

## Documents

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**Human health risk assessment of nitrate in private well waters of shallow quaternary alluvial aquifer**  
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### Abstract

Excessive nitrate intake via ingestion pathway and dermal absorption exposures has adverse health impacts on human health. This study evaluated groundwater (GW) nitrate concentrations and health risks which focused on ingestion and dermal exposures to residents in Bachok District, Kelantan, Malaysia. Three hundred (300) samples of private wells were collected and it is found that the nitrate concentrations ranging between 0.11 and 64.01 mg/L NO<sub>3</sub>-N with a mean value of 10.45 ± 12.67 mg/L NO<sub>3</sub>-N. The possible health hazards of nitrate by ingestion and dermal contact were assessed using USEPA human health risk assessment model for adult males and females. It is observed that the mean Hazard Quotient (HQ) values of adult males and females were 0.305 ± 0.364 and 0.261 ± 0.330, respectively. About 7.3% (n = 10) and 4.9% (n = 8) of adult males and females had HQ values more than 1, respectively. It was also observed that the mean of HQ<sub>derm</sub> was lesser than HQ<sub>oral</sub> for males and females. The spatial distribution of HQ by interpolation method showed high nitrate concentrations (> 10 mg/L NO<sub>3</sub>-N) were distributed from the centre to the southern part of the study location, which identified as an agricultural area, indicating the used of nitrogenous fertilizers as the main source of GW nitrate contamination in this area. The findings of this study are valuable for establishing private well water protection measures to stop further deterioration of GW quality caused by nitrate. © 2023, The Author(s), under exclusive licence to Springer Nature B.V.

### Author Keywords

Alluvial aquifer; Dermal absorption; Drinking water; Groundwater (GW); Human health risk assessment (HHRA); Nitrate

### Index Keywords

agricultural land, aquifer, concentration (composition), fertilizer, groundwater-surface water interaction, hazard assessment, health risk, ingestion rate, nitrate, pollution incidence, risk assessment, well water; Kelantan, Malaysia, West Malaysia; ground water, nitric acid derivative, organic compound; adult, environmental monitoring, female, human, male, procedures, risk assessment, water pollutant; Adult, Environmental Monitoring, Female, Groundwater, Humans, Male, Nitrates, Organic Chemicals, Risk Assessment, Water Pollutants, Chemical

### Chemicals/CAS

Nitrates; Organic Chemicals; Water Pollutants, Chemical

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