Cognitive Impairment in Urban/rural Populations of the Middle Altitude in Bolivia: Prevalence and Associated Factors

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Introduction: *Cognitive impairment is an important pathology among elderly people, but few studies evaluate population living at high altitude.* ***Objectives:*** *to characterize and find factors associated with cognitive impairment in urban/rural population, living at high altitude.* ***Methodology:*** *Analytical cross-sectional study. Cognitive impairment was evaluated with the Pfeiffer´s Test (Cronbach's Alpha: 0.69). Its results were combined and compared with three socio-educational variables and four comorbidities. Analytical statistics are as follows.* ***Results:*** *400 elderly people participated in the study. From these, 26.5% (106) had no cognitive impairment; 47.5% (190) of them had a mild impairment; 25.5% (102) of them had a moderate impairment; 0.5% (2) of them had a severe impairment. 60% were women; their median age was 66 years old (interquartile range: 63-69 years old); 67% of them lived in rural areas. The multivariate analysis found more moderate/severe cognitive impairment at an older age (RPa: 1.05; 95% CI: 1.02-1.08; p <0.001), among those who suffered from diabetes (RPa: 1 23; 95% CI: 1.17-1.29; p <0.001), arterial hypertension (RPa: 1.47; 95% CI: 1.33-1.61; p <0.001), chronic kidney disease (RPa: 2.21, 95% CI 2.01-2.43, p <0.001) and heart failure (RPa: 2.25, 95% CI 1.92-2.64, p <0.001). On the other hand, those people who had a university degree had less cognitive impairment (RPa: 0.89, 95% CI: 0.22-0.65, p <0.001); adjusted for sex and place of residence.* ***Conclusion:*** *Important associations of cognitive impairment were found in elderly population, living between 2,500 to 3,900 of altitude. These results are important, as they are not a highly studied population. Therefore, these data should be taken into account, for diagnosis and treatment.*

Keywords: *Cognitive Dysfunction, Altitude, Aged.*

INTRODUCTION

Aging is part of the evolution. During the last few years, elderly people population has increased in many places around the world, due to life quality improvements[(1)], thus leading to increasing prevalence of chronic diseases; therefore, need for more hospital care[(2,3)].

On the other hand, increase of the elderly people has been reported in several regions, even in those deemed as inhospitable, such as cities at a high altitude. This situation plus environmental effects may directly impact on people´s health. A study made in India (at an altitude higher

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than 4,300 meters above the sea level) proved the increased prevalence of a slight cognitive decline in the population who remain for a longer time, at high altitude, seemingly, due to high altitude global hypoxia, which could negatively impact on cognitive performance[4]. It is important to understand underlying mechanisms and differences in cognitive aging. Some may have a preserved cognitive capacity, while others have a decreased one, which may be detrimental for their welfare, independence and, mostly, their quality of life[5.6]. Main disturbances reported during this cognitive loss process are, slowing down, inhibitory deficit, transmission deficit, impairment of operative memory/processing of the language self-regulation[7]. In turn, this impairment onset is associated to brain damage, and as it becomes more evident it may be translated into an increased risk to suffer Alzheimer´s disease or any other neurodegenerative diseases[8]. This is a worrying situation in big cities, such as Cochabamba, where nearly 300,000 inhabitants are older than 60 years old[9]. That is why, the objective was to characterize and find factors associated to cognitive decline in urban/rural population of a medium geographic altitude.

METHODOLOGY

Design and Population

A cross sectional analytical study was made, based on secondary data. The information was retrieved from a record made by one of the authors, as a part of his Annual Report for the Geriatric Residence.

Elderly patients who were patients of the Hospital Clínico Viedma were included. This Hospital is located at 2,587 meters above the sea level. These patients had an evaluation of their cognitive decline and had complex variables. No patients were excluded, as all of them had full assessment records.

Sampling was non randomized. In order to know if it is a good sampling size a calculation was made on the strength of each of the crossings comparing moderate/severe cognitive decline versus the other variables, such as sex (33%), schooling level (100%), diabetes mellitus (14%), high blood pressure (70%), chronic renal disease (100%), heart failure (100%) and place of residence (57%).

Variables and Procedures

The dependent variable was cognitive decline, which was assessed by means of the Pfeiffer´s Test. With Cronbach Alpha measurement the value obtained was 0.69. This test comprises 10 questions, aimed to evaluate the long/short term memory, orientation, information about daily facts and skills to perform a serial mathematical task[10]. In other investigations, this test has been proved to have a sensitivity of 91% and 90% specificity. Additionally, it is a test easy to apply, no specific material is required to perform it and it may be applied in elderly people with a low schooling level[11,12]. It is made within a period of about 5-10 minutes. A result of 3 or more mistakes (4 or more in case of illiteracy) suggests cognitive decline[13].

The other variables were sex (masculine or feminine), age (quantitative considered), schooling level (college and non college studies, the latter including primary, secondary and technical levels), having any of the evaluated comorbidities (these were retrieved as they are the most important variables for cognitive decline[3] and place of residence (urban or rural). For gathering data, a spreadsheet for recording the answers was used. Such data was further fed into an Excel software. These were retrieved in an external survey of the Hospital Clínico Viedma.

Data Analysis and Ethics

Data analysis was made with Stata 11.1 statistics program (the License was purchased by one of the authors). First, a descriptive statistic was made, where frequencies and percentages of categorical variables, medians, and interquartile ranges of quantitative variables were obtained (due to having a non-normal behavior). P values were obtained at this stage, with the chi square test and the summation of ranges (for the crossing versus categorical/quantitative variables; respectively). Later, prevalence ratios, confidence intervals, at 95% (IC95%) and p values were obtained. All this was made by means of generalized linear models (with the Poisson´s family, the log link function, robust and adjusted models, according to place of residence). A p value <0.05 was considered as

statistically significant.

Regarding Ethics, all participants agreed on an informed consent. Participants´ data were protected, so they cannot be identified.

RESULTS

400 elderly people participated in the study. 59.8% (239) of them were women. Median age was 66 years old (interquartile range: 63-69 years old). 66.5% (266) lived in rural areas. 32.0% (128) had diabetes mellitus. 34.8% (139) had high blood pressure. 5.0% (20) had chronic renal disease. 26.8% (107) had heart failure. According to the place of residence, there were no statistically significant differences, according to sex (p=0.054), age (p=0.297), having diabetes mellitus (p=0.513), high blood pressure (p=0.152), chronic renal disease (p=0.264) or heart failure (p=0.450); there was a significant difference in Schooling Level (p<0,001). (Table 1).

26.5% (106) had no cognitive decline; 47.5% (190) had a mild decline; 25.5% (102) had a moderate decline; and 0.5%[(2)] had a severe decline. When the crossing was made, according to the place of residence there was no statistical correlation (p=0.503 with the chi square test), subjects who lived in a rural area had 68%, 69%, 61% and 50% normal parameters, i.e.

Table 1. Characteristics of the population, according to elderly people´s place of residence from Cochabamba-Bolivia.

Variables	Living in Urban		Value p
	Area (n=134)	Rural (n=266)	
Sex			
Masculine	45 (28.0%)	116 (72.0%)	0.054
Feminine	89 (37.2%)	150 (62.8%)	
Age (years)*	65 (62-69)	66 (63-69)	0.297
Schooling Level			
Up to Technical	119 (31.3%)	261 (68.7%)	<0.001
College	15 (75.0%)	5 (25.0%)	
Diabetes Mellitus			
No	94 (34.6%)	178 (65.4%)	0.513
Yes	40 (31.3%)	88 (68.7%)	
High blood pressure			
No	81 (31.0%)	180 (69.0%)	0.152
Yes	53 (38.1%)	86 (61.9%)	
Chronic renal disease			
No	125 (32.9%)	255 (67.1%)	0.264
Yes	9 (45.0%)	11 (55.0%)	
Heart failure			
No	95 (32.4%)	198 (67.6%)	0.450
Yes	39 (36.5%)	68 (63.5%)	

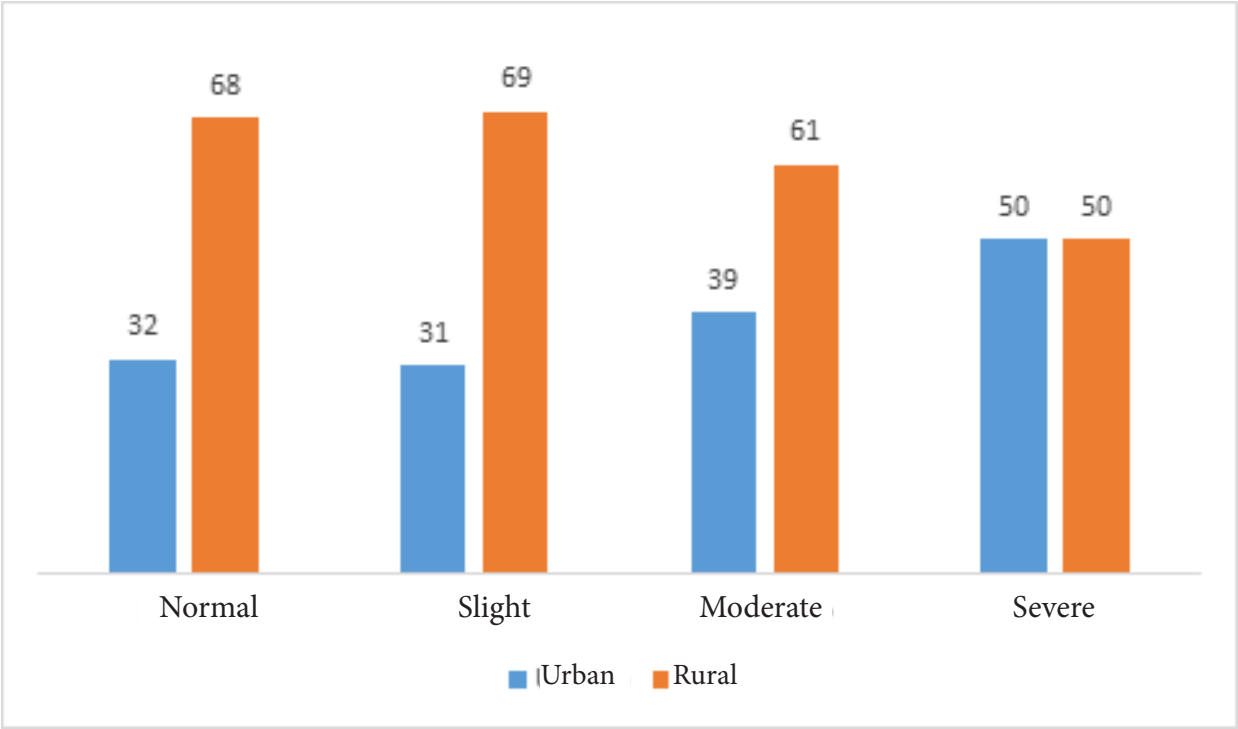
P values are obtained with the chi square test and the summation of ranges (as per age). *Age was taken quantitatively and values displayed are medians (interquartile ranges).

mild, moderate and severe cognitive decline; respectively. *Figure #1*

When cognitive decline analysis was made, statistical differences were found, according to age (those who had moderate or severe cognitive decline were older; p<0.001), whether if people suffered from chronic renal disease (the sick people had nearly twice as much cognitive decline; p=0.047) and suffering from heart failure (sick people had twice as much cognitive decline; p<0.001). *Table 2*

The multivariate analysis showed there was more moderate cognitive decline/severe at an older age (RPa: 1.05; IC95%: 1.02-1.08; p<0,001), among those who had diabetes (RPa: 1.23; IC95%: 1.17-1.29; p<0.001), high blood pressure (RPa: 1.47; IC95%: 1.33-1.61; p<0.001), chronic renal disease (RPa: 2.21; IC95%: 2.01-2.43; p<0.001) and heart failure (RPa: 2.25; IC95%: 1.92-2.64; p<0.001); however, those who had a college degree had lower cognitive decline (RPa: 0.89; IC95%: 0.22-0.65; p<0.001); adjusted by sex and place of residence. *Table 3*

Figure #1. Cognitive decline percentages, if elderly people live in rural/urban areas of Cochabamba-Bolivia.



DISCUSSION

One of four elderly people had moderate cognitive decline. Less than 1% had severe cognitive decline, unlike a study made at some Hospitals in Spain, where only 39% had a cognitive decline, Additionally, patients studied were elderly patients (average age 77.9 ± 9.8 years old)[14]. At an older age there was a higher moderate or severe cognitive decline, just as reported in the study made in Chile, where the main factors associated to suspicion of cognitive decline were age, low schooling level and masculine sex[15,16]; which involves higher risks in hospital management[17,18].

Those with college studies had a lower moderate/severe cognitive decline, which matches the studies made in Italy, where the highest mortality rates were reported for Primary Education or lower schooling[19].

Those who had one of the four comorbidities evaluated had a higher moderate or severe cognitive decline. In Chile, the association is reported to be higher in diabetic people and/or people with family background of diabetes mellitus[20], this is important as reported in the follow-up study made in Japan, where mortali-

Table 2. Characteristics of the population, according to elderly people´s place of residence, in Cochabamba-Bolivia.

Variables	Cognitive decline		Value p
	No or mild	Moderate or severe	
Sex			
Masculine	114 (70.8%)	47 (29.2%)	0.232
Feminine	182 (76.2%)	57 (23.8%)	
Age (years)*	65 (63-68)	69 (64-72)	<0.001
Schooling Level			
Up to Technical	278 (73.2%)	102 (26.8%)	0.094
College	18 (90.0%)	2 (10.0%)	
Diabetes Mellitus			
No	199 (73.2%)	73 (26.8%)	0.577
Yes	97 (75.8%)	31 (24.2%)	
High blood pressure			
No	200 (76.6%)	61 (23.4%)	0.101
Yes	96 (69.1%)	43 (30.9%)	
Chronic renal disease			
No	285 (75.0%)	95 (25.0%)	0.047
Yes	11 (55.0%)	9 (45.0%)	
Heart failure			
No	235 (80.2%)	58 (19.8%)	<0.001
Yes	61 (57.0%)	46 (43.0%)	
Place of residence			
Urban	93 (69.4%)	41 (30.6%)	0.137
Rural	203 (76.3%)	63 (23.7%)	

P values are obtained with the chi square test and the summation of ranges (as per age). *Age was taken quantitatively and values displayed are medians (interquartile ranges).

Table 3. Bivariate/multivariate analysis of factors associated to cognitive decline in elderly people living in Cochabamba-Bolivia.

Variables	Bivariate analysis	Multivariate analysis
Feminine sex	0.82 (0.80-0.83) <0.001	0.90 (0.72-1.14) 0.383
Age (years)	1.07 (1.02-1.12) 0.004	1.05 (1.02-1.08) <0.001
College	0.37 (0.18-0.76) 0.006	0.38 (0.22-0.65) <0.001
Diabetes mellitus	0.90 (0.82-0.99) 0.026	1.23 (1.17-1.29) <0.001
High blood pressure	1.32 (0.86-2.03) 0.197	1.47 (1.33-1.61) <0.001
Chronic renal disease	1.80 (1.39-2.33) <0.001	2.21 (2.01-2.43) <0.001
Heart failure	2.17 (1.34-3.52) 0.002	2.25 (1.92-2.64) <0.001

Prevalence ratios (confidence intervals, at 95%). P values were obtained with generalized linear models (Poisson´s family, link function log, robust and adjusted models, according to place of residence). Age variable age is quantitative.

ty rate increased with the additional number of risk factors, being cognitive decline a mortality predictor[21].

It is important to highlight that elderly people have various comorbidities, as reported in the national study made in USA within the population aged 62 to 90 years old. The average number was 2.7 pathologies for this group[22].
No enough studies have been made about cognitive decline in locations with medium geographic altitude. In China, at an altitude of 2,275 meters above the sea level, 24% of studied patients had cognitive decline[23]. Unlike our study as, at a higher altitude (2,500-3,900 meters above the sea level) 73.5% of younger patients were found to have a certain degree of cognitive decline.

The study was limited, in terms of selection bias, as the sampling did not allow to extrapolate the data to all the elderly population in Cochabamba. Neither could we do with other of similar altitude; however, because of the significance of the sample and the correlations found, we may take this Report as an important precedent. Health Agencies should lead studies including a higher amount of population and locations. However, because of the strength of the variables crossing, analytic results can be used; therefore, this may help in future investigations and Agencies located at a high geographic altitude aiming to evaluate factors associated to cognitive decline.

Because of the aforementioned, the conclusion is that 25% of elderly people, who live at an intermediate geographic altitude have a moderate cognitive decline; 0.5% of them had a severe cognitive decline. At an older age there was a higher moderate or severe cognitive decline, as well as those who had a comorbidity. Those who had college studies had a lower moderate or severe cognitive decline.

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