



OPEN Quality of life and well-being in Colombian centenarians

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The study of quality of life (QoL) and subjective well-being in relation to extreme longevity has important implications for developing public health policies that promote healthy aging. Data on QoL and well-being in Centenarians from middle-income countries living in inequalities conditions are scarce. Thus, the aim of this study was to explore the QoL and well-being among Colombian centenarians, and their relationship with age-related clinical variables. This was a cross-sectional study in which 160 centenarians were included. QoL and well-being were assessed using the WHOQOL-AGE and the 7-item Satisfaction with Life Scale questionnaires, respectively. Independent variables were sociodemographic, economic, functional, cognitive, and other clinical characteristics. This population of centenarians predominantly reports a favorable QoL, well-being and life satisfaction status, despite having significant economic, social and educational inequities, in addition to a high prevalence of frailty and cognitive impairment. QoL and life satisfaction status were correlated with physical performance, cognitive status and depression. The findings indicate a high level of resilience among Colombian centenarians and provide primary data for healthcare professionals and public health policymakers to build evidence-based strategies to promote healthy aging and the determinants of active aging in the region.

Keywords Centenarians, Quality of life, Well-Being, Health inequities, Resilience

Abbreviations

GAI-SF	Geriatric Anxiety Inventory - Short Form
ISI	Insomnia Severity Index
IQR	Interquartile Range
MNA	Mini Nutritional Assessment
MMSE	Mini-Mental Status Exam
MoCA	Montreal Cognitive Assessment
QoL	Quality of life
SPPB	Short Physical Performance Battery
SD	Standard deviation
SWLS	Satisfaction with Life Scale
WHOQOL-AGE	World Health Organization Quality of Life – AGE

The study of quality of life (QoL) and subjective well-being and their relationship to extreme longevity has substantial implications for designing public health policies that support healthy aging^{1,2}. Studying centenarians can shed light on age-related diseases, resilience, and biological mechanisms of aging^{2,3}. However, a paradigm shifts toward promoting healthy aging has spurred interest in uncovering the proximal influences of longevity, which refer to the factors that have a direct and immediate impact on a person's lifespan. These influences can encompass a variety of biological, environmental, and lifestyle elements. Understanding these proximal influences can help individuals and communities develop strategies to promote healthier, longer lives^{2,4–7}. Thus, centenarians provide a compelling model for studies on aging and provide important insights into the mechanisms underlying extraordinary longevity^{2,7,8}.

The scientific literature on centenarians has been traditionally centered on biological and genetic mechanisms underlying exceptional longevity, including studies on inflammation, immune function, metabolic markers, and long-lived genotypes such as *APOE* and *FOXO3A* variants⁹. In the health sciences, most research has focused on

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cognitive aging, neurodegenerative diseases, and functional decline^{2,3,9}. However, more recently, complementary research efforts have emerged exploring psychosocial dimensions of aging, such as subjective well-being^{10–12}, QoL^{1,13}, emotional regulation^{14,15}, and sleep^{16–18}. These emerging areas aim to understand how centenarians adapt psychologically to extreme longevity, particularly in sociocultural contexts of disadvantage, and how these factors interact with physical and cognitive health¹⁹.

Culture is a significant factor that influences various aspects of healthy aging. The cultural diversity among centenarians highlights several important factors that necessitate nuanced and culturally sensitive approaches to research and interventions such as varied lifestyles and practices, different health outcomes, social determinants of health and respect for traditions and values^{20,21}. Colombia, a middle-income country, is a multicultural and multiethnic country, characterized by a high level of admixture (i.e., European, Native American, and African ancestries)²². While admixture can have nuanced effects on psychosocial health outcomes in centenarians, the interplay of genetic, cultural, and environmental factors may be crucial in understanding these impacts. Thus, exploring these variables would extend overall understanding about the behavior and influence of various determinants of aging in specific cultural contexts, allowing for the development of genuine and useful solutions to promote healthy aging initiatives among diverse populations such as ours²³.

In Colombia, official estimates from the National Administrative Department of Statistics (DANE) suggest that approximately 20,000 individuals have reached the age of 100 based on live birth records²⁴. However, due to incomplete death registration, the actual number of living centenarians remains uncertain. Centenarians represent only about 0.12% of the national population and are mostly concentrated in rural and underserved areas, posing significant challenges for their identification and access²¹. These limitations have been previously acknowledged in geroscience research and studies on extreme longevity²⁵. Thus, designing studies in this population requires tailored sampling strategies that account for these demographic and logistical constraints.

Methods

Participants and clinical assessments

Study design

This was a cross-sectional, population-based study conducted between September 2023 and January 2025. Centenarians included in the Colombian Centenarians Project were identified through a subsidized health insurance program that primarily serves individuals from lower socioeconomic backgrounds.

Eligible participants were aged 100 years or older, with age formally verified through official documents such as civil birth records, national identification cards, or notarial certificates, actively enrolled in the program, and capable of providing informed consent. In cases of illiteracy or physical limitations, consent was obtained from legally authorized family members. Recruitment was conducted using a consecutive, non-probabilistic sampling strategy. Potential participants were initially contacted by telephone through the insurance provider's registry, followed by home visits by trained field staff.

Of the individuals contacted, a small number declined participation due to personal or family-related reasons. This approach allowed for the inclusion of a socially vulnerable yet demographically relevant segment of the centenarian population and ensured methodological transparency in participant selection. Participants were identified in four Colombian departments: Bogotá D.C., Bolívar, Sucre, and Valle del Cauca.

No exclusion criteria were applied. All centenarians who met the inclusion criteria and were accessible at the time of fieldwork were invited to participate. A total of 160 centenarians were identified and evaluated. Participants were assessed at their homes or in outpatient centers equipped for geriatric care.

Clinical assessments

The outcomes, whether categorical or quantitative, were the results of the scales used to determine QoL and well-being. Independent variables were sociodemographic, economic, functional, cognitive, and clinical characteristics as explained below.

A semi-structured questionnaire was used to gather data on the variables of active aging (i.e., the process of optimizing opportunities for health, participation, and security to enhance the QoL as people age) that affect the health phenotype in extreme longevity. Previously validated scales and tools used in older persons in Colombia²⁶, and other centenarian cohorts were employed^{1,3}. The QoL was measured by using the World Health Organization Quality of Life – AGE (WHOQOL-AGE) tool^{27,28}. To be eligible for the application of this tool, participants did not need to be fully cognitively intact but able to reliably respond to questions about themselves. In some cases, caregivers or relatives helped them comprehend and respond to the questions.

The well-being was measured using the 7-item Satisfaction with Life Scale (SWLS) tool^{29,30}. This is a validated unidimensional measure assessing the cognitive-evaluative dimension of subjective well-being. Comprising five items rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree), it yields a total score ranging from 5 to 35. The SWLS demonstrates high internal consistency ($\alpha > 0.80$), strong test-retest reliability, and construct validity in older populations. Its brevity, psychometric robustness, and sensitivity to interindividual differences render it suitable for centenarian samples in quality-of-life research.

As centenarians with poor cognition had difficulty understanding items formulated as statements (e.g., in most ways, my life is close to my ideal), it was reformulated those into questions (e.g., in most ways, is your life close to your ideal?). Higher mean scores represent subjective well-being. When necessary, participants received support from caregivers or relatives to facilitate comprehension and ensure accurate completion of the items.

Frailty was measured using the Fried scale^{17,31}. To assess nutritional status, the Mini Nutritional Assessment (MNA) scale was used³². The Barthel Index^{33,34} and Short Physical Performance Battery (SPPB)³⁵ scales were used to determine functional status. The Mini-Mental Status Exam (MMSE)³⁶ and the Montreal Cognitive Assessment (MoCA)³⁷ were used to evaluate cognitive status, accompanied by the Yesavage scale^{38,39} and GAI-SF (Geriatric Anxiety Inventory – Short Form)^{16,40} to inquire about depression and anxiety, respectively. Sleep

quality was assessed using the Insomnia Severity Index (ISI) scale^{41,42}. Finally, exposure to episodes of violence was defined as having experienced at least one of the following: physical, psychological, or sexual violence; forced displacement; social exclusion; or ethnic discrimination.

Statistical analysis

The normality of quantitative variables was tested using the Kolmogorov–Smirnov test. Data are presented as mean $\pm$ standard deviation (SD) for continuous variables and median (interquartile range, IQR) for skewed variables. Qualitative variables were summarized using frequency and percentages. For quantitative variables, comparative analyses were conducted using Pearson's Chi-square test or Student's t-test. Multiple regression analyses and Pearson's or Spearman's correlation coefficient tests were used for the evaluation of potential associations and correlations between QoL, well-being and the other's outcomes. Furthermore, since sex is a characteristic that influences active aging, the results were assessed according to sex. Due to multiple statistical comparisons and to avoid the risk of type I error, p-values were adjusted by the Bonferroni correction. A p-value < 0.05 was considered statistically significant. All analyses were performed using the R statistical package (Version 4.3.1) (<https://www.r-project.org/>)⁴³.

Ethical statements

The study was performed in compliance with Act 008430/1993 of the Ministry of Health of the Republic of Colombia, which classified it as minimal-risk research. The study protocol was reviewed and approved by the Medical Ethics Committee of Coosalud EPS (Colombian Health Insurance Company).

Results

A total of 160 centenarians were included, of whom 72% were females, and a significant proportion were widowed (70%) (Table 1). A notable characteristic of the participants was their low educational level, with only a minority having completed primary school and a substantial portion having no formal education. Furthermore, the majority reported lower economic income and were categorized as having a low economic status. A significant proportion of participants exhibited some degree of functional dependency (82%). Nonetheless, 86% reported favorable life satisfaction (Table 1).

Quantitative results of health-related outcomes are shown in Table 2. The mean MoCA result was 6.46 ± 5.35 . While MoCA is a useful screening tool for the elderly, its accuracy among centenarians was limited, precluding its use to further analysis.

QoL was positively correlated with well-being, functional performance, cognitive status (MMSE), nutritional assessment, and functional independence, but was negatively correlated with depression (Table 3). Well-being was positively correlated with QoL but negatively correlated with depression (Table 3).

The correlations vary between males and females. In women, QoL was positively correlated with functional performance, cognitive status (MMSE), nutritional status and functional independence, whereas a negative correlation between QoL and well-being with depression was observed (Table 4). Men disclosed positive correlations between QoL and well-being, functional performance, nutritional status and functional independence, but negative correlation with depression (Table 4). Well-being in men was positively correlated with QoL but negatively correlated with depression (Table 4).

Multiple linear regression analysis was conducted to explore the impact of various covariates on the perceived QoL (Table 5). After implementing a variable selection method from a set of candidate variables, the final included the Yesavage score, SWLS score, and the MNA score. The assumptions of the multiple linear regression model were evaluated and verified. The model fitted well. The analysis revealed significant associations between these covariates and the perceived QoL. Depression was negative correlated with QoL ($\beta = -1.534$, $p = 0.0003$), indicating that greater mental impairment is linked to a diminished perception of QoL (Table 5). Conversely, both the SWLS score ($\beta = 0.772$, $p = 0.0001$) and the MNA score ($\beta = 1.121$, $p < 0.001$) exhibited significant positive correlations with QoL (Table 5).

Discussion

This study examined the QoL and well-being of Colombian centenarians living in a complex psychosocial environment that includes low or extremely low socioeconomic status, no or just a primary level of education, and exposure to episodes of violence (Table 1). Previously, the studies on centenarians have come predominantly from Mediterranean Europeans, Asians, North Americans, and other groups^{1,44}. Despite global advances in the study of longevity, substantial knowledge gaps persist regarding centenarians living in low- and middle-income countries⁴⁵. These include population-level gaps due to limited access to national registries, empirical gaps stemming from the underrepresentation of centenarians in epidemiological studies, theoretical gaps in understanding aging across diverse cultural contexts, and methodological gaps related to the applicability of standardized instruments in cognitively and educationally heterogeneous populations⁴⁶. The present study contributes novel evidence precisely in response to these gaps, offering primary data from an underserved population and highlighting variables explored in the global centenarian literature, such as subjective well-being and perceived QoL in the context of social and economic adversity.

The mean QoL score of $51.31 (\pm 14.89)$ observed in our study is lower than those reported in studies of validation^{27,28}, however the validation studies do not included centenarians. Nevertheless, our findings suggest that the evaluated centenarians demonstrated a good overall perception of life satisfaction, with favorable scores in domains related to interpersonal relationships, perceived autonomy, and environmental satisfaction as assessed by the WHOQOL-AGE instrument. These findings suggest the presence of functional psychological adaptation despite adversity¹⁹. Furthermore, the ability to maintain high levels of subjective well-being and

Variable	<i>n</i>	%
Age , years, median (IQR)	102.2 (3.00)	-
Sex		
Female	115	72
Residence area		
Urban	127	80
Civil status		
Single	22	14
Married	18	12
Widowed	107	70
Other	5	4
Educational Level		
Without education	96	63
Primary education	49	32
Secondary education or higher	8	5
Religious belief		
Yes	156	98
Household Economic Income		
< 1 MMW	107	68
1 MMW	28	18
1–2 MMW	16	10
> 2 MMW	6	4
Socioeconomic stratum		
Stratum 1	72	46
Stratum 2	50	32
Stratum > 3	36	22
Former occupation		
Farmers, agricultural, forestry and fishing	37	24
Elementary Occupations	34	22
Home and Child Care	35	23
Officials, Operators, Craftsmen and Related	23	15
Others	31	16
Difficulty paying for basic needs		
Very hard	56	35
Hard	51	32
Something difficult	30	19
Without difficulties	22	14
Functionality		
Independence	18	11
Mild dependence	54	34
Moderate dependence	18	11
Severe dependency	23	14
Total dependency	46	30
Violence experienced*	36	24
Frailty	117	77
Malnutrition	55	35
Continued		

Variable	<i>n</i>	%
Depression	23	15
Anxiety	2	1
Cognitive impairment**	130/137	94.9
Insomnia	28	18
Favorable life satisfaction***	126	86

Table 1. Baseline characteristics of the population studied ($N = 160$). *At least one of the following: physical, psychological or sexual violence, social exclusion, displacement, or racism. **The Mini-Mental Status Exam ≤ 24 . ***Defined based on a favorable final outcome on the SWLS scale (slightly satisfied, satisfied, or extremely satisfied). MMW: Minimum monthly wage.

Variable	Mean	SD
Quality of life (WHOQOL-AGE) (13–65)	51.31	14.89
Life satisfaction - Well-being (SWLS) (7–35)	27.29	5.81
Functional performance (SPPB) (> 10)	3.22	3.49
Mini-mental status (MMSE) (26–30, 4 categories)	14.25	7.57
Depression (GDS-15) (0–4, 3 categories)	2.62	3.06
Anxiety (GAI-SF) (≤ 3)	0.28	0.78
Insomnia (ISI) (< 10)	3.97	5.37
Nutritional assessment (MNA) (≥ 24 , 3 categories)	18.59	5.06
Functional independence (Barthel Index) (≥ 60)	49.09	36.32

Table 2. Quantitative results of health-related outcomes in Colombian centenarians ($N = 160$). SD: Standard deviation, WHOQOL-AGE: World Health Organization Quality of Life – AGE, SWLS: Satisfaction with the Life Scales, SPPB: Short Physical Performance Battery, MMSE: The Mini-Mental Status Exam, GAI-SF: Geriatric Anxiety Inventory – Short Form, ISI: Insomnia Severity Index, MNA: Mini Nutritional Assessment. Numbers in parenthesis indicate the normal values or ranges.

Variable	QoL	Well-being
QoL (WHOQOL-AGE)	--	0.526*
Well-being (SWLS)	0.526*	--
Functional performance (SPPB)	0.443*	0.166
Mini mental status (MMSE)	0.463*	0.311
Depression (GDS-15)	-0.519*	-0.540*
Anxiety (GAI-SF)	0.082	-0.142
Insomnia (ISI)	-0.295	-0.191
Nutritional assessment (MNA)	0.478*	0.255
Functional independence (Barthel Index)	0.476*	0.303

Table 3. Quality of life and well-being overall correlations with clinical and functional factors in centenarians ($N = 160$). * $p < 0.05$ after Bonferroni's correction. QoL: Quality of life, WHOQOL-AGE: World Health Organization Quality of Life – AGE, SWLS: Satisfaction with the Life Scales, SPPB: Short Physical Performance Battery, MMSE: The Mini-Mental Status Exam, GAI-SF: Geriatric Anxiety Inventory – Short Form, ISI: Insomnia Severity Index, MNA: Mini Nutritional Assessment.

quality of life in the face of social and health-related disadvantages may reflect a form of resilience, as understood in the context of extreme longevity¹⁹. This interpretation is supported by the consistent correlations observed across cognitive, emotional, and functional dimensions. Resilience acts as a protective factor, helping individuals cope with challenges and maintain or regain well-being⁴⁷.

In our study, subjective well-being average score of 27.29 (± 5.81) indicates high satisfaction with overall well-being. This score aligns with the criteria established by the original scale^{1,48}, suggesting that the centenarians in our sample maintain a robust personal perception of welfare or happiness. Specifically, they demonstrate a profound appreciation for their own lives in relation to their individual goals, expectations, and cultural context. These findings agree with those of Nakagawa and colleagues⁴⁹, whose study of centenarians in Japan and United States similarly reported high levels of subjective well-being among participants. Such consistency across diverse cultural contexts underscores the universal significance of subjective well-being as a key determinant

Variable	QoL		SWLS	
	Women	Men	Women	Men
QoL (WHOQOL-AGE)	--	--	0.442*	0.697*
Well-being (SWLS)	0.442*	0.697*	--	--
Functional performance (SPPB)	0.396*	0.536*	0.099	0.256
Mini mental status (MMSE)	0.565*	0.149	0.373	0.373
Depression (GDS-15)	-0.544*	-0.443*	-0.545*	-0.503*
Anxiety (GAI-SF)	-0.009	-0.247	-0.066	-0.287
Insomnia (ISI)	-0.234	-0.393	-0.123	-0.337
Nutritional assessment (MNA)	0.485*	0.430*	0.169	0.309
Functional independence (Barthel Index)	0.437*	0.526*	0.236	0.322

Table 4. Quality of life and well-being correlations by gender with clinical and functional factors in centenarians (*N* = 160). **p* < 0.05 after Bonferroni’s correction. QoL: Quality of Life; SWLS: Satisfaction with the Life; SPPB: Short Physical Performance Battery; MMSE: The Mini-Mental Status Exam; GDS-15: Geriatric Depression Scale (Yesavage); GAI-SF: Geriatric Anxiety Inventory – Short Form; ISI: Insomnia Severity Index; MNA: Mini Nutritional Assessment.

	$\hat{\beta}^a$	95% CI ^b	<i>P</i> -value ^c
Depression (GDS-15)	-1.534	(-2.346, -0.722)	0.0003
Well-being (SWLS)	0.772	(0.383, 1.161)	0.0001
Nutrition (MNA)	1.121	(0.727, 1.514)	< 0.001

Table 5. Factors associated with the QoL (WHOQOL-AGE) according to an adjusted multiple lineal regression model (*N* = 160). ^aThe numbers in this column are the estimated multiple regression coefficients. ^b95% CI: 95% confidence interval. ^c*p* < 0.05. Tests the null hypothesis that β is equal to 0 vs. the hypothesis that β is different from 0. GDS-15: Geriatric Depression Scale (Yesavage); SWLS: Satisfaction with the Life; MNA: Mini Nutritional Assessment.

of QoL among centenarians⁵⁰. This result has important implications due to the existing relationship between QoL, subjective well-being, and cognitive status. Therefore, interventions aimed at promoting these outcomes would have a significant influence on healthy brain aging promotion, and consequently on disability-free life expectancy in extreme longevity.

Emotional well-being, QoL, and life satisfaction encompass a general sense of contentment with one’s life circumstances. Research in this area suggests that centenarians who exhibit higher levels of positive affectivity tend to experience various health benefits, including a reduced risk of mortality^{1,51}. Studies have consistently demonstrated that older adults with greater emotional balance and autoregulation tend to exhibit better physical health outcomes and are less likely to have age-related chronic diseases. Moreover, emotional well-being has been linked to enhanced immune function, faster recovery from illness, and longevity³⁶.

Although the occurrence of depression was relatively low (15% - Table 1), which is comparable to or even lower than earlier research^{39,52,53}, there was a negative correlation between depression and both QoL and well-being (Table 3).

Subjective well-being serves as a general indicator of successful aging, reflecting how well older individuals adapt to their lives². The positive correlation between subjective well-being and QoL underscore the importance of functional well-being in protecting against stress, depression, anxiety, and psychological trauma in older adults⁹. Conversely, the negative correlation between depression with well-being indicates that higher levels of depressive symptoms are associated with a significant decrease in QoL in centenarians. Similar data were found in studies from Europe and China^{15–17}. These findings highlight a pronounced role of depression as a determining factor to consider in the overall health status of centenarians, particularly in women (Table 4). It even supports the need for timely diagnosis and treatment of depression, even in extreme ages of life, as it could significantly influence the life course of centenarians and their healthy lifespan, impacting physical and functional outcomes as well^{54,55}.

Another finding of this study emphasizes the importance of nutrition in shaping QoL. Nutrition plays a pivotal role in maintaining physical health, cognitive function, and emotional stability, all of which are essential components of QoL. Nutritional status in centenarians is associated with functional and cognitive status, physical performance, use of dental prostheses, and specific biochemical and anthropometric variables⁵⁶. The strong positive correlation observed in our study suggests that centenarians with better nutritional status experience a higher QoL, likely due to the enhanced physical health and greater capacity for self-care^{1,15}.

Additionally, it was identified that the physical performance of Colombian centenarians is slightly higher compared to that reported in other countries⁵⁷. However, the average MMSE, which reflects cognitive status, was observed to be lower compared to another cohort in Sweden⁵⁸. Although both the MMSE and MoCA were

administered to assess cognitive function, only the MMSE was included in the correlation analyses. This decision was based on the observation that nearly all participants scored below the dementia threshold on the MoCA, likely reflecting its limited applicability in centenarian populations with low educational attainment or illiteracy, an issue previously documented in geriatric research⁵⁹. In contrast, the MMSE showed greater variability and discriminatory capacity, allowing for more robust statistical analysis and meaningful correlations with quality of life and well-being. Particularly and favorably, there was a notably higher average Barthel score compared to Spanish centenarians (49.09 vs. 39.7)⁶⁰. These results reflect the population variability and health outcomes, which could be the result of the environmental, behavioral, and genetic variables possessed by the Colombian population, distinguishing it from other regions.

Similarly, life satisfaction plays a crucial role in shaping the health and longevity of older adults. The evidence shows that individuals who report higher levels of life satisfaction tend to engage in healthier lifestyle behaviors, such as regular exercise, balanced nutrition, and adequate sleep, contributing to overall well-being and longevity^{46,60}. This permit inferring that even older people with disparities in health determinants can disclose a favorable QoL and life satisfaction comparable to that reported in high-income nations^{6,28}.

Limitations

We acknowledge some shortcomings of the study, including differences in cognitive function that may have influenced the participants' responses and their ability to accurately report their QoL. Due to the cross-sectional design, causal relationships cannot be established, nor can temporary changes be tracked.

Given the participants' old age and cognitive profile, self-reported outcomes such as QoL and subjective well-being should be interpreted with caution. Although we used interviewer-facilitated administration and modified the response formats to reduce cognitive stress, the impact of cognitive impairment on perception and recollection cannot be completely ruled out. Nonetheless, our findings remain useful because they reflect real-world experiences in extreme old age, where cognitive limitations are common.

Conclusion

Studying QoL and well-being in centenarians is important for several reasons, including, understanding longevity, improving elder care, and promoting healthy aging. The findings of this study indicate Colombian centenarians disclose the ability to adapt, recover, and maintain their physical, mental, and emotional well-being despite the challenges of aging and any health issues they may face (i.e., resilience). Here, we provide primary data for healthcare professionals and public health policymakers to build evidence-based strategies to promote healthy aging and the determinants of active aging in the region. The observed resilience in centenarians may contribute to their unusual lifespan and general quality of life, emphasizing the relevance of psychological and biological variables that promote healthy aging.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Author contributions

J.-M. A. conceptualized, designed the project, collected and gathered data, wrote and revised the manuscript; S. V. A. and S. C.-T. wrote and revised the manuscript; I. D. L.-M. gathered data, wrote and revised the manuscript; J. C. S.-U. performed the statistical analyses, wrote and revised the manuscript; All the authors proofread and approved the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Ethical approval and consent to participate

This study adhered to both local and international ethical standards, including those set forth in the Declaration of Helsinki. The ethics approval was obtained from the Medical Ethical Committee of Coosalud EPS. Written informed consent was obtained from all participants or their legally.

Consent for publication

Participants signed informed consent regarding publishing their anonymous data.

Additional information

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