Biological age based on clinical biomarkers from multiple systems: development and validation at ELSA-Brasil

Amanda V Machado[1,2], Juliana F M Silva[3], Enrico A Colosimo[1], Belinda L Needham[2], Chams B Maluf[1], Luana Giatti[1], Lidyane V Camelo[1], Sandhi M Barreto[1]

[1]Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, [2]University of Michigan, Ann Arbor, United States, [3]Fundação Oswaldo Cruz, Salvador, Brazil

Biological age estimated using clinical biomarkers is strongly related to **mortality** and is a valid estimate to predict death in Brazilian adults, especially among men.

BACKGROUND

- Hypothesis: Biological age is a better predictor of mortality than chronological age in Brazilian adults.

Biological age seeks to evaluate the organism's biological wear and tear process, which cannot be observed by chronological age. It was validated in high-income countries but not in low- and middle-income countries, like Brazil, which has a very mixed population marked by social inequalities and racism. As a weathering marker, biological age can help understand the factors that lead to inequalities in the distribution of diseases related to aging in the country. We estimate individuals' biological age based on biomarkers from multiple systems and validate it through its association with mortality from natural causes.

METHODS

Biological age was estimated in 12,109 participants (6,621 women and 5,488 men) from the first visit of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) who had valid data for the biomarkers used in the analyses. Biological age was estimated using the Klemera and Doubal Method. The difference between chronological age and biological age (Δ age) was computed. Cox proportional hazards models stratified by sex were used to assess whether Δ age was associated with mortality risk after a median follow-up of 9.1 years. The accuracy of the models was estimated by the Area Under the Curve (AUC).

RESULTS

The Δ age mean was equal for men and women, but greater variability was observed among men. We found that independently of chronological age, every 1-year increase in Δ age was related to 21% e 24% of the increase in mortality in men [HR(95%CI):1.21;1.17-1.25] and women [HR(95%CI):1.24;1.15-1.34], respectively (Table 1).

Table 1 – Association between Δ age (in years), chronological age (in years), and mortality from natural causes after 9.1 years of follow-up (2008-2010 to December 31, 2018). The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil).

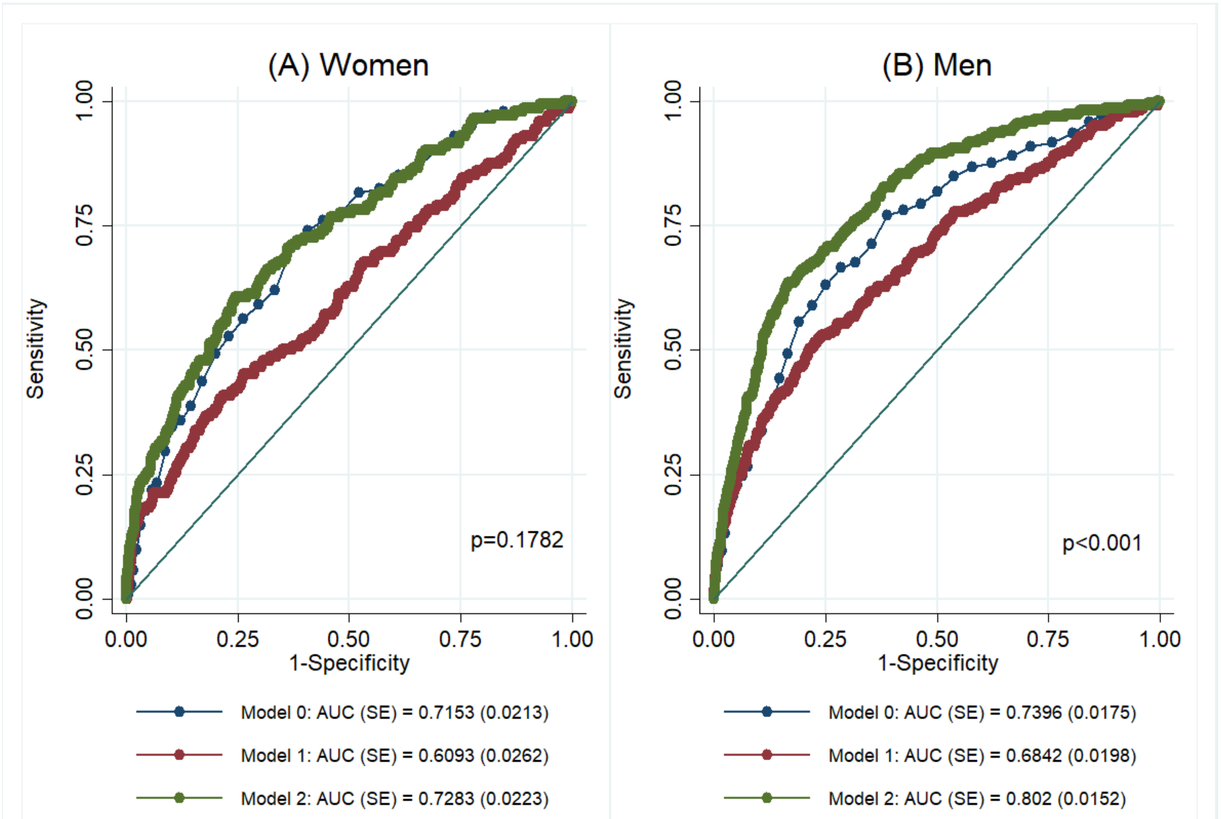
	Women (N=6,621)		Men (N=5,488)	
	Hazard Ratio (CI 95%)			
	Chronological Age	Δ age	Chronological Age	Δ age
Model 0	1.09 (1.07-1.11)*	-	1.10 (1.08-1.12)*	-
Model 1	-	1.29 (1.19-1.39)*	-	1.25 (1.21-1.30)*
Model 2	1.09 (1.07-1.11)*	1.24 (1.16-1.33)*	1.10 (1.08-1.11)*	1.21 (1.17-1.25)*

Notes: Model 0 = Chronological age;
Model 1 = Δ age BA-KDM
Model 2 = Chronological age + Δ age BA-KDM;
CI=Confidence Interval; BA=Biological Age; KDM=Klemera and Doubal Method
*p<0,001

RESULTS CONTINUED

The predictive power of models that only included chronological age (AUC chronological age=0.7274) or Δ age (AUC Δ age=0.6688) was lower than those that included both, chronological age and Δ age (AUC chronological age + Δ age=0.7820), but only in men (Fig. 1). This difference was not observed in women.

Fig. 1: Accuracy of mortality prediction models in women (A) and men (B) assessed by the area under the curve after 9.1 years of follow-up (2008-2010 to December 31, 2018). The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil).



Notes: Model 0 = Chronological age; Model 1 = Δ age BA-KDM; Model 2 = Chronological age + Δ age BA-KDM; AUC = Area Under the Curve; SE=Standard Error; BA=Biological Age; KDM=Klemera and Doubal Method. The p-value is from the DeLong test and compares the areas of Model 0 and Model 2.

CONCLUSIONS

We demonstrate that biological age is strongly related to mortality and is a valid estimate to predict death in Brazilian adults, especially among men. The biological age estimate will allow us to assess factors that accelerate as well as slow down the population's biological weathering to subsidy public policies to promote healthy aging and prevent premature mortality.

Acknowledgments: We thank all ELSA-Brasil participants for their invaluable contribution to this study.

Funding: This work was supported by the Brazilian Ministry of Health (Department of Science and Technology) and the Brazilian Ministry of Science, Technology and Innovation (FINEP, Financiadora de Estudos e Projetos and CNPq, National Research Council), Grant No 01 06 0010.00, 01 06 0212.00, 01 06 0300.00, 01 06 0278.00, 01 06 0115.00 and 01 06 0071.00. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasil (CAPES) Finance Code 001. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflicts of interest: None.

Contact: amandavianam83@gmail.com

WCE WORLD CONGRESS OF EPIDEMIOLOGY 2024