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COMMENTARY

What are blue zones? An argument in favor of its definition based on the most successful model of biological aging

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The exhaustive and rigorous study of aging, especially healthy aging, constitutes a highly interesting area of research today, due to the demographic transition the world is undergoing with a dramatic increase in the proportion of older persons. Due to the imprecise capacity of health systems to be able to respond to this scenario,[1] a transformation and restructuring of priorities in public health and global health have been considered. In recent years, the United Nations declared the period between 2021 and 2030 as the decade of healthy aging, defining four principles that have the potential to impact the human rights of healthy longevity,[2] and the health outcomes of older persons.[3] These principles, accompanied by some objectives of the World Health Organization on aging and health, propose strengthening research on healthy longevity to impact, more than life expectancy, on healthy lifespan.[4]

The term "blue zone" was coined by Poulain et al.[5] who arbitrarily defined it as a geographical area with a higher proportion of male centenarians compared to female centenarians (which is commonly the opposite case) in Sardinia. Despite this, the term has been used heterogeneously in some studies on extreme longevity, referring to areas or populations with high rate of centenarians, high life expectancy/healthy lifespan, high proportion of octogenarians and nonagenarians (but not centenarians), or very low prevalence of age-related chronic diseases in aged over 80 years old.

Dan Buettner, an American explorer, and journalist, is known for disseminating information about some "well-documented" blue zones,[6] which can be explored through documentary films on National Geographic and the Netflix series called "Live to 100: Secrets of the Blue Zones." These zones include Okinawa in Japan, Sardinia in Italy, Nicoya in Costa Rica, Ikaria in Greece, and Loma Linda in California.[6] In these documentary films, anecdotes and experiences related to lifestyles, customs, and social behaviors typical of areas, where octogenarians, nonagenarians, and centenarians with favorable health phenotypes can be found, are shared. However, just as there are similarities, there are also significant differences in the demographic and clinical characteristics of these populations, which must be examined and discussed considering the evidence.

In a nonsystematic search in PubMed, there are no more than 12 documents published to January 2024 that include the term "blue zones" in their titles. What is even more intriguing, most of the available documents are reviews or correspondences where claims are made about lessons, outcomes, and special considerations regarding extreme longevity. These analyses often include people starting from the age of 65 (who are not extreme longevity candidates).[7] Therefore, it is evident that the initial definition by Poulain et al.[5] is not being met since they exclusively referred to centenarians. Interestingly, the author of the blue zone's documentary films presents some anecdotal recommendations for reaching the chronological age of 100, specifically referring to centenarians.[8] However, he does refer to Poulain et al.'s initial definition[5] which contradicts some of his statements in the documentary films. In some instances, he also refers to areas where life expectancy is relatively high but not enough to support a representative rate of centenarians.

This analysis is worth to discus, given that not necessarily in areas where there is a significantly high rate of octogenarians or nonagenarians compared to a reference average, regardless of whether these older persons have a favorable health phenotype or not, there is a significantly high rate of centenarians.

During the execution of the Colombian Centenarians Cohort Study (COOLCEN Cohort),[9] we made a geographical and demographic finding that exemplifies our stance on the discrepancy in concepts regarding the use of the term "blue zones." Through our

own analysis of the 2018 National Population and Housing Census of Colombia (the latest available data on the demographic behavior of this country),[10] we calculated the overall and sex-differentiated rate of the population aged 85 and older, as well as centenarians per 10,000 inhabitants, for each territorial division of Colombia (32 territorial divisions and 44,164,417 inhabitants) (Figure 1). Specifically, we identified that all five territorial divisions with the highest rate of the population aged 85 and older are different from the five territorial divisions with the highest rate of centenarians per 10,000 inhabitants. It would be expected that a blue zone should be characterized by having a population pattern with extreme longevity, reflected in a high rate of both octogenarians and nonagenarians as well as centenarians. However, we did not observe this pattern in our country. Then, what defines a blue zone?

Many authors arbitrarily and heterogeneously use the term "blue zones" without an operational definition, affecting the validity, applicability, and reproducibility of results concerning longevity, centenarians, and healthy aging. The study of what would be the most successful model of healthy aging in the world (centenarians), demands rigorousness, seriousness, and scientifically robust foundation to extrapolate evidence that is useful, valid, and relevant to global health objectives regarding aging and human rights in healthy aging.[2,11] Within this framework, it is a mistake to investigate and make health-related assertions using concepts of global concern lacking methodological definition and validity, impeding falsifiability and reproducibility of the obtained results.

We propose that as defined by Poulain and colleagues,[5] a blue zone should be considered as the geographical area where there is a prevalence of centenarians higher than expected by demography (regardless of the centenarian's gender). This theoretically reflects an area that possesses unique characteristics, considering its population and environment, which allow the development of genuine healthy extreme longevity. This longevity is characterized by a chronological age of 100 years or older but a biological age that is younger (a slower aging process compared to the general population). Therefore, exclusive reference is made to the concept of the most successful model of healthy aging, as well as the opportunities and challenges in the care, study, and research of extreme longevity and healthy aging. Due to the relevance of this topic and the mentioned priorities, we make a call to establish an operational consensus on blue zones, based on the centenarian population, to avoid the emergence of significant biases that may affect the applicability of results regarding healthy aging.

AUTHOR CONTRIBUTIONS

IDLM and JMA conceptualized the study design, reviewed the literature, curated data, reviewed and confirmed abstracted data, wrote the first draft of the manuscript, and all authors reviewed and revised subsequent and finalized the draft of the manuscript.

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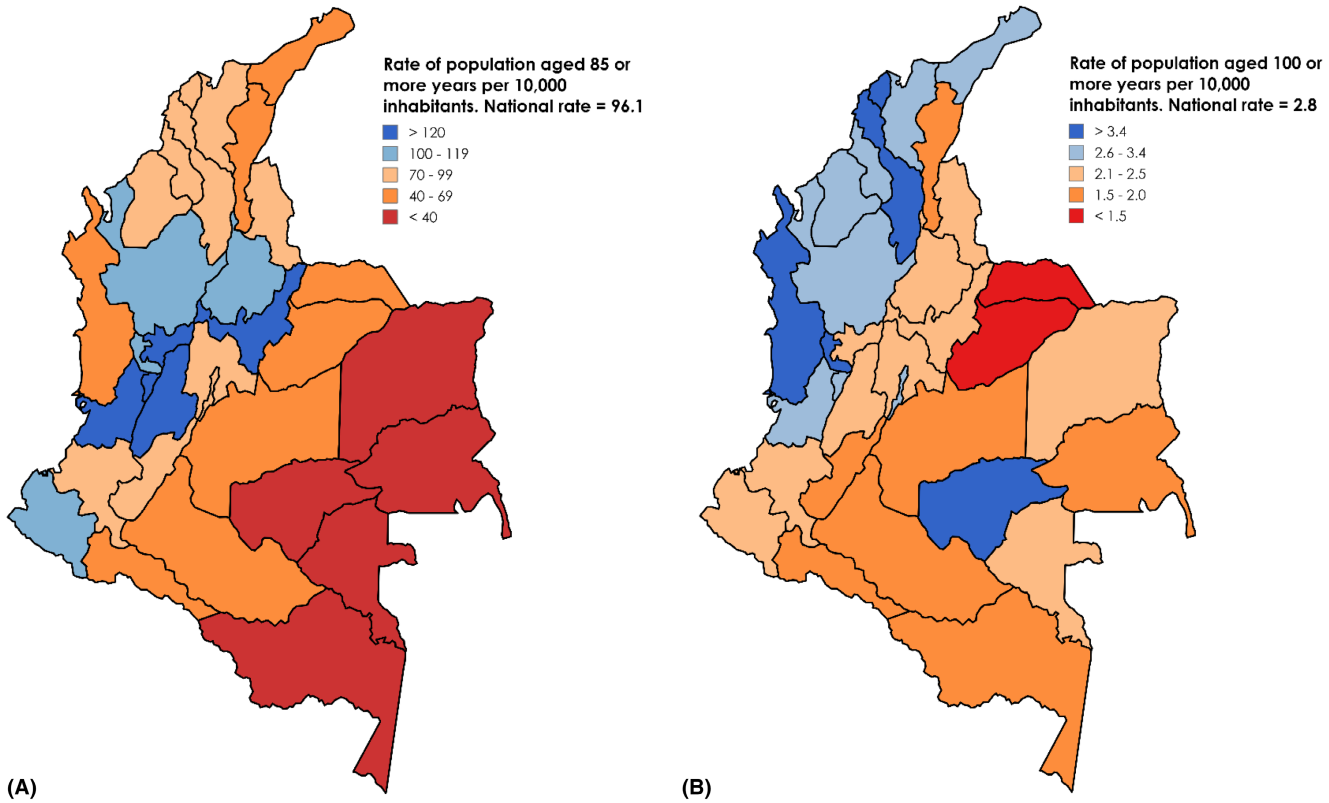

FIGURE 1 Comparison between rate of older persons aged 85 or more years, and centenarians per 10,000 inhabitants, disaggregated by territorial divisions of Colombia. (A) Rate of population aged 85 or more years. (B) Rate of centenarians.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Not applicable.

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