

## **Nitrate in groundwater: determining associated health risk among residents in Tumpat, Kelantan using hazard quotient (HQ) calculation**

### **ABSTRACT**

**Introduction:** Contamination of nitrate is one of the most common groundwater problems worldwide. Around 70% of residents in the state of Kelantan still rely on groundwater as their primary source of water supply. Extensive usage of fertilizer in agricultural areas may cause nitrate leaching into the groundwater. This study aimed to determine the level of nitrate in groundwater and health risk assessment at three villages in Tanah Merah District, Kelantan, Malaysia. **Subjects and Method:** This was a cross-sectional study conducted at Tanah Merah district, Kelantan, in January 2020. A total of 52 residents was selected by purposive sampling. The inclusion criteria for study subjects were long life residents, age  $\geq 18$  years old, and groundwater as a primary source of drinking supply. The study variables were (1) Level of nitrate in groundwater measured according to age (year), depth (meter), and distance (meter) of well from the agricultural area; and (2) Health risk assessment measured by hazard quotient (HQ). A set of questionnaires consisted of four sections to gather information related to socio-demographic, water usage, living environment, and health status. Groundwater samples were collected in duplicates and were analysed using a Hanna Instruments portable pH/ORP/ISE meter with an attached nitrate electrode. The data were reported descriptively. **Results:** Nitrate levels were found to be under the maximum acceptable value of 10 mg/L, as stated by the Drinking Water Quality Standard of Malaysia. Nitrate level ranged from 0.22 to 8.81 mg/L (Mean= 2.94; SD= 2.27). Spearman rho correlation showed that nitrate level was significantly and negatively correlated the age of wells ( $r = -0.31$ ;  $p = 0.025$ ). Nitrate level was not significantly correlated with the depth ( $r = 0.19$ ;  $p = 0.183$ ) and distance of wells ( $r = -0.05$ ;  $p = 0.751$ ). Hazard quotient (HQ) for all study subjects was  $< 1$ , which means that exposure to nitrate contained drinking water in study subjects was not detrimental to health. **Conclusion:** Nitrate levels were below the maximum acceptable value, but continuous monitoring from health authorities is essential since other seasons of paddy planting may contribute higher deposition of nitrate into groundwater.

**Keyword:** Nitrate; Groundwater; Levels; Hazard quotient; Tanah Merah