

Human health risk estimation of mercury vapor around artisanal small-scale gold mining area, Palu city, central Sulawesi, Indonesia

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Emissions of elemental mercury, Hg(0), from artisanal small-scale gold mining activities accounted for 37% of total global Hg(0) emissions in 2010. People who live near gold-mining areas may be exposed to high concentrations of Hg(0). Here, we assessed the human health risk due to Hg(0) exposure among residents of Palu city (Central Sulawesi Province, Indonesia). The area around the city has more than 60 tons of gold reserves, and the nearby Poboya area is the most active gold-mining site in Indonesia. Owing to its geography, the city experiences alternating land and sea breezes.

Sampling was done over a period of 3 years (from 2010 Aug. to 2012 Dec.) intermittently with a passive sampler for Hg(0), a portable handheld mercury analyzer, and a mercury analyzer in four areas of the city and in the Poboya gold-processing area, as well as wind speeds and directions in one area of the city. The 24-h average concentration, wind speed, and wind direction data show that the ambient air in both the gold-processing area and the city was always covered by high concentration of mercury vapor. The Hg(0) concentration in the city was higher at night than in the daytime, owing to the effect of land breezes. These results indicate that the inhabitants of the city were always exposed to high concentrations of Hg(0).

The average daytime point-sample Hg(0) concentrations in the city, as measured with a handheld mercury analyzer over 3 days in July 2011, ranged from 2,096 to 3,299 ng m⁻³. In comparison, the average daytime Hg(0) concentration in the Poboya gold-processing area was 12,782 ng m⁻³. All of these concentrations are substantially higher than the World Health Organization air-quality guideline for annual average Hg exposure (1000 ng m⁻³). We used the point-sample concentrations to calculate hazard quotient ratios by means of a probabilistic risk assessment method. The results indicated that 93% of the sample population overall was at risk (hazard quotient ratio ³1 and cut off at the 95th percentile value of the sample population) of mercury toxicity, that is, damage to the central nervous system due to chronic exposure. The corresponding percentages for the northern, central, southern, and western areas of the city were 83%, 84%, 95%, and 95%, respectively. Our results indicate that the residents of Palu city are at serious risk from exposure to high concentrations of atmospheric Hg(0).

Keywords: Mercury Vapor, Artisanal Small-scale Gold Mining, Human health risk