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# Original contribution

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## Keywords

Cognitive reserve, adult, indigenous, cognition, depression, disease.

## Cognitive reserve and associated factors in a sample of indigenous older adults

Cognitive reserve in indigenous

### Abstract

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**Objective:** To describe cognitive reserve and factors associated among older Indigenous from Camëntsá Biyá community of Sibundoy valley, Putumayo (Colombia).

**Methods:** Cross-sectional study in 67 older indigenous participants aged 60 years and over. Cognitive reserve was described according to demographic characteristics and comorbidity. We explore relation between cognitive reserve and demographic and comorbidity variables and its correlation with Minimental and Fototest.

**Results:** Female sex ( $p = 0.002$ ), low educational level ( $p < 0.001$ ), history of chronic obstructive pulmonary disease ( $p = 0.025$ ) and depressive symptoms ( $p < 0.001$ ) were associated with less cognitive reserve. The cognitive reserve showed moderate correlations with the Minimental ( $Rho = 0.572$ ,  $p < 0.001$ ), and Fototest ( $Rho = 0.558$ ,  $p < 0.001$ ).

**Conclusions:** Cognitive reserve among older indigenous is related to demographic factors according to gender and educational level. Likewise, an association with depressive symptomatology and the general cognitive state is determined.

## Resumen

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**Objetivo:** Describir la reserva cognitiva y los factores asociados en una muestra de adultos mayores indígenas pertenecientes a la comunidad Camëntsá Biyá, del valle de Sibundoy, Putumayo (Colombia).

**Métodos:** Estudio corte transversal, en 67 indígenas de 60 años o más. Se evaluó la reserva cognitiva según características demográficas y la comorbilidad y su correlación con el Minimental y el Fototest.

**Resultados:** Sexo femenino ( $p=0.002$ ), bajo nivel educativo ( $p<0.001$ ), antecedente de enfermedad pulmonar obstructiva crónica ( $p=0.025$ ) y síntomas depresivos ( $p<0.001$ ) se encontraron asociados a la reserva cognitiva. La reserva cognitiva mostró correlaciones moderadas con el Minimental ( $Rho=0.572$ ;  $p<0.001$ ), y el Fototest ( $Rho=0.558$ ;  $p<0.001$ ).

**Conclusiones:** El nivel de reserva cognitiva se relaciona con factores sociodemográficos en función de género y nivel educativo. Asimismo, se determina asociación con sintomatología depresiva y el estado cognitivo general.

### Palabras clave

*Reserva cognitiva, adulto mayor, indígena, cognición, depresión, enfermedad.*

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## Introduction

The cognitive reserve is conceptualized as a hypothetical construct emerging from the field of dementia, proposed as a mediating factor between a brain pathology and its differential clinical manifestations.<sup>1</sup> It is constituted as a complex theoretical reference with no direct measurements for its valuation process, which makes it challenging to develop rigorous investigations that might clarify its characteristics, effects, and possible causal relationships.<sup>2</sup> This construct can only be measured indirectly by proxy indicators, that is, indirect variables that are conceived as representative of the original construct.<sup>3</sup> Therefore, one of the main limitations in the study of this subject is the absence of a detailed operational definition of this construct.

Consequently, different measurements are used for its quantification.<sup>4</sup> For research, in particular, variables such as sociodemographic characteristics, medical history, cognitive level, and emotional state were considered;<sup>5</sup> however, of all of them, education is consistently and systematically the most used variable,<sup>6</sup> repeatedly analyzed and related through indices of activity or cognitive performance. Culture is also considered a significant factor that intervenes in the development and potentialization of the cognitive reserve<sup>7</sup> concerning rural contexts. The literature mentions that the indigenous cultural environment can have a significant and differential influence in the structuring of this construct.<sup>8</sup>

Thus, when studying cognitive reserve in indigenous senior citizens, a common factor must be considered which is related to the deficiencies present in all sectors, especially those related to the social, educational, and health components. Hence, the two categories of an indigenous ethnic group and the older adult are multiplying factors that together lead to a greater degree of vulnerability in this segment of the population. Therefore, the main objective of this project is to describe the cognitive reserve and the associated factors in a sample of older adults from the Camëntsá Biyá community of the Sibundoy Valley in Putumayo, Colombia.

## Methods

A descriptive, cross-sectional study was conducted to analyze the effect of demographic factors, medical conditions, emotional state, and cognitive performance with respect to the level of cognitive reserve in elderly adults of the Camëntsá Biyá indigenous community from the Sibundoy Valley in Putumayo, Colombia. The population is of approximately 5,000, of which 300 are elderly. The research included adults of both sexes, 60 years of age or older, belonging to the indigenous community who voluntarily accepted to participate in the study and signed the informed consent. Candidates with visual or auditory impairments or any medical condition that prevented the application of the protocol were excluded. The type of sampling was intentional, not probabilistic, from a database containing information corresponding to this ethnic group.

The evaluation was conducted in the health center of the municipality of Sibundoy Putumayo, during the weekends from March to May 2017. This process was carried out by health professionals in the areas of nursing and psychology. The collected information included age in years, gender, affiliation to the General System of Social Security in Health (SGSS), level of studies, marital status, number of children, whether they receive an economic subsidy, employment status, economic dependence, monthly income, and whether they have a caregiver and what their relationship is to them.

We evaluated history of infectious, chronic, respiratory, and musculoskeletal diseases from self-reports with the following instruction in the questionnaire: "I will list a series of diseases below. Which of them have you suffered or do you currently have?" Among them, the presence of high blood pressure, cerebrovascular disease (CVD), diabetes, obesity, chronic obstructive pulmonary disease (COPD), pneumonia, osteoporosis, arthritis, cataracts, fractures, cancer, and dementia were evaluated. These data were compiled from a structured questionnaire applied by students of nursing and ninth semester of psychology.

The demographic factors and medical history were evaluated according to a pre-designed questionnaire, applied to the participant or a family member or responsible caregiver. This format was validated at the investigation of multidimensional factors in older adults of the city of San Juan de Pasto.<sup>9</sup> Finally, the instrument was piloted including the screening scales.

The Mini-Mental State Examination was used, adapted, and validated in Colombia for the cognitive evaluation.<sup>10</sup> The maximum total score is 30 and the main parameters of normality are age and schooling. In daily practice, a score of 23-21 suggests mild dementia, 20-11 means moderate, and less than 10 is severe dementia. This instrument was chosen because it is widely used and has a lower level of complexity with respect to the assessment of global cognitive performance. The images test, or Fototest,<sup>11</sup> was applied to evaluate cognitive processes at the memory (visual), language (denomination and verbal fluency), and executive functions levels. Its advantage is its ability to be applied to illiterate subjects. It consists of six items and has an open score in a range of 45 points or more.

Depressive symptomatology was determined using the Yesavage<sup>12</sup> Geriatric Depression Scale, which has three categories corresponding to the total score from the sum of 15 items: from 0 to 5 normal, 6 to 10 moderate depression, and from 11 to 15 severe depression. This instrument was chosen for its applicability in the elderly population. Finally, the level of cognitive reserve was assessed by applying the Cognitive Reserve Index questionnaire (CRIq).<sup>13</sup> It consists of eight items measuring aspects such as schooling, the completion of training courses, job occupation, musical training, parents' schooling, and language proficiency. It also inquires about the approximate frequency with which cognitively stimulating activities have been realized throughout life, such as reading and practicing intellectual games like crossword puzzles and chess. To obtain the total CRIq score, the results of each item are added with a maximum of 25 points—higher scores indicate a greater cognitive reserve.

## Ethical Considerations

In accordance with the Mariana University's Manual of Bioethics (Agreement 040 of 2012) and the Ministry of National Health's resolution 008430 of 1993, this study was determined to be a minimal risk investigation. Its purpose is eminently scientific with no therapeutic intent. At the beginning of the evaluation process, participants were informed about the procedures and objective of the study, the risks, benefits, and confidentiality of the results, as well as of their freedom to withdraw or refuse to participate at any time during the evaluation. This research was endorsed by the Bioethics Committee of the Mariana University.

## Statistical Analysis

The demographic characteristics were taken from the absolute frequency and the percentage. The scores on the CRIq, the Mini-Mental, the Fototest, and the Yesavage were defined using the median and interquartile range (Percentile75-Percentile25). The cognitive reserve score was described and compared using the Chi-Squared test or the Mann-Whitney U test according to demographic characteristics and the presence or absence of medical history (arterial hypertension, dyslipidemia, diabetes mellitus, obesity, heart disease, CVD, COPD, arthritis, consumption of alcoholic beverages, and consumption of psychoactive substances). The Spearman correlation coefficient ( $\rho$ ) was calculated for the analysis of the correlation between the CRIq, the Mini-Mental, the Fototest, and the Yesavage scores—statistical significance level  $\alpha=0.05$ . All analyses were performed in IBM SPSS version 23.

## Results

The demographic characteristics are presented in [Table 1](#). The majority of the participants were female (73%), 43.3% were married, 43.28% were widowed, almost half reached a primary level, 35% were illiterate, and the majority were economically dependent on their family (56.7%). A statistical association was found between cognitive reserve score and sex ( $p=0.002$ ) as well as schooling ( $p<0.001$ ).

**Table 1.** Demographic characteristics and average result in the score of the cognitive reserve scale in older adults of the Camëntsá Biyá indigenous community of the Municipality of Sibundoy-Putumayo.

	Total sample n = 67		Cognitive Reserve Scale				Statistical; p-value
	Frecuency	%	Mean	SD	Median	IR	
<b>Sex</b>							Z=3.1; p=0.002
Female	49	73.1	7.5	2.6	8,0	3,0	
Male	18	26.9	10.3	3.4	10,0	4,0	
<b>Age, years</b>							Z=0.9; p=0.386
60 – 72	34	50.7	8.7	3.4	8,0	4,3	
72 a 88	33	49.3	7.7	2.3	8,0	3,0	
<b>Marital status</b>							$\chi^2=5.5$ ; p= 0.065
Married	29	43.3	9.1	2.3	9,0	4,0	
Widowed	29	43.3	7.2	2.7	8,0	3,5	
Single / divorced / partnered	9	13.4	8.7	5.3	8,0	4,0	
<b>Schooling</b>							$\chi^2=15.7$ ;
Cannot read/write	6	9.0	4.6	1.8	4,5	2,8	
Learned to read and write	24	35.8	7.5	2.9	7,5	3,0	
Primary	37	55.2	9.3	2.8	8,0	3,0	
<b>Type of affiliation</b>							p<0.001
Beneficiary	10	14.9	10.9	4.2	10,0	4,0	
Subsidized	57	85.7	7.8	2.6	8,0	3,5	
<b>Financially dependent on family</b>							Z=0.17; p=0.869
Yes	38	56.7	8.1	3.8	8,0	3,0	
No	29	43.3	8.6	3.8	8,0	5,0	

**SD:** Standard deviation, **IR:** Interquartile range

**Z:** Z statistic with asymptotic approximation of the Mann-Whitney U test.

## Discussion

**Table 2** presents the results of the presence of medical history and its association with the cognitive reserve questionnaire. Only COPD showed statistically significant association with the score in the cognitive reserve questionnaire ( $p=0.025$ ). Significant correlations were found between the scores of the CRIq and the Mini-Mental ( $\rho=0.572$ ,  $p<0.001$ ), Fototest ( $\rho=0.558$ ,  $p<0.001$ ) and Yesavage ( $\rho=0.583$ ,  $p<0.001$ ).

Aging in the indigenous context must be approached taking into account the sociocultural factors that define it. In this regard, the prevalence of female gender in the evaluated sample is present. This phenomenon is likewise evidenced in the diagnosis of older adults in Colombia due to the process of feminization of old age for the past fifty years, where the masculinity index has decreased and life expectancy for women has increased by 5.9 years

**Tabla 2.** Result in the cognitive reserve scale according to presence or absence of medical history.

History, n (%)	Ausente				Presente				Estadístico; valor p
	Mean	SD	Median	IR	Mean	SD	Median	IR	
Arterial hypertension, n=23 (34.3)	8.4	8.5	8,0	4,5	7.9	2.3	7,0	2,0	Z=0.9; p=0.386
Dyslipidemia, n=5 (7.5)	8.3	3.1	8,0	3,3	8.2	1.9	8,0	3,5	Z=0.02; p=0.991
Diabetes mellitus, n=12 (17.9)	8.3	3.1	8,0	3,0	8.0	3.1	7,0	4,5	Z=0.5; p=0.592
Obesity, n=3 (4.5)	8.3	3.1	8,0	3,1	7.3	1.5	7,0	-	-
CVD, n=6 (7.5)	8.4	3.0	8,0	3,0	6.2	3.8	6,0	6,5	Z=1.6; p=0.115
COPD, n=9 (13.4)	8.6	3.1	8,0	3,3	6.4	2.4	7,0	3,0	Z=2.2; p=0.025
Arthritis, n=33 (49.3)	8.4	3.4	8,0	3,5	8.2	2.6	8,0	3,5	Z=0.01; p=0.955
Consumption of alcoholic beverages, n=9 (13.4)	10.3	4.5	9,0	4,5	7.9	2.8	8,0	4,0	Z=1.4; p=0.153
Consumption of psychoactive substances (including Yagé), n=47 (70.1)	9.3	3.9	8,0	3,9	7.8	2.5	8,0	4,0	Z=1.2; p=0.216

**SD:** Standard Deviation; **IR:** Interquartile range;

**Z:** Z statistic with asymptotic approximation of the Mann-Whitney U test.

more than men, regardless of the ethnic group to which they belong—a situation that does not differ in the age group evaluated.<sup>14</sup> Regarding schooling, the greater percentage of the population has a primary basic education, though there are some subjects in the category of illiterate. This is explained by factors such as difficulty in accessing the educational system, inadequate infrastructure, schooling processes not in accordance with ethnic characteristics, and cultural patterns, among others. Similarly, the level of schooling evidenced is corroborated by the SABE Colombia study (2015) where, on average, the older adult population reached five years of schooling, corresponding to the primary school level.<sup>15</sup>

Regarding marital status in the evaluated sample, the data show a significant percentage of older adults in the categories of married and widowed.

The participants report that the prevalence of widowhood is due to the armed conflict of the period which had mostly male casualties. Relating it to the sociodemographic diagnosis of indigenous older adults,<sup>16</sup> it is observed that 64.6% of them are coupled or married. Out of the six ethnolinguistic groups evaluated, more than 50% of these subjects live in this condition. This is a protective factor, making evident the primary support network—the perception of support and protection in matters related to emotional and economic stability improves with a partner.

In function with the demographic factors, an association of the education variable was determined in the project with the CRIq ( $p < 0.001$ ). Schooling has been the component most referenced by the literature as a predictor of this construct, not only

at the cognitive level but also at the cerebral level.<sup>17</sup> Thus, the level of schooling is a factor that explains the greater percentage of the variance in syndromes such as cognitive impairment and dementia. Therefore, this variable seems to promote the formation and increase of neuronal connections and a greater regional thickness of the cerebral cortex.<sup>18</sup>

In this line of analysis, the gender category was also significant for the CRIq ( $p < 0.002$ ). The bibliographical references are divergent around this topic.<sup>19</sup> Traditionally, the existence of a differential profile is considered not only at a cognitive level but also cultural and functional; however, the existing literature has not always been able to demonstrate such differences—on the contrary, the results in this regard seem to be contradictory.<sup>20</sup> Therefore, the study of homogeneity or heterogeneity between men and women is still recent. In this regard, several authors report that cognitive performance by gender shows significant differences in groups of illiterate subjects in favor of men.<sup>21</sup>

With regard to medical history, COPD was correlated with the CRIq level ( $p = 0.025$ ). It is a progressive disease whose prevalence increases with age and is characterized by its high number of comorbidities including cognitive impairment.<sup>22</sup> The hypoxemia observed in some patients with COPD seems to be the most significant factor for the incidence of cognitive impairment, since it affects the oxygen-dependent enzymes that are important in the synthesis of neurotransmitters such as acetylcholine. Several studies have shown that cognitive deterioration has a prevalence of 77% in patients with COPD and hypoxemia.<sup>23</sup>

At the level of the emotional component, the CRIq showed significant correlation with depressive symptomatology ( $\rho = 0.583$ ;  $p < 0.001$ ). Its diagnosis is very important because the mere fact of suffering it represents a criterion of frailty. It is also the main cause of suffering and poor quality of life during old age.<sup>24</sup> Now, with respect to the population evaluated, a high percentage of older adults live in a situation of social disadvantage, given the unfavorable socio-economic conditions in which most of them have developed, a situation that contributes even more in

the presence of depressive symptomatology.<sup>25</sup> Finally, in terms of mental health, the previous argument is more relevant if the relationship between cognitive reserve and emotional component is considered.

Likewise, the existing relationship between the CRIq level and cognitive performance has also been referenced.<sup>26</sup> Particularly in the study, this association was determined from the application of the Mini-Mental ( $\rho = 0.572$ ;  $p < 0.001$ ) and Fototest ( $\rho = 0.558$ ,  $p < 0.001$ ). In this regard, the literature demonstrates the usefulness and predictive capacity of these screening tests, which can be used to systematically evaluate the mental state and identify cognitive impairment.<sup>27</sup> However, when analyzing the cognitive reserve component, the importance of factors such as education should be considered, since the general cognitive level is not capable of explaining by itself the higher index of cognitive reserve.

Regarding the limitations of the project, we should primarily mention the non-probabilistic nature of the selection of the study sample. The sample size was small, which limited the potential to evaluate previously reported cognitive reserve associations with other factors. In addition, the type of cross-sectional study does not account for temporal antecedents for a purpose of causality. Similarly, schooling was not counted in years. It limited explaining with appropriate statistical models the relationship with the subject of study. Despite this, the work makes a contribution to the understanding of the cognitive reserve in indigenous communities, as it is the first study undertaken in our national context.

## Conclusion

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The level of cognitive reserve is related to sociodemographic factors according to gender and educational level. It is determined there is also an association with obstructive pulmonary disease, depressive symptomatology, and the general cognitive state.

### Conflicts of interest

The authors declare there is no conflict present regarding the production of the manuscript.

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