

Association between Aluminium Levels and Cognitive Decline in Environmentally Exposed Elders

Bianca Gerardo^{1,2,3,4} | Marina Cabral Pinto^{4,5,6} | Joana Nogueira^{1,2,3} |
Agostinho Almeida^{7,8,9} | Edgar Pinto^{7,8,9,10,11} | Mário Rodrigues Simões^{3,12} |
Sandra Freitas^{1,2,3}

¹Faculty of Psychology and Educational Sciences, University of Coimbra, Coimbra, Portugal

²University of Coimbra, Coimbra, Portugal

³CINEICC, Coimbra, Portugal

⁴Geobiotec Research Centre, Aveiro, Portugal

⁵University of Aveiro, Aveiro, Portugal

⁶Department of Geosciences, Aveiro, Portugal

⁷LAQV/REQUIMTE, Porto, Portugal

⁸University of Porto, Porto, Portugal

⁹Faculty of Pharmacy, Porto, Portugal

¹⁰CISA/Research Center in Environment and Health, Porto, Portugal

¹¹Porto Politecnic, Porto, Portugal

¹²University of Coimbra, Faculty of Psychology and Educational Sciences, Coimbra, Portugal

Correspondence

Bianca Gerardo, Faculty of Psychology and Educational Sciences, University of Coimbra, Coimbra, Portugal.

Email: bianca.s.gerardo94@gmail.com

Abstract

Background: Normal brain functioning depends on metals homeostasis, as imbalances may increase oxidative stress and cause other detrimental intracellular events that lead to cell loss. Furthermore, environmental exposure to toxic metals is hypothesized to induce neuroinflammation and neuropathology, paving the way to neurodegeneration. The aim of this study was to examine whether such Potentially Toxic Elements (PTE) are associated with cognitive performance over time in a sample of elderly individuals of environmentally contaminated regions.

Method: A total of 146 elders permanently residing in environmental risk areas were recruited. Participants completed the Mini Mental State Examination (MMSE) for cognitive assessment and were biomonitoring for several PTE through hair and urine analysis. After 5 years, the cognitive assessment was repeated.

Result: Cognitive performance significantly declined from baseline to follow-up ($p < 0.001$), with participants scoring on average 4.41 less points on MMSE (Baseline: $M = 25.79$, $SD = 3.520$, $Md = 27.00$; Follow-up: $M = 21.38$, $SD = 5.343$, $Md = 21.00$). Regression analysis on the relationship between PTE and cognitive performance revealed that Aluminium ($\beta = -0.322$, $p = 0.32$) and Zinc ($\beta = -0.372$, $p = 0.15$) in hair and Aluminium in urine ($\beta = -0.368$, $p = 0.010$) significantly predicted MMSE scores past 5 years of biomonitoring ($p = 0.002$). Higher contents of these PTE were associated with worse cognitive performance at follow-up, after controlling the effects of age, education and supplement intake.

Conclusion: Higher levels of Aluminium significantly predict worse general cognitive performance 5 years after biomonitoring across different biological samples. Environmental exposure to this metal may constitute a risk factor for cognitive decline.