Genotoxicity in humans exposed to arsenic and lithium in drinking water in the Bolivian Andes

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Abstract

Elevated concentrations of arsenic, lithium and boron in drinking water have already been reported in the Bolivian Andes. Arsenic causes genotoxicity but that caused by lithium and boron is less well known. The aim of the present study was to evaluate associations between arsenic, lithium and boron exposure and genotoxicity, while taking genetic susceptibility into account. Women (n=230) were recruited in ten villages around Lake Poopó. Arsenic exposure was determined as the sum of concentrations of arsenic metabolites (iAs, MMA, and DMA) in urine. Exposure to lithium and boron was determined based on their concentrations in urine. Genetic susceptibility was determined by GSTM1 and GSTT1 null genotypes and AS3MT rs3740393,. Genotoxicity (DNA strand breaks) was measured peripheral blood by the comet assay. Median arsenic, lithium, and boron concentrations were 60 µg/L, 989 µg/L, and 3929 µg/L, respectively. GSTM1 and GSTT1 null carriers showed more DNA strand breaks than gene carriers (p=0.008, p=0.005). We found no correlation between urinary arsenic and DNA strand breaks (rS=0.03, p=0.64), and only a weak non-significant positive association in the multivariate analysis (β=0.09, p=0.14). Unexpectedly, increasing concentrations of lithium in urine were negatively correlated with DNA strand breaks (rS=-0.24, p=0.0006), and the association persisted in multivariate analysis after adjusting for arsenic (β=-0.22, p=0.003). We found no association between boron and DNA strand breaks. The lack of genotoxic effect of arsenic could be associated with the specific metabolic adaptation to arsenic previously reported in this population. The apparent protective effect of lithium against genotoxicity merits further investigation.

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