Exposure to silica, arsenic, and chromium (VI) in cement workers: a probability health risk assessment

ABSTRACT

Cement mineral dust contains a variety of carcinogenic and non-carcinogenic substances. The study aimed to determine the probability of health risk among cement workers due to respirable silica (Si), arsenic (As), and chromium (Cr) VI dust exposure. A cross-sectional study was carried out among 123 cement workers. A personal air sampling pump was used to assess respirable cement dust exposure. Inductively coupled plasma mass spectrometry (ICP-MS) was used for As, and Cr analysis, and X-ray powder diffraction (XRD) was used for Si analysis. The Fractional Exhaled Nitric Oxide levels and lung function test were obtained by using NIOX MINO and Chestgraph H1-105 spirometer. Risk assessment was calculated by using the incremental lifetime cancer risk (ILCR) and non-cancerous hazard quotient (HQ). The geometric mean and standard deviation of respirable Si and Cr dust concentrations were 5.27 ± 2.36 mg m–3 and 1.53 ± 2.47 mg m–3, respectively, in manufacturing workers. The mean concentration for As in administrative workers was 0.07 ± 0.02 mg m–3. After controlling for confounders, the abnormalities of FVC% predicted and FEV1% predicted were significantly associated with the respirable Si dust among cement workers (OR = 6.913; CI = 1.965–24.322 and OR = 18.320; CI = 3.078–109.027). FENO concentrations in administrative workers were significantly influenced by the exposure to respirable Si dust (R2 = 0.584, p = 0.006). Manufacturing workers had a high probability of getting cancer due to Si exposure in cement respirable dust at 29.81 × 10–4 times compared to administrative workers at 4.14 × 10–4 times. After reducing for control factors, the probability of manufacturing workers reduced to 0.45 × 10–4 times. As and Cr (VI) dust exposures among cement workers had a probability of cancer risk of 7.49 × 10–4 and 44.09 × 10–4 times, respectively, after reducing for control factors. The non-cancerous disease risk of the workers from exposure to cement mineral dust exceeded the acceptance limit (HQ > 1). Cement workers were at high risk of developing cancerous and non-cancerous diseases due to exposure while working. Cement workers were highly exposed to respirable Si, As, and Cr dust above the permissible exposure limit.

Keyword: Cement mineral dust; Incremental lifetime cancer risk (ILCR); Hazard quotient (HQ); Health risk assessment