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Determination concentration of Radon 222 in tap drinking water, Jask City, Iran

Yadolah Fakhri[1], Maryam Mirzaei[2,*]
[1]*Social Determinants in Health Promotion Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.*
[2,*]*Corresponding author: Research Center for non-communicable disease, Msc of critical care nursing, Jahrom University of Medical Sciences, Jahrom, Iran.*

Abstract: *Radon 222 is a colorless, odorless, with a half-life of 3.825 days radioactive element which can endanger human health. Using water containing Radon 222 can cause lung and stomach cancer in the long term. In this cross-sectional study, 24 samples from 8 areas in Jask city were collected during June 2013. The concentration Radon 222 was measured by portable Radon detector model RTM1688-2. Range and mean of Radon 222 concentrations in tap drinking water is 105-304 Bqm^3 and 198.8±61.9 Bq/m^3, respectively. The highest and lowest concentrations of Radon 222 is related to Zolm Abbad and Sarrig areas respectively. The concentration Radon 222 of tap drinking water of Jask city is lower than WHO and EPA standard limits.*
Keywords:*Concentration of Radon 222, tap drinking water, Jask City.*

I. Introduction

Radon 222 and its daughters are inert, colorless and odorless gas which is produced from the breakdown of uranium-235. Radon 222 can be provided from various sources such as surface water and groundwater, soil, igneous (granites) and sedimentary rocks [1]. Radon 222 is the most important isotopes of water which can be dangerous to human health by inhalation or direct consumption [3 ,2]. Many studies have shown that when a person consumes water containing Radon 222, alpha radiation emitted during its decay causes damage to the DNA of cells in the stomach. On the other hand, through penetration in to the stomach wall enter in to the bloodstream and then spread throughout the body [5 ,4]. Although the subjects confronted with Radon 222 through drinking water is much lower than exposure but many of the international organizations have set limits for the radionuclide in drinking water, particularly for Radon 222 [6]. WHO and Europe Committee guidelines for Radon 222 of drinking water is 100000 Bq/m^3[7]. The EPA standard limit for drinking water radon 222 has proposed 11000 Bq/m^3[8].Due to the more contact of groundwater with igneous bed rocks (granites) and sedimentary bed (containing radium), the concentration of radioactive substances in this water kind can be more than surface water[10 ,9].Also concentration radon 222 in ground and surface waters, is 2 to 3 times higher than other radioactive materials [11]. Numerous studies have been done in the world in the field of the measurement 222 concentration of Radon in drinking water [14-12]. According to the healthy value of Radon-222 in drinking water, in this study for the first time the concentration of Radon 222 in Jask city tap drinking water was measured and compared with the standard limits.

II. Materials and Methods

1.2 The study area

The port town of Jask is located in the southeast of Hormozgan province and 220 kilometers far from Bandar Abbas city (Hormozgan Province Center) with Geographic coordinates 25˚ 39′ 11″ N and 57°47' 21" E (Figure 1) [15]. The height of this city is about 2 meter above sea level and the climate is hot and humid [16]. Drinking water of the residents is provided of nearby wells.

2.2. Sample collection

In this cross-sectional study, according to other similar studies in June 2013 from 8 areas in Jask city, including regions; Yekbeni, Louran, Sarrig, Moghsa, Kampa, Zolm Abbad, Sarkaleh and Gharib Abbad, 24 samples in volume 1.5 liter were collected (each area 3 samples in two different places) [18 ,17].

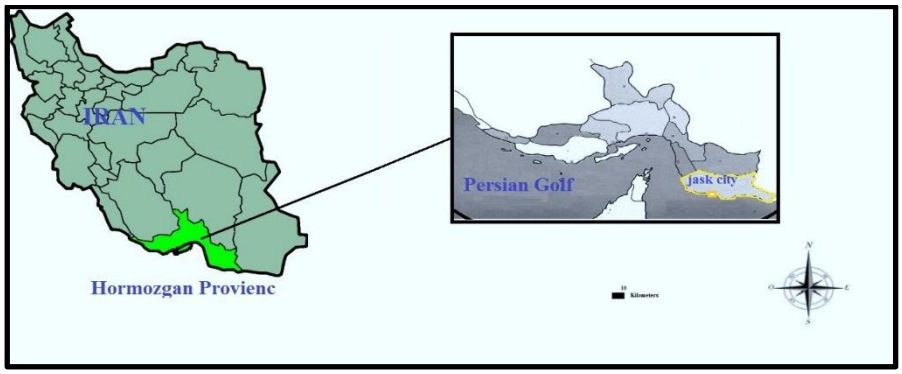

Figure1. City of Jask in east of Hormozgan province and south of Iran

2.3. Measurement concentrations of Radon 222

Due to the influence of temperature on emission of Radon 222 of water, before measuring, temperature of all samples was the same and reached to 12°C [20 ,19]. The concentration of Radon 222 measurement was done by the radon meter model RTM166-2 manufactured by Sarad Company from Germany (Figure 2). The sensitivity of this device in 150 minutes of continuous measurement is 6.5 Counts/min×KBqm^{-3}[21]. concentration of radon 222 measuring of water samples was done in accordance with the instructions provided by the Sarad Company [22]. Also the 2 hour mean concentration of radon 222 for all samples was recorded and was analyzed [22].

Figure2.Measurementconcentration of Radon 222 in the water by radon meter devicemodelRTM1688-2

III. Results

The meanconcentration of Radon222 in tap drinkingwaterin areas; Yekbeni, Louran, Sarrig, Moghsa, Compa, ZolmAbbad,Sarkaleh and Gharib abbad is 180, 161, 115, 200, 212.5, 302, 199 and 286.5Bq/m^3 , respectively.Range andGeometric meanconcentration of Radon 222 in tap drinking wateris 105-304 Bq/m^3 and198.8±61.9 Bq/m^3 (Figure3). Also the highestandlowestconcentration of Radon222 is related to Zolm AbbadandSarrigareas, respectively (Table1).

Table1. Geometric mean concentration of Radon 222 in the tap drinking water in 8 area of Jask city (Bq/m^3)

Area	Location Sampling	Concentration of radon 222	Mean
Yekebeni	1	186	180.0
	2	174	
Louran	3	154	161.0
	4	168	
Sarrig	5	125	115.0
	6	105	
Maghsa	7	195	200.0
	8	205	
Kampa	9	220	212.5
	10	205	
Zolm abbad	11	302	302.0
	12	304	
Sarkalah	13	194	199.0
	14	204	
Gharib Abbad	15	295	286.5

	16	278	
	Geomean		198.8
	Standard deviation		61.9

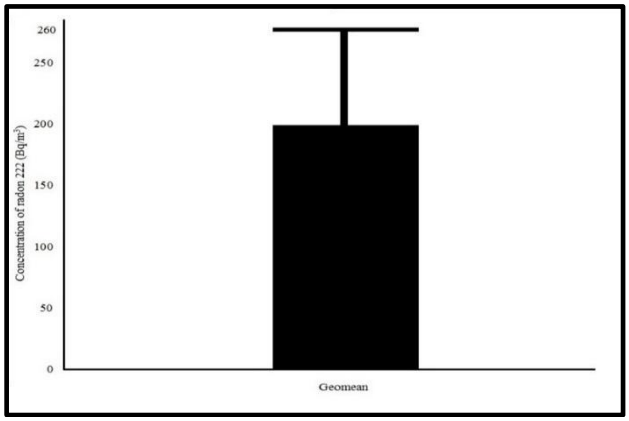

Figure3. Thegeometric meanand standard deviation ofRadon222 tap drinking waterinJask city

IV. Discussion

The order of different areasbased onconcentration of Radon222 in tap water is Zolm Abbad>Gharib Abbad>Campa>Maghsa>Sarkaleh>Yekbeni>Louran>Sarrig. Thisdifference among the concentrationof radon 222 in different parts ofthe city is due tothe water retention timein the distribution network[23]. The mean concentration ofRadon 222 relativetoWHO and EPA standard limits is 0.19%and1.8%, respectively. The mean concentration ofRadon 222 in8areas islessthanWHO and EPAstandard limits in Jask city (Figure3).

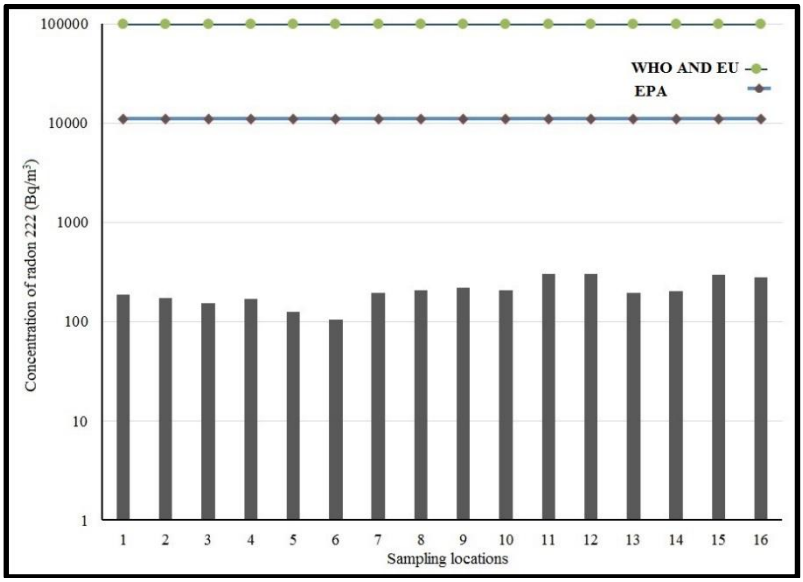

Figure 3. The meanconcentration ofRadon222 in tap drinking waterat 16 pointsfrom8areas inJask city

Table 2.Comparison concentration of Radon222in tapwaterJaskcitywith other Counters of the worldandIran

Kind of water	Concentration of radon 222 (Bq/l)	Country	References
Tap water	0.91-12.58	Turkey	[24]
Tap water	3.7	Iran (Tehran)	[25]
Tap water	17.99	Iran (Neyshabour)	[25]
Tap water	16.23	Iran (Mashhad)	[25]
Tap water	3.4	Iran (Ramsar)	[25]
Tap water	0.082	Iran (Bandar abbas)	[5]
Tap water	0.019	Iran (Jask)	This study

The mean concentration ofRadon222 in tap waterof Jask city is much lower than thecity of Ramsar, Mashhad, Neyshabour, TehranandTurkeybutnear to Bandar Abbas City(Table 2). The mean concentration ofRadon222 of tap waterinKulachiPakistanintheNasiret al study (602 Bq/m^3)isalsohigher thanourstudy[26]. This closeness concentration ofRadon 222 to Bandar AbbasandJask citycanbetheresult ofsimilargeological structure[27].

V. Conclusion

Since thegeometric meanconcentration of Radon222 of tap waterJaskcityismuch lowerthanWHO and EPA standard limits, hencewe can say thatthe populationof the Jask city aresafe from Radon 222radiationdanger in tap drinking water.

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References

[1]. Somlai, K., et al., 222 Rn concentrations of water in the Balaton Highland and in the southern part of Hungary, and the assessment of the resulting dose. Radiation Measurements, 2007. 42(3): p. 491-495.
[2]. Duenas, C., et al., 226 Ra and 222 Rn concentrations and doses in bottled waters in Spain. Journal of environmental radioactivity, 1999. 45(3): p. 283-290.
[3]. Somashekar, R. and P. Ravikumar, Radon concentration in groundwater of Varahi and Markandeya river basins, Karnataka State, India. Journal of radioanalytical and nuclear chemistry, 2010. 285(2): p. 343-351.
[4]. Rožmarić, M., et al., Natural radionuclides in bottled drinking waters produced in Croatia and their contribution to radiation dose. Science of the Total Environment, 2012. 437: p. 53-60.
[5]. Fakhri, Y., et al., Determination concentration of Radon222 in Tap drinking water; Bandar Abbas City, Iran.
[6]. Bem, H., et al., Radon (^{222}Rn) in underground drinking water supplies of the Southern Greater Poland Region. Journal of Radioanalytical and Nuclear Chemistry, 2014. 299(3): p. 1307-1312.
[7]. Risica, S. and S. Grande, Council Directive 98/83/EC on the quality of water intended for human consumption: calculation of derived activity concentrations. 2000: Istituto Superiore di Sanità Roma.
[8]. Somlai, K., et al., 222Rn concentrations ofwater in the Balaton Highland and in the southern part of Hungary, and the assessment of the resulting dose. Radiation Measurements, 2007: p. 491 – 495.
[9]. Ali, N., et al., Estimation of mean annual effective dose through radon concentration in the water and indoor air of Islamabad and Murree. Radiation protection dosimetry, 2010. 141(2): p. 183-191.
[10]. Akawwi, E., Radon-222 Concentrations in the Groundwater along Eastern Jordan Rift. Journal of Applied Sciences, 2014. 14(4): p. 309-316.
[11]. Forte, M., et al., The measurement of radioactivity in Italian drinking waters. Microchemical Journal, 2006. 85 p. 98–102.
[12]. Faheem, M., et al., Assessment of lung cancer risk using weighted average indoor radon levels in six districts of the Punjab province in Pakistan. Indoor and Built Environment, 2010. 19(3): p. 382-390.
[13]. Yakut, H., et al., Measurement of 222RN concentration in drinking water in Sakarya, Turkey. Radiation protection dosimetry, 2013: p. nct157.
[14]. Xinwei, L., Analysis of radon concentration in drinking water in Baoji (China) and the associated health effects. Radiation protection dosimetry, 2006. 121(4): p. 452-455.
[15]. Llc, B., Hormozgan Province: Strait of Hormuz. 2010: General Books LLC.
[16]. Kitchin, R. and N.J. Thrift, International Encyclopedia of Human Geography. 2009: Elsevier.
[17]. Kralik, C., M. Friedrich, and F. Vojir, Natural radionuclides in bottled water in Austria. Journal of environmental radioactivity, 2003. 65(2): p. 233-241.
[18]. Somlai, J., et al., Concentration of 226Ra in Hungarian bottled mineral water. Journal of environmental radioactivity, 2002. 62(3): p. 235-240.
[19]. Ishikawa, T., et al., Airborne and waterborne radon concentrations in areas with use of groundwater supplies. Journal of radioanalytical and nuclear chemistry, 2005. 267(1): p. 85-88.
[20]. Somlai, K., et al., 222Rn concentrations of water in the Balaton Highland and in the southern part of Hungary, and the assessment of the resulting dose. Radiation Measurements, 2007. 42: p. 491-495.
[21]. Ursulean, I., et al. ESTIMATION OF INDOOR RADON CONCENTRATIONS IN THE AIR OF RESIDENTIAL HOUSES AND MINES IN THE REPUBLIC OF MOLDOVA. in Paper presented at the First East European Radon Symposium–FERAS. 2012.
[22]. GmbH, S. APPLICATION NOTE AN-003_EN: Measurement of the Radon concentration of water samples. June 2007; Available from: www.sarad.de.
[23]. Todorovic, N., et al., Public exposure to radon in drinking water in Serbia. Applied Radiation and Isotopes, 2012. 70(3): p. 543-549.
[24]. Tarim, U.A., et al., Evaluation of radon concentration in well and tap waters in Bursa, Turkey. Radiation protection dosimetry, 2012. 150(2): p. 207-212.
[25]. Mowlavi, A.A., A. Shahbahrami, and A. Binesh, Dose evaluation and measurement of radon concentration in some drinking water sources of the Ramsar region in Iran. Isotopes in environmental and Health Studies, 2009. 45(3): p. 269-272.
[26]. Nasir, T. and M. Shah, Measurement of annual effective doses of radon from drinking water and dwellings by CR-39 track detectors in Kulachi City of Pakistan. Journal of Basic & Applied Sciences, 2012. 8: p. 528-536.
[27]. Georgy, C., Z. Rafael, and B. Ivan, Radon Monitoring in Groundwater and Soil Gas of Sakhalin Island. Journal of Geoscience and Environment Protection, 2015. 3(05): p. 48.