

# Hydrochemical and microbiological investigation in radon-contaminated groundwater with potential human health risk assessment under seasonal variations

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Investigating environmental and human health risk assessment is important for sustainable water resource management. Especially, radon in groundwater has harmful effects on human health if it has high concentrations. There are the water quality issues including radon in the study site, and the rare weather events, such as heavy rain with typhoon, become common in South Korea. Thus, the seasonal effects on groundwater environment and related health risks should be investigated in radon-contaminated groundwater areas. This research employed hydrochemical-microbiological survey for three seasons, rainy season, after typhoon, and dry season. It also calculated groundwater quality index (GWQI) and hazard index of radon with a limit set by WHO. The results showed that the groundwater collected after the typhoon has similar hydrochemical-microbiological characteristic with those in the dry season, not with the rainy season. These mechanisms can be explained by groundwater flow path, accumulated precipitation amount, and percolation rate. Calculated effective dose values of radon surpassed the threshold limit of WHO in all groundwater samples despite low GWQI. Infants and children are more susceptible to radon-contaminated groundwater. The values were high in the dry season compared to the rainy season, as shown in the decrease of microbial diversity indices and the increase of pathogenic bacterium. It can suggest the need of intensive management in the dry season, especially for young people. Moreover, this novel approach, combined analysis of environmental risk and human health risk, demonstrates its usefulness to establish the management plan effectively in radon-contaminated groundwater areas.

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