Data Article

Dataset on non-carcinogenic risk via nitrate and nitrite in the groundwater of Divandarreh County, Kurdistan province, Iran: A potential concern for drinking

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A B S T R A C T

The presence of elevated nitrate (NO₃⁻) and nitrite (NO₂⁻) concentration in drinking water higher than the standard limits could endanger the health of consumers. For this data article, concentration of NO₃⁻ and NO₂⁻ was measured in 118 samples collected from 59 active rural wells in Divandarreh County and the non-carcinogenic risk in the adults and children was estimated by Monte Carlo simulation (MCS). The obtained data showed that the average concentration of NO₃⁻ and NO₂⁻ was ranges from 31.37 ± 18.87 mg/L and 1.45 ± 0.90 mg/L respectively. Based on acquired data, NO₃⁻ concentrations were 37 times higher than NO₂⁻ with significant p value of < 0.05. The average concentration of NO₃⁻ and NO₂⁻ was lower than the national standard with p value < 0.05. However, the concentration of NO₃⁻ and NO₂⁻ in 23.7% and 13.5% of wells was higher than the national standard of Iran. Total target hazard quotient (TTHQ) in the adults and children was 1.78 and 1.54, respectively. Although, the average concentration of NO₃⁻ and NO₂⁻ in drinking water was lower than the
national standard limits, but the non-carcinogenic risk assessment showed that the children and adults are at a significant risk via nitrate and nitrite in the rural Divandarreh County (TTHQ > 1).

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Specifications table

| Subject area                  | Environmental sciences |
|-------------------------------|------------------------|
| More specific subject area    | Environmental chemistry |
| Type of data                  | Table and figure       |
| How data was acquired         | For this data article, concentration of NO$_3^-$ and NO$_2^-$ was measured in 118 samples collected from 59 active rural wells in Divandarreh County and the non-carcinogenic risk in the adults and children was estimated by Monte Carlo simulation (MCS). |
| Data format                   | Raw, analyzed          |
| Experimental factors          | The wavelength for determination of nitrate and nitrite by emission spectroscopy method are 500 and 507 nm, respectively. |
| Experimental features         | The samples collection and nitrate and nitrite ions analysis was performed according to the standard method. |
| Data source location          | Divandarreh county, Kurdistan province, Iran |
| Data accessibility            | Data are included in this article |
| Related research article      | X. Su, H.Wang, Y.Zhang, Health risk assessment of nitrate contamination in groundwater: a case study of an agricultural area in Northeast China, Water. Resourc. Manage. 27(2013)3025–34 [1]. |

Value of the data

- Nitrate and nitrite are one of the most common contaminants in drinking water in Iran [2–5]. Therefore, monitoring these two pollutants and assessing their associated health risks (provided in this data article) will be very beneficial for the selection of safe drinking water sources.
- The obtained data can provide useful information on the quality of drinking groundwater (wells) in the Divandarreh County, in terms of nitrite and nitrate.
- The acquired data can be useful for management plans for drinking water.
- The effect of nitrate and nitrite on human health is assessed via Monte Carlo simulation (MCS) method. Therefore, this evaluation method in present data article can be useful and applicable for future similar studies.

1. Data

1.1. Concentration of nitrate (NO$_3^-$) and nitrite (NO$_2^-$)

Concentration of NO$_3^-$ and NO$_2^-$ was measured in 118 samples collected from 59 active rural wells. The minimum and maximum concentration of NO$_3^-$ in both spring and autumn seasons was observed in Tazeh Abad Ghaziali (0.9 mg/L) and Gorbabaali (134 mg/L) rural localities (Table 1). While, the minimum level of NO$_2^-$ in the spring season was reported from Zaki Bigalia (ND), Hazarkanian (ND) and Gorbabaali (ND) and maximum concentration was observed in Vazman rural (5.6 mg/L) locality (Table 1).
Table 1

Concentration of Nitrate and Nitrite in 59 rural localities of Divandarreh County, Iran.

| Rural name               | Latitude | Longitude | Nitrate (mg/L) | Nitrite (mg/L) |
|--------------------------|----------|-----------|----------------|---------------|
|                          |          |           | Spring          | Autumn         | Average       |
|                          |          |           | Dar asb         | Bash ghshlagh  | Darband       |
|                          |          |           | 69.7952        | 68.947        | 70.66           |
|                          |          |           | 3.987,484      | 3.999,916     | 3.977,609      |
|                          |          |           | 48.00          | 25.00         | 20.20          |
|                          |          |           | 42.00          | 18.00         | 13.20          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
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|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
|                          |          |           | 42.00          | 21.50         | 16.70          |
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|                          |          |           | 42.00          | 21.50         | 16.70          |
|                          |          |           | 45.00          | 21.50         | 16.70          |
The average concentration of NO$_3^-$ in the 23.7% groundwater samples (14 localities) was found to be higher than the national standard limit (50 mg/L). The average concentration of NO$_2^-$ in 13.5% samples (8 localities) was also higher than the national standard limit. The average concentration of NO$_3^-$ (31.37 ± 18.87 mg/L) and NO$_2^-$ (1.45 ± 0.9 mg/L) was lower than the national and WHO standard limit, significantly (p value < 0.05) (Table 2).

The results of Pearson correlation analysis showed a non-significant correlation (P value > 0.05) between NO$_3^-$ and NO$_2^-$ concentration (Fig. 1). The difference in the biological or chemical reactions could be the probable cause for insignificant correlation between NO$_3^-$ and NO$_2^-$ concentration [6,7]. Similarly, earlier study conducted by Amarlooei et al. in Iran also suggests insignificant correlation between NO$_3^-$ and NO$_2^-$ concentration [8].

In Divandarreh County, the concentrations of NO$_3^-$ was 37 times higher than NO$_2^-$ concentration, with significant P value of < 0.05 during autumn while, NO$_3^-$ and NO$_2^-$ suggests insignificant P value of > 0.05 in summer season.

1.2. Health risk assessment

THQ in the children and adults due to NO$_3^-$ was 0.84 and 0.88 and NO$_2^-$, 0.78 and 0.87 respectively (Fig. 2). THQ in the adults was observed to be 13% higher than those of children. Further, TTHQ in the adults and children was 1.78 and 1.54.

2. Experimental design, materials and methods

2.1. Study area

The Divandarreh County (35.9137°N and 47.0267°E) is located at 98 km North of Sanandaj city covering an area of around 4203 km$^2$ and at 1850 m above mean sea level (Fig. 3). Divandarreh

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Table 2

| Contaminants | Range (mg/L) | Median | Average ± SD |
|--------------|--------------|--------|---------------|
| Nitrate      | 1.1–105.5    | 27.48  | 31.37 ± 18.87 |
| Nitrite      | 0.02–5.8     | 0.15   | 1.45 ± 0.90   |

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Fig. 1. Bivariant plot between nitrate and nitrite in the wells of rural Divandarreh County, Iran.
County experiences cold weather with temperature ranges from 20 to 32 °C throughout the year and receives an average rain of 500 mm/y. According to the latest census of Iran conducted in 2016, the population living in 98 rural areas in Divandarreh County was around 58,503.

Fig. 2. THQ in adults and children due to ingestion of drinking water containing high level of nitrate and nitrite.

Fig. 3. Location of Divandarreh County in Kurdistan province, Iran.
2.2. Sampling and analysis

A total of 118 samples of groundwater from 59 active wells were collected during spring and autumn of 2016. The collected samples in the glass bottle were transferred to the laboratory of Rural Water and Wastewater Company (RWWC) in Kurdistan Province [9]. Concentration of NO$_3^-$ and NO$_2^-$ in water samples was measured by spectrophotometry UV (HACH DR/5000) in 220 and 507 nm wavelength.

The methods for analyzing the concentration of NO$_3^-$ and NO$_2^-$ was cadmium reduction (8039) and diazinon (10207), respectively. Limit of detection (LOD) in the cadmium reduction and diazinon methods was 0.3 mg/L for NO$_3^-$ and 0.05 mg/L for NO$_2^-$ [9,10].

2.3. Non-carcinogenic risk

2.3.1. Target Hazard Quotient

The Target Hazard Quotient (THQ) for the exposed population was calculated by the Environmental Protection Agency (EPA) method (Eq. (1)) [11,12].

$$\text{THQ} = \frac{C \times E_F \times E_D \times W_{IR}}{RfD \times A_{Tn}}$$  \hspace{1cm} (1)

All parameters of Eq. (1) is shown in Table 3.

THQ $> 1$ suggests the consumer population is at a significant risk of non-carcinogenicity while THQ $\leq 1$ indicates, consumer population are safe w.r.t risk for non-carcinogenicity [12,13].

2.3.2. Total target hazard quotient

Total target hazard quotient (TTHQ) in the consumer population due to NO$_3^-$ and NO$_2^-$ was calculated by EPA method (Eq. (2)) [11]:

$$\text{TTHQ} = \text{THQ-NO}_3^- + \text{THQ-NO}_2^-$$  \hspace{1cm} (2)

TTHQ value more than 1 shows the consumer population is at a significant risk of non-carcinogenicity, while TTHQ value less than 1, indicates insignificant risk for non-carcinogenicity [14,15].

2.4. Monte Carlo Simulation model

The Monte Carlo Simulation (MCS) is one of the most commonly used models for estimating the probable health risk. In this model, the range of variables as well as other uncertainties are considered for accurate health risk estimation [16,17]. The worse scenario of health risk of population in the study area was determined based on MCS model (percentile 95% of THQ).

2.5. Statistical analysis

Statistical analysis was performed by Kolmogorov-Smirnov test (KS). Since the data were normal distribution (P value $> 0.05$), for comparison of NO$_3^-$ and NO$_2^-$ concentrations with standard values, one sample t test was used. The significant level was P value $< 0.05$.

Table 3

| Variable | Define | Unit      | Value | Reference |
|----------|--------|-----------|-------|-----------|
| C        | Concentration | mg/L     | –     |           |
| $E_F$    | Exposure frequency | day/year | 365   | [10]      |
| $E_D$    | Exposure duration  | year     | Adults : 70 ; children : 6 | [10] |
| $W_{IR}$ | Water ingestion rate | ml/kg-d  | Adults : 25 ; children : 20 | [12] |
| $A_{Tn}$ | Average time       | day      | Adults : 25,550 ; children : 2190 | [12] |
| RfD      | Reference dose     | mg/kg-d  | Nitrate:1.6 and Nitrite : 0.1 | [10] |
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Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.09.035.

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