SHORT REPORT

Identification of the Potential Radiation Risk of Indoor Radon in Old Buildings of Pabedan Township, Yangon Region

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Radon is a heavy gas and tends to collect in basements or in other low places in the building. In closed and lower areas such as ground floor of a building, tunnels and caverns, however, the radon concentrations may reach a level of several thousand Bqm^{-3}. Almost all risk from radon comes from breathing air containing radon and its decay products. When radon is inhaled, the alpha particles from its radioactive decay directly strike sensitive lung tissue causing damage that can lead to lung cancer.[1]

The action level of the indoor radon concentration set by Environmental Protection Agency's National Emission Standards for Hazardous Air Pollutants (NESHAPs) is 48 Bqm^{-3}. International Commission on Radiological Protection (ICRP) and National Commission on Radiological Protection (NCRP) recommended the Annual Effective Dose limit to be 5mSvy^{-1} received from radon and it progeny above which it can be health hazard.[2-4]

Several decay products can be detected in urine, blood and lung and bone tissue. However, the best way to assess exposure to radon is by measuring concentrations of radon (or radon decay products) in the air at building. Annual Effective Dose is used to better describe the biological relevance of a radiation exposure where different tissues/organs receive varying absorbed doses in a year.[5] In this cross-sectional study, indoor radon concentration was measured in ground floor of concrete old buildings (>40 years of age) from Pabedan Township in Yangon Region and then the level of Annual Effective Dose of indoor radon was calculated. Pabedan Township was selected purposively because of its predominance of old buildings. Fifty ground floor residence in Pabedan Township were randomly selected by lot drawing.

Permission was obtained from householders of that selected buildings. Indoor radon concentration was measured directly by RAD 7, Electronic Radon Detector in living room of the ground floor of old buildings according to the manufacturer's instructions for proper quality control of result. Ten minutes before the test, all windows and doors were closed. Air exchange system or ventilation, fans were also off. The RAD7 was placed near the center of the room, about 3 - 4 feet above the floor, away from walls, vents, fireplaces, windows, draft, and direct sunlight. The air intake was from a probe placed at least 30 inches (75 cm) above the floor, and away from the walls. Data were printed at the end of 4 cycles (30 minutes), and a summary, bar chart and cumulative spectrum printed at the end of the run. Some

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behaviors of the inhabitants that can affect indoor radon concentration were asked by a short interview for 5 minutes to the householder. This interview included as: residing of in this apartment and opening doors and windows at daytime for ventilation. The total duration was 1 hour.

Data entry and analysis were done by using Microsoft Excel 2007 and SPSS-16 software. Mean, standard deviation and median values were computed for radon concentration in air samples using by CAPTURE Software of RAD7, DURRIDGE Co., Ltd. The annual average effective dose for indoor radon was calculated using parameters formula by International Commission on Radiological Protection (ICRP).

ERn(nSvy-1)=CRn(Bq.m-3)x0.4x7000 (hy-1) x 9nSv (Bq.m-3.h)-1

Where CRn is the mean radon concentration in the units of Bqm-3,

The typical value of 0.4 was used as the equilibrium factor for radon indoors.

A recommended value of 9nSv (Bqm-3.h)-1 was used to convert radon equilibrium-equivalent concentration to the effective dose, and an 80% home occupancy time (7000 h per year) was assumed.

In this study, the minimum and maximum values of radon concentrations calculated and the Annual Effective Dose in building age varied from 3.0±1.3 Bqm^{-3} to 84.8±7.0 Bqm^{-3} and 0.076$mSvy^{-1}$ to 2.16$mSvy^{-1}$, respectively. The mean value of radon concentration was 18.8 Bqm^{-3} and Annual Effective Dose was 0.5$mSvy^{-1}$. Radon concentration in 28% (14/50) of the buildings was higher than 48 Bqm^{-3} which is action level set by Environmental Protection Agency’s National Emission Standards for Hazardous Air Pollutants (NESHAPs).

Radon concentrations of 43% of old buildings (60 years and above), 36% of above 50 years and 21% of above 40 years were higher than those of the other old buildings. Radon concentration of 28 old buildings (60 years and above) were lower because those old buildings were carried out the regular maintenance, renovation and good ventilation and flooring type. Radon concentration of apartments with cracks and the bare concrete floor (84.8±7.0 Bqm^{-3}) was the highest and 13 old buildings with bare concrete floor were more than other floor types. Radon concentration of room with cracks place and poor painted color cement floor (68.4±6.3 Bqm^{-3}) was also more than action level (48 Bqm^{-3}). Increased radon concentration (<48 Bqm^{-3}) was found out in apartments of old building with bare concrete floor (26%). Increased radon concentration (<48 Bqm^{-3}) was found out in 12 apartments with smaller room size (<2000 Vol ft^3) and poor ventilation (less opening status of windows [88% of buildings], no airconditioners or exhaust fans) (Fig. 1).

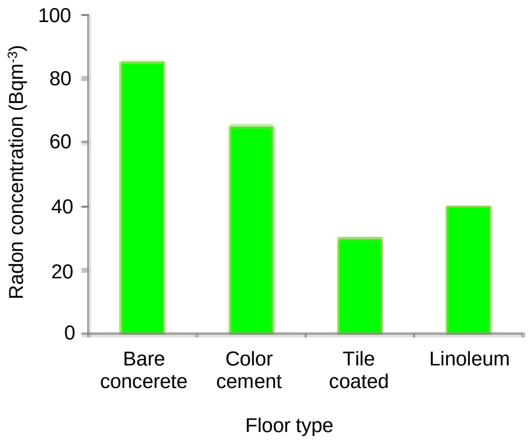

Fig 1. Identification of radon concentration and floor types

Geological and environmental parameters such as crowed place and humidity may be responsible for the radon exposure. Another reason for the difference in radon concentration is ventilation and floor type. An increase in ventilation rate would probably reduce the radon concentration level. In all selected 50 old buildings, the radon concentrations in bare concrete floor were greater than those of other floors. High radon concentration in ground floor of old buildings indicated age of building, type of floor, ventilation status and environmental pollution in these buildings.

This study highlighted the need for an action plan for the reduction of radiation risk to prevent the detrimental long-term respiratory disorders. Therefore, regular monitoring is necessary to measure in old buildings for air pollutants and indoor air is important for residents of the old buildings. Further health education of the ventilation and floor type is entail to find out the ways of reducing radon exposure in old buildings.

Competing interests

The authors declare that they have no competing interests.

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