proximal determinants.

For the interpretation of the regression results, *p*<0.05 was considered to indicate statistically significant differences and independent association between a particular factor and worse functional status (WFS) after adjustment for possible factors in the same block and in the higher hierarchical blocks. The Wald

test comparing the models of the different blocks was carried out to test the statistical significance.

## Results

One hundred and twenty-nine older adults were evaluated, and almost 53% were female. The age ranged from 80 to 96 years (median=83 years), with approximately 65% under 85. A considerable percentage of the older adults were widowed (46.5%), most of them earning between one-half and three times the minimum wage. The mean educational level was 2.4 years. The vast majority had resided in rural areas (80%), and more than half lived in the countryside for more than 26 years. Most of the participants had very good or good functional status (71.3%), and nearly one-quarter of them were underweight. Approximately one-third used public health services exclusively, and 41% rated their health as good or excellent.

Table 1 shows the results of univariate analysis between the socioeconomic and demographic variables and FS. Female gender, age group and the absence of a spouse were significantly associated with WFS. As described in Table 2, several factors related to biological and health aspects have also been associated with WFS, such as polypharmacy and certain morbidities such as depression, arthropathies, and nervous system diseases. Regarding the social relations aspects (Table 3), the factor "no visits to friends and/or relatives at least once a week" showed a positive association with WFS as did the factor "not taking part in social programs and not attending social events". There was also a positive association between worse perceived health in relation to peers and worse FS.

Table 4 shows the results of the multiple logistic regressions using a hierarchical selection model. Model 1 shows that the individuals over 85 years of age are three times more likely to have functional dependence than younger individuals. Additionally, the older women are six times more likely to have WFS than older men. After adjusting for socioeconomic and demographic factors (Model 2), we found a positive and independent association between polypharmacy and WFS. WFS was also independently associated with the factor "no visits to friends and/or relatives at least once a week" after the adjustment for socioeconomic, demographic, biological and health factors (Model 3). Worse perceived health relative to peers, after adjustment for the variables of the more distal blocks, was an independent factor associated with WFS (Model 4). The Wald test showed that the inclusion of each block of variables contributed significantly to the model adjustment.

**Table 1.** Association between socioeconomic/demographic variables and functional status. São Geraldo, MG, Brazil, 2008.

Variables	Worse functional status %	Better functional status %	Gross OR (IC 95%)	p
Gender				
Male	4.7	42.6	1.00	<0.001
Female	24	28.7	7.68 [2.70-22.91]	
Group age				
<85 years	13.2	53.5	1.00	0.002
≥85 years	15.5	17.8	3.53 [1.58-7.86]	
Spouse				
Living	6.2	34.1	1.00	0.006
Deceased/None	22.5	37.2	3.32 [1.28-8.88]	
Education level (years)				
>2 years	12.4	40.3	1.00	0.172
≤2 years	16.3	31	1.71 [0.74-3.96]	

**Table 2.** Association between biological/health variables and functional status. São Geraldo, MG, Brazil, 2008.

Variables	Worse functional status %	Better functional status %	Gross OR (IC 95%)	p
Number of medications				
Up to four	10.8	47.4	1.00	0.003
Five or more	17.8	24	3.23 [1.46-7.14]	
Nervous system disease				
No	16.3	57.4	1.00	0.005
Yes	12.4	13.9	3.13 [1.26-7.81]	
Circulatory system disease				
No	3.1	17	1.00	0.071*
Yes	25.6	54.3	2.59 [0.76-9.70]	
Arthropathy				
No	8.5	37.2	1.00	0.021
Yes	20.1	34.2	2.58 [1.07-6.33]	
Depression				
No	17.8	57.4	1.00	0.03
Yes	10.8	14	2.50 [1.00-6.30]	
WC				
Appropriate	5.1	29	1.00	0.057
IR or HIR	20.5	45.4	2.57 [0.88-7.86]	
Falls in the last 3 months				
No	17.8	55.8	1.00	0.060
Yes	10.9	15.5	2.19 [0.88-5.44]	
Self-rated vision				
Good/excellent	11.6	41.1	1.00	0.079
Regular/poor/very poor/blind	17.1	30.2	1.99 [0.92-4.33]	
Self-rated hearing				
Good/excellent	14	45.7	1.00	0.105
Regular/poor/very poor	14.7	25.6	1.89 [0.87-4.09]	

\* Fisher's exact test; WC=waist circumference; IR=increased risk; HIR=high increased risk.

## Discussion

The relevance of the present study is in the fact that there are few studies on the living and health conditions of the oldest old in Brazil. Therefore, it investigated the determinants of FS, one of the most important health indicators in older adults. It is also important to conduct studies outside large urban centers

as 71% of Brazilian towns have up to 20,000 residents and account for 18% of the total population<sup>28</sup>. It is worth noting that, although the present study was conducted with older residents in an urban area, it took place in a provincial town with typically rural characteristics, e.g. less motorized transport, more contact with the rural environment, and country traditions such as meeting friends in the town square.

**Table 3.** Association between social relations/perceived health and functional status. São Geraldo, MG, Brazil, 2008.

Variables	Worse functional status %	Better functional status %	Gross OR (IC 95%)	p
Visiting friends and/or relatives				
Yes	2.3	36.4	1.00	<0.001*
No	26.4	34.9	11.84 [3.16-52.18]	
Taking part in social programs				
Yes	6.2	31.8	1.00	0.015
No	22.5	39.5	2.91 [1.12-7.79]	
Attending social events				
Yes	1.5	17	1.00	0.010*
No	27.2	54.3	5.5 [1.15-35.93]	
Being part of a religious group				
Yes	17	51.9	1.00	0.138
No	11.7	19.4	1.83 [0.76-4.39]	
Perceived health in relation to peers				
Better/same	16	68	1.00	0.003
Worse	8.4	7.6	4.26 [1.55-11.69]	

\* Fisher's exact test.

**Table 4.** Factors independently associated with worse functional status among the oldest old. Multiple logistic regressions using a hierarchical selection model. São Geraldo, MG, Brazil, 2008.

Variables	Adjusted OR [CI 95%]	p
Model 1 – socioeconomic and demographic aspects		
Age group		0.017
< 85 years	1.00	
≥ 85 years	2.91 [1.21-6.99]	
Gender		0.001
Male	1.00	
Female	6.09 [2.16-17.14]	
Model 2 – Biological and health aspects *		
Number of medications		0.047
Up to four	1.00	
Five or more	2.67 [1.01-7.04]	
Model 3 – Social activity aspects **		
Visits to friends and/or relatives at least once a week		0.001
Yes	1.00	
No	11.91 [2.89-49.07]	
Model 4 – Perceived health ***		
Perceived health in relation to peers		0.037
Better/same	1.00	
Worse	4.40 [1.09-17.76]	

\*Adjusted by socioeconomic and demographic aspects; \*\* Adjusted by biological and health aspects; \*\*\* Adjusted by social activity aspects.

It was observed that 71% of the oldest old in this study had good or very good FS, reflecting a high degree of independence

in this population, particularly as concerns individuals with advanced age. Considering the methodological differences, this result is similar to that observed in studies conducted in developed countries such as Portugal and China. In Portugal, 62% of patients aged 75 and over had better FS<sup>29</sup>. In China, a longitudinal study on the oldest old identified a prevalence of ability to perform ADLs of 83% among octogenarians and of 63% among nonagenarians<sup>30</sup>. We found no national surveys that evaluated the prevalence of functional disability specifically in the oldest old. Moreover, the protocols used by other studies were different, besides the cultural issues, which limit the comparison with the present results.

The higher risk of functional dependence with age demonstrated in the present study confirms the results of other national and international studies with respect to aging as an important risk factor for the reduction in FS<sup>10,12,17,31,32</sup>. The present study also showed a strong association between female gender and FS after adjustment for the control variables. This result is consistent with the findings of other studies on older adults in general<sup>11,19,33,34</sup> and on the oldest old<sup>35,36</sup>. In contrast, this result differs from that observed in studies carried out in Belo Horizonte and São Paulo, although these studies were not specific to the oldest old<sup>14,18</sup>.

The greater risk of disability among the female older adults can be attributed to a longer survival rate and also to the slight inability shown in adulthood, thus leading to increased risk of developing some degree of functional disability<sup>35</sup>. In a cohort of older adults, Murtagh and Hubert<sup>37</sup> compared the determinants of functional disability in men and women and observed a high prevalence of non-fatal conditions associated with functional disability such as depression, fractures, and osteoporosis, which contribute

substantially to greater disability among the older women compared to older men.

The study participants showed, on average, five self-reported morbidities, with 96% reporting at least one disease. However, there was no independent association between morbidities (both grouped and isolated) and FS. Although advanced age is often accompanied by several morbidities, having a diagnosed illness does not necessarily imply the same degree of impairment in health levels and in ADL and IADL performance<sup>38</sup>. Independence is predictive of successful aging in both men and women<sup>39</sup>.

With regard to the observed association between polypharmacy and WFS, few studies that observed this issue were identified in the literature, and the present results are consistent with some of them<sup>40-43</sup>. Pérès et al.<sup>43</sup> observed a positive association between the progression of disability and the number of medications (four or more) in a cohort of older adults (65 years and over). High medication intake may constitute a measure of the individual's health status<sup>43</sup>. Furthermore, it may reflect aspects other than co-morbidities, such as the severity of the co-morbidity or the probability of iatrogenesis and/or the use of inadequate medications<sup>44</sup>. Hanlon et al.<sup>45</sup> found a significant association between inappropriate use of medications and the decline in FS in a cohort of community-dwelling older Americans (65 to 105 years).

Certain medications can be associated with a worse functional performance, such as anticholinergic drugs<sup>46</sup>. Moreover, polypharmacy and the use of specific medications (such as benzodiazepines) may be associated with increased risk of falls in older adults<sup>47,48</sup>. This fact highlights the important role of medications in maintaining health and FS in this age group. Therefore, steps must be taken to promote the appropriate prescription of medicine in health care.

Among the observed results, it is important to point out the independent association between social relations and FS. Although it is not possible to determine the direction of this association due to the cross-sectional design of the present study, the results are consistent with the findings of other longitudinal<sup>49,50</sup> and cross-sectional<sup>14,18,51</sup> studies. Besides improving FS, the social life of older adults seems to positively affect memory capacity. Older adults who are more integrated into the community have slower memory loss than those who have no active social life<sup>52</sup>. They are also less likely to have depression<sup>53</sup>.

In a longitudinal study carried out in Denmark, the diversity of social relations and high social participation were important factors in maintaining FS among older adults aged 75 and over. Conversely, the lack of social support was a risk factor for functional decline among men aged 80 and over<sup>49</sup>. Boulton et al.<sup>54</sup> also identified social support as a protective factor against functional decline, although another study<sup>55</sup> did not find a significant association between social support and FS.

The association observed between worse perceived health in relation to peers and WFS was also found in other studies<sup>11,14,17,31</sup>. Perceived health is a general subjective measure that includes cognitive, emotional and physical aspects<sup>56</sup> that has emerged as an important health indicator. In some studies<sup>8,57-59</sup>, it was considered a strong indicator of mortality in older adults.

## Conclusion ::::

After hierarchical modeling, it was observed that age of 85 years and over, female gender, continuous use of five or more medications, no visits to relatives and/or friends at least once a week, and worse perceived health relative to peers are factors independently associated with worse FS in the oldest old, which shows the existence of a complex web of factors associated with FS in this population. Caution is advised when extrapolating the results to other groups of oldest old due to cultural, socioeconomic and lifestyle differences. It is also important to note that FS was assessed by self-reports as the advanced age of the participants would hinder a direct evaluation, especially considering ethical issues. Further studies are needed in this direction.

Considering the significant increase in the number of the oldest old forecasted in the coming decades in Brazil and the relevance of this topic, it is important to emphasize the preventable nature of some of the factors associated with the FS level in the present study, such as the number of medications and social relations. Actions that promote the rational use of medications and strategies that enhance the social inclusion of older adults may help to reduce the prevalence of functional dependence and improve health and quality of life in the oldest old.

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## Appendix 1

Theoretical mark for the investigation of socioeconomic, demographic, epidemiological and nutritional determinants of functional status in the oldest old, structured in hierarchical blocks.

**Socioeconomic and demographic aspects:** age, gender, educational level, time of residence in rural areas, marital status, income

**Biological and health aspects:** use of health services health and medications, self-rated vision and hearing, occurrence of falls in the last three months, number of daily meals, waist circumference and self-reported morbidities.

**Social relations:** Visiting friends and/or relatives at least once a week, taking part in social programs, attending social events and being part of a religious group.

**Perceived health:** perceived health and perceived health in relation to peers.

FUNCTIONAL DISABILITY