Factors Associated with Cognitive and Functional Performance in Indigenous Older Adults of Nariño, Colombia

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Introduction. Ethnicity in Latin America is a factor of poverty and social exclusion. Like in developed countries, demographic, medical, psychosocial, global cognitive, and functional variables interact in a complex relationship on the elderly population. Such interaction should be considered to determine cognitive and functional performance using screening tests. The aim of this study was to evaluate the demographic, medical, and psychosocial factors affecting global cognitive performance as well as functional activities. Methods. The study was conducted in a Colombian elderly indigenous population which included a sample of 518 adults. This research employed a structural model of latent factors to assess the effects of demographic, medical, and psychosocial factors on cognitive and functional performance. The model was estimated by least squares and used a maximum-likelihood procedure, and it was determined RMSEA, TLI, and CFI to assess the model’s goodness of fit. The categorical variables used in the model were as follows: (1) demographics, (2) psychosocial factors, (3) medical condition, (4) global cognition, and (5) functional factors. Results. Demographics, in addition to medical and psychosocial factors, were related to global cognition and functional factors (RMSEA = 0.051, CI 90% 0.045–0.057, CFI = 0.901, and TLI = 0.881). Conclusion. These results provide strong evidence about the complex relationships among demographics, medical conditions, and psychosocial factors and their influence on global cognition and functional performance in Colombian indigenous elderly population.

1. Introduction

In Latin America, ethnicity is a strong risk factor associated with poverty, inequality, and social exclusion, mainly in rural areas and in low-income families. Ethnicity has a negative impact on the most vulnerable sectors of the population such as children and the elderly [1]. Ethnicity, as a condition of social inequality, when it is related to differences in language and low education, can impact global cognitive tracking evaluations. Such impacts can cause heterogeneity in the execution of tests, limiting an individual’s operational characteristics despite a priori adjustments that could be proposed in [2].

On this subject, there are studies that inform about the direct and indirect effects demographic conditions, general health problems, and psychosocial variables have on the execution of cognitive tracking tests as well as functional evaluations. Such data can be adjusted into a multivariate model of complex interactions of 3 factors (the factors have been medical history, global mental state, and gender) related to the functional condition and cognitive involvement of the elderly [3]. The model shows a complex structure of interrelations between factors such as genetics, emotions, sociodemographic factors, and health status. The health status is usually associated with the comorbidity of chronic diseases. All these associated factors entail a greater risk for
the development of neurodegenerative diseases with negative consequences in daily life activities [4]. In this manner, the epidemiological profile of the disease in the indigenous community has gradually changed from a scenario characterized by infectious and parasitic disorders to an increase in the rates of chronic noncommunicable diseases. Nevertheless, this study does not disregard the strong relationship between cardiovascular risk factors, functional performance, emotional state, cognitive impairment, and dementia in the population of indigenous older adults [5, 6].

These conditions are shared by indigenous communities in other Latin American countries, where the precarious health situation of these contexts constitutes another relevant factor for the increase in dependence and mortality [7]. The increase in risks such as chronic diseases, dependence, and mortality could be related to an acculturation process of the native population. The natives have acquired lifestyles which in part have increased their life expectancy but, on the other hand, increased the prevalence of chronic diseases, causing dependence on the elderly [7, 8]. The aim of this study was to evaluate the demographic, medical, and psychosocial factors affecting global cognitive performance and functional activities, through a structural model of latent factors. The model was applied to a group of indigenous senior citizens in the province of Nariño, Colombia. This study is of great relevance because the most important problems in the adult stage are the loss of cognitive and functional abilities, even more regarding ethnic communities belonging to a scenario of old age and multimorbidity [9]. Therefore, knowing the state of cognitive and functional performance of these adults allows to understand the levels of dependence of indigenous population from others to do activities, an important indicator of their health condition.

2. Materials and Methods

This project was designed as an observational and analytical study and is based on a transversal descriptive nature. The reference population was 5759 older indigenous people who belonged to 13 subregions of the former jurisdiction of Obando in the province of Nariño, in southern Colombia, data obtained by the DANE Census and its estimate for 2016. In this way, the sample size included a total of 518 older adults. To estimate the sample, a prevalence of 50% was considered, a margin of error between 3 and 5% with a 10% increase in potential losses. The sample size was considered appropriate for this study, taking into account the rule of 10 participants per variable in the structural model, for a ratio of 23 participants per variable (n = 518/22 variables in the model) [8].

The inclusion criteria were as follows: being an adult 60 years of age or older, belonging to an indigenous council, and voluntarily accepting participation in the study by signing the informed consent. The exclusion criteria were established based on the presence of some medical or cognitive implications that prevented the application of the protocol.

2.1. Valuations. We considered the following variables: sociodemographic, medical, nutritional, cognitive, and functional factors. These factors were evaluated with a multidimensional questionnaire previously validated [10] and a self-report provided by each participant or a relative responsible for caregiving. The demographic characteristics were evaluated depending on the particularity of these; age was approached in ranges since it allows a better analysis of it; in relation to the education variable, it was guided by categories that may or may not read and write and by primary, secondary, technical, undergraduate, and postgraduate levels; regarding income, it was investigated based on the current legal minimum wage. The medical component was consulted for the presence or not of medical illness. The nutritional assessment was determined using the full version of the Mini-Nutritional Test [11]. This evaluation was carried out by an interdisciplinary team in areas such as nursing, neuropsychology, physical therapy, and occupational therapy. The presence of malnutrition or risk of malnutrition was defined as follows: malnutrition was considered when a person scored in the Mini-Nutritional Test less than 17 points (<17); malnutrition risk relates to a score between 17 and 23.5; and good nutritional status relates to 24 points or more. The study applied the Mini-Mental State Examination (MMSE) test for cognitive evaluation. For this study, it was used the cutoff point of ≥24 [12].

Additionally, it was used the Rowland Universal Dementia Assessment (RUDAS) test considering a cutoff point of 21. The latter was used because it does not contain biases linked to instruction level. Its ordinal scoring system is 30 points [13]. Further, the study applied the subjective memory complaints (SMC) consisting of 15 questions to determine the functioning of the patient’s memory in daily life using a Likert frequency scale. The maximum score for the Likert scale is 45 and the cutoff point is 19 [14]. Likewise, depressive symptoms were evaluated according to a self-report that used the Yesavage geriatric depression scale [15]. The scale considers three categories (normal, moderate depression, and severe depression) according to a total score obtained from a sum of 15 items. A score of 0 to 5 denotes normal (no depression), 6 to 10 moderate depression, and 11 to 15 severe depression. The social variables were evaluated through the Medical Outcomes Study—Social Support Survey (MOS-SSS) with 20 questions in total, related to the perception of support of the individual, in addition to exploring about the accompaniment in the instrumental, affective, social, and family dimensions. The response options are given through a Likert scale of 1 (never) to 5 (always) [16].

The study used the Lawton and Brody scale to assess the degree of functional independence regarding instrumental daily life activities [17]. The scale assesses the ability to perform tasks that involve the handling of habitual utensils and routine social activities. The Lawton and Brody scale uses 8 items for assessment (ability to use the phone, shopping, preparing food, taking care of home, laundry, use of transportation means, responsibility for medication, and economy administration) and assigns a numerical value 1 (independent) or 0 (dependent) for the assessment process. The final score results from the sum of the values in each
answer and goes between 0 (maximum dependence) and 8 (total independence). Concerning the psychometric properties, the scale is reliable with a Pearson coefficient of interobserver reliability of 0.85 and good concurrent validity with other scales of cognitive and daily activities. It assesses the ability of a person to perform ten basic activities of daily life in a dependent or independent way. The Barthel index score ranges from 0 (completely dependent) to 100 (completely independent). A degree of dependence is established according to the score obtained, being the most frequent completely independent. A degree of dependence is established completely independent. A degree of dependence is established completely independent. A degree of dependence is established completely independent.

2.2. Ethical Issues. The study was reviewed and approved by the Bioethics Committee of Mariana University, located in Pasto, Nariño, Colombia. The study complies with the recommendations provided by the Resolution 8430 of 1993 of the Colombian Ministry of Health to conduct research. Additionally, the study fulfills the Helsinki Declaration of the World Medical Association guidelines [19]. Further, the investigation sought approval from each indigenous community council. This process was carried out in the first semester of 2017.

2.3. Statistical Analysis. The study used frequency to describe variables identified as demographic characteristics, medical history, social support, and cognitive performance. The study used the percentage value to describe categorical variables and mean along with standard deviation to describe continuous variables. According to these characteristics, we explored differences in the cognitive performance evaluated by the MMSE and RUDAS using the t-test for independent samples (gender, place of residence, economic dependence, and medical history) and analysis of variance (ANOVA) for level of schooling, marital status, and home income. MMSE had to be transformed using a cubic power since it did not fulfill the assumption of homogeneity in variance. Additionally, the Scheffe test was used when comparing groups as a post hoc test. The Pearson correlation coefficients between MMSE and RUDAS were calculated with the MOS-SSS dimension scores. It was proposed a structural model (Figure 1) assuming latent variables such as (1) demographics, (2) psychosocial factor, (3) health condition, (4) cognitive dimension, and (5) functional dimension. The model assumed that demographic factors and psychosocial factors influenced a person’s health condition, in addition to the cognitive and functional dimensions. The RMSEA index (root mean square error of approximation), CFI (confirmatory fit index), and TLI (Tucker–Lewis index) were determined to assess the model’s goodness of fit. A good adjustment was assumed if the RMSEA index was less than 0.08 and the CFI and TLI >0.90 [20]. Given that the model included categorical variables, we used a robust estimation method through weighted least squares with a likelihood ratio (WLSMV), using a diagonal weight matrix with standard errors and chi-square test statistic with an adjusted mean and variance [21]. The results in the model are presented as standardized coefficients that indicate the correlation between the factors and dimensions. The analyses were carried out in the SPSS IBM software version 23 and in MPLUS 7.0 [22].

3. Results

3.1. Description of Cognitive and Functional Performance according to Demographic Characteristics. From the 518 participants in the study, it was found an average in the MMSE of 22 points (SD = 5.4) and in the RUDAS scale of 20.3 (SD = 4.7). The SMC showed an average of 23.6 (SD = 9.9). Concerning the functional scales, the average was 97 (SD = 7) and 6 (SD = 2) for the Barthel and Lawton scales, respectively. After adjusting for age and educational level, the correlation between RUDAS and MMSE was 0.60 (p < 0.001). Table 1 presents the behaviour of the MMSE, the RUDAS, and the subjective complaints of memory and functional scales, according to demographic characteristics. The correlation with age was −0.33 (p < 0.001), −0.36 (p < 0.001), −0.20 (p < 0.001), and −0.30 (p < 0.001) for the MMSE, the RUDAS, Barthel, and Lawton, respectively. Significant differences were found according to gender (MMSE (t = 4.4; gl = 506; p < 0.001) and QM (t = -2.2; gl = 510; p = 0.028)); level of education (MMSE (F = 91.3; gl1 = 2; gl2 = 515; p < 0.001), RUDAS (F = 29.3; gl1 = 2; gl2 = 515; p < 0.001), and Barthel (F = 4.3; gl1 = 2; gl2 = 515; p = 0.014)) marital status (MMSE (F = 14.6; gl1 = 2; gl2 = 515; p < 0.001), RUDAS (F = 7.3; gl1 = 2; gl2 = 515; p = 0.001), and Barthel (F = 6.0; gl1 = 2; gl2 = 509; p < 0.003)), and economic dependence (MMSE (t = 4.4; gl = 516; p < 0.001), RUDAS (t = 2.4; gl = 516; p = 0.015), Lawton (t = 3.7; gl = 423; p < 0.001), and Barthel (t = 2.7; gl = 383; p = 0.007)). No significant differences were found regarding the area of residence and home income.

3.2. Description of Cognitive and Functional Performance according to Medical History. Table 2 presents the cognitive and functional performance according to the presence of medical history. Hypertension was associated with MMSE (t = 3.0, df = 499, p = 0.003), RUDAS (t = 2.8, GL = 188, p = 0.005), and Yesavage (t = -2.0, df = 199, p = 0.047). Diabetes was associated with MMSE (t = 2.6, df = 496, p = 0.009), RUDAS (t = 2.2, df = 496, p = 0.027), and Barthel (t = 1.6, df = 23.6, p = 0.004). The presence of osteoporosis was associated with the scale of memory complaints (t = -2.8, df = 481, p = 0.006) and Barthel (t = 2.2, df = 481, p = 0.029). The correlation between the MMSE, RUDAS, Lawton, and Barthel with Yesavage was −0.257 (p < 0.001), −0.310 (p < 0.001), −0.183 (p < 0.001), and −0.233 (p < 0.001), respectively.

3.3. Relationship between General Cognitive Performance with Memory Complaints, Depression, Functional Scales, and Social Support. Table 3 presents the Pearson correlation coefficients between the MMSE and RUDAS with SMC, depression, functional scales, and social support. An
Inversely proportional correlation was observed in both scales regarding the scores related to subjective complaints of memory and depression. Additionally, a positive correlation was observed with the functional scales. Only the RUDAS showed significant correlation with MOS-SSS in its 4 dimensions and for the total scale.

3.4. Structural Model to Evaluate the Relationship between Demographic Conditions, Comorbidity, Social Support, and Its Relationship with Cognitive Profile and Functionality.

Figure 1 presents the structural model that represents the relationship between demographic conditions, comorbidity, social support, and its relationship with cognitive profile and functionality. Econ. Depend: economic dependency; MOS-SSS1: informational/emotional dimension; MOS-SSS2: instrumental dimension; MOS-SSS3: positive social interaction dimension; MOS-SSS4: affective support dimension; Demog Cond: demographic conditions; Psycho F: psychosocial factor; Comob: comorbidity; Cognit: cognition; Funct: functionality; HT: hypertension; DM: diabetes mellitus; Obes: obesity; COPD: chronic obstructive pulmonary disease; Osteop: osteoporosis; Dyslip: dyslipidemia; Nutr: nutritional status; SMC: subjective memory complaints.

This model explained 36.0% of the variability of functionality, 63.0% of the variability of cognitive profile, and 39.9% of the variability of comorbidity.

4. Discussion

Nowadays, the relevance of research in ethnic minorities has received more recognition. The scientific community has begun to consider ethnicity as a potential differentiating factor in the aging process. This increased interest in this subject could be explained by the disparity in terms of health and illness compared to other contexts [23]. Furthermore, it could be explained by the need to better understand the interaction of health determinants’ characteristics with this type of population given their ability to influence morbidity and mortality [24]. Thus, the aim of this study was to evaluate the demographic, medical, and psychosocial factors that affect global cognitive performance and functional activities in a group of indigenous older adults, using a multifactorial structural model of latent factors. The results of this study show a significant relevance of the aforementioned factors in cognitive and functional performance in the study group, evaluated through the multidimensional geriatric model.

Regarding the demographic factors, and specifically considering the education variable, it was evaluated based on the following categories: the person’s ability to read and write or the lack of such skills and the level of instruction in...
primary school. In the evaluated subjects, a minimum proportion of them reached primary education and illiteracy prevailed significantly. This situation is corroborated not only in indigenous contexts but also in rural communities, where poor infrastructure conditions, difficult geography, dispersed population, and armed conflict have led to educational vulnerability [25]. Thus, in Colombia, the percentage of illiterate people is 1.9%, while among indigenous people that percentage amounts to 3.7%, or approximately 30,000 individuals [26]. In relation to gender, a higher prevalence of the male sex is observed. This is a datum that differs from the common theoretical references, especially in rural and urban contexts. Usually, there is more convergence towards a greater incidence of the female gender, something also referred to as the “feminization phenomenon” of aging [27].

In relation to marital status, the data show a significant percentage of older adults who belong to the married category. About this, it could be argued that marriage becomes a protective factor for these people because it determines an individual’s main support network. Thus, with a partner, an individual’s perception of support in matters related to emotional and economic stability improves [28]. Concerning income, it was determined that most of the subjects evaluated do not receive income. This reality provides an important account about the difficult economic situation in which indigenous elderly adults live. This problem is exacerbated if one considers the precarious health and the deep social inequalities they face [29]. This issue has also been observed in older adult farmers where demographic determinants are precarious [30]. Therefore, the demographic profile of this population is characterized by situations of extreme vulnerability around health conditions, education, infrastructure, and basic services (e.g., water and health care).

At the level of cognitive performance, this was determined through the application of the Mini-Mental and RUDAS scales cognitive. The latter was used for its psychometric properties which decrease schooling bias towards the subjects to whom it is applied given that most test items do not require basic instruction. Similarly, a lower cutoff point was chosen compared to other population groups, like from the rural or urban context. Despite this, the studied population obtained a significantly lower average score than

| Table 1: Cognitive and functional performance according to the demographic characteristics of 518 indigenous senior citizens in the province of Nariño, Colombia. |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Variables         | Frequency | % | RUDAS Mean | SD | MMSE Mean | SD | SMC Mean | SD | Lawton and Brody Mean | SD | Barthel Mean | SD |
| Gender            |          |    |            |    |            |    |            |    |                  |    |                  |    |
| Female            | 231      | 44.6 | 20.2 | 5 | 23.2 | 5 | 22.6 | 10 | 6 | 2 | 97 | 7 |
| Male              | 287      | 55.6 | 20.4 | 4 | 21.2 | 5.4 | 24.5 | 9.7 | 6 | 2 | 96 | 7 |
| Age               |          |    |            |    |            |    |            |    |                  |    |                  |    |
| 60–65             | 130      | 25.1 | 22.4 | 4 | 24.5 | 4.3 | 22.5 | 9.5 | 7 | 1 | 98 | 5 |
| 66–70             | 149      | 28.8 | 20.7 | 4 | 22.3 | 5 | 23.1 | 10 | 6 | 2 | 97 | 6 |
| 71–75             | 111      | 21.4 | 20.3 | 5 | 21.8 | 5.4 | 25.1 | 9.8 | 6 | 2 | 96 | 8 |
| 76–80             | 78       | 15.1 | 18.4 | 5 | 20.7 | 5 | 24.4 | 10 | 6 | 2 | 96 | 6 |
| 80 or more        | 50       | 9.7  | 16.6 | 5 | 18.2 | 6.1 | 23.6 | 11 | 5 | 2 | 93 | 10 |
| Speaks native language |        |    |            |    |            |    |            |    |                  |    |                  |    |
| Yes               | 74       | 14.3 | 20.6 | 5 | 22.4 | 5.3 | 22.8 | 9.1 | 6 | 2 | 95 | 9 |
| No                | 444      | 85.7 | 20.2 | 5 | 22.1 | 5.4 | 23.8 | 10 | 6 | 2 | 97 | 7 |
| Schooling         |          |    |            |    |            |    |            |    |                  |    |                  |    |
| S/he cannot read/write |     |    |            |    |            |    |            |    |                  |    |                  |    |
| 208               | 40.2     | 18.5 | 5 | 18.8 | 5.1 | 23.9 | 10 | 6 | 2 | 96 | 9 |
| S/he can read/write | 249     | 48.1 | 21.6 | 5 | 24.5 | 4.2 | 23.5 | 9.5 | 6 | 2 | 97 | 6 |
| Basic primary education | 61 | 11.7 | 21.2 | 4 | 23.4 | 4.4 | 23.4 | 11 | 6 | 2 | 98 | 6 |
| Residence         |          |    |            |    |            |    |            |    |                  |    |                  |    |
| Rural             | 475      | 91.7 | 20.2 | 5 | 22.1 | 5.4 | 23.4 | 9.9 | 6 | 2 | 97 | 7 |
| Urban             | 42       | 8.3  | 20.8 | 5 | 22.3 | 5.3 | 26.2 | 9.9 | 6 | 2 | 97 | 5 |
| Income            |          |    |            |    |            |    |            |    |                  |    |                  |    |
| Without income    | 276      | 53.3 | 19.7 | 5 | 20.7 | 5.6 | 23.3 | 10 | 6 | 2 | 95 | 8 |
| Less to a LMMW*   | 237      | 45.8 | 20.9 | 5 | 23.6 | 4.6 | 24.2 | 9.6 | 6 | 1 | 98 | 8 |
| Between 1 and 3 LMMW* | 5   | 0.9  | 25.2 | 4 | 28.6 | 1.5 | 15.8 | 15 | 7 | 1 | 99 | 2 |
| Marital status    |          |    |            |    |            |    |            |    |                  |    |                  |    |
| Single            | 82       | 15.8 | 20.2 | 4 | 21.5 | 5.8 | 25.6 | 9.4 | 6 | 2 | 97 | 5 |
| Married/consensual union | 329 | 63.5 | 20.8 | 4 | 23.1 | 4.8 | 23 | 10 | 6 | 2 | 97 | 6 |
| Widowed/divorced  | 107      | 20.6 | 18.8 | 6 | 19.9 | 5.7 | 24 | 9.9 | 6 | 2 | 95 | 10 |
| Economic dependency |        |    |            |    |            |    |            |    |                  |    |                  |    |
| Yes               | 356      | 67.6 | 19.9 | 4 | 21.4 | 5.4 | 23.8 | 9.9 | 6 | 2 | 96 | 7 |
| No                | 162      | 32.4 | 21.4 | 4 | 23.6 | 4.9 | 23.4 | 9.9 | 7 | 1 | 98 | 6 |

*LMMW: legal minimum monthly wage in Colombia.
expected. This situation is corroborated in a report obtained in studying an indigenous population of Putumayo, Colombia [31], where 87% of the elderly presented mild cognitive impairment. Similarly, this type of data has been reported in more general rural contexts [27]. The above is argued based on the demographic characteristics of the population, where age represents a fundamental determinant in this type of performance in ethnic groups, whose gradual increase tends to decrease the ability to solve problems and process new information [32].

Likewise, gender is a significant factor in terms of cognitive functioning [33]. However, bibliographic references are still divergent on this issue. Traditionally, the existence of a differentiated profile is cognitively significant and can affect at cultural and functional levels [28].

Moreover, education is a variable that greatly affects cognitive performance. Low schooling could explain the substantial variation in cognitive test scores among different population groups [24]. In this way, the consensus is generally established that performance on low-educated individuals can result in two standard deviations below the normal average on the cognitive follow-up scales [33]. Indeed, such a situation was presented in the evaluated population where a percentage of them had basic primary education and in the worst case belonged to the illiterate category. Possibly, this situation can be explained due to schooling processes not consistent with their ethnic characteristics and cultural patterns, among others.

Further, in indigenous contexts, there is an increased risk of medical comorbidity characterized by the incidence of cardiovascular diseases and greater exposure to cardiometabolic risk factors, such as obesity, diabetes, and...
hypothesis is a greater risk of functional dependence. This argument is based on the increased prevalence of functional dependence and the impact of cognitive dysfunction in older adults. However, the results of the present investigation indicate otherwise. The above could be explained due to the agricultural work culture that women are immersed in. It is also clear that the armed conflict and colonization of these ethnic groups can have an important effect.

In another context, Early and colleagues argue that functional capacity is conditioned by multiple factors. In this sense, one of the most referenced variables in this type of research is gender. Apparently, women are more vulnerable to functional dependence attributed to their greater longevity in relation to men. The results of the present investigation indicate otherwise. The above could be explained due to the agricultural work culture that women have carried out and was an aspect evaluated in the investigation performed for a specific type of population, that is, indigenous older adults. In addition, it is the first study of this nature conducted in Colombia. Therefore, these findings allow an emotional exchange that leads to a structural and functional strengthening of this group.

5. Conclusion
In a group of older indigenous adults, conditions of extreme demographic vulnerability prevail, mainly in the field of cognitive and emotional state.
educational training. Likewise, depending on the medical comorbidity, there is evidence of the presence of hypertension, diabetes, and depressive symptoms among the adults. This profile affects and predisposes the indigenous elderly to clinical conditions such as cognitive impairment and dementia.

**Data Availability**

The university in which we work does not allow us to share the database.

**Conflicts of Interest**

The authors declare that they have no conflicts of interest.

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**Supplementary Materials**

Structural model was used to evaluate the relationship between demographic conditions, comorbidity, social support, and its relationship with cognitive profile and functionality. This model showed an adequate adjustment with an RMSEA index $= 0.042$ (CI 90% 0.036—0.047, CFI = 0.85, and TLI = 0.82). This model explains 36.0% of the variability of functionality, 63.0% of the variability of cognitive profile, and 39.9% of the variability of comorbidity. (Supplementary Materials)

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