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625 - METAL MIXTURES AND SARCOPENIA-RELATED OUTCOMES IN OLDER ADULTS: A BAYESIAN KERNEL MACHINE REGRESSION STUDY IN THE ENRICA COHORT

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Resumen

Background/Objectives: Sarcopenia is a major contributor to disability and frailty in older adults. While individual metal exposure is linked to musculoskeletal health, the impact of real-world metal mixtures remains understudied. We investigated the joint, individual and interactive associations of 13 serum metals with muscle mass, strength and physical performance in older adults.

Methods: We analyzed 2,362 participants from the Seniors-ENRICA-2 cohort. Serum concentrations of 13 metals (Al, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, V, Zn) were measured using inductively coupled plasma-mass spectrometry. Outcomes included grip strength, chair stand performance, calf circumference, the Short Physical Performance Battery (SPPB), gait speed, and sarcopenia based on EWGSOP2 criteria. Bayesian Kernel Machine Regression (BKMR) was employed to flexibly assess the joint and individual association between metal exposures and each functional outcome. To avoid masking opposing biological effects, three distinct mixtures (all metals, essential metals and potentially toxic metals) were evaluated.

Results: The potentially toxic metal mixture (Al, Cu, Cr, Pb) was consistently associated with increased prevalence of adverse musculoskeletal outcomes, with Cu and Pb being the main drivers of this toxicity. Conversely, the essential metals mixture (specifically Mg, Se, Zn) showed protective associations, though high Fe levels exhibited toxicity on every outcome but grip strength. BKMR revealed non-linear patterns, such as U-shaped or reverse J-shaped associations, and effect modification was observed, where higher concentrations of certain essential metals such as Se and Zn attenuated the harmful effects of toxic, pro-oxidant metals, mostly Cu and Pb.

Conclusions/Recommendations: Metal mixtures are associated with musculoskeletal health in older adults through non-linear and interactive relationships. While Cu, Fe and Pb increase the risk of functional impairment, essential elements such as Mg, Se, and Zn are protective and may mitigate toxic effects. These findings highlight the importance of considering multi-metal exposures rather than isolated agents to better inform preventive strategies for sarcopenia in aging populations.