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Assessment of Gamma Radiation Levels In Indoor Environment

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Abstract

Gamma radiation has become a part of our daily exposure due to cosmic spray and primordial radionuclides content of the building materials. In the present study, six villages in East Khasi Hills District of Meghalaya, India, have been surveyed covering a total of fifty-eight dwellings. A portable gamma radiation survey meter-based Geiger Muller tube has been used in the measurement methodology. Average gamma level in the whole study region is found to be 183.56 $nGy.h^{-1}$, and annual effective dose is estimated at 0.71 mSv.

Keywords: Gamma radiation, Survey meter, Effective dose.

1. Introduction

Prolonged exposure to gamma radiation may pose serious health hazard to the general populacedue to its ionization effect, and thus may have fatal consequences.Gamma ray have both terrestrial and extra-terrestrial origins, where the former is focussed in the present study. Primordial radionuclides such as ^{40}K, ^{238}U and ^{232}Th, are usually found in trace amount in majority of the commonly used building materials and thus may act as crucial gamma source to the indoor environment due to their spontaneous activity processes. Secondary source such as the soil beneath, may also contribute significantly to the indoor gamma level.Outdoor sources include secondary radiation from the atmospheric interaction with cosmic ray particles and few other natural sources such as lightning strikes and terrestrial gamma ray flashes. Terrestrial radiation is known to vary appreciably compared to cosmic rays, due to this, a proper monitoring technique must be adopted to accurately assess the concentration levels in different kind of environment [1-3].The present study focussed on the baseline database of gamma level in the region, since no such measurement has been reported yet. Absorbed gamma dose rate have been measured in fifty-eight dwellings, from which annual effective dose has been estimated.

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2. Material and Method

A portable gamma survey meter (POLIMASTER PM 1405), has been used for the measurement of ambient gamma dose rate in indoor environment of the studied dwellings. This device works on the principle of multiple ionization events inside the Geiger Muller tube, where the inert gas present in the tube becomes conductive due to interaction with incident radiation. The ionization event is further amplified within the tube by Townsend discharge effectto produce a measured detection pulse, which is finally fed to the processing-display electronics to obtain the radiation dose reading. The detection limit of this device for gamma energy is in the energy range of 0.05 – 3 MeV, and for dose rate measurement, it ranges from 0.1 $\mu Sv.h^{-1}$ to 100 $mSv.h^{-1}$ [4].

Around ten dwellings from each village has been chosen for carrying out the measurement. The room where measurement is being performed, vary from dwelling to dwelling, depending upon the comfort and permission of the respective house owner, which include; sitting room, kitchen, bed room etc. During the measurement process, the device is held at 1 meter above the ground and a minimum distance of around 100 meter is maintained between the dwellings. The types of dwelling we come across in the present study are mostly concrete, semi-concrete and wooden.

The annual effective dose due to exposure to gamma radiation is estimated using the equation (1) given below [5], a conversion factor of 0.7 $SvGy^{-1}$ was used as suggested in UNSCEAR Publication, 1993.

$$AED_{indoor}\ (mSv.y^{-1}) = \text{Absorbed dose rate}\ (nGy.h^{-1}) \times 8760h \times 0.7\ SvGy^{-1} \times 0.8 \qquad (1)$$

3. Results and Discussions

The villages and their respective coordinates of the studied area have been tabulated in table 1, together with thevalues of absorbed dose rate and estimated annual effective dose.Absorbed dose rate in the six villages range from 96.4 $nGy.h^{-1}$ to 385.5 $nGy.h^{-1}$with an average value of 183.5 $nGy.h^{-1}$. These ranges of values seem to be higher than those of other countries as given in UNSCEAR 2000, which are also higher when compare with other data reported elsewherein the country [6]. The reason for the elevated value of average absorbed rate in the study region may be due to rich radionuclides content of the building material in majority of the dwellings, which are the primary source of gamma ray in indoor environment. Overall, the annual effective dose values range from 0.37 mSv to 1.51 mSv with an average value of 0.71 mSv. These values are found to be comparable with that of Nambi et.al [6]. It is seen that Pyndenglitha village recorded the highest value of both absorbed dose and annual effective dose, this may be due to the geological feature of thisplace. From the frequency distribution plot, fig 1, it is observed that 75 % of the surveyed dwellings possess annual effective dose value in the rangeof 0.2 mSv to 0.8 mSv, and the rest 25 % of dwellings have much higher level of annual effective dose, but still lie within the safe limit as recommended by ICRP [7]. As depicted in fig 2, the distribution of absorbed dose data in the whole study area is rightly skew and un-symmetric, which is proved by the longer upper whisker length of the box-plot.

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Table 1. Statistics of themeasured parameters in the study area.

Villages	Coordinates	Value	Absorbed dose (nGy.h^{-1})	Annual effective dose (mSv)
Lyngkyrdem	N-25°34' 46.92" E-91°89' 47.70"	Min.	114.01	0.45
		Max.	175.40	0.69
		Avg.	141.20	0.55
Mawkdok	N-25°42' 27.46" E-91°79' 44.84"	Min.	149.09	0.58
		Max.	263.10	1.03
		Avg.	194.69	0.76
Mawsmai	N-25°24' 38.42" E-91°73' 89.15"	Min.	114.01	0.45
		Max.	166.63	0.65
		Avg.	136.81	0.54
Pyndenglitha	N-25°44' 79.83" E-91°61' 84.87"	Min.	192.94	0.76
		Max.	385.88	1.51
		Avg.	312.21	1.22
Mawryngkneng	N-25°55' 96.39" E-92°06' 11.99"	Min.	96.47	0.38
		Max.	210.48	0.83
		Avg.	156.98	0.62
Thynroid	N-25°49' 41.22" E-91°96' 98.91"	Min.	114.01	0.45
		Max.	175.40	0.69
		Avg.	153.48	0.60

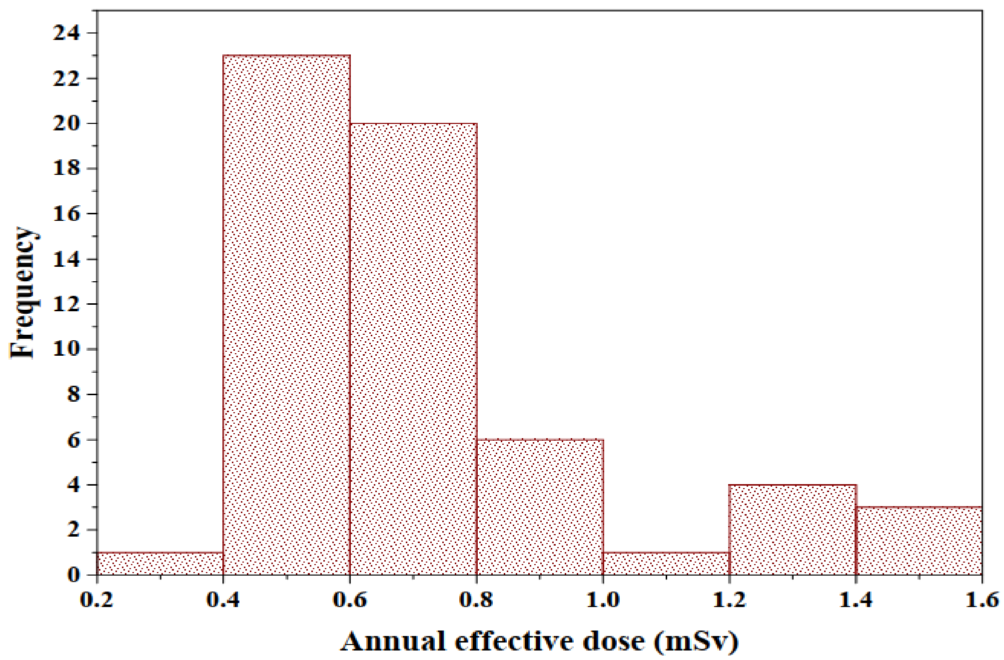

Figure 1. Frequency plot of annual effective dose (AED) in the study

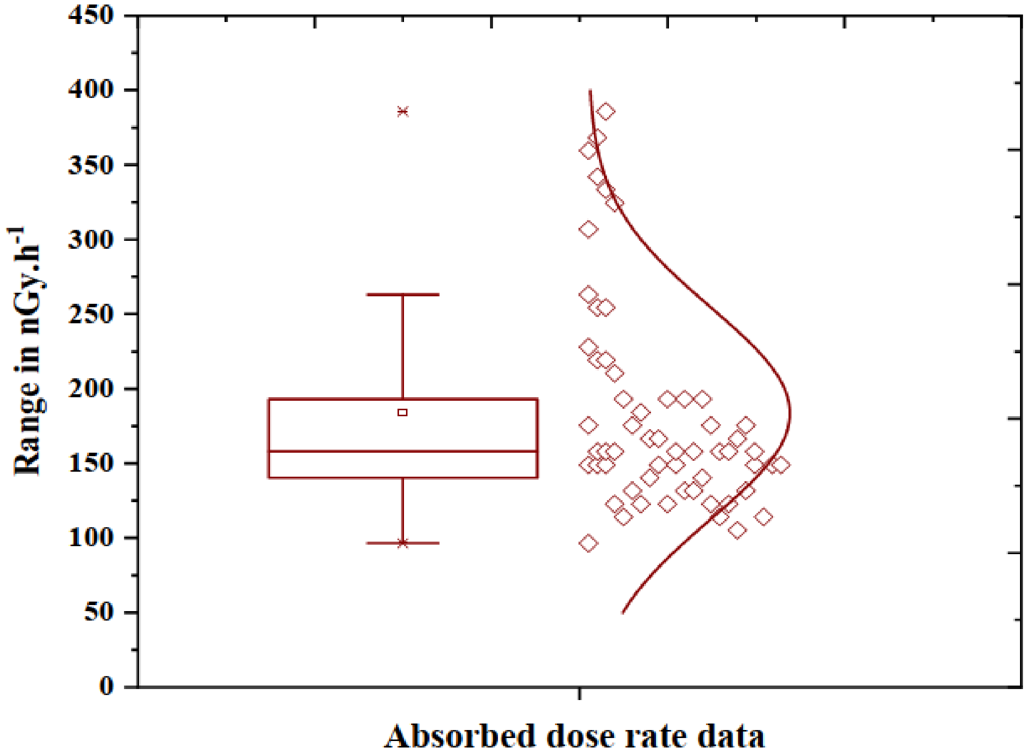

Figure 2. Box and normal plot of the absorbed dose data of the whole study

4. Conclusion

To conclude, the measured gamma dose rate in the present study show slightly higher value compared to the country's average dose rate [6].The estimated annual effective dose falls within the safe range of limit as prescribed by renowned agencies in the field of radiation study [7, 8]. Thus, no fatalities may be expected in the study region due to exposure to gamma radiation.

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References

[1] I. R McAulay and P. A Colgan *Radiat. Prot. Dosim* **7,** 309-311,1984.

[2] R. S Matiullah and D. J. Steck *Lambert Academic Publishing*,2011.

[3]S. A Durrani and R Illi‟c *World Scientific Publishing co. Pvt. Ltd, 1997.*

[4] S. Monica, A. K. V Prasad, S. R Soniya and P J Jojo *Inter. Jr. Pure. Appl. Phys* **13,**179-187, 2007.

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[5] M. A Kobeissi, S. E Omar, Z Khaled, R Ibrahim *New York: Springer* 2014.

[6]Nambi K. S, BapatV. N, DavidM, SundaramV. K, SantaC. M,SomanS. D 1986 *HPDBARC*

[7] International Commission on Radiological Protection,ICRP 2014 Publication 126Annals of the ICRP

[8] UNSCEAR 2008 United Nation Commission on the Effect of Atomic Radiation