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Measurement of background gamma radiation in surgical and other wards of teaching hospitals affiliated to birjand university of medical sciences, birjand, iran

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Abstract

Introduction: Measurement of background gamma radiation in the human living environment, including hospitals, can provide useful information for epidemiological studies and authority bodies to consider appropriate strategies to reduce the exposure of these resources. Therefore, this study aimed to evaluate the background gamma radiation in surgical and other hospital wards, as well as indoors and outdoors of Valiasr, Razi, and Imam Reza hospitals in Birjand, Iran.

Methods: Measurement of background gamma was performed according to the protocols of the International Commission on Radiation Protection by X5CPLUS survey meter. This study was conducted in Valiasr, Razi, and Imam Reza hospitals, South Khorasan province, Birjand, Iran, using a Geiger- Müller dosimeter in nano Sieverts per hour (nSv/h). Measurements were taken in the general sections and five stations outside the buildings (18 stations in total), and at each station, for half an hour and every minute, the readings were recorded at a distance of one meter from the ground. The average readings as dose background gamma were reported at the measured stations.

Results: In the present study, among three evaluated hospitals, the maximum values in Razi, Imam Reza, and Valiasr hospitals were related to the urology department (62.04±13), orthopedic unit (94.66±20), and ENT department (60.7±19), respectively. On the other hand, the maximum outdoor dose values in Razi, Valiasr, and Imam Reza hospitals were in the southwest (62.5±12), southeast (57.9±13), and northwest (57±14), respectively. Furthermore, the minimum observed background radiation values in Valiasr, Razi, and Imam Reza hospitals were related to the emergency department (47.3±17), neurology department (51.86±17), and southwest point (53.9±19), respectively.

Conclusion: The results of this study show that none of the hospital units nor outdoors in these hospitals can be introduced as a point where the amount of background radiation has an important concern.

Keywords: Background Radiation, Gamma Rays, Hospitals, Hospital Units, Surgery

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Introduction

In general, ionizing radiation that living beings are constantly and naturally exposed to is called background radiation (1-2). Background radiation is present in all regions of the Earth. These types of radiation are the main source of human exposure and other living organisms from natural resources that permanently affect the dose received by humans and depend on the concentration of natural radioactive elements existing in the Earth's crust with different amounts (3-4). The amount of the received dose from background gamma radiation can vary depending on latitude and longitude, and therefore, the intensity of biological effects can be different in different places (5-6).

Terrestrial radiation is emitted from radioactive nuclei in the Earth's crust and is present with different concentrations in natural environments, including water, soil, and air, as well as the human body. Some of the radioactive nuclei in the Earth's crust were produced with the Earth formation, such as the nuclei in the decay series of uranium and thorium. Some other radioactive nuclei, including cesium-137 and strontium-90, are the result of nuclear tests on the Earth. A considerable portion of human external exposure is due to emitted gamma radiation with the origin from existing radioactive nuclei in the 238U decay series, as well as 232Th and 40K decay series (1).

In addition to natural sources of ionizing radiation, due to the widespread and increasing medical and industrial applications of this radiation, man-made sources are among the most important artificial sources of ionizing radiation. Both natural and artificial radiation leads to external exposure in the population. In general, about 85% of the total annual individual radiation dose is from natural radionuclides, as well as both terrestrial and cosmic sources (7-9). According to the latest reports by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the total worldwide average effective dose from natural radiation is approximately 2.4 mSv a year, of which 1.1 mSv is from gamma rays arising from cosmic rays and existing radioactive materials in the Earth's crust, and its 1.3 mSv is due to radon (10-11). About one-third of the total radiation is from external sources, and the remaining two-thirds is from internal sources. It is estimated that the dose from external sources and the dose from internal sources can be increased up to 1.5 and 2.5 times, respectively (12-13). Radiation exposure from radon depends on the geological characteristics, the type of residential buildings, and their materials (14-17).

The study of the ionizing radiation level inside the buildings is of significant importance for the following reasons: 1) some building materials may be radioactive, 2) typically, indoor air has more radon than outdoor air, and 3) due to lifestyle changes, people spend more time indoors. Surveys conducted by the World Health Organization and the International Commission on Radiological Protection (ICRP) show that the residents of temperate climates spend 20% and 80% of their time outdoors and indoors (homes, offices, schools, and other buildings), respectively. Based on these studies, it is clear that the probability of indoor ionizing radiation exposure is higher than outdoor, and by considering the higher-stop coefficient in indoor spaces rather than outdoor, this type of exposure is very important (10). Therefore, in recent years, different studies around the world have been performed to assess population exposure to natural radiation.

Measurement of background gamma radiation in the human living environment, including hospitals, can provide useful information for epidemiological studies and authority bodies to consider appropriate strategies to reduce exposure to these resources. Therefore, this study aimed to evaluate the background gamma radiation in surgical and other hospital wards, as well as indoors and outdoors of Valiasr, Razi, and Imam Reza hospitals in Birjand, Iran.

Materials and Methods

This cross-sectional descriptive study was conducted in Valiasr, Razi, and Imam Reza hospitals, South Khorasan province, Birjand, Iran, in 2018. Considering the protocols of the ICRP and by the use of the X5CPLUS survey meter, the measuring

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range of this dosimeter was obtained from 0 nSv/h to 20 mSv/h.

This study was extracted from a research plan (4665) approved by the Ethics Committee of Birjand University of Medical Sciences, Birjand, Iran (IR. BUMS.REC.1396.332).

Measurements were performed in general surgery, MRI, burns, orthopedics, intensive care, pediatrics, ENT, gynecology, neurology, cardiology, infectious, urology, internal medicine, and general emergency departments, as well as five stations outside the buildings (18 stations in total, the same as similar studies) using the Geiger-Müller dosimeter in terms of nano Sieverts per hour (nSv/h). At each station, for half an hour and once every minute, the readings were recorded one meter above the ground, and the average readings were reported as the background gamma dose in the measured stations. The units in these hospitals in which the measurements were performed were divided into two groups of surgical and other units. The results are presented in separate tables.

Results

The results of dose measurement of background gamma radiation in the units and outdoor stations of Razi, Valiasr, and Imam Reza hospitals are mentioned below. Table 1 shows the mean dose values in the surgical units of three hospitals. Some units may not exist in each hospital; therefore, only the measured values of the existed units in each hospital are reported. Table 2 tabulates the dose values in the non-surgical units entitled to the other units of the three hospitals in which some units may not exist; therefore, only the measured values of the existed units in each hospital have been reported the same as the previous table. The measured outdoor values in each hospital are summarized in Table 3.

Table 1. Measured mean background gamma radiation (nSv/h) in surgical units in three hospitals

	Burns	Orthopedic	General surgery	ENT	Gynecology	Urology	Emergency
Razi Hospital	-	-	-	-	-	53.2±14	50.8±10
Valiasr Hospital	-	-	-	60.7±19	75.36±15	57.63±17	74.3±3
Imam Reza Hospital	76.6±19	94.66±19	63.06±15	-	-	69.44±16	75.2±21

Table 2. Measured background gamma radiation (nSv/h) in non-surgical units in three hospital

	MRI	Intensive care	Pediatric	Neurology	Cardio	Infectious	Internal
Razi Hospital	-	-	-	51.68±17	54.4±15	65.7±17	59.6±13
Valiasr Hospital	-	53.3±17	58.32±16	-	-	-	-
Imam Reza Hospital	63±15	71.32±16	-	67.43±13	-	-	67.71±11

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Table 3. Measured outdoor background gamma radiation (nSv/h) in three hospitals

	Northwest	Southwest	Central	Southeast
Razi Hospital	55.8±21	62.5±12	55.43±20	75.9±15
Valiasr Hospital	45.43±17	25.5±13	56±18	75.9±13
Imam Reza Hospital	57±14	53.9±19	54±16	56±14

Discussion

Radiation sources are in the Earth's crust, air, food, and building materials. Ionizing radiation causes damages to living cells in different degrees as it passes through the cells; therefore, it must always be assumed that the smallest amount of radiation has the ability to cause biological effects (18-20). In the present study, three hospitals were evaluated, and the results indicated that among three evaluated hospitals, the maximum values in Razi, Imam Reza, and Valiasr hospitals were related to the urology department (62.04±13), orthopedic unit (20±94.66), and ENT department (19±60.7), respectively. On the other hand, the maximum outdoor dose values were measured in Razi Hospital in the southwest (62.5±12), Valiasr Hospital in the southeast (57.9±13), and Imam Reza Hospital in the northwest (57±14). The minimum observed background radiation doses in Valiasr, Razi, and Imam Reza hospitals were related to the emergency department (17±47.3), neurology department (51.86±17), and southwest point (53.9±19), respectively. On the other hand, the highest outdoor values were related to Razi Hospital in the southwest (62.5±12), Valiasr Hospital in the southeast (57.9±13), and Imam Reza Hospital in the northwest (57±14). The minimum observed background radiation values in Valiasr, Razi, and Imam Reza hospitals were related to the emergency department (47.3±12), neurology department (51.86±17), and southwest point (53.9±19), respectively.

In general, background gamma radiation in Imam Reza Hospital was higher than that in the other hospitals. The obtained values were checked by the standards of the ICRP and were under the standard levels. The annual effective dose rates in different countries are in the range of 0.3-0.6 mSv (21). The results of this study showed that the average indoor and outdoor values of radiation of Razi, Valiasr, and Imam Reza hospitals are very close to each other. In a study conducted by Quindos et al. in 1994 on natural radioactivity and indoor gamma dose in Spain, the average estimated indoor gamma dose rate for the entire Spanish population was estimated at 53.3 nGy/h, which was in accordance with the results of this study (22). Bahraini et al. measured background gamma radiation in Kurdistan province, and the highest level of indoor radiation was obtained at 166±26 nSv/h (23). Furthermore, Buraeva et al. measured the background gamma radiation and showed that the level of background gamma radiation was within the standard range (24). The results of similar studies show that the amount of indoor gamma radiation in residential areas is higher than that in the outdoors, which is due to the fact that materials are used for buildings taken from stone and soil mines. The ratio of indoor to outdoor radiation in this study is about 1.12, which is estimated by UNSCEAR to be 1.4 (25). In a study, the level of indoor and outdoor background ionizing radiation of Kwali General Hospital in Abuja was measured. In general, the average measured indoor dose was 0.107µSv/h, and the average measured outdoor dose was estimated at 0.108 µSv/h (26).

There are no special limitations in conducting this study. However, for dose level measurement, the survey meter should be installed in the center of these medical units for an hour, and it might cause inconveniences for the staff, which was made possible with the patience of these unit staff.

Conclusion

According to the findings, it can be considered that mean indoor gamma radiation was higher than the

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average outdoor background radiation. In addition, the important point is that the average background radiation levels in this study was not higher than that in other studies. The results of this study show that none of these hospital units or outdoor stations can be identified as a point where the background gamma radiation has a considerable concern. In the end, it is suggested that the staff received dose from portable radiography examinations in surgical units be evaluated and also the total effective dose be estimated for cancer risk calculation.

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Conflict of interest

The authors declare that there is no conflict of interest in conducting this study.

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