

Outdoor Radon Dose Conversion Coefficient in South-Western and South-Eastern United States

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Two hundred and forty samples of radon (^{222}Rn) gas concentration, together with unattached and attached-to-ambient-aerosol radon progeny concentrations, were collected at 16 outdoor sites in four US states. The effective dose rate (to the lungs) was calculated with ICRP's recently recommended lung dosimetry model (ICRP Publication 66) using the measure potential alpha energy concentration (PAEC) and unattached fraction (f_p). The measurement procedure for f_p assumed a characteristic particle diameter of 1.1 nm for the unattached progeny. The site-average value of the conversion coefficient between radon gas concentration and effective dose rate was found to be $6.7 \text{ nSv}\cdot\text{h}^{-1}$ per $\text{Bq}\cdot\text{m}^{-3}$, with a standard deviation of $1.3 \text{ nSv}\cdot\text{h}^{-1}$ per $\text{Bq}\cdot\text{m}^{-3}$. The correlation coefficient ρ of effective dose rate with respect to radon gas concentration between these 16 sites was 0.98. Thus, the radon gas concentration alone was a good predictor of effective dose rate in outdoor air, at least when the dose calculation was based on a known PAEC and the assumption of discrete unattached and attached particle size does. For an average outdoor occupancy of $5 \text{ h}\cdot\text{d}^{-1}$ together with the average radon gas concentration, the annual effective dose rate average for outdoor exposure at these 16 sites was approximately $80 \text{ uSv}\cdot\text{y}^{-1}$, with a median value of $54 \text{ uSv}\cdot\text{y}^{-1}$ and a geometric standard deviation between sites of about 1.9. The average effective dose rate from outdoor radon progeny found in this study is approximately one-tenth the value of $740 \text{ uSv}\cdot\text{y}^{-1}$ from indoor exposure, which is based on the EPA's value of $46.3 \text{ Bq}\cdot\text{m}^{-3}$ for the average radon gas concentration in US homes, and ICRP's recommended dose conversion convention of 1.1 mSv per $\text{mJ}\cdot\text{h}\cdot\text{m}^{-3}$ ($3.8 \text{ mSv}\cdot\text{WLM}^{-1}$). Correlations between the outdoor dose rate and a number of meteorological and environmental variables were examined: equivalent uranium concentration in soils, wind speed, terrain roughness, atmospheric stability and particle concentration.

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