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Health risk assessment of drinking water consumption along Indus Suture Zone, Kohistan region, northern Pakistan

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The study was conducted to determine the concentrations of physico-chemical parameters in drinking water (surface water and groundwater) of Kohistan region, northern Pakistan. Water samples were collected from the streams, springs and Indus River and analyzed for physical parameters (i.e., pH, EC and TDS) by COSORT electrochemical analyzer C931, anions (i.e., NO_3, SO_4, PO_4, Cl and HCO_3) by Hach DR2800 spectrophotometer and heavy metals (i.e., Cu, Pb, Zn, Ni. Cr, Co, Cd, Mn, Fe and As) by atomic absorption spectrometer equipped with graphite furnace in the Geochemistry laboratory of the Nation Centre of Excellence in Geology, Universirty of Peshawar. All the physical parameters and anions and majority of the heavy metals (HMs) concentrations were found within the permissible limits set by world health organization (WHO). However, Pb, Zn, Cd, Ni and As showed higher concentrations than their permissible limits in 29%, 6%, 7%, 2% and 2% water samples, respectively. Heavy metal concentrations were evaluated for non-carcinogenic risk such as chronic daily intake (CDI), hazard quotient (HQ) and cancer risk (CR). The non-carcinogenic risk HQ were <1 for all the HMs except As. This level of contamination revealed a low chronic risk and medium cancer risk when compared with US-EPA guidelines. Furthermore, the statistical analysis such as univariate (one-way ANOVA, inter-metals correlation) and multivariate analysis (i.e., cluster and principal component analysis) results revealed that geogenic and anthropogenic activities were major sources of water contamination in Kohistan region.