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Oldest-old population in Colombia: A pilot study

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Abstract

Background: The population of elderly people in the world and in Colombia is growing. Thus, the population over 80 years of age has different needs and characteristics than the population of older people under 80 years of age. However, the information available for Colombia is limited, which merits its study for the design of intervention strategies at the clinical and social level.
Objective: To explore the sociodemographic, clinical, and cognitive characteristics of Colombia's oldest-old population and examine the relationship between cognition and frailty, a previously understudied group in a Colombian population from a genetic isolate.
Methods: We analyzed cognitive function (MMSE, CERAD-Col), physical frailty (Clinical Frailty Scale, gait speed, hand-grip strength), depression and anxiety screening (GAD-7, GDS) and functionality (FAST scale, Barthel, Katz and Lawton & Brody index) among individuals aged 80+ who were cognitively unimpaired at age 80. Statistical analyses included Spearman, Kruskal Wallis, and Mann-Whitney-Wilcoxon tests.
Results: Of the 89 participants (71 women), 52.8% were between 90-99 years old, and 16.9% were

over 99. The median Mini-Mental State Examination (MMSE) score was 23, and 65% had a Functional Assessment Staging (FAST) score between 1-3. Higher cognitive performance (MMSE) was correlated with lower frailty ($p<0.001$), and higher FAST scores associated with more fragile states ($p<0.001$), lower gait speed ($R=-0.36$, $p=0.042$), and lower grip strength ($R=-0.34$, $p=0.026$). **Conclusion:** This study describes a group of older adults aged 80 years and shows, as expected, an association between physical frailty and cognitive impairment. However, some individuals exhibited high levels of frailty without corresponding cognitive decline, indicating a potential dissociation between physical and cognitive health in these oldest-old subgroups. The observed dissociation between physical frailty and cognitive decline in some individuals warrants further investigation into protective factors and mechanisms underlying this phenomenon. Studies focusing on biomarkers and genetic factors should account for this possible disconnection to better understand healthy aging in the oldest old population.

Research in context

Similar to trends observed across Latin America, Colombia is experiencing a progressive increase in its elderly population. However, Colombia's unique ethnic, cultural, and geographic diversity necessitates a specific focus on studying the characteristics of its oldest-old population. This detailed examination is crucial for identifying specific needs and phenotypes, which in turn will facilitate the generation of hypotheses regarding risk factors, protective factors, and the development of targeted interventions designed to address the unique challenges and opportunities within this population.

Introduction

With the aging of the world's population, diseases of advanced adult onset, such as dementia due to Alzheimer's, have led to an increased interest in dementia prevention and the promotion of healthy aging.[1, 2]

Successful aging is described as a multidimensional concept that brings together biological, medical, and psychosocial factors contributing to an active, productive, and healthy old age.[3] This holistic vision has advantages, as it allows focusing on protective interventions across different levels of care to achieve more desirable outcomes for the aging population.[4] However, characterizing this holistic approach presents significant challenges due to the scarcity of objective measures. An alternative perspective focuses on the medical and biological variables of successful aging, including functionality, longevity, protection against specific risk factors, and other indicators.[5]

The study of the oldest-old is important for highlighting the segment of the elderly population that has reached advanced ages, a group that is becoming increasingly prevalent. Many authors refer to the population aged 80 years or older (i.e., at the peak of the population pyramid) as the oldest-old.[6, 7, 8]

Another relevant concept in the aging population is frailty. Frailty has been defined as a clinical condition associated with aging, characterized by a loss of functional capacity, which reflects a reduced ability to recover from homeostatic stressors, and has been associated with falls, disability, dependence, and death.[9, 10] Multiple scales to assess frailty have been developed and validated across different populations.[11]

The SABE (Health, Wellbeing, and Aging) survey, a cross-sectional study conducted in 2014-2015, studied the Colombian population aged 60 and over. With this information, a frailty prevalence of approximately 18 % has been estimated. Some factors associated with the frailty status included increased age, female sex, rural residence, low education level, multiple comorbidities, insufficient current income, among others.[12]

Recently, the Neuroscience Group of Antioquia (GNA, for its name in Spanish), based in Medellín, Colombia, identified protective genetic factors for high-penetrance genetic diseases such as Autosomal Dominant Familial Alzheimer's disease, caused by PSEN1-E280A.[13, 14] Following this methodology, we designed a pilot study to explore factors related to the successful aging of the Colombian population, with the goal of developing a future cohort to study genetic and environmental factors that influence healthy aging.

Thus, this study aimed to describe the sociodemographic, clinical, and neuropsychological features of a group of patients assessed as part of a study of the oldest-old. We also aimed to compare selected clinical and neuropsychological data with frailty parameters.

Methods

Study design, participants and settings

This is a cross-sectional study. Inclusion criteria were as follows: All participants were Colombian individuals over 80 years of age who, regardless of their cognitive status at the time of their first evaluation, could be ascertained to have been cognitively unimpaired up to 80 years of age. These criteria were established through historical reconstruction with the participants and at least one close person (family member/friend/caregiver) during a semi-structured medical assessment. No individuals were excluded.

Participants were recruited by snowball sampling. To determine cognitive status, each participant, accompanied by a close person, underwent neurological and neuropsychological assessments either at home or at the Neuroscience Group of Antioquia research facilities. Home-based assessments were conducted when participants faced functional or social difficulties that limited their ability to travel to the clinic, or when explicitly requested by the patient or their family.

Study size and missing data

A sample size of 89 participants was defined for the general description. This number corresponds to the total number of evaluations carried out during the first year of recruitment. Subgroup analyses were performed for specific tests due to variability in the completeness of the dataset. Reasons for missing data included the inability to complete the assessment due to patient-reported fatigue or the unavailability of measurement instruments during home visits, such as the dynamometer or the 4-meter walking track.

Variables and measurements

All participants underwent a semi-structured medical assessment, during which personal and family history, as well as cognitive, behavioral, sensory-perceptual, and affective complaints reported by the participants or their close relatives were recorded. In addition, all participants underwent a neuropsychological assessment conducted by neuropsychologists experienced in working with the dementia population, using a standardized test battery.[15]

Social and demographic variables included age at the time of assessment, years of education, number of years of repeated education, and area of residence. Socioeconomic status was defined according to the Colombian housing classification system, which is ranked from 1 to 6 by the National Administrative Department of Statistics ("DANE").[16]

1. Cognitive assessment

The battery of neuropsychological tests administered to this population included the original Mini-Mental State Examination (MMSE) test[17] and the CERAD-Col neuropsychological battery test adapted for the Colombian population.[18]

2. Clinical and functional assessment

We used the Yesavage's geriatric depression screening scale[19] and the 7-items Generalized Anxiety Scale (GAD-7)[20] to explore symptoms of depression and anxiety, respectively. And functional assessment included the Functional Assessment Staging scale (FAST), the Lawton & Brody functional assessment scale, and the Barthel Index.[15]

3. Frailty assessment

The 4-meter walking speed (WS) was measured on a 6-meter walking track.[21] Participants were asked to walk at their usual pace, and timing began after the first meter was completed. Timing was conducted by the evaluating physician using a stopwatch capable of measuring milliseconds. Two measurements were taken, and the shorter time was selected.

For the dominant and non-dominant hand grip strength (HGS), the participants were first instructed using visual and verbal examples. Then, they were asked to position the hand at a 90° angle, with fingers two to five resting on the pressure handle, while the thumb was placed on the static bar.

The participants were asked to make three attempts with each hand while receiving repeated verbal commands during the measurement. Finally, the highest value recorded for each hand was retained. All measurements were made with the same dynamometer (Baseline® Digital Smedley Dynamometer).

The Clinical Frailty Scale (CFS)[22] was calculated retrospectively by reviewing information on functionality and quality of life in the medical record and neuropsychological functionality tests.

The motoric cognitive risk syndrome was identified in participants with an average score of 20 or higher on the memory complaint scale (based on both patient and caregiver reports), and a gait speed of less than 0.45 m/s.[23]

Statistical methods

For the statistical analysis, data were presented using absolute and relative measures. For our bivariate analysis, frailty (measured by the CFS, HGS, and WS) was considered the dependent variable. As numerical variables had non-parametric distribution, groups were compared using the Kruskal-Wallis test and the respective Mann-Whitney-Wilcoxon tests for independent samples in case of comparison between categorical-continuous variables. Spearman correlations were calculated to assess relationships between continuous variables. Data were processed using R version 4.3, and a cut-off point of $p<0.05$ was defined for statistical significance.

As a secondary analysis, differences in neuropsychological tests and clinical variables were explored by grouping levels of frailty into two categories according to the CFS: 1–4 (ranging from fit to very mild frailty) and >4 (living with mild frailty or more). In addition, based on the initial results and for exploratory purposes, the same variables were examined within the subgroup with mild frailty or greater, separated by FAST scale 1–3 and >3.

Results

A total of 89 adults were evaluated (71 women and 18 men), and the majority of this group were between 90 and 99 years old (52.8 %). Half of the participants had five years of formal education or less. In addition, most lived in an urban area (88 %) and had a middle income by Colombian standards (level 3 or 4 based on the Colombian socioeconomic stratification) (43 %) (Table 1).

Table 1. Sociodemographic variables.

	Female (N=71)	Male (N=18)	Overall (N=89)
Age			
Mean (SD)	92.4 (6.24)	92.4 (8.23)	92.4 (6.64)
Groups of age			
80-90	20 (28.2 %)	7 (38.9 %)	27 (30.3 %)
90-99	40 (56.3 %)	7 (38.9 %)	47 (52.8 %)
>99	11 (15.5 %)	4 (22.2 %)	15 (16.9 %)
Site of the clinical assessment			
Home visit	56 (78.9 %)	13 (72.2 %)	69 (77.5 %)
Office	15 (21.1 %)	5 (27.8 %)	20 (22.5 %)
Years of education			
Median [Q1, Q3]	5.00 [3.00, 8.50]	4.50 [1.00, 11.8]	5.00 [3.00, 10.0]
Number of years of education repeated			
0	67 (94.4 %)	18 (100 %)	85 (95.5 %)
1	3 (4.2 %)	0 (0 %)	3 (3.4 %)
3	1 (1.4 %)	0 (0 %)	1 (1.1 %)
Dominant hand			
Right	69 (97.2 %)	18 (100 %)	87 (97.8 %)

Left	2 (2.8 %)	0 (0 %)	2 (2.2 %)
Socioeconomic status			
Low	15 (21.1 %)	6 (33.3 %)	21 (23.6 %)
Middle	33 (46.5 %)	5 (27.8 %)	38 (42.7 %)
High	19 (26.8 %)	7 (38.9 %)	26 (29.2 %)
Missing	4 (5.6 %)	0 (0 %)	4 (4.5 %)
Living area			
Urban	64 (90.1 %)	14 (77.8 %)	78 (87.6 %)
Rural	2 (2.8 %)	4 (22.2 %)	6 (6.7 %)
Missing	5 (7.0 %)	0 (0 %)	5 (5.6 %)

The median MMSE score was 22 for women and 24.5 for men; 25 % of the sample had a score of 26 or higher (Table 2). For all tests, at least 50 % of the population obtained scores within two standard deviations of the mean according to the reference population, except for the TMT-A, for which more than 50 % of the participants took more than 180 seconds to complete the test, the threshold at which the test is suspended (Supp. Table 1).

Table 2. Mini-Mental State Examination, functional, depression, and anxiety scales.

	Female (N=71)	Male (N=18)	Overall (N=89)
MMSE			
Median [Q1, Q3]	22.0 [18.0, 25.8]	24.5 [19.5, 27.0]	23.0 [18.0, 26.0]
Missing	1 (1.4 %)	2 (11.1 %)	3 (3.4 %)
Geriatric Depression Scale /15			
Non-depressed (0-4)	53 (74.6 %)	13 (72.2 %)	66 (74.2 %)
Mild depression (5-8)	7 (9.9 %)	1 (5.6 %)	8 (9.0 %)
Moderate depression (9-11)	1 (1.4 %)	0 (0 %)	1 (1.1 %)
Missing	10 (14.1 %)	4 (22.2 %)	14 (15.7 %)
Generalized Anxiety Disorder (GAD-7) scale			
No anxiety (0-4)	38 (53.5 %)	11 (61.1 %)	49 (55.1 %)
Mild anxiety (5-9)	12 (16.9 %)	2 (11.1 %)	14 (15.7 %)
Moderate anxiety (10-14)	6 (8.5 %)	0 (0 %)	6 (6.7 %)
Severe anxiety (15-21)	3 (4.2 %)	0 (0 %)	3 (3.4 %)
Missing	12 (16.9 %)	5 (27.8 %)	17 (19.1 %)
FAST scale			
1-3	45 (63.4 %)	13 (72.2 %)	58 (65.2 %)
4-6	21 (29.6 %)	3 (16.7 %)	24 (27.0 %)
>6	5 (7.0 %)	2 (11.1 %)	7 (7.9 %)
Missing	2 (2.7 %)	0 (0 %)	2 (2.2 %)

Barthel index /50			
Median [Q1, Q3]	50.0 [50.0, 50.0]	50.0 [50.0, 50.0]	50.0 [50.0, 50.0]
Missing	1 (1.4 %)	0 (0 %)	1 (1.1 %)
Katz index /6			
Median [Q1, Q3]	0 [0, 0]	0 [0, 0]	0 [0, 0]
Lawton & Brody scale /8			
Median [Q1, Q3]	8.00 [4.50, 8.00]	8.00 [5.75, 8.00]	8.00 [5.00, 8.00]

Of 70 individuals who responded to the self-reported and significant-reported memory complaints scale, 30 (43 %) had a difference greater than 10 points between the patient and their significant other. In 16 cases, patients rated themselves better, and in 14 cases, worse. Depression and anxiety screening scores were predominantly low (74 % not depressed, 72 % with no or mild anxiety). In addition, 65% had a FAST scale score between 1 and 3 (cognitively unimpaired or mild cognitive impairment), and more than 75% of individuals had a Barthel index score of 50 and a Katz index score of 0, suggesting preservation of basic daily life activities. 50 % had a Lawton & Brody index score of 8, suggesting preservation of instrumental daily life activities (Table 2).

Of the 72 individuals who had all the information to calculate their score based on the Clinical Frailty Scale, 31.5 % were between 3 and 4 points (no to very mild frailty), followed by 5-6 points (28 %) and >6 points (16 %). The median dominant hand grip strength was 16 kg for women and 19.8 kg for men. The median gait speed was 0.83, and 2 % had criteria for motoric cognitive risk syndrome (2/59) (Table 3).

Table 3. Frailty measures.

	Female (N=71)	Male (N=18)	Overall (N=89)
Clinical Frailty Scale score			
1-2	4 (5.6%)	1 (5.6%)	5 (5.6%)
3-4	19 (26.8%)	9 (50.0%)	28 (31.5%)
5-6	25 (35.2%)	0 (0%)	25 (28.1%)
>6	10 (14.1%)	4 (22.2%)	14 (15.7%)
Missing	13 (18.3%)	4 (22.2%)	17 (19.1%)
Hand grip strength (dominant hand) kg			
Median [Q1, Q3]	16.0 [10.3, 18.5]	19.8 [18.2, 22.8]	16.1 [12.6, 18.9]
Missing	35 (49.3%)	11 (61.1%)	46 (51.7%)
Cutoff point*	8.6	4.9	NA
Hand grip strength (non-dominant hand) kg			
Median [Q1, Q3]	15.0 [11.3, 17.3]	18.0 [15.5, 21.2]	15.0 [11.9, 17.8]
Missing	34 (47.9%)	11 (61.1%)	45 (50.6%)
Gait speed in 4m (m/s)			
Median [Q1, Q3]	0.72 [0.50, 0.97]	1.37 [1.02, 1.38]	0.83 [0.53, 1.09]

Missing	44 (62.0%)	13 (72.2%)	57 (64.0%)
Cutoff point**	0.43	0.45	NA
Motor cognitive syndrome			
No	46 (64.8%)	11 (61.1%)	57 (64.0%)
Yes	2 (2.8%)	0 (0%)	2 (2.2%)
Missing	23 (32.4%)	7 (38.9%)	30 (33.7%)

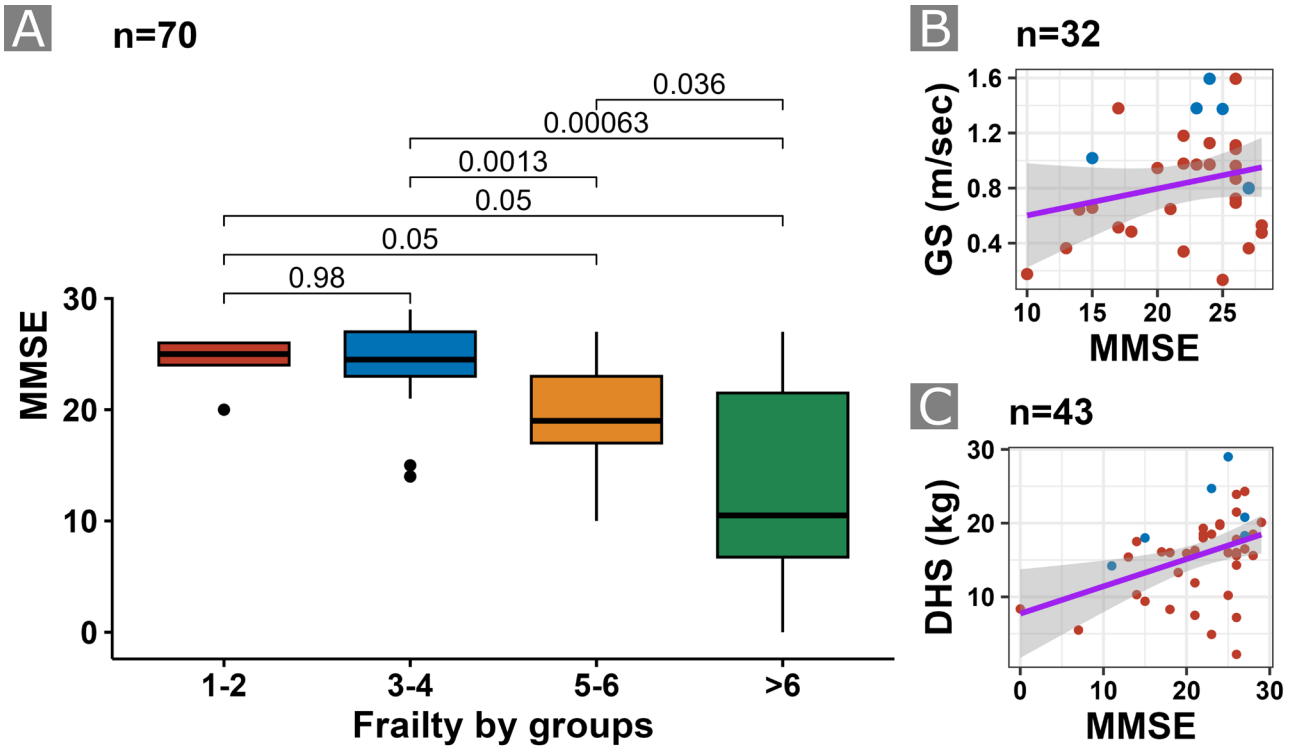
* Weak handgrip cutoff values by sex in 85 years of age or older Colombians.[24]

** Gait speed cutoff values by sex in 80 years of age or older Colombians.[25]

We found that there were statistical differences in multiple comparison tests when comparing the MMSE scores with the CFS frailty groups ($p < 0.001$). The greatest differences were found in the groups of five to six points and more than six in frailty, which is associated with low MMSE. This difference is evident both in lower MMSE values and in greater dispersion of the data (Figure 1A). No association was found between gait speed and MMSE score. In addition, there was a statistically significant tendency for dominant hand grip strength to decrease as MMSE performance decreased ($p = 0.006$). However, at higher MMSE values, greater heterogeneity in dominant hand grip strength was apparent (Figures 1B and 1C).

Figure 1. Correlation between MMSE total score and frailty measures.

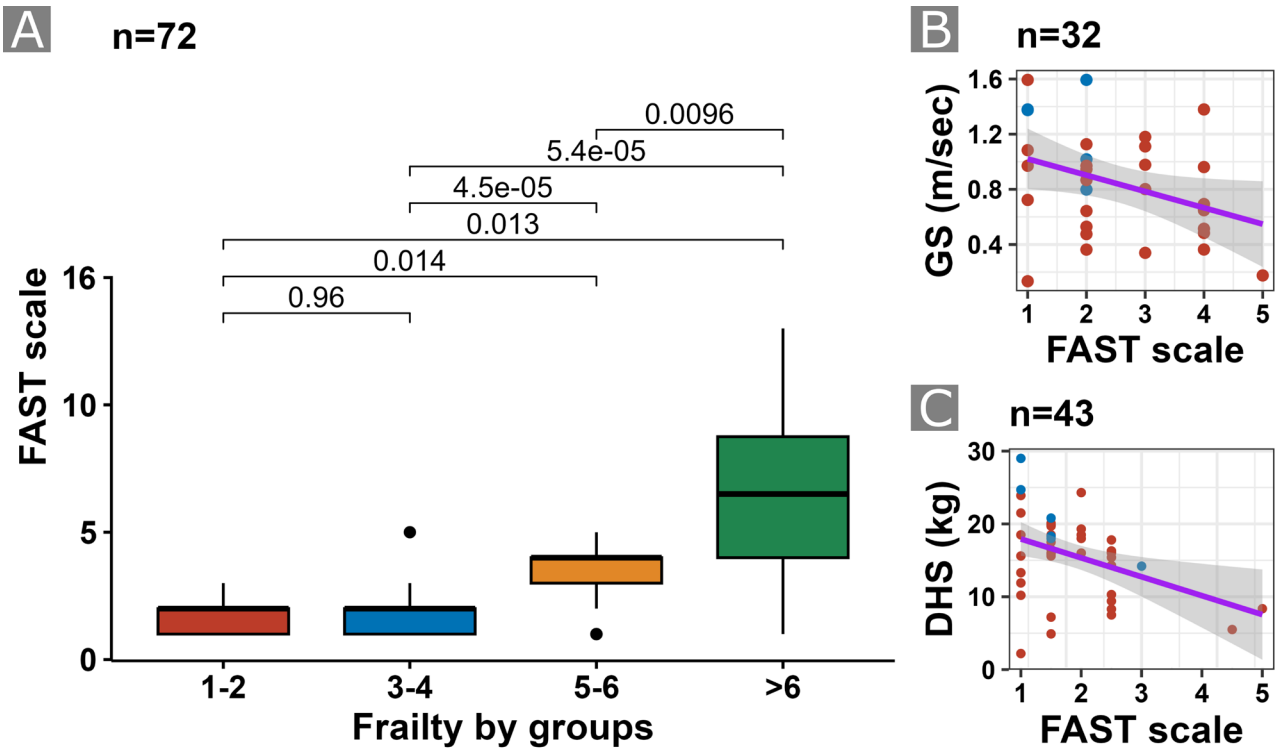
A) Clinical Frailty Scale by groups (K–W $p < 0.001$). **B)** Gait speed (GS) ($R = 0.24$, $p = 0.18$). **C)** Grip strength in the dominant hand (DHS) ($R = 0.4$, $p = 0.006$). Dots in B and D are colored by sex (red=women, blue=men).



When comparing the FAST scale scores with the CFS frailty groups, we found that there were statistical differences in multiple comparison tests ($p < 0.001$). When analyzing by groups, the most pronounced differences were found in the groups of five to six points and more than six. This difference is evident both in higher FAST scale scores and greater dispersion of the data (Figure 2A). In the comparison between gait speed and FAST scale score, the maximum value of the latter was 5/16; however, there was a negative and statistically significant correlation ($R = -0.36$; $p = 0.04$), as well as for the comparison with grip strength in the dominant hand ($R = -0.34$; $p = 0.03$) (Figures 2B and 2C).

Figure 2. Correlation between FAST scale and frailty measures.

A) Clinical Frailty Scale by groups (K–W $p < 0.001$); **B)** Gait speed (GS) ($R = -0.36$, $p = 0.042$); **C)** Grip strength in the dominant hand (DHS) ($R = -0.34$, $p = 0.026$). Dots in B and D are colored by sex (red = women, blue = men).



1. Comparison by levels of grouped fragility

When exploring differences between individuals with CFS scores of 1–4 (from fit to very mild frailty) and CFS >4 (mild frailty or more), the neuropsychological tests showed statistically significant differences in all tests except for the TMT-A time (Supp. Table 2). For the clinical variables, no differences were found between scores on the depression (GDS) or anxiety (GAD–7) scales.

As expected, there was a statistically significant difference ($p < 0.001$) in the scores on the FAST scale, with stages 1–3 predominating in the CFS 1–4 group (97 %) compared to the CFS > 4 group (31 %) (Supp. Table 2).

Additionally, when comparing the memory complaint scale, there is no difference between both groups for the self-reported scale ($p = 0.909$), while there is a statistical difference between the CFS 1–4 and CFS > 4 groups ($p < 0.001$; median [Q1, Q2]: 13.0 [8.0, 19.0] and 26.5 [17.3, 35.5] respectively).

2. Mild frailty or more separated by FAST scale

Of all the individuals grouped as having mild frailty or more (n = 39), 31 % were classified as having FAST scores of 1–3 (from aging without complaint to mild cognitive impairment) and the rest with a FAST score of 4 or more (dementia). When comparing the variables in these two groups, those with FAST 1–3 showed a lower mean age (93.7 ± 6.8 vs. 96.4 ± 6.4), a higher median education level (7.0 [3.0, 11.3] vs. 5.0 [3.0, 8.5]) and a better performance in most of the neuropsychological tests, except for TMT-A time, as both groups reached the time limit.

Strikingly, while the median self-reported memory complaint is higher for the FAST 1–3 group than for FAST >4 (22.5 [9.3, 24.0] vs. 14.0 [9.5, 26.0]) this trend is reversed for caregiver memory complaints (11.0 [5.8, 16.3] vs. 31.0 [25.0, 39.5]).

Discussion

This study aimed to describe the sociodemographic, clinical, and neuropsychological features of a group of patients assessed in an oldest-old study. According to the literature reviewed, this is the first cohort of oldest-old adults with successful aging in Colombia.

One of the main difficulties in studying this population is the variability of methodological criteria for choosing the population of interest and the comparison groups.[26] In this case, subgroups were created within the cohort of interest, as presented above, to analyze specific tests.

The relationship between frailty and cognition has been described in different studies, mostly in the elderly, showing a greater possibility of developing cognitive impairment in those classified as frail.[27]

Previous studies have shown that higher levels of frailty are predictors of cognitive impairment in the elderly population.[21] In addition, having cognitive impairment also exposes individuals to an increased risk of physical frailty.[22] In our study, the association between frailty measured by the Clinical Frailty Scale and the MMSE would favor this correlation.

More recently, other concepts such as cognitive frailty have gained relevance. Cognitive frailty has been used to describe the simultaneous presence of frailty and cognitive impairment without dementia. From this, it has been identified that these individuals have a higher risk of adverse health outcomes like death, disability, hospitalization, and dementia.[28]

However, in our cohort, some subjects exhibited high levels of frailty while maintaining preserved cognitive function. This raises the possibility of a subgroup of individuals with a dissociation between physical and cognitive health. Additionally, it is especially striking that, when comparing memory complaints within the frailty group, those with better functionality and cognitive status showed higher scores in self-reported complaints but lower scores in those reported by the caregiver.

There are many ways to measure frailty in the elderly population. For this, several scales exist, such as the CFS which we used in this study, but isolated measures have also been used (mostly physical) such as gait speed and handgrip strength.[29, 30, 31]

Although our population was older, near 50 % of men had hand grip strength values below the 25th percentile reported in Colombian populations aged 80-84 years (P25: 15.7 kg), while more than 75 % of women had hand grip strength values above the respective value (P25: 9.6 kg).[24] Previously, Ching-Yi Wang and Li-Yuan Chen explored the test-retest reliability of hand grip strength in Taiwanese community-dwelling older adults, and they identified 18.5 and 28.5 kg as the cutoffs for strength needed to manage heavy tasks in women and men, respectively.[32]

Al Snih et al.[33] reported a population-based sample of 2,488 Mexican-American individuals aged 65 or older, with an average handgrip strength of 28.4 kg ± 9.5 in men and 18.2 kg ± 6.5 in women. Here, 38.2 % of men and 41.5 % of women with a handgrip strength less than 22.01 kg and 14 kg, respectively, had died 5 years later. However, less than 6 % of the population of this study were 85 years old or more.[33]

More than 75% of our population had a handgrip strength below 19 kg. This is relevant because literature about cut-off points of hand strength in the oldest-old population and its relation with other outcomes is scarce. Also, our results showed a significant negative correlation between FAST scale score and grip strength. Although those with higher FAST scale scores have uniformly lower grip strength, individuals with FAST 1 and 2 have high variability in grip strength.

Based on the above, we hypothesize that, unlike what is expected in the average older adult population, there is a group of the oldest old who have limitations and physical wear and tear with relative cognitive stability that allows them to maintain their functionality despite their frailty.

The major limitation of this study is the relatively small sample size and the heterogeneity of missing data accross variables, for the reasons previously described. This limitation also constrained the analysis related to the motoric cognitive risk syndrome variable. Additionally, the predominance of women over men limits the study across sexes.

Additionally, the small number of participants required us to categorize frailty states into few groups that encompass a broad clinical spectrum within what would be considered the levels of frailty. While this approach was chosen to facilitate understanding, the heterogeneity of individuals within each group may affect the interpretation of results. Another important limitation is that snowball sampling prevents drawing conclusions across groups with different demographic characteristics, such as sex differences, due to its lack of external validity.

Unlike most studies of successful aging that take cohorts of older adults in general, this study applied more stringent inclusion criteria, including the exclusion of non oldest-old elders. For this reason, we hypothesize that our population is more likely to elucidate common protective factors.

Conclusion

This pilot study describes the first cohort of Colombian oldest-old individuals with successful aging, both cognitively healthy and cognitively impaired. Our results emphasize the need to investigate the factors influencing healthy aging, especially the physical and cognitive variables that may play a protective role. Future research exploring the genetic and environmental factors linked to successful aging will need to implement specific genetic and cognitive screening criteria that are

sensitive to the unique challenges that come with advanced age. Furthermore, our findings suggest a potential dissociation between physical frailty and cognitive decline in some oldest-old individuals, a hypothesis that warrants further investigation.

Conflicts of interest

The authors declare no potential conflicts of interest.

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Authors' contributions

- **Daniel Vasquez:** Conceptualization, Formal Analysis, Investigation, Methodology, Validation
- **Liliana Hincapie:** Investigation, Project Administration
- **Yesica Zuluaga:** Investigation
- **Manuela Arcila Ortiz:** Investigation
- **Ana Baena:** Investigation
- **Lucia Madrigal:** Investigation
- **Margarita Giraldo:** Investigation
- **Yakeel T. Quiroz:** Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Validation
- **Francisco Lopera:** Conceptualization, Funding Acquisition, Investigation, Methodology, Supervision
- **Joseph Arboleda-Velasquez:** Conceptualization, Formal Analysis, Funding Acquisition, Methodology, Validation
- **David Aguillon:** Conceptualization, Data Curation, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Writing (Original Draft Preparation), Writing (Review & Editing)

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Supplementary figures

Supplementary Table 1. Neuropsychological tests by sex and normative data.

	Female (N=71)	Male (N=18)	Overall (N=89)	Ref. * mean (SD) [-2 SD]
MMSE				
Median [Q1, Q3]	22.0 [18.0, 25.8]	24.5 [19.5, 27.0]	23.0 [18.0, 26.0]	28.4 (3.2)
Missing	1 (1.4%)	2 (11.1%)	3 (3.4%)	[22.1]
Animal fluency				
Median [Q1, Q3]	10.0 [6.25, 13.0]	10.0 [6.00, 12.0]	10.0 [6.00, 13.0]	17 (4.9)
Missing	1 (1.4%)	1 (5.6%)	2 (2.2%)	[7.3]
Word list learning test (number of correct words) /30				
Median [Q1, Q3]	10.0 [7.00, 13.0]	10.0 [8.00, 12.0]	10.0 [7.25, 13.0]	16.1 (3.6)
Missing	2 (2.8%)	1 (5.6%)	3 (3.4%)	[8.9]
Word list learning test (recall) /10				
Median [Q1, Q3]	2.00 [0, 3.00]	2.00 [1.50, 3.00]	2.00 [1.00, 3.00]	5.3 (1.8)
Missing	5 (7.0%)	3 (16.7%)	8 (9.0%)	[1.7]
TMT-A time				
Median [Q1, Q3]	180 [139, 180]	179 [124, 180]	180 [137, 180]	83.3 (44.7)
Missing	23 (32.4%)	4 (22.2%)	27 (30.3%)	[172.7]
Phonemic Fluency (FAS)				
Median [Q1, Q3]	21.0 [10.0, 26.3]	23.0 [19.0, 33.0]	21.0 [13.0, 28.0]	26.1 (13.0)
Missing	13 (17.8%)	5 (27.8%)	18 (19.8%)	[0.1]

* = Normative data in Colombian individuals with >65 years of age (Torres VL, Vila-Castelar C, Bocanegra Y, et al. Appl Neuropsychol Adult. 2021 Mar 4;28(2):230–44.).

Supplementary Table 2. Neuropsychological tests and clinical scales by grouped CFS.

	Clinical Frailty Scale categorized		
	From fit to very mild frailty (1 to 4) (N=33)	Living with mild frailty or more (> 4) (N=39)	*p-value*
MMSE			
Median [Q1, Q3]	25.0 [23.0, 26.0]	18.0 [13.0, 23.0]	< 0.001
Missing	0 (0%)	2 (5.1%)	
Animal fluency			
Median [Q1, Q3]	13.0 [10.0, 15.0]	8.00 [4.00, 11.0]	< 0.001
Missing	0 (0%)	2 (5.1%)	
Word list learning test (number of correct words) /30			

Median [Q1, Q3]	11.0 [9.00, 14.0]	8.00 [6.00, 10.0]	< 0.001
Missing	0 (0%)	3 (7.7%)	
Word list learning test (recall) /10			
Median [Q1, Q3]	3.00 [2.00, 4.00]	1.00 [0, 2.00]	< 0.001
Missing	1 (3.0%)	7 (17.9%)	
TMT-A time			
Median [Q1, Q3]	178 [114, 180]	180 [167, 180]	0.047
Missing	5 (15.2%)	20 (51.3%)	
Phonemic Fluency (FAS)			
Median [Q1, Q3]	24.5 [16.8, 34.0]	19.5 [9.25, 23.0] 0.037	0.037
Missing	1 (3.0%)	13 (33.3%)	
Self-reported memory complaints scale			
Median [Q1, Q3]	17.5 [9.75, 24.0]	16.0 [9.00, 24.5]	0.909
Missing	1 (3.0%)	12 (30.8%)	
Significant-reported memory complaints scale			
Median [Q1, Q3]	13.0 [8.00, 19.0]	26.5 [17.3, 35.5]	< 0.001
Missing	3 (9.1%)	1 (2.6%)	
Yesavage's geriatric depression screening scale (GDS)			
Non-depressed (0-4)	31 (93.9%)	22 (56.4%)	0.084
Mild depression	1 (3.0%)	5 (12.8%)	
Moderate depression	0 (0%)	1 (2.6%)	
Missing	1 (3.0%)	11 (28.2%)	
Generalized Anxiety Disorder (GAD-7) scale			
No anxiety	26 (78.8%)	15 (38.5%)	0.083
Mild anxiety	4 (12.1%)	5 (12.8%)	
Moderate anxiety	1 (3.0%)	3 (7.7%)	
Severe anxiety	0 (0%)	3 (7.7%)	
Missing	2 (6.1%)	13 (33.3%)	
FAST scale categorized			
1-3	32 (97.0%)	12 (30.8%)	< 0.001
4-6	1 (3.0%)	20 (51.3%)	
>6	0 (0%)	7 (17.9%)	
Barthel index /50			
Median [Q1, Q3]	50.0 [50.0, 50.0]	50.0 [50.0, 50.0]	0.023
Katz index /6			
Median [Q1, Q3]	0 [0, 0]	0 [0, 0]	0.022
Lawton & Brody scale /8			
Median [Q1, Q3]	8.00 [8.00, 8.00]	4.00 [0, 8.00]	< 0.001

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