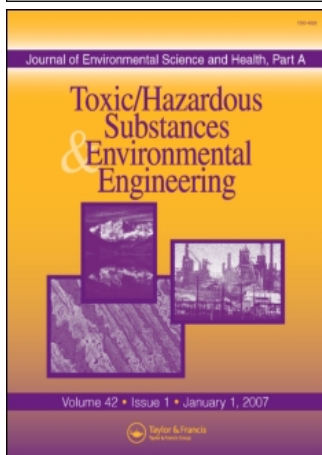


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# Assessment of Hg contamination and exposure to miners and schoolchildren at a small-scale gold mining and recovery operation in Thailand

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Gold extracted by Hg-amalgamation process, which can cause both health and environmental problems, is widespread in South East Asia including Myanmar, Laos, Cambodia, and Thailand. Small-scale gold mining operations have been carried out since the year 2000 in Phanom Pha District, Phichit Province, Thailand. Since no data is available for evaluating Hg exposure, an investigation of mercury (Hg) contamination and exposure assessment was carried out at this mine site. Environmental monitoring illustrated the total Hg in water was as high as 4 µg/l while Hg in sediment ranged between 102 to 325 µg/kg dry weight. Both Hg deposition from the air (1.28 µg/100 cm<sup>2</sup>/day) and concentration in surface soil (20,960 µg/kg dry weight) were elevated in the area of amalgamation. The potential of Hg exposure to miners as well as to schoolchildren was assessed. The concentrations of Hg in urine of 79 miners who were directly (group I) or indirectly (group II) involved in the gold recovery operation were 32.02 and 20.04 µg/g creatinine, respectively, which did not exceed regulatory limits (35 µg/g creatinine). Hair Hg levels in both groups (group I and group II) also were not significantly higher than the non-exposed group. In terms of risk factors, gender and nature of food preparation and consumption were the two significant variables influencing the concentration of Hg in urine of miners ( $P < 0.05$ ). A hazard quotient (HQ) was estimated based on the inorganic Hg exposure of individual miners. The HQ values of group I were in a range 16 to 218 times higher than the safety level set as 1. By comparison the group II HQ index was very low (0.03–0.39). The miners in group I who worked and ate food from this area experienced potentially high exposure to Hg associated with the mining process. In a second Hg exposure assessment, a group of 59 schoolchildren who attended an elementary school near the gold mine site was evaluated for Hg exposure. A slightly higher Hg urine concentration was detected in group I and group II (involved and not involved in gold recovery) at average levels of 15.82 and 9.95 µg/g creatinine, respectively. The average Hg values for both groups were below the established levels indicating no risk from Hg intake. Average Hg hair level in all schoolchildren (0.93 µg/g) was not significantly higher than reference group. There were two variables (gender and personal hygiene) which affected the concentration of Hg in urine of schoolchildren ( $P < 0.05$ ). The result (HQ) also suggested that schoolchildren were not at risk ( $< 1$ ). Schoolchildren involved in gold mining activities showed some indirect exposure to Hg from the adults working in mining area.

**Keywords:** Mercury; amalgam; gold miners; exposure assessment; hazard quotient

## Introduction

Mercury (Hg), one of the most toxic heavy metals has been widely used for thousands of years. Hg can have adverse impact both on human health and the environment. Great interest has been shown in mercury pollution and distribution in the environment following the health effects asso-

ciated with the discharges of mercury into Minamata Bay in the 1950s and in Choropampa, Peru.<sup>[1]</sup> World wide direct human exposure to mercury has occurred due to many sources.<sup>[2]</sup> In industry, mercury has been used in various applications such as thermometers, paints, plastic, fluorescent lamps, batteries, gold and silver mining etc. In the United States in the early 1990s, unexplained changes in neurobehavioral was displayed in people who lived in building contaminated with Hg produced by Hg vapor lamps.<sup>[3]</sup> Barregard demonstrated a correlation between cumulative mercury exposure and micronuclei effects among a group of chlor-alkali workers, suggesting a possible genotoxic effect.<sup>[4]</sup> Reported studies of people exposed to a moderate

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