GENETIC DAMAGE AND MULTI-ELEMENTAL EXPOSURE IN POPULATIONS IN PROXIMITY TO ARTISANAL AND SMALL-SCALE GOLD MINING AREAS IN NORTH COLOMBIA

Pedro Espitia-Pérez [a], Lyda Espitia-Pérez [a], Claudia Galeano-Páez [a], Karina Pastor-Sierra [a], Ana Marcela Peñata-Taborda [a], Tatiana Dillenburg Saint'Pierre [b], Solange Cristina García [c], Hugo Brango [d]

[a] Facultad de Ciencias de la Salud, Grupo de Investigación Biomédica y Biología Molecular, Universidad del Sinú, Calle 38 Carrera 1W, Barrio Juan XXIII, Montería, Córdoba, Colombia.
[b] Departamento de Química, Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio), Rio de Janeiro, Rio de Janeiro, Brasil.
[c] Laboratorio de Toxicologia (LATOX), Universidade Federal do Rio Grande do Sul, Avenida Ipiranga, 2752, Porto Alegre, Rio Grande do Sul, Brasil.
[d] Departamento de Matemáticas y Estadística, Universidad del Norte, Barranquilla, Colombia

Colombia has seen a significant increase in total gold production. The bulk of auriferous material extraction and processing is conducted through artisanal and small-scale gold mining (ASGM), predominantly focusing on exploiting alluvial deposits. In the northern region of Colombia, a highly active zone for gold production, the intense ASGM activities have result in substantial release of pollutants into the environment, adding to the already present Hg contamination. These pollutants, notably As, Co, Pb, Mn, and Zn, are recognized carcinogens, posing potential combined health risks to the local populations through unknown additive or synergistic effects. This study aimed to assess cytogenetic damage in isolated human peripheral lymphocytes using the cytokinesis-block micronucleus cytome assay (CBMN-Cyt) and its association with multi-elemental exposure measured via Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) analysis of hair samples. The study encompassed 112 healthy subjects, comprising 39 individuals from an unexposed area (Cotorra municipality) and 73 residents from the 'La Mojana' region, known for a high Hg contamination and intense gold mining activities.

The findings revealed a significant increase in micronuclei (MNBN), nucleoplasmic bridges (NPB), and frequencies of necrotic and apoptotic cells in binucleated cells among individuals living in proximity to ASGM areas. Hair samples indicated elevated levels of toxic elements such as Pb, Hg, As, Cd, and Ba in exposed residents, while essential elements like Mg, Mn, V, and Sr showed a similar pattern. Positive associations were observed between Hg exposure and MNBN, whereas increased Mn and Pb levels correlated with NPB.

Considering MNBN frequency as a predictive biomarker of cancer risk, our results underscore the potential risks posed by this economic activity and multi-elemental exposure to environmentally exposed communities. This emphasizes the critical need for further research in this specific area to inform governmental decision-making.

Keywords: Artisanal and Small-Scale Gold Mining; Multi-elemental exposure; Trace elements; Genetic damage