Iran. J. Radiat. Res., 2012; 10(3-4): 171-175

Evaluation of ^{222}Rn rate in medical dormitory of Kerman city

A.R. Montazerabadi[1], M. Ahmadian[2], M.R. Vahed[1], N. Yousefi[3], A. Fatehizadeh[4], P. Borhani[5], A. Rajabizadeh[6], A.R Binesh[7], A. Shakerizadeh[1], A.H. Mahvi[3,8]

[1]Department of Medical Physics, Afzalipour Medical School, Kerman University of Medical Sciences, Kerman, Iran
[2]Social Developments and Health Promotion Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran
[3]Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
[4]Environment Research Center, and Department of Environmental Health Engineering, School of Public Health, Isfahan University of Medical Sciences, Isfahan, Iran
[5]Department of Radiology, School of Allied Medical Sciences, Kerman University of Medical Sciences, Kerman, Iran
[6]Department of Environmental Health Engineering, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran
[7]Department of Physics, Payame Noor University, Fariman, Iran
[8]Center for Solid Waste Research, Institute for Environmental Research, Tehran University of Medical Science, Tehran, Iran

Background: Radon (^{222}Rn) Measurement in the residential environments is very important because of its effecting on human health and causing cancer in the respiratory system. ^{222}Rn is individually responsible for half of the natural radiation received in humans and influences on human by breathing. Hence, this study was undertaken to access the ^{222}Rn level in the dormitories of Kerman university of medical science (southeast of Iran) to ensure its safety level. *Materials and Methods:* In this study, for measuring ^{222}Rn level in seven dormitories of the Kerman University of Medical Sciences, the Lucas cell technique was used. This study was undertaken during the winter because of the high concentration of radon in this season due to closed building ambience. *Results:* In this study, the highest measured radon gas rate was 24.5 Bq/m^3 in Boustan (1). Average concentrations of the radon gas in all dormitories were 4.7 Bq/m^3, which is lower than the standard level. *Conclusion:* The results of this study showed that the ^{222}Rn level in all dormitories was lower than the normal amount (48 Bq/m^3) as well as the standard level. **Iran. J. Radiat. Res., 2012; 10 (3-4): 171-175**

Keywords: *Radon gas, Medical Dormitory, Kerman, radioactive pollution, indoor air.*

INTRODUCTION

Determination of radioactive pollution rate existing in the air resulted from the natural radiation is the great importance (1). Radon is a radioactive gas which is naturally emitted from some types of stones. The radon gas commonly enters into the district area through the basement (2). Numerous studies have been performed in order to estimate of risks resulted from exposure to the radon gas and its potential ability to produce lung cancer in the residential areas. Indoor radon levels are considerably depended on two major factors; the concentration of uranium in the beneath of soil and rocks and the size and number of openings to the ground (such as cracks in the flooring) (3). Radon existing in indoor air is the main factor creating lung and bronchus cancers (4). Also, in the closed areas like factories or even skyscrapers and towers which air ventilation is less and undesirable, risk of respiratory system cancers is high due to high concentration of radon gas in the air (5, 6).

Therefore estimating air concerning

** Corresponding author:*
Dr. A.H. Mahvi,
Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.
Fax: *+98 21 66462267*
Email: *ahmahvi@yahoo.com*

radioactive materials is very crucial because concentration of these materials in the human body increase the risk of complications like respiratory system cancer. Also, estimating radioactive level and radon-meter is a useful and important research in regard to environmental health and safety regarding radiation of radioactive which has a direct relationship with various and dangerous diseases of respiratory system [7]. About 50% of people's natural radiation is created by radon gas which kills a lot of people due to respiratory and digestive cancers. Nearly about 21000 people die of this type of cancer only in America every year [8]. In U.S, deaths resulted from radon gas are several times more than accidents like falling, drawing, and fire [9]. It should be mentioned that if only 40 to 50% of radon in the water (before entering the houses) can be reduced, number of people that morbid to respiratory system and digestive system cancers will decrease to 30 to 35% and thus it reduces treatment expenses [10]. United states environmental protection agency (USEPA) has suggested that the radon level of every house should be measured after construction and before residence [9]. Therefore, empirical measurement and collection of data related to radon-meter play an important role with regard to environmental health and safety of the society which will be very significant in terms of saving heavy medical expenses and its associated costs. Many studies in the other countries have investigated with the aim of measuring the level of radon in the residential areas. Babai *et al.* showed that indoor radon concentration in the residential areas of chennai city, India was varied from 21.6 to 139.3 Bq/m^3 [11]. In Hoshiarpur district of Punjab, India the measured values of indoor radon concentration in dwellings areas was varied from 10 Bq/m^3 to 28.2 Bq/m^3 with an average value of 20.28 Bq/m^3 [12]. In study conducted by Akortia *et al.* the indoor radon gas levels in selected region of Ghana was 10.18 Bq/m^3 [13].

The importance of assessing radon in the residential areas in Iran is negligible and there is no rule in this regard. Thus, we decided to carry out a research in this matter in dormitories of Kerman University of Medical Science.

MATERIALS AND METHODS

In this research, radon gas was measured in seven dormitories of Kerman University of medical sciences (southeast of Iran) in three months of winter because of the high concentration of radon in this season due to closed building ambience. Radon gas rate was measured in different floors and in places far from the doors and windows; in every dormitory, measurement operation are performed three times in the various floors for a period of 15 minutes. The results were analyzed using One-way ANOVA Statistical Test. this research was carried out with the Lucas Cell Technique which consisted of PRASSI portable system (model 5s from SILENA Co. Ltd, Italy) and was useful for this type of study. PRASSI (Portable Radon Gas Surveyor SILENA) system consists of cells with 1.83 volume (coated with zinc sulphide, activated with silver) and is equipped with a pump with fixed current amount of 3 L/m [14]. Basis of this method, the ^{222}Rn is measured in the ambient air which is suitable for continuous and random sampling. This machine can also measure changes in radon concentration periodically in long time duration and is mainly used to assess radon gas inside and outside residential areas. This machine was calibrated with the ^{226}Ra solution; for this goal, certain concentrations of radium with range between 0.5 and 50 Bq/m^3 were prepared [15].

RESULTS AND DISCUSSION

Radioactive radon gas was produced by uranium and thorium chains decay. Radon gas is mobile and can diffuse from the site of production into the open air. Inhalation of the radioactive ^{222}Rn increases the lung cancer risk [16]. Radon distribution is related to the tectonic lines and high heat flow zones in the region [17].

Results of assessing radon in the various dormitories have been shown in figure 1. The maximum measured amount was 24.5 Bq/m^3 in Boustan (1) Dormitory. Average concentration of the radon in all dormitories was 5.85 Bq/m^3.

Nowadays, assessing air pollutants inside the buildings has been become a very essential issue and is taken into special consideration. According to the various studies, level of the radon gas in the residential areas in the winter is higher than other seasons due to lower ventilation. In the warm seasons like summer, since windows are open and air ventilation is good, radon level decreases [15, 18, 19].

As shown in figure 1, the maximum and minimum level of radon gas is related to Boustan (1) dormitory (24.5 Bq/m^3) and Fatemiyeh dormitory (1.01 Bq/m^3). The materials used for construction of buildings are sufficiently porous and allow radon to enter into the indoor environment. The earlier studies have shown that there is a positive correlation between the exhalation rate and concentration in building materials [20]. Granite samples show higher radon exhalation rate than marbles. There is a positive correlation between radium content of granite with radon exhalation and its concentration [21].

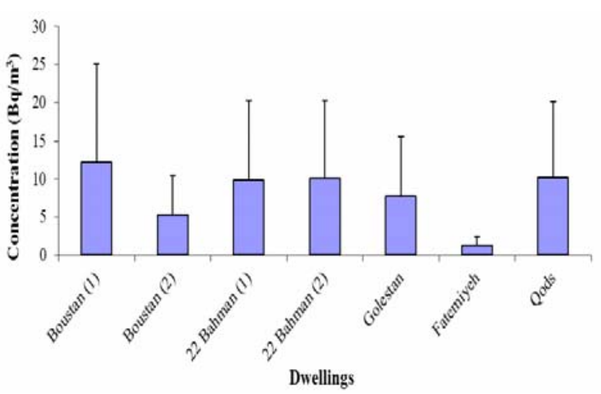

Figure 1. Variations of radon in different dormitories (Bq/m^3).

Higher level of radon in the Boustan (1) dormitory can be related to constructional materials, differences in the soil of that region and undesirable ventilation of this dormitory. Average gas concentration in all dormitories was 5.85 Bq/m^3 and in all dormitories this level was lower than its natural level (48 Bq/m^3). According to a study carried out in the apartments in Mashhad city (Iran), 35% of the apartments have less radon than its natural level while 65% have higher levels [14]. Based on the previous studies carried out in Iran, the northern cities have the highest levels of radon so that Ramsar has the highest level and Lahijan, Ardebil, Sarayen and Namin have the next levels with 160, 168, 124 and 133 Bq/m^3, respectively [22]. Level of radon in the southern beaches of India in the residential areas is 56 Bq/m^3; in Irbid, this level is 44 Bq/m^3 [18, 19].

In all cases mentioned above, levels of the radon gas were higher levels measured in this research. Results of this research showed that in all dormitories, level of the radon was lower than its natural level (48 Bq/m^3) and lower than standard level.

The results of the comparison of concentration level of the radon in the various floors are shown in figure 2. According to this figure, radon level in the basements was higher than upper floors. The maximum radon level in the basement was 24.5 Bq/m^3 and the lowest level was related to the third floor.

In this study, levels of the radon gas in different floors of building were measured too. As shown in figure 2, levels of radon in basements and ground floors are higher than its levels in upper floors. Based on the previous studies, levels of the radon in lower floors is higher than upper floors due to emission of radon from soils beneath the buildings as well as bad ventilation in lower floors [22]. Figure 3 shows the result of the radon measurement in all dormitories of Kerman University of medical sciences. According to these results, February-January have the highest concentrations of radon which is due to weaker ventilation in these seasons.

Results of this study were analyzed using One-way ANOVA Statistical Test. Using this test, a significant difference was observed between levels of the radon in different floors (p=0.000), while no significant difference was observed in levels of the radon in various dormitories (p=0.398) and various months of winter (p=0.245).

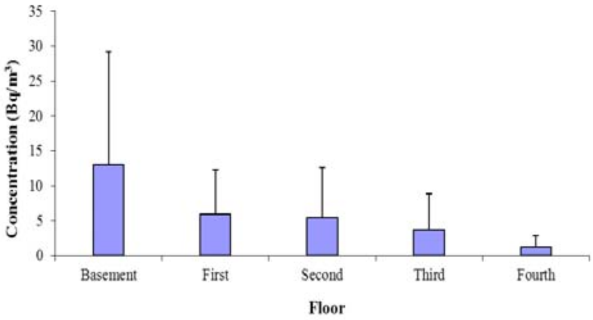

Figure 2. Variations of radon in different floor in all dormitories (Bq/m^3).

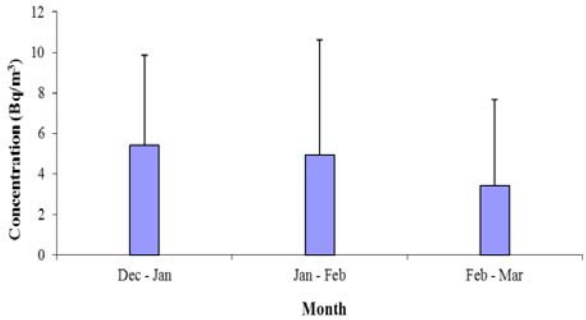

Figure 3. Variations of radon in different months (Bq/m^3).

CONCLUSION

Based on the results, the concentration level of the radon in dormitories is depended on various factors such as the soil beneath, local geology, the house construction materials and last but not the least life style in the dwelling since higher concentration in the poor ventilated rooms. The average concentration of radon was 5.85 Bq/m3 in all dormitories and it was less than radon nature levels (48 Bq/m^3).

ACKNOWLEDGMENT

The authors would like to thank for financial support this research was provided by Vice-Chancellor for Research and Technology of Kerman University of Medical Sciences.

REFERENCES

1. UNSCEAR (1988) United Nations Scientific Committee on the Effects of Atomic Radiation. Sources, effects and risks of ionizing radiation. UNSCEAR, New York.
2. Kennedy C, Gray A, Denman A, Phillips P (1999) A cost-effectiveness analysis of a residential radon remediation programmer in the United Kingdom. *British Journal of Cancer*, ***81:*** *1243–1247.*
3. Bochicchio F, McLaughlin J, Walsh C (2003) Comparison of radon exposure assessment results: 210Po surface activity on glass objects vs. contemporary air radon concentration. *Radiation Measurements,* ***36:*** *211–215.*
4. Ruano-Ravina A, Pérez-Becerra R, Fraga M, Kelsey K, Barros-Dios J (2008) Analysis of the relationship between p53 immunohistochemical expression and risk factors for lung cancer, with special emphasis on residential radon exposure. *Annals of Oncology,* ***19:*** *109-114.*
5. Baykara O, Doğru M (2006) Measurements of radon and uranium concentration in water and soil samples from East Anatolian Active Fault Systems (Turkey). *Radiation Measurements,* ***41:*** *362–367.*
6. Ghosh D, Deb A, Patra KK (2004) Measurements of alpha radioactivity in arsenic contaminated tube well drinking water using CR-39 detector. *Radiation Measurements,* ***38:*** *19–22.*
7. Boice J and Lubin J (1997) Occupational and Environmental Radiation and Cancer. *Cancer Causesand Control,* ***8:*** *309-322.*
8. UNSCEAR (1993) United Nations Scientific Committee on the Effects of Atomic Radiation. Sources, effects and risks of ionizing radiation. UNSCEAR, New York.
9. EPA (2002) Reducing radon risks. Report No. 520/1.
10. Tayyeb Z, Kinsara A, Farid S (1998) A study on the radon concentrations in water in Jeddah (Saudi Arabia) and the associated health effects. *Journal of Environmental Radioactivity,* ***38:*** *97-104.*
11. Babai KS, Poongothai S, Santhanam R (2011) Measurement of Radon Levels in Dwellings in and Around Chennai City Using SSNTD. *European Journal of Scientific Research*, **62:** *6-13.*
12. Mehra R, Badhan K, Sonkawade RG (2010) Radon Activity Measurements in Drinking Water and in Indoors of Dwellings, Using RAD7. *Tenth Radiation Physics & Protection Conference, Nasr City-Cairo, Egypt. 35-39.*
13. Akortia E, Oppon OC, Serfor-Armah Y (2010) Indoor Radon Gas Levels in Selected Homes in the Greater Accra Region of Ghana. *Research Journal of Applied Sciences, Engineering and Technology*, **2:** 734-742.
14. Binesh A, Mowlavi A, Mohammadi S, Parvaresh P (2009) Indoor radon measurement in some apartments of Mashhad city (Iran). *IFMBE Proceeding,* ***25:*** *189-190.*
15. Abbady A, Abbady A, Michel R (2004) Indoor radon measurement with The Lucas cell technique. *Applied Radiation and Isotopes,* ***61:*** *1469–1475.*

16. Cheng J, Guo Q, Ren T (2002) Radon levels in china. *Journal of Nuclear Science and Technology, **39:** 695-399.*
17. Bouzarjomehri F and Ehrampoosh MH (2008) Radon level in dwellings basement of Yazd-Iran. *Iranian Journal of Radiation Research, **6:** 141-144.*
18. Abumurad K and Al-Omari R (2008) Indoor radon levels in irbid and health risk from internal doses. *Radiation Measurements, **43:** S389–S391.*
19. Narayana Y, Somashekarappa H, Karunakara N, Balakrishna K, Siddappa K, Kumar S, Gopalani D, Ramaseshu P (1998) Seasonal variation of indoor radon levels in coastal Karnataka on the south-west coast of India. *Radiation Measurements, **29:** 19-25.*
20. Gaso MI, Segovia N, Pulinets S, Leyva A, Ponciano G, Pena P (2005) Indoor radon and annual effective doses at a high altitude region in central Mexico. *Journal of Applied Sciences,* **5:** 1356-1362.
21. Sathish LA, Nagaraja K, Ramanna HC, Nagesh V, Sundareshan S (2009) Concentration of radon, thoron and their progeny levels in different types of floorings, walls, rooms and building materials. *Iranian Journal of Radiation Research, **7:** 1-9.*
22. Hadad K, Doulatdar R, Mehdizadeh S (2007) Indoor radon monitoring in Northern Iran using passive and active measurements. *Journal of Environmental Radio-activity, **95:** 39-52.*