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Clinical, functional, mental and social profile of the Nicoya Peninsula centenarians, Costa Rica, 2017

Fabian Madrigal-Leer[1] · Alvaro Martìnez-Montandòn[1] · Marielos Solìs-Umaña[1] · Faridy Helo-Guzmàn[1] · Kattia Alfaro-Salas[1] · Isabel Barrientos-Calvo[1] · Zianne Camacho-Mora[1] · Vanessa Jimènez-Porras[2] · Susana Estrada-Montero[1] · Fernando Morales-Martìnez[3]

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Abstract

Background In Latin America, knowledge about the demography and health status of adults aged 100 years and over is scarce. Insufficient studies of the elderly population in Costa Rica exist despite having a "Blue Zone" (geographical area with a high concentration of centenarians) in the Peninsula of Nicoya, with a high percentage of centenarians in the districts of Santa Cruz, Nicoya, Hojancha, Nandayure and Carrillo.

Aims To describe the clinical, functional, mental and social profile of centenarians residing in the Blue Zone of the Peninsula of Nicoya, Costa Rica.

Methods This is a cross-sectional study using a population base of 43 community-dwelling centenarians. A comprehensive geriatric assessment was performed, including sociodemographic information, health status, electrocardiogram and laboratory tests.

Results The mean age of centenarians was 101.93 years, of whom 18 (42%) were men and 25 (58%) women. Two (4.6%) resided in nursing homes. Women had worse results than men in the evaluation of dependence on basic and instrumental activities of daily living, and the short physical performance battery performance test. A high prevalence of low Vitamin D levels (87.3%), atrial fibrillation (9.3%) and visual impairment (46.5%) was found.

Conclusions This is the first study describing the medical, functional, mental and social profile of centenarians in the Peninsula of Nicoya (Blue Zone) in Costa Rica. This population has a high prevalence of malnutrition and hypertension with dependence on the basic activities of daily living, and a low prevalence for diabetes, depression, ischemic heart disease, chronic obstructive pulmonary disease, and polypharmacy.

Keywords Centenarians · Geriatrics · Gerontology · Quadri-functional approach · Blue zone

Introduction

The centenarian population is among those that are constantly growing at a rapid pace. There are existing reports of these population groups in Australia, China, Denmark, Greece, Italy, Switzerland, Portugal, United States of America, France, Canada and the United Kingdom [1–10]. Within developing countries, few reports of centenarians are known. In the Latin American region, sociodemographic studies have been published in Mexico and Cuba [11, 12].

Costa Rica's population is in an ongoing aging process. Even though Costa Rica is a medium-income country, it has good health indicators with an average life expectancy at birth of 80.2 years: 77.2 years for men and 82.3 years for

Madrigal Leer Fabián, Martínez-Montandón Álvaro, Solís-Umaña Marielos, Helo-Guzmán Faridy, Alfaro-Salas Kattia, Barrientos-Calvo Isabel, Camacho-Mora Zianne, Jiménez-Porras Vanessa, Estrada-Montero Susana, Morales-Martínez Fernando contributed equally.

✉ Fabian Madrigal-Leer
fundogen@gmail.com

[1] National Geriatric and Gerontology Hospital CCSS, San José, Costa Rica

[2] La Anexión Hospital CCSS, Nicoya, Costa Rica

[3] Faculty of Medicine, University of Costa Rica, San José, Costa Rica

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women [13]. It has the third-highest life expectancy in the American continent, placing it below Canada and Chile [14].

To date, there are 623 centenarians in Costa Rica [13, 15]. Most of this population resides in the province of San Jose. However, in 2005, the Costa Rica Longevity Study on Health and Well-being (CRELES) was carried out [16]. This study's objective was to determine life expectancy, quality of life and their causative factors in the elderly population of Costa Rica and it included a sample of 8000 subjects. When analyzing the population data, its authors became aware of the presence of a zone in the Nicoya Peninsula with an unusually high prevalence of centenarians (1:4322 vs 1:7541 in Costa Rica). This area was later defined as a "Blue Zone". Blue Zones are "limited areas with a high prevalence of centenarians, with rather homogeneous characteristics, life styles and environment." [17].

This Blue Zone, located in the Nicoya Peninsula, is in the province of Guanacaste. It represents a total population of 183,184 inhabitants and is composed of 5 municipalities: Santa Cruz, Carrillo, Nicoya, Nandayure and Hojancha.

There are only four other generally accepted Blue Zones throughout the world; the island of Sardinia in Italy, Okinawa in Japan, Ikaria in Greece and Loma Linda, California, USA [18].

Even though Costa Rica has this Blue Zone, there are no studies that clinically characterize the centenarians of the region, which is why the main goal of this study is to determine a profile based on a quadri-dimensional geriatric assessment describing their main medical, functional, mental and social characteristics.

Methodology

Localization of centenarians and age verification

An updated list of all centenarians of the Nicoya Peninsula was obtained through the latest census report held nationally by the National Institute of Statistics and Census (INEC) and the official electoral roll of the Supreme Electoral Tribunal [13, 15]. The addresses and health status were corroborated by means of field work. Ages of the centenarians were verified using social security reports for each municipality, birth and baptism certificates registered by the Catholic Church in the National Catholic Metropolitan Archives, the Family Search website [19] and national identity documents issued by the national civil registry.

Data collection

The data were collected over two visits made to each centenarian. In the first visit, done by two researchers, the informed consent was read and signed, and a thorough comprehensive geriatric assessment including anthropometric measurements and a 12-lead electrocardiogram was carried out. Data were collected directly from the centenarian in 32 cases (74%), with caregivers being allowed to comment on the answers, and indirectly from family caregivers in the remaining 11 cases (26%). All nine researchers who made the first visits were specialists in geriatrics and gerontology. The second visit was done by a microbiologist, and a clinical laboratory technician highly skilled in venipuncture. This visit's sole purpose was to collect the samples needed for laboratory assessment.

Measurement of variables

Sociodemographic variables

Age, gender, birthplace, civil status, religion, education level, residence, income, living conditions, basic services (clean drinking water, sewage, electricity, and garbage disposal) and economic activities were analyzed.

Pathological and non-pathological personal history

Each centenarian was asked about their history of the following diseases: hypertension, diabetes mellitus, lung disease, osteoarthritis, kidney and liver disease, thyroid disorders, cancer, Parkinson's disease, glaucoma, cataracts, peripheral arterial disease, dyslipidemia, constipation, anxiety and acid reflux disease. Their exposure to wood smoke, alcohol, tobacco and illicit drug use was also recorded.

Medication

All prescription as well as non-prescription medications, were thoroughly recorded. For this study, polypharmacy was defined as the concurrent use of five or more medicines.

Nutritional status

To assess their nutritional state, the Mini Nutritional Assessment (MNA®) [20] was used, where a score of 17 or less implies malnutrition, 17.5–23.5 is classified as nutritional risk, and those with scores of 24 and above are considered as having a good nutritional status [21].

Anthropometry

For the anthropometric measurements, the knee height was taken according to the Chumlea technique. This result permitted the estimation of overall height [22]. To obtain the weight, a portable weight scale (model WCS-410 Coney made in China) was used. For those unable to stand upright, the calculated weight was obtained by means of the Chumlea

formula [23]. With the data, every participant's body mass index (BMI), expressed in kg/m^2, was obtained.

Muscle strength

Muscle strength was assessed by measuring hand-grip strength with a Jamar hydraulic hand dynamometer (model 5030J1 made in United Kingdom). Grip strength was measured with participants in a sitting position, elbow in 90-degree flexion and wrist in neutral position. After three repeated measurements of the dominant hand's grip strength, the maximum measured grip strength was recorded as the grip strength, according to the validated protocol [24].

Functional tests

Physical performance

The short physical performance battery was used. This test consists of three components: balance; rising to standing from a chair then sitting, repeated five times; and gait speed [25].

Basic and instrumental daily living activities

To measure the functional performance level in basic activities, the Barthel Scale was used [26]. The Lawton Scale was used to measure performance in instrumental activities [27].

Falls risk

Falls risk was assessed from responses to interview questions. With that information, the Downton Scale score, which determines the risk of falls, was obtained for this population [28].

Visual and hearing impairment

The centenarian or the caregiver, as their representative, was asked about the existence of vision and hearing impairments.

Geriatric Depression Scale

The Geriatric Depression Scale is a screening tool designed especially for the elderly [29].

AD-8

AD-8 was designed as a brief questionnaire to screen for dementia. The questionnaire, given to a family member or other carer, is composed of eight questions that the interviewee is required to answer either yes, no or do not know. Only the affirmative answers are scored [30]. This questionnaire was given to 37 caregivers of study participants. For six participants, the caregivers were unable to complete the AD-8.

Cardiovascular parameters

Arterial blood pressures were taken by the researchers using Welch Allyn aneroid sphygmomanometers. Cardiac pulse and oxygen saturation were taken with a Veridian pulse oximeter (model No.11-50D).

A 12-lead electrocardiogram was performed in each subject at rest using automatic, portable Mortara electrocardiographs (model ELI 250) calibrated at 25 mm/s and 10 mm/mV. The electrocardiogram interpretations were carried out by two of the researchers following a previously established set of criteria.

Biochemical tests

The samples obtained for laboratory analysis were centrifuged to separate serum onsite at the visit, then placed in ice for transportation within an hour to the laboratory, where they were immediately frozen.

The following parameters were then analyzed: complete blood count, renal and liver function tests, blood glucose, HbA1C, electrolytes, lipid profile, thyroid-stimulating hormone (TSH), albumin, Vitamin D and B12 levels, as well as total and free testosterone in the male participants.

The blood counts were done at the Clinical Laboratory Unit of Hospital La Anexión, Nicoya, using a model Sysmex XT 1800i analyzer. A Siemens model Inmulite 2000 XPi was used for the hormonal analysis at the National Geriatrics and Gerontology Hospital, and for the biochemical tests, an AU 680 Beackman analyzer.

Ethics

The study protocol was reviewed and approved by the Scientific Ethical Committee of the National Geriatrics and Gerontology Hospital, and given the protocol register: CEC-09-2017. The study complied with all the requirements that the Ministry of Health of Costa Rica demanded. All participants gave written informed consent.

Statistical analysis

The statistical analysis was done using the Statistical Package for the Social Sciences (SPSS), version 22. Data were analyzed with descriptive statistics for all variables by calculating means and standard deviations. The comparison study of the means was carried out using factor variance analysis (ANOVA). Absolute values were established for the qualitative variables.

Results

Sociodemographic characteristics

All 43 centenarians in the Blue Zone participated, of whom 18 (42%) were men and 25 (58%) were women. The mean age was 101.93 years. Most of the participants were born in Guanacaste (36 participants), two were born in Alajuela, three in Puntarenas, one in San Jose and one in another country. Widowers predominated in marital status with 32 participants (74.4%), likewise followers of Catholicism predominated in identification with a religion with 37 participants (86%).

All the participants were 100% covered by the social security system. The main income was provided by the pension for 24 persons under the non-contributory regimen. In this scheme, the government entitles persons in condition of poverty who did not contribute to a pension system to approximately 135 US dollars per month.

Regarding literacy, 58.8% (11 men and 13 women) knew how to read and write, while 41.2% (7 men and 12 women) did not. Two participants lived in an institution, while 41 lived in their homes accompanied by their relatives. Refer to Table 1.

Mental health assessment

The Yesavage Geriatric Depression Scale could not be passed to 11 participants due to functional conditions (for example, advanced hearing loss or cognitive impairment). From the 32 participants who did the test, 30 recorded being satisfied with their lives. According to the scale, 20 participants were within normal limits, 12 participants were

Table 1 Sociodemographic characteristics of the interviewed centenarians by gender. 2017

Characteristic	Total		Male		Female	
	Number	%	Number	%	Number	%
Total	43	100.0	18	100.0	25	100
Age						
100	10	23.26	8	44.44	2	8.00
101	11	25.58	5	27.78	6	24.00
102	8	18.60	2	11.11	6	24.00
103	7	16.28	1	5.56	6	24.00
104	3	6.98	0	0.00	3	12.00
105	2	4.65	1	5.56	1	4.00
106	1	2.33	0	0.00	1	4.00
107	1	2.33	1	5.56	0	0.00
Birthplace						
San José	1	2.3	0	0.00	1	4.00
Alajuela	2	4.7	1	5.56	1	4.00
Guanacaste	36	83.7	14	77.78	22	88.00
Puntarenas	3	7	2	11.11	1	4.00
Other countries	1	2.3	1	5.56	0	0.00
Marital status						
Married	2	4.65	2	11.11	0	0.00
Widow/widower	32	74.42	12	66.67	20	80.00
Single	6	13.95	2	11.11	4	16.00
Free union	2	4.65	1	5.56	1	4.00
No response	1	2.33	1	5.56	0	0.00
Resided over 80 years in one place						
Yes	34	79.07	15	83.33	19	76.00
No	9	20.93	3	16.67	6	24.00
Religion/faith						
Catholic	37	86.05	14	77.78	23	92.00
Evangelical/Christian	4	9.30	3	16.67	1	4.00
No response	2	4.65	1	5.56	1	4.00

Source: clinical, functional, mental and social profile interview of the Nicoya Peninsula centenarians, Costa Rica, 2017

classified as having mild depression and 1 participant was classified as having clinical depression.

Using the AD-8 screening scale applied to the caregivers, of which there were 37, 6 participants, 5 men and 1 woman (14%), had no suspicion of cognitive decline. The 31 remaining participants had some possibility of cognitive decline.

Falls risk assessment

When analyzing the history of previous falls and the risk of falling in the centenarian population, 48.8% had no history of previous falls, which corresponded to 21 centenarians (8 men and 13 women). Included in this group were five participants who could not walk. The other 22 study participants recorded a history of having fallen at least once during the past year (51.2%).

Functional assessment

From the total group of centenarians, only five (four women and one man) were totally dependent for mobility, and could not walk or do transfers. Of those who could walk or sit in a chair, 60.5% used some mobilization device (15 men and 11 women). Regarding the ability to perform basic daily living activities, evaluated using the Barthel Scale, men presented a mean of 69.2 points (29.1 SD) and women showed a mean of 44.2 points (33.9 SD). As for the instrumental living activities (using the Lawton Scale), the mean was 1.4 points for men and 1 point for women. The short physical performance battery (SPPB) resulted in an average of 3 points for men and 1 for women with a mean of 1.9 (Table 2).

Table 2 Functional characteristics of the interviewed centenarians by gender

Scales	Total number	Male	Female
Barthel			
Total dependence	10	1	9
Severe	13	5	8
Moderate	15	9	6
Mild	3	1	2
Total independence	2	2	0
Lawton			
Total dependence	27	9	18
Severe	5	2	3
Moderate	7	4	3
Mild	3	2	1
Total independence	1	1	0
Short physical performance battery (SPPB)			
1. Balance testing			
Feet together			
Yes	8	6	2
No	35	12	23
Semi-tandem position			
Yes	4	3	1
No	39	15	24
Tandem position			
Yes	8	6	2
No	35	12	23
2. Stand from a chair			
Yes	10	8	2
No	35	12	23
Five repeated chair stands			
≤ 11.19 s	6	4	2
11.20–13.69 s	1	1	0
13.70–16.69 s	2	2	0
≥ 16.7 s	1	1	0
Unable to perform task	18	6	12
3. Gait speed			
> 13.04 s	24	13	11
Unable to perform task	19	5	14

Source: clinical, functional, mental and social profile of the Nicoya Peninsula centenarians, Costa Rica, 2017

Visual and hearing assessment

Of the total participants, 11 men and 13 women (55.8%) reported having good eyesight and were able to count fingers from a distance of 3 m, while the remaining 44.2% reported having diminished eyesight and were unable to perform the finger count.

Only 23.3% registered normal hearing as confirmed by their family, while the other 76.7% had differing degrees of hearing impairment, women being more affected than men.

Sleep pattern

The average number of sleeping hours per 24 h was 8.45, with a minimum of 5 h per night in men and 2 h in women, and a maximum of 14 h per night in men and 12 h in women.

Nutritional status

Twenty-three participants (16 women and seven men) presented with weight loss, having reported losing weight in the past 6 months according to the information obtained during the interview given to the centenarians or their proxies.

Six patients reported having poor appetites (two men and four women), while 31 centenarians stated they had a normal appetite. Sixteen centenarians described other problems with their food intake and 31 centenarians stated they had a normal appetite.

The average weight of male centenarians was 51.8 kg with a BMI of 22.0 kg/m^2, an arm circumference of 24.1 cm and a calf circumference of 29.9 cm. For women the

corresponding measures were 38.8 kg, 20.0 kg/m^2, 21.6 cm and 25.3 cm.

The nutritional status classification in the centenarians according to the Mini Nutritional Assessment was 12 participants with malnutrition (27.9%), 19 participants at nutritional risk (44.2%) and 12 participants (27.9%) in a good nutritional status.

Only 25 participants were able to perform the grip strength test. The mean result for men was 12.6 kg (5.48 SD) and 7 kg for women (3.41 SD).

Personal non-pathological history

Regarding smoking and alcohol intake, ten men (55.6% of the men) and four women (16% of the women) had smoked in the past, while 13 men (72.2% of the men) had taken alcohol at some moment in their life compared to three women (12% of the women). No consumption of illicit drugs was reported and only three participants (7%) were exposed to sugar cane harvest smoke. A total of 42 centenarians (97.7%) [18 males (100%), 24 females (96%)] were exposed to woodsmoke at some time in their lives.

Personal pathological history

The reported history of diseases is shown in Table 3.

Medications

It was found that the 43 centenarians were taking 48 different medications in total. Anti-hypertensives (calcium antagonists, angiotensin II receptor blockers and diuretics) were taken by 25 patients and were the most common drug group taken, while analgesics such as acetaminophen were second most commonly taken with nine patients using them.

Vital signals

The average systolic blood pressure was 122/63 mmHg for women in sitting position, and 124/62 mmHg in standing position; for men, 116/67 mmHg in sitting position, and 105/67 mmHg in standing position. The average radial pulse was 79.7 beats per minute in women, and 80.5 beats per minute in men. Of those who could do the orthostasis test, there was no significant results to report.

Table 3 Pathological history of the interviewed centenarians, by gender, Costa Rica, 2017

Pathology	Total number	Male	Female
Hypertension	24	9	15
Diabetes mellitus	5		5
Dyslipidemia	6	2	4
Hyperuricemia	2	1	1
Chronic obstructive pulmonary disease (COPD)	9	4	5
Parkinson's disease	1		1
[a]Tumors	3	2	1
Ischemic and hypertensive cardiopathy	4	2	2
Rheumatoid disease	0		0
Osteoarthritis	11	3	8
Depression	11	3	8
Anxiety	6	1	5
Liver disease	1	1	0
Venous insufficiency	6	1	5
Peripheral arterial disease	2		2
AIDS	0		0
Kidney disease	2	1	1
Hypothyroidism	1		1
Hyperthyroidism	0		0
Constipation	19	6	13
Acid reflux disease	8	3	5
Osteoporosis	4	1	3
Cataracts	29	10	19
Glaucoma	4	1	3

Source: clinical, functional, mental and social profile interview of the Nicoya Peninsula centenarians, Costa Rica, 2017

[a]Tumors: epiglottis, parotid (men), gastric (women)

Biochemical studies

The overall average level of Vitamin D in the centenarians was below normal: 49.05 nmol/L, with a higher mean for men (56.28 nmol/L) than women (43.39 nmol/L). According to laboratory parameters, the normal range established for the study was above 75 nmol/L.

The average levels of Vitamin B12 were 450.72 ng/mL for men and 478.61 ng/mL for women. One male patient recorded 70 ng/mL.

The mean for thyroid-stimulating hormone (TSH) was 3.33 mU/L for men and 2.61 mU/L for women.

The free testosterone level for centenarian men recorded a mean of 25.19 ng/dL.

The average blood glucose was 4.78 mmol/L, 5.5% for HbA1C, 12.8 g/dL for hemoglobin, 98.13 mmol/L for creatinine and 0.047 mmol/L for albumin.

12-Lead electrocardiogram

Only six (14%) of the 43 electrocardiograms carried out were considered normal, 28 (65%) had normal sinus rhythms while the most common arrhythmia was atrial fibrillation recorded in four (9.3%) of the cases. Conduction disorders were found in 35 (81.0%) of the participants.

Discussion

In this study, all data obtained from the 43 centenarians that reside in the Nicoya Peninsula Blue Zone were analyzed. An advantage of this study is that it included all the centenarians registered in the zone and did not rely on a sample group, albeit with the shortcoming of a small number of participants unrepresentative of the whole country. However, this is the first clinically and epidemiologically oriented study which incorporates a comprehensive geriatric assessment plus biochemical and electrocardiogram (EKG) analysis ever developed of a centenarian population in Latin America.

The Nicoya Peninsula includes one centenarian per 4322 inhabitants (23:100,000), in comparison to the rest of the country where the ratio is 13:100,000 persons [13]. This density is much higher than Mexico's (4.4:100,000), but much lower than Okinawa's, another Blue Zone, which has the world's highest centenarian density at 50:100,000 inhabitants. The mean age was 101.93 years; with four participants over the age of 105 years and none reported over the age of 110 ('Supercentenarian'), a finding similar to what has been documented for the Mexican population. The male to female ratio was 1:1.38 which differs from other studies in which females are more dominant (Okinawa, 1:1.9; Sydney, 1:2.4; Mexico 1:3.2) [1].

Most centenarians were born in the Nicoya Peninsula explaining the homogenous nature of their customs, such as eating habits, labor activities and general lifestyles. This is common among specific regional centenarian studies such as the Blue Zones but different to those centenarian studies where a larger region or number of countries were analyzed [17].

This study documented a very low percentage of institutionalized centenarians (two cases or 4.6%), compared to other studies where this finding is much higher, among them, Denmark (60%), Georgia, USA (56%), Portugal (29%) and Japan (32%) [6]. However, it is very similar to Mexico's (4.4%), probably reflecting more numerous and cohesive families, where women have a stronger role as caretakers and still remain at home more frequently than in more developed countries where they are more strongly incorporated into the workforce. Nursing homes in Costa Rica are also expensive, and most families cannot afford the costs; therefore, the Costa Rican institutions which house most of these aged persons who need care are charitable institutions or funded with public resources. Funding of these institutions is, therefore, scarce, as is the availability of free accommodation. As family profiles start to change in Latin America, demand for institutionalization of the elderly will undoubtedly become more frequent and funding will become a public issue.

Regarding mental capacity, where the cognitive assessment was done using the AD-8 scale, 31 out of the 37 participants recorded suspected cognitive impairment while the remaining 6 showed normal results. A limitation of the AD-8 test is that it is applied to the family member or other carer instead of the patient. However, other tests such as the mini-mental state examination (MMSE) used to evaluate cognitive decline, are also limited by the presence of factors such as visual and hearing impairment, and the low educational attainment within the centenarian population [31, 32]. The Geriatric Depression Scale could only be applied to 32 participants. Specifically, for the question regarding life satisfaction, 30 participants responded as being satisfied, and only 1 participant resulted with a score indicating a high suspicion of depression. These data reflect the centenarians' high percentage (93.75%) of satisfaction with their current lifestyle, in contrast to the CRELES study from Costa Rica, where the risk of depression using the Yesavage scale was 17% for the population aged over 65 years [33].

For the functional evaluation, a total dependence in both basic activities of daily living (ten centenarians) and instrumental activities of daily living (27 centenarians) was observed. Men performed better than women in the gait speed test, and also scored higher for the Barthel Index. These findings are consistent with results from other studies that show men having more functionality

than women [34, 35]. Regarding falls, there was no documented difference between men and women, with instability being identified as the main risk factor.

With respect to the nutritional state, this study identified a high percentage of participants with malnutrition and at nutritional risk. The prevalence of both is similar to that found in the Mexican centenarian study [11]. Women showed a worse nutritional state.

Regarding the centenarians' presence of diseases, cataract was the most frequent pathology followed by hypertension. Prevalence of diabetes was low with five cases (11.6%) presenting overall, which differs from the incidence of 20.6% in the 65-years-of-age Costa Rican population [33]. Likewise, chronic obstructive pulmonary disease (COPD) prevalence was recorded in low numbers (44%) even though most participants were exposed to wood smoke.

Only two centenarians did not report any disease. The presence of multimorbidity (two or more chronic diseases, according to the World Health Organization) [36] was reported in 34 of the 43 centenarians. This matches with other centenarian studies that demonstrate multiple comorbidities in this population, and where in chronic diseases, the prevalence of hypertension is higher (55.8%) than the prevalence of diabetes as found in our study [37].

Regarding polypharmacy (five or more medications being taken), 15 centenarians (35%) reported taking this amount of medications, a finding very similar to that in Mexico of 30%. Only two participants reported not taking any medication. The average amount used was 0.9 medications per centenarian; a very low finding compared to other studies [38].

With respect to biochemical findings, the mean blood sugar, HbA1C, lipid profile and hemoglobin were below normal levels. This can be explained by this population's diet which is mainly low in fats and carbohydrates, high in grains (such as black beans and corn), white meats (poultry) and eggs, as a protein source. The average BMI was 20.8 kg/m^2. Most centenarians recorded Vitamin D deficiency. Even though the Costa Rican climate is tropical, sun exposure is limited in the study population due to the functional limitation.

The 12-lead electrocardiographic (EKG) findings suggest a higher prevalence of heart disease than was reported during the interview process. Only 14% of EKGs were normal, 35% showed an arrythmia, the most common being atrial fibrillation (9.3% of all EKGs and 26.7% of the arrythmia), which concurs with what has been reported in literature [39]. Thirty percent of the EKGs showed evidence of left ventricular hypertrophy suggesting a high prevalence of cardiomyopathy. A history of previous myocardial infarction (MI) was reported in three individuals but electrocardiographic evidence of previous MI was found in six patients. This could reflect ignorance due to poor physician-to-patient communication or a very silent kind of heart sickness which does not motivate complaints or draw medical attention.

Limitations and strengths

This study has the limitation of being a descriptive and not interventional study. Also, it has the limitations inherent in self-reported parameters (not objectively measured) such as visual and hearing impairment, and sleeping hours.

However, it has important strengths such as being the first clinically and epidemiologically oriented study done by geriatricians which incorporates a comprehensive geriatric assessment, biochemical and EKG analysis that has ever been undertaken in a Latin American centenarian population. Its results offer a base for which other studies can be compared, either targeting Costa Rican centenarians from other regions or Blue Zones in other countries. Also, it describes the medical and sociodemographic profile of these older adults, identifying not only the most relevant positive factors but also the negative ones that in the future could be prevented to allow a better quality of life at this grand age.

Conclusion

This centenarian group, as reported in other trials, presents low incidences of diabetes mellitus (9%), dyslipidemia (14%) and depression (2.3%). Women live longer, but have more functional impairment than men. The percentage of institutionalized centenarians is low when compared to European and North American trials. Most of the centenarians receive a pension from the government and benefit from being covered by the social security system that is universal in the Costa Rica population.

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Compliance with ethical standards

Conflict of interest The authors have no conflicting or competing interests to declare.

Statement of human and animal rights All human and animal studies have been approved by the appropiate ethics committe and have there-

fore been performed in accordance with ethical standars laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed consent Not applicable.

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