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Cytogenetic instability in populations with residential proximity to open-pit coal mine in Northern Colombia in relation to PM10 and PM2.5 levels

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Epidemiological studies indicate that living in proximity to coal mines is correlated with numerous diseases including cancer and that exposure to PM10 and PM2.5 components could be associated to this phenomenon. However, the understanding of the mechanisms by which PM exerts its adverse effects is still incomplete and comes mainly of studies in occupationally exposed populations. The aims of this study were to: (1) Evaluate DNA damage in lymphocytes assessing the cytokinesis-block micronucleus cytome assay (CBMN-cyt) parameters; (2) To identify aneugenic or clastogenic effects in lymphocytes of exposed populations using CREST immunostaining for micronuclei; (3) To evaluate multi-elemental composition of atmospheric particulate matter; and (4) To verify relation between the DNA damage and PM2.5 and PM10 levels around the mining area. Analysis revealed a significant increase in micronuclei frequency in binucleated (MNBN) and mononucleated (MNMONO) cells of individuals with residential proximity to open-pit coal mines compared to residents from non-mining areas. Correlation analysis demonstrated a highly significant association between PM2.5 levels, MNBN frequencies and CREST+ micronuclei induction in exposed residents. These results suggest that PM2.5 fraction generated in coal mining activities may induce whole chromosome loss (aneuploidy) preferentially, although there are also chromosome breaks. Chemical composition of PM2.5 by PIXE demonstrated the presence of highly enriched elements like S and moderate enrichment of Cr, Cu and Zn. Mining regions had also higher concentrations of extractable organic matter (EOM) related to nonpolar and polar compounds. Our results demonstrate that PM2.5 fraction represents the most important health risk for residents living near open-pit mines, underscoring the need for incorporation of ambient air standards based on PM2.5 measures in coal mining areas.

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