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Assessment of Health Risk Due To Soil Radioactivity Concentration Levels in Five Hospitals in Abia State Nigeria.

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ABSTRACT
Thallium doped Sodium odideNaI (Tl) detector is the most commonly used detector in experimental physics for the measurement of the gamma-ray activity of various soil samples. This NaI (Tl) detector is used in the measurement of nuclear reaction cross-section induced by neutrons and protons in the activation technique. In addition, the scintillation detector has a lot of applications in the elemental analysis of various and compounds, alloys using activation analysis. In each application, the precise values of detection efficiency for different gamma energies and knowledge of detector resolution for different gamma energies are necessary. In the present work, detection efficiency and resolution of NaI (Tl) detector are measured and optimized for following gamma-ray energies: 0.662 MeV, 1.460 MeV, 1.760 MeV and 2.614 MeV. The mean activity values obtained for the radioanuclides^{40}K, ^{226}U and ^{232}Th (respectively) in Federal Medical Centre Umuahia, General Hospital, Aba, Abia State; Living World Hospital Aba, abia State; Nigeria Christian Hospital, Obingwa in Nlagu of Abia State and Seventh Days Adventist Hospital Aba are: 91.93±1.45, 21.52±3.18 and 22.94±0.80 Bqkg^{-1}; 79.64±1.55, 20.38±3.67 and 24.22±0.72Bqkg^{-1}; 96.29±1.48, 20.85±3.27 and 22.17±0.71Bqkg^{-1}; 122.87±1.49, 30.78±3.65 and 33.04±0.75Bqkg^{-1} and 79.98±1.62, 19.50±3.21 and 25.26±0.69Bqkg^{-1} respectively. These values were below the worldwide average values: 32 Bqkg^{-1} for ^{226}Ra, 45 Bqkg^{-1} for ^{232}Th, and 412 Bqkg^{-1} for ^{40}K as documented by UNSCEAR (2000). The standard gamma sources provided by the IAEA (International Atomic Energy Agency) are used in the present work. We measure the radiation doses and excess lifetime cancer risk from the radionuclides C^{226}Ra, ^{232}Th and ^{40}K in 50 soil samples collected from the five selected hospitals within Abia State, Nigeria.

Keywords: Soil, Activity concentration levels, Sodium detector, Gamma energies, Detection efficiency. Excess lifetime cancer risk.

INTRODUCTION

In radioactivity, a constant emission of radiation occurs when unstable nuclei or nuclear reactions decompose, leading to the emission of radiation by radioactive elements (Jordan, Kailyn, Maddy & Jason, 2020). Radioactivity can be artificial or natural; by bombarding stable isotopes with neutrons, Andrew (2020) describes artificial radioactivity as an induced form of radioactivity, while nuclear reactions which occur spontaneously are said to be an example of natural radioactivity.
Notably, there are three naturally occurring radioactive series among the elements in the periodic table. These are known as the uranium series, the actinium series and the thorium series, each named after the element at which the series start (except the actinium series which starts with a different uranium isotope). Each series decays through a number of unstable nuclei by means of alpha and beta emissions, until each series ends on a different stable isotope of lead (Andrew, 2020). The radiations from these natural radioactivity is what individuals in various parts of the world and in Nigeria have been continuously exposed to (Ibrahim, Akpa & Daniel, 2013).

The term ionizing radiation is used to describe the emission of charged particles and waves through the space or material medium as part of the ionization process (Weissteinet al., 2014). Basically, there are four major types of radiation which include alpha, beta, neutrons, and electromagnetic waves such as gamma rays and X- rays (USNRC, 2018). As the heaviest type of radiation particle, Alpha particles are composed of two protons and two neutrons. Many of the naturally occurring radioactive materials in the earth, like uranium and thorium, emit alpha particles. Beta particle is an electron that is not attached to an atom. It has a smallmass and a negative charge; whereasneutron is a particle that doesn't have any charge and is present in the nucleus of an atom. Neutrons are commonly seen when uranium atoms split, or during fission in a nuclear reactor. Electromagnetic radiations like X-rays and gamma rays are probably the most familiar type of radiation because they are used widely in the hospitals for diagnostic andtherapeutic purposes. These rays are like sunlight, except they have more energy. The amount of energy can range from very low, like in dental x-rays, to the very high levels seen in irradiators used to sterilize medical equipment inhospitals (USNRC, 2018).

Radioactive materials have been found to be very effective when used in a variety of medical applications for diagnostic, therapeutic and research purposes in hospitals. As a consequence of handling these materials in hospitals, a wide range of radioactive waste is produced and deposited on the soil (IAEA, 2000).In a study by (Nwachukwu and Ugbogu; 2013), radioactive wastes resulting from various hospital operations across Nigeria include radioactive diagnostic materials and radiotherapy supplies contaminated with radioactive diagnostic materials.; liquids, gas and solids contaminated with radionuclides whose ionizing radiations have genotoxic effects. However, the ionizing radiations of interest in hospitals include x-rays and gamma- rays as well as alpha and beta particles.

Unfortunately, inadequate practices of radioactive waste disposal in hospitals are the principal human activities responsible for soil radioactive contamination and degradation (Smičiklas, 2016). Therefore, there is a need for safedisposal of radioactive wastes in hospitals with its primary objectives as to ensure that the radiation exposure to public and environment does not exceedthe prescribed safe limits (ICRP, 1995; Murthy &

Mumbai, 2000). Also, keeping the exposure levels within the prescribed limits reduces the short term and long-term effects of ionizing radiation on humans, besides reducing its negative impact on theenvironment (Khan et al., 2010).

Although since ages, the soil or earth's crust has always contained radionuclides with long half-lives, such as ^{40}K, ^{238}U, and ^{232}Th, as a result oftheir radioactivity, those radionuclide cause natural background radiations (Durosoy& Yildirim, 2017).Soil is therefore, considered as one of the major sources of radiation exposure to a population through the transfer of radionuclide into the environment (Ahmad, Jaafar, Bakhash, & Rahim, 2015). Likewise, deposits of radioactive wastes from medical practices in hospitals soils have been found to increase soil radiation in such environment(IAEA, 2000). Therefore, determination of the activity levels of the radionuclide of the soil can helpto ascertain the natural radioactivity in a region and thus, will serve as a baseline for futurecontamination of the area.

Several studies have been conducted around the world to assess natural radioactivity levels in the soil of certain areas (Ibrahim, Akpa & Daniel, 2013), yet in Abia State, there seems to be no empirical information on soil radioactivity concentration levels in hospitals. Examining the soilradioactivity levels of hospitals in Abia state would play a salient role as it will provide vital empirical information that can be used for decision making in economic, legal or environmental management. Hence, the present study aimed at assessing the health risk due to soil radioactivity concentration levels in some hospitals in Abia State, Nigeria.

MATERIALS AND METHODS

SAMPLE LOCATIONS

The sampling hospitals include Federal Medical Centre (FMC) Umuahia, Seventh Day Adventist Hospital (SDA) Aba, Living Word Hospital (LWH) Aba, Nigerian Christian Hospital (NCH) Aba and General Hospital (GH) Aba.

EQUIPMENT USED

The equipment used in this study are as follows:Nal (Tl) gamma ray detector
Local mortar and pestle
2mm sieve
Sample container
Adhesive tape
Gamma ray detector
Hand trowel
Spring balance
Measuring tape
Polyethene bag

COLLECTION OF SOIL SAMPLES

Soil samples were collected in polythene bags which were previously washed with tap water. The depth for sample collections were 150 mm each below the surface using hand trowels. Samples were collected from 10 locations in each institution. Soil samples were transport to the University of Ibadan for spectroscopic analysis after the period of four weeks.

PREPARATION OF SOIL SAMPLES

The collected soil samples were dried at room temperature until a constant mass was reached. Thereafter, the soil samples were crushed,homogenized and sieved with a 2.0 mm mesh sieve.200 g of the sieved soil samples were transferred into empty cylindrical plastic containers of uniformsize (60 mm height by 65 mm diameter) and sealed.A time of four weeks was allowed after packing and sealing to attain secular radioactive equilibrium between Ra-226 and its short-lived daughter products (Ramasamy et al., 2009).

MEASURING SYSTEM

The system for the radioactivity measurements was a lead-shielded 76 mm × 76 mm NaI (Tl) detector (Model No. 802-series, Canberra Inc.) coupled to a Canberra Series 10+ Multichannel Analyser (MCA) (Model No. 1104) through a preamplifier base. The MCA is a complete system having all the functions needed for spectroscopic analysis. The measuring system has the advantage ofoperating on rechargeable batteries which prevent interruption in counting in case of public power outage. Investigations of some spectralcharacteristics were performed before counting of the samples in order to evaluate the reliability of thesystem for the measurement.

Energy Calibration

The energy calibration was performed in order to relate channel numbers to gamma-rays energy in MeV. After a preset counting time of 1000s, the channels of the various photopeaks corresponding to known gamma energies were identified. The channel numbers were obtained from gamma energies of some known radionuclides from standard reference samples from Nucleus Inc. Oak Ridge, TN USA and geological certified reference material for radiometric measurement from International Atomic Energy Agency (IAEA) Vienna.The channel numbers corresponding to the gamma energies while thecalibration curve is shown .A linear equation was obtained with which the gamma energy, E (MeV) corresponding to a channel number, N can be obtained. The equation is given as: $(MeV) = 0.02097N + 0.41680$ --------------------------------3.1

Equation 3.1 was stored in the memory of the MCA for the purpose of identifying the various radionuclides which may be present in the samples through the gamma energies they emit.

ASSESSMENT OF RADIOLOGICALRISKS DUE TO NATURAL RADIATION EXPOSURES

From the direct or Linear-No-Threshold(LNT) probability between effective dose and probability of effects for low-level doses, it follows that the collective detriment G, on N people is directly proportional to the collective effective dose resulting from an exposure (Farai et al., 2006). Thatis:

$$G = R_K S_E$$

Where S_E is the collective effective dose equivalent, R_K is the constant of proportionality referred to as the total risk factor. It has been determined from data on epidemiological studies that the value of R_K is $16.5x10^{-3}$ Sv^{-1} (IAEA, 1996) and Collective Effective Dose Equivalent (S_E) = Effective Dose Equivalent x Population (3.7)

The incidence of a particular health burdensuch as cancer in a population is a function ofpopulation size. To eliminate the factor of population size when risk is related to other factors, the collective detriment G will be computed in a fixed population size of 10^5 (Ujeno, 1983). Hence, the normalized collective detriment N_G is:

$$N_G = \frac{G \times 10^5}{Population\ Size}$$

Thus, the normalized collective detriment (risk) due to natural radioactivity was computed using risk factor, effective dose equivalent values and fixed population sizes of the institutions.

RESULTS AND DISCUSSION

ACTIVITY CONCENTRATION OFRADIONUCLIDES IN SOIL SAMPLE

Radionuclide concentrations in soilsamples of the five selected hospitals in Abia State was measured using gamma spectroscopic methods.The results obtained from the measurements are

presented in tables 4.1-5 for Federal Medical Centre Umuahia, General Hospital Aba, Living World Hospital Aba, Nigeria Christian Hospital Obingwa and Seventh Days Adventist Hospital Aba respectively.

The activity concentrations for obtained at the Federal Medical Centre Umuahia, ranged from 35.50Bqkg^{-1} - 140.45Bqkg^{-1}, BDL-36.01Bqkg^{-1} and BDL-43.87Bqkg^{-1} for the radionuclides^{40}k, ^{226}Raand ^{232}Th, respectively.

In General Hospital Aba, Abia State, the activity concentrations range from 26.47Bqkg^{-1} – 122.99Bqkg^{-1}, BDL-

30.10Bqkg^{-1} and BDL- 37.15Bqkg^{-1} for^{40}k, ^{226}Ra and ^{232}Th, respectively. At Living World Hospital Aba, Abia State, the Activity Concentrations ranges,BDL- 30.90Bqkg^{-1}, BDL-147.18 Bqkg-^{1}, BDL-30.11Bqkg^{-1} and BDL-37.15Bqkg^{-1} for ^{40}k, ^{226}Ra and ^{232}Th respectively.

At Nigeria Christian Hospital Obingwa in NlaguAbia State. The activity concentrations range from BDL—189.11Bqkg-^{1},BDL-42.17Bqkg-^{1} andBDL-42.11Bqkg-^{1}for^{40}k, ^{226}Ra and ^{232}Th.

In Seventh Days Adventist Hospital Aba. The activity concentration ranges from 53.22Bqkg-^{1} – 121.24Bqkg-^{1}, BDL-30.10Bqkg-^{1} and BDL-39.10Bqkg-^{1} For ^{40}k, ^{226}Ra and ^{232}Rq and ^{232}Th respectively. The results obtained from this study were lower than what (Orosunet al., 2019) obtained for a granite mining site in North-central Nigeria, but was similar to what (Amakom et al., 2021)obtained for soil samples in a reclaimed auto- mechanic village in Imo state, Nigeria. Generally, inthe five Hospitals in Abia State considered, the mean activity concentrations were belowthe world average of 33 Bqkg^{-1} 45 Bqkg^{-1} and 420 Bqkg^{-1} foe ^{226}Ra, ^{232}Th and ^{40}K respectively(UNCSEAR 2000).

ACTIVITY CONCENTRATIONS OF THE RADIONUCLIDE AT DIFFERENT LOCATIONSIN FMC.

Sample ID	Sample Location	^{40}k(Bqkg-^{1})	^{226}Ra(Bqkg-^{1})	^{232}Th(Bqkg-^{1})
1.	Nursing Block	113.58 ± 1.41	36.01 ± 2.25	35.42 ± 0.77
2.	Eyes, Ear Clinic Block	140.45 ± 1.39	18.08 ± 3.61	23.51 ± 0.81
3.	Kitchen Building Block	113.23 ± 1.41	22.92 ± 3.11	33.98 ± 0.77
4.	Theatre Block	125.96 ± 1.39	24.66 ± 2.96	33.03 ± 0.77
5.	Children Block (Building)	88.80 ± 1.44	10.92 ± 4781	5.58 ± 0.90
6.	Labour Block (Building)	55.39 ± 1.52	BDL	15.21 ± 0.83
7.	Female Block (Building)	98.75 ± 1.42	18.66 ± 2.97	24.17 ± 0.78
8.	Administrative Office	56.96 ± 1.51	10.63 ± 4.14	14.62 ± 0.78
9.	Car Park	90.64 ± 1.43	26.83 ± .35	20.94 0.79
10.	Emergency and Accident Block	35.50 ± 1.56	24.95 ± 2.46	BDL

ACTIVITY CONCENTRATIONS OF THE RADIONUCLIDE AT DIFFERENT LOCATIONIN GH

Sample ID	Sample Location	^{40}k(Bqkg-^{1})	^{226}Ra(Bqkg-^{1})	^{232}Th(Bqkg-^{1})
1.	Security Block	105.54 ± 1.58	5.00 ± 4.33	37.15 ± 0.63
2.	Male Block	100.24 ± 1.39	21.14 ± 2.48	27.15 ± 0.81
3.	Accident and Emergency Building	87.11 ± 1.54	10.32 ± 3.58	22.25 ± 0.55
4.	Consulting Building	122.99 ± 1.69	15.78 ± 3.74	18.00 ± 0.84
5.	Day Room (Back)	20.90 ± 1.64	28.91 ± 3.37	15.55 ± 0.77
6.	Delivery Building (Back)	91.30 ± 1.68	16.44 ± 4.65	30.10 ± 0.87

7.	Dispensary (Front)	25.47 ± 1.46	30.10 ± 3.93	24.44 ± 0.74
8.	Intensive Care Unit Building	57.80 ± 1.33	27.40 ± 2.73	14.79 ± 0.57
9.	Pharmacy Building	84.55 ± 1.67	28.90 ± 3.72	25.53 ± 0.75
10.	Operating Theatre	100.50 ± 1.47	19.77 ± 4.13	27.19 ± 0.66

ACTIVITY CONCENTRATIONS OF THE RADIONUCLIDES AT DIFFERENTLOCATIONS IN LWH.

Sample ID	**Sample Location**	^{40}**k(Bqkg-**^{1}**)**	^{226}**Ra(Bqkg-**^{1}**)**	^{232}**Th(Bqkg**^{1}**)**
1.	Out Patient Department(Block)	86.18 ± 1.53	24.01 ± 2.70	BDL
2.	Medical Department	124.11 ± 1.29	19.45 ± 3.11	37.15 ± 0.81
3.	Nursing Block School	99.51 ± 1.72	28.78 ± 4.10	BDL
4.	Paramedical Building	100.75 ± 1.30	23.48 ± 3.04	25.91 ± 0.75
5.	Theatre Complex Block	72.71 ± 1.28	12.54 ± 2.57	25.86 ± 0.77
6.	Pharmacy Department	147.18 ± 1.51	18.97 ± 2.92	18.57 ± 0.59
7.	Radiology Department	114.40 ± 1.61	21.47 ± 3.84	5.44 ± 0.54
8.	Emergency Block	98.94 ± 1.52	14.33 ± 3.27	15.92 ± 0.64
9.	Dietary Department	88.23 ± 1.64	30.11 ± 3.91	16.99 ± 0.75
10.	Physical Medicine and Rehabilitation Building	30.90 ± 1.47	15.39 ± 3.29	31.49 ± 0.83

ACTIVITY CONCENTRATIONS OF THE RADIONUCLIDE OF DIFFERENTLOCATIONS IN NCH.

Sample ID	**Sample Location**	^{40}**k(Bqkg-**^{1}**)**	^{226}**Ra(Bqkg-**^{1}**)**	^{232}**Th(Bqkg**^{1}**)**
1.	Mortuary Building Back	151.13 ± 1.30	20.11 ± 3.01	39.44 ± 0.76
2.	Security Building Front	99.11 ± 1.61	16.67 ± 3.11	27.48 ± 0.52
3.	Labour BuildingFront	118.0 ± 1.55	38.76 ± 4.43	37.23 ± 0.91
4.	Children Ward Front	89.25 ± 1.53	26.66 ± 2.49	42.11 ± 0.77
5.	Theatre Building (Beside)	166.33 ± 1.52	32.74 ± 4.33	27.88 ± 0.64
6.	Pharmacy Building	88.37 ± 1.36	39.32 ± 3.89	BDL
7.	Kitchen Unit Front	BDL	37.10 ± 2.97	39.13 ± 0.75
8.	Administrative Block	95.11 ± 1.39	8.47 ± 4.99	15.44 ± 0.62

	Front			
9.	Car Part Field	179.07 ± 1.45	45.78 ± 3.88	38.88 ± 0.92
10.	Consulting Ward Outside	119.47 ± 1.70	42.17 ± 3.36	29.73 ± 0.88

ACTIVITY CONCENTRATIONS OF THE RADIONUCLIDE AT DIFFERENTLOCATIONS IN SDA.

Sample ID	**Sample Location**	**^{40}k(Bqkg-^{1})**	**^{226}Ra(Bqkg-^{1})**	**^{232}Th(Bqkg^{1})**
1.	CAR Park Field	108.14 ± 1.21	15.10 ± 410	27.40 ± 0.77
2.	Mortuary Building	69.11 ± 1.43	23.11 ± 2.11	39.10 ± 0.54
3.	Laboratory Building	86.58 ± 1.70	16.44 ± 4.24	30.15 ± 0.61
4.	Delivery Building	86.15 ± 1.43	8.62 ± 2.07	15.11 ± 0.74
5.	X-ray Building	53.22 ± 1.48	16.17 ± 2.55	29.12 ± 0.80
6.	Kitchen Site (Front)	92.40 ± 1.57	28.10 ± 3.01	28.12 ± 0.66
7.	Laundry Building	102.25 ± 1.41	17.30 ± 3.74	BDL
8.	Building of Nursing Building	51.78 ± 1.59	32.72 ± 3.92	30.97 ± 0.81
9.	Pharmacy Building	79.41 ± 1.31	18.33 ± 2.18	27.10 ± 0.64
10.	Male Building (Front)	122.10 ± 1.68	19.14 ± 4.15	25.48 ± 0.69

ABSORBED DOSE RATES AND ANNUAL EFFECTIVE DOSE EQUIVALENT FROM SOIL SAMPLES.

The absorbed dose rate and annual effective dose rates due to radionuclide concentrations in soil samples from Federal MedicalCenters (FMC), General Hospital (GH), Living Word Hospital (LWH), Nigerian Christian Hospital(NCH), and Seventh Day Adventist Hospital (SDA)are presented in tables 4.6-4.10 respectively.

The mean absorbed dose rates for FMC, GH, LWH, SDA and NCH were 25.99 ± 8.35nGyh^{-1}, 27.68 ±5.14nGyh^{-1}, 32.98 ± 6.20nGyh^{-1}, 37.12 ± 9.10nGyh^{-1}, and 29.45 ± 9.30nGyh^{-1}, respectively, while themean annual effective dose equivalent were 31.77±10.23

µSvy^{-1}, 34.56 ± 6.18 µSvy^{-1}, 31.01 ±6.42 µSvy^{-1}, 46.52±10.97 µSvy^{-1}, 39.90 ± 13.84 µSvy^{-1}for the FMC, GH, LWH, NCH, and SDA respectively. Both the absorbed dose rate and annual effective dose equivalent obtained from this study were found to be less than the world average of 51nGyh^{-1} and 70 µSvy^{-1}for the absorbed dose rate and annual effective dose respectively (UNSCEAR, 2000) but was similar to the results obtained by (Farai and Jibiri, 2000) and (Eke et al., 2015) in thecapital city of Owerri.

Table 6: ABSORBED DOSE RATES AND OUTDOOR ANNUAL EFFECTIVE DOSE RATES ATDIFFERENT LOCATIONS IN FMC

Samples ID	Sample locations	Absorbed Dose Rate (nGyh^{-1})	Annual outdoor Effective Dose Rate (µusvy^{-1})
1.FMC	Nursing School Block	43.71	53.64
2.FMC	Eyes, Ear Clinic Block	29.32	35.99
3.FMC	Kitchen Building Block	37.15	45.59
4. FMC	Theatre Block	37.81	46.40
5. FMC	Children Building	12.18	14.94
6. FMC	Labour Building Ward	12.45	15.28
7. FMC	Female Building Block	28.21	34.63
8. FMC	Administrative Office	16.67	20.45
9. FMC	Car Park Field	29.22	35.86
10. FMC	Emergency and Accident	12.18	14.95

Table 7: ABSORBED DOSE RATES AND OUTDOOR EFFECTIVE DOSE RATES AT DIFFERENTLOCATIONS IN GH.

Samples ID	Sample Locations	Absorbed Dose Rate (nGyh^{-1})	Annual outdoor Effective Dose Rate (µusvy^{-1})
1. GH	Security Building	31.27	38.38
2. GH	Male Building	31.31	38.43
3. GH	Accident and Emergency	22.88	28.08
4. GH	Consulting Room Building	23.94	29.38
5. GH	Day Room Back	23.54	28.89

6. GH	Delivery Building (Back)	30.87	37.89
7. GH	Dispensary (Front)	30.13	36.98
8. GH	Intensive Care Unit Building	23.98	29.43
9. GH	Pharmacy Building	32.88	40.35
10. GH	Operating Theater	30.76	37.75

Table 8: ABSORBED DOSE RATES AND OUTDOOR EFFECTIVE DOSE RATES AT DIFFERENT LOCATIONS IN LWH

samples ID	Sample Locations	Absorbed Dose Rate ($nGyh^{-1}$)	Annual outdoor Effective Dose Rate ($\mu usvy^{-1}$)
1.LWH	Out Patient Department (Block)	16.59	20.36
2.LWH	Medical Department (Building)	38.24	46.93
3.LWH	Nursing Block Building	18.82	23.09
4. LWH	Paramedical Building	31.51	38.67
5. LWH	TheatreComplex Building	25.60	31.42
6. LWH	Pharmacy Department Building	26.72	32.79
7. LWH	Radiology Department Building	17.69	21.71
8. LWH	Emergency Building	20.91	25.66
9.LWH	Dietary Building	27.89	34.23
10. LWH	Physical Medicine And Rehabilitation Building	28.75	35.28

Table 9: ABSORBED DOSE RATES AND OUTDOOR EFFECTIVE DOSE RATES AT DIFFERENT LOCATIONS IN NCH.

Samples ID	Sample Locations	Absorbed Dose Rate ($nGyh^{-1}$)	Annual outdoor Effective Dose Rate ($\mu usvy^{-1}$)
1.NCH	Mortuary Building (Back)	41.19	50.55
2.NCH	Security Building (Front)	29.57	36.29
3.NCH	Labor Building (Front)	46.27	56.79
4. NCH	Children Ward Front	43.10	52.89

5. NCH	Theatre Building (Beside)	39.59	48.59
6. NCH	Pharmacy Building	23.21	28.48
7. NCH	Kitchen Unit (Front)	42.41	52.05
8. NCH	Administrative Block Front	17.93	22.00
9. NCH	Car Park Field	52.99	65.03
10. NCH	Consulting Ward Outside	42.83	52.56

Table 10: ABSORBED DOSE RATES AND OUTDOOR EFFECTIVE DOSE RATES AT DIFFERENTLOCATIONS IN SDA.

Samples ID	Sample Locations	Absorbed Dose Rate (ngyh^{-1})	Annual Outdoor Effective Dose Rate (µusvy^{-1})
1.SDA	Car Park Field	29.24	35.89
2.SDA	Mortuary Building	38.72	47.52
3.SDA	Laboratory Building	30.70	37.68
4. SDA	Delivery Building	17.39	21.34
5. SDA	X-Ray Building	28.47	34.94
6. SDA	Kitchen Site (Front)	34.59	42.45
7. SDA	Laundry Building	14.43	17.71
8. SDA	School Of Nursing Building	36.71	45.05
9. SDA	Pharmacy Building	29.18	35.81
10. SDA	Male Ward Building (Front)	65.87	80.83

CONCLUSION

This study determines the level of background ionizing radiation (BIR) in the various five hospital withinAbia State, Nigeria. The measurement of the background ionizing radiation was taken using the Nal (Tl) gamma ray detector. Result show that for all the hospital in Abia State, the Nigerian Hospital poses the highest radioactivityconcentration level due to the health risk of the soil radiation. The living world hospital has the least calculated radiological risk.

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REFERENCES

[1]. Ademola, A. K. and Obed, R. I. (2012). Gamma radioactivity levels and their corresponding external exposure of soil samples from Tantalite mining areas in Oke-Ogun, South-Western Nigeria. Radioprotection. 47; 243-252.

[2]. Ahmad N., Jaafar M.S., Bakhash M.& Rahim M. (2015) An overview on measurements of natural radioactivity in Malaysia. Journal of Radiation Research and Applied Sciences, 8 (1), pp. 136-141

[3]. Ahmed, N. K. and El-Arabi, A. G. M. (2005). Natural radioactivity in farm soil and phosphate fertilizer and its environmental implications in Qena governorate, Upper Egypt. Journal of Environmental Radioactivity. 84; 51-64.

[4]. Akhtar, N., Tufail, M. and Ashraf, M. (2005). Natural environmentalradioactivity and estimation of radiationexposure from saline soils. International Journal of Environmental Science and Technology.1; 279-285.

[5]. Andrew S. (202). Natural and ArtificialRadioactivity, Retrieved fro http://www.chm.bris.ac.uk/webprojects2002/sidell/NAT&ART.htm

[6]. Bastos, R. O. and Pascholati, E. M. (2005).Environmental gamma radiation inMunicipalities of Eastern Sao Paulo State, Brazil. Terrae. 2(1-2); 37-45.

[7]. Becegato, V. A., Ferreira, F. J. F. and Machado, W. C. P. (2008). Concentration of radioactivity elements derived from phosphate fertilizers in cultivated soils. Brazilian Archives of Biology and Technology. 51, 1255-1266.

[8]. Durosoy A. & Yildirim M. (2017). Determination of radioactivity concentrations in soil samples and dose assessment for Rize Province, Turkey. Journal of Radiation Research and AppliedSciences. Vol.10(4), pp 348-352

[9]. Eke, B. C., Jibiri, N. N., Anusionwu, B. C., Orji, C. E. and Emelue, H. U. (2015). Baseline Measurements of natural radioactivity in soil samples from the Federal University of Technology, Owerri,South – East, Nigeria. British Journal of Applied Sciences & Technology. 5(2); 142– 149.

[10]. Emelue H U, Eke B C, Oghome P, and Ejiogu B C (2013), "Evaluation of Radiation Emission from Refuse Dump Sites in Owerri, Nigeria" IOSR Journal of Applied Physics (IOSR-JAP) e-ISSN: 2278-4861. 4(6); 01-05.

[11]. Emelue H U, Eke B C, Oghome P, and Ejiogu B C (2013), "Evaluation of Radiation Emission from Refuse Dump Sites in Owerri, Nigeria" IOSR Journal of Applied Physics (IOSR-JAP) e-ISSN: 2278-4861. 4(6); 01-05.

[12]. Farai, I. P., Obed, R. I. and Jibiri, N. N. (2006). Soil radioactivity and incidence ofcancer in Nigeria. Journal of Environmental Radioactivity. 90; 29 – 36.

[13]. Feinendegen, L. E., Brooks, A. L. and Morgan, W. F. (2011). Biological consequences and health risks of low-level exposure to ionizing radiation: Commentary on the workshop. Health Physics. 100 (3); 247-259.

[14]. Feinendegen, L. E., Pollycove, M. and Neumann, R. D. (2010). Low-dose cancer risk modeling must recognize up- regulation of protection. Dose Response. 8; 227-252.

[15] Harb, S., Salahel, D. K., Abbady, A. and Mostafa, M. (2010). Activity concentration for surface soil samples collected from Armant, Qena, Egypt. Proceedings of the 4th Environmental Physics Conference, Hurghada, Egypt. 4; 49-57.

[16] IARC (International Agency for Research on Cancer). (2000). IARC monographs on the evaluation of carcinogenic risks to humans. Ionizing Radiation, Part 1: X – and γ -Radiation and Neutrons. 75.

[17] Ibrahim, F. A. and Mohammad, I. A. (2009). Soil radioactivity levels and radiation hazard assessment in the highlands of Northern Jordan. Radiation Measurements. 44; 102-110.

[18] Ibrahim, U., Akpa, T.C., & Daniel, I.H.(2013). Assessment of Radioactivity Concentration in Soil of Some Mining Areas in Central Nasarawa State, Nigeria. Science World Journal Vol 8 (2). Available at www.scienceworldjournal.org

[19] ICRP (1995). Recommendations of the International Commission on Radiological Protection. British Journal of

Radiology. (6)

[20] Innocent, A. J., Onimisi, M.Y. and Jonah, S. A. (2013). Evaluation of naturally occurring radionuclide materials
in soil samples collected from some mining sites in Zamfara State, Nigeria. British Journal of Applied Science
and Technology. 3(4); 684-692.

[21] Innocent, A. J., Onimisi, M.Y. and Jonah, S. A. (2013). Evaluation of naturally occurring radionuclide materials in soil samples collected from some mining sites in Zamfara State, Nigeria. British Journal of Applied Science and Technology. 3(4); 684-692.

[22] International Atomic Energy Agency (2000). Management of radioactive waste from the use of radio-nuclides in medicine IAEA-TECDOC-1183

[23] Jibiri, N. N. (2001). Assessment of health risk levels associated with terrestrial gamma radiation dose rates in Nigeria. risk levels associated with terrestrial Environment International. 27; 21 – 26

[24] Jibiri, N. N. (2001). Assessment of health risk levels associated with terrestrial gamma radiation dose rates in Nigeria. Environment International. 27; 21 – 26.

[25] Jordan, H., Kailyn S., Maddy S. & Jason D., (2020). Radioactivity. Available at https://energyeducation.ca/encyclopedia/R adioactivity

[26] Karahan, G. and Bayulken, A. (2000). Assessment of gamma dose rates around Istanbul (Turkey) journal of Environmental Radioactivity. 47; 213-221.

[27] Khan, S., Syed, A., Ahmad, R., Rather, T. A., Ajaz, M., & Jan, F. (2010). Radioactive Waste management in a hospital. International journal of health sciences, 4(1), 39–46

[28] Mehta R, Badhan K, Sonkawade RG, Kansal S, Singh S. (2010). Analysis of terrestrial natural radionuclides in soil samples and assessment of average effective dose. Indian journal of pure and applied physics. 48: 805-808

[29] Murthy B. K. S. & Mumbai B. A. R. C.(2000). Operational limits. Training workshop on Radiation Safety in Nuclear Medicine and RSO Certification Examination; pp. 6.1–6.6. Available at https://scienceworld.wolfram.com/physic/Radiation.html

[30] NCRM (National Council on Radiation and Measurement) Reports 92, 93, 94, 95 and100

[31] NCRP, (1987). Exposure of the population of the United States and Canada from natural background radiation. Report No. natural background radiation. Report No. Protection and Measurements, Bethesda Maryland.

[32] Njinga, R. L. and Tshivhase, V. M. (2016). Lifetime cancer risk due to gamma radioactivity in soils from Tudor shaft mine environs,South Africa. Journal of Radiation Research and Applied Sciences9; 310-315

[33] Nkechi C. N., Frank A. O. and Ositadinma C.U. (2013).Health Care Waste Management – Public Health Benefits and the Need for Effective Environmental Regulatory Surveillance in the Federal Republic of Nigeria. http://dx.doi.org/10.5772/53196

[34] NRC (National Research Council). (2006). Health risks from exposure to low levels of ionizing radiation (BEIR VII). Washington, DC: National Academy Press.

[35] Nuclear Science (2018)—A Guide to the Nuclear Science Wall Chart ©2018 Contemporary Physics Education Project (CPEP)