Acta Scientific Clinical Case Reports

Volume 3 Issue 7 July 2022

Case Study

Cancer Implication of Background Radiation Exposure to Sensitive Organs in Keffi and Karu Local Government Areas of Nasarawa State, Nigeria

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Received: May 02, 2022

Published: June 22, 2022

Abstract

This research work tends to uncover the effect of exposure to radiation on human organs as a result of quarry mining taking place in Keffi and Karu of Nasarawa State using Inspector Alert Nuclear Radiation Monitor. The results showed that, the mean effective dose and excess lifetime cancer risk (ELCR) in Keffi and Karu are found to be 0.03372 and 0.02844 mSv/y for effective dose and 0.04956×10^{-3} and 0.09954×10^{-3} for excess lifetime cancer risk respectively. The mean Effective Dose to Organs (D_{organ}), for the lungs, ovaries, bone marrow, testes, kidney, liver and whole body in Keffi and Karu are found to be 0.01215 and 0.01820, 0.01101 and 0.01650, 0.01310 and 0.01962, 0.01556 and 0.02332, 0.01177 and 0.01763, 0.00873 and 0.01308, and 0.01290 and 0.01934 mSv/y respectively. From the findings presented, it can be concluded that the radiation in different mining sites of Keffi and Karu of Nasarawa State is not an issue of health concern except on seventy years of exposure. It is therefore, advised that, government should stop the illegal mining and introduce mechanize mining for easy control of the health effects. It is also recommended that water and soil sample be taking for elemental analysis to ascertain the effect of the mining activity in these areas through ingestion, since it has no much effects on the populace of the area through inhalation according to this research.

Keywords: Radionuclides; Mining; D_{organ}; Radiation; Effective Dose; Excess Lifetime Cancer Risk

Introduction

The association of radiation with matter can pose biological hazard which may show the clinical symptoms later. Radiation Safety is bothered about cellular effects, which may damage the chromosomes and their components (e.g., genes, DNA, etc.). Radiation association with the body produces micro sub-cellular-level effects that may course cellular responses and, in the accumulation, may produce macro observable health effects on some organs or tissues. Irradiation of tissue may lead to cellular injury, which may later cause injury to the organ and to the organism. Some factors can modify the response of a living organism to a fixed dose. Molecules effects, like effect to the DNA, can occur in any of two ways from an exposure to radiation. Firstly, radiation can relate directly with DNA, causing a single or double-strand DNA breaks or bonding pairs. Secondly, radiations can relate directly with neighboring molecules within or outside the cell, such as water, to produce free radicals and active oxygen species. These reactive molecules, later, relate with the DNA and/or other molecules within the cell such as membranes, mitochondria, lipids, proteins, etc. to produce several of health implication to cellular and tissues [1-5]. Cellular/Organ Radio sensitivity [6-8]. The effect of radiation depends also on some biological factors like species, age, sex, part of the exposed tissues, different radio sensitivity, and repair mechanisms [9-14]. If the cells are adequately repaired and relatively normal function is restored, the subtler DNA alterations may also be expressed at a later time as mutations and/or tumors [12-15].

This study will unveil the various factors that leads to the variation in radiation effects in Keffi and Karu, the hazards of man's continual exposure to radiation through different radiation emitting source and possible protection and control measures to its exposure.

Materials and Methods

Materials

The materials used to execute this research work are; The inspector Alert Nuclear Radiation Monitor, Scientific Calculator, Personal Computer (laptop), Pen and Exercise Book.

Method

The methods of radiation measurement used in this research work was by using radiation monitor with in-build Geiger Muller tube operating in the Dose Rate mode to determine the background ionizing radiation level from the selected Quarry Mining Sites across Keffi and Karu of Nasarawa State. The Geiger Muller tube generates a pulse of electrical current each time radiation passes through the tube which cause ionization. Each pulse is electrically detected and registered as a count , but CPM, been the most direct and appropriate method of measuring alpha and beta activity was chosen as the correct mode. The inspector Alert was held above the ground level (1m above). The device was turn on and measurements were taken after a deep sound that indicates the statistical validity of the readings on the liquid crystal display (LCD) of the monitor.

Study Area

Keffi is a town in Nasarawa State, Nigeria. The headquarters are in the town of Keffi which is 50 kilo meters from Abuja.

It has an area of 138 km^2 and a population of about 92,664 at the 2006 census. The postal code of the area is 961.

Karu is a Local Government Area in Nasarawa State, Nigeria. It is close to the Federal Capital of Nigeria. It has an area of 2,640 km^2. The headquarters of Karu is located in New Karu town.

The map of Nasarawa State showing Keffi and Karu Local Government Areas and the map of Keffi and Karu Local Government Areas showing the data points are shown respectively in figures 1 and 2. The geographical coordinates of the data points are tabulated in table 1.

Figure 1: Map of Nasarawa State Showing Nasarawa West Senatorial District.

Figure 2: Map of Nasarawa West Showing Data Point.

S/N	Sample Point	E (Coordinate)	N (Coordinate)
1	Keffi 1	7° 50' 24"	8° 52' 44.4"
2	Keffi 2	7° 47' 20.4"	8° 50' 42"
3	Keffi 3	7° 48' 36"	8° 48' 54"
4	Karu 1	7° 55' 44.4"	9° 15' 14.4"
5	Karu 2	7° 52' 40.8"	9° 4' 30"
6	Karu 3	7° 43' 44.4"	8° 43' 58.8"

Table 1: The Geographical Coordinates of the Data Points.

Method data collection and measurement

The instrument used was Inspector Alert Meter. This detector is a relatively economical meter frequently used to perform surveys of very low radiation fields. It can measure variations in dose rate. The measuring range is 0 to 5000 μR/hr. (For μSv/h, use Model 19 Series 8, P/N: 48-2582.) The cast aluminum instrument housing with a separate battery compartment and accompanying metal handle offer an industrial robustness and quality that promote long lasting protection.

The meter was held one meter above the ground to reflect abdominal level of human readings in count per minute. Readings were taken three times in μR/hr after which the average reading was calculated for each of the camp work visited. The analytical procedure was conducted for five days, in Plateau State.

Method of data analysis

[20] Recommended indoor occupancy factors of 0.8. The factor is the proportion of the total time during which an individual is exposed to a radiation field. 8760 hr/yr were used. Equation (1) converts from Gamma Activity in milli Röentgen per hour to Exposure Dose Rate in micro – Sievert per hour, equation (2) converts the Exposure Dose Rate in micro – Sievert per hour to Annual Effective Dose Rate in milli Sievert per year, equation (3) evaluates the Excess Lifetime Cancer Risk, while equation (4) evaluates the Annual Effective Dose Rate to organs.

$$10mR/hr(GA) = 1\mu Sv/hr(EDR) \text{------------}1$$

$$AEDR\,mSv/yr = [(EDR)\mu Sv/hr \times 8760hr/yr \times 0.8] \div 1000 \text{ ---------------}2$$

$$ELCR = AEDR \times DL \times RF \text{---------------------}3$$

$$D_{organ} = AEDR \times F \text{ -----------}4$$

Results and Discussion

Results

Gamma activity level was obtained from the field, after which equations (1) – (4) were used to evaluate the Exposure Dose Rate (EDR), Annual Effective Dose Rate (AEDR), Excess Lifetime Cancer Risk (ELCR) and Effective Dose to different organs of the body (D_{organ}) and are presented in table 2, 3, 4 and 5.

S/No.	Sample Points	Gamma Activity (mR/hr)	Exposure Dose Rate (μSv/hr)	Effective Dose Rate (mSv/yr)	Excess Lifetime Cancer Risk x10^{-3}
1.	Keffi 1	0.026	0.0026	0.01822	0.06377
2.		0.023	0.0023	0.01612	0.05641
3.		0.025	0.0025	0.01752	0.06132
4.		0.027	0.0027	0.01892	0.06623
5.	Mean	0.003	0.0030	0.01770	0.06193
6.	Keffi 2	0.022	0.0022	0.01542	0.05396
7.		0.025	0.0025	0.01752	0.06132
8.		0.027	0.0027	0.01892	0.06623
9.		0.028	0.0028	0.01962	0.06868
10.	Mean	0.026	0.0026	0.01787	0.06255
11.	Keffi 3	0.032	0.0032	0.02243	0.07849
12.		0.015	0.0015	0.01051	0.03679
13.		0.047	0.0047	0.03294	0.11528
14.		0.028	0.0028	0.01962	0.06868
15.	Mean	0.031	0.0031	0.02137	0.07481
16.	Karu 1	0.102	0.0102	0.07148	0.25019
17.		0.100	0.0100	0.07008	0.24528

18.		0.097	0.0097	0.06798	0.23792
19.		0.078	0.0078	0.05466	0.19132
20.	Mean	0.094	0.0094	0.06605	0.23118
21.	Karu 2	0.024	0.0024	0.01682	0.05887
22.		0.020	0.0020	0.01402	0.04906
23		0.021	0.0021	0.01472	0.05151
24.		0.023	0.0023	0.01612	0.05641
25.	Mean	0.022	0.0022	0.01542	0.05396
26.	Karu 3	0.002	0.0002	0.00140	0.00491
27.		0.005	0.0005	0.00350	0.01226
28.		0.007	0.0007	0.00491	0.01717
29.		0.008	0.0008	0.00561	0.01962
30.	Mean	0.006	0.0006	0.00385	0.01349

Table 2: Exposure Levels and Related Radiological Health Indices in Keffi and Karu.

Table 2 presented the raw data obtained for gamma activity level at different mining points of Keffi and Karu of Nasarawa State, which was later summarized in table 3 for further interpretation and analysis.

S/No.	Sample Points	Gamma Activity (mR/hr)	Exposure Dose Rate (µSv/hr)	Effective Dose Rate (mSv/yr)	Excess Lifetime Cancer Risk x 10^{-3}
1	Keffi 1	0.003	0.0030	0.01770	0.06193
2	Keffi 2	0.026	0.0026	0.01787	0.06255
3	Keffi 3	0.031	0.0031	0.02137	0.07481
4	Mean	0.020	0.0078	0.03372	0.04956
5	Karu 1	0.094	0.0094	0.06605	0.23118
6	Karu 2	0.022	0.0022	0.01542	0.05396
7	Karu 3	0.006	0.0006	0.00385	0.01349
8	Mean	0.041	0.0041	0.02844	0.09954

Table 3: Summary of Exposure Levels and Related Radiological Health Indices in Keffi and Karu**.**

Table 3 presented the summary of the raw data obtained for gamma activity level at different points of Keffi and Karu and the calculated values for exposure dose rate, effective dose rate and excess lifetime cancer risk.

Based on the data presented, Keffi has the mean gamma activity of 0.02 mR/hr with keffi 3 having the highest value of 0.031 mR/hr followed by keffi 2 with 0.026 mR/hr then keffi 1 having the lowest value of 0.003 mR/hr. Meanwhile, Karu has the mean gamma activity of 0.041 mR/hr with karu 1 having the highest value of 0.094 mR/hr followed by karu 2 with 0.022 mR/hr then karu 3 having the lowest value of 0.006 mR/hr.

On exposure dose rate, Keffi has the mean exposure dose rate of 0.0078 µSv/hr with keffi 3 having the highest value of 0.0031 µSv/hr followed by keffi 1 with 0.003 µSv/hr then keffi 2 having the lowest value of 0.0026 µSv/hr. Meanwhile, Karu has the mean exposure dose rate of 0.0041 µSv/hr with karu 1 having the highest value of 0.0094 µSv/hr followed by karu 2 with 0.0022 µSv/hr then karu 3 having the lowest value of 0.0006 µSv/hr.

On effective dose rate, Keffi has the mean effective dose rate of 0.03372 mSv/yr with keffi 3 having the highest value of 0.02137 mSv/yr followed by keffi 2 with 0.01787 mSv/yr then keffi 1 having the lowest value of 0.01770 mSv/yr. Meanwhile, Karu has the mean effective dose rate of 0.02844 mSv/yr with karu 1 having the highest value of 0.006605 mSv/yr followed by karu 2 with 0.01542 mSv/yr then karu 3 having the lowest value of 0.00385 mSv/yr.

On excess lifetime cancer risk, Keffi has the mean excess lifetime cancer risk of 0.04956 $x10^{-3}$, with keffi 3 having the highest value of 0.07481 $x10^{-3}$ followed by keffi 2 with 0.06255 $x10^{-3}$ then keffi 1 having the lowest value of 0.06193 $x10^{-3}$. Meanwhile, Karu has the mean excess lifetime cancer risk of 0.09954 $x10^{-3}$ with karu 1 having the highest value of 0.23118 $x10^{-3}$ followed by karu 2 with 0.05396 $x10^{-3}$ then karu 3 having the lowest value of 0.01349 $x10^{-3}$.

S/No.	Sample Points	Effective Dose Rate to Sensitive Organs						
		Lungs	Ovaries	Bone Marrow	Testes	Kidney	Liver	Whole Body
1.	Keffi 1	0.01166	0.01057	0.01257	0.01494	0.01130	0.00838	0.01239
2.		0.01033	0.00935	0.01112	0.01322	0.00999	0.00741	0.01096
3.		0.01121	0.01016	0.01209	0.01437	0.01086	0.00806	0.01191
4.		0.01211	0.01097	0.01306	0.01552	0.01173	0.00870	0.01287
5.	Mean	0.01132	0.01026	0.01221	0.01451	0.01097	0.00814	0.01203
6.	Keffi 2	0.00987	0.00894	0.01064	0.01264	0.00956	0.00709	0.01048
7.		0.01121	0.01016	0.01209	0.01437	0.01086	0.00806	0.01191
8.		0.01211	0.01097	0.01306	0.01552	0.01173	0.00870	0.01287
9.		0.01256	0.01138	0.01354	0.01609	0.01217	0.00903	0.01334
10.	Mean	0.01144	0.01036	0.01233	0.01465	0.01108	0.00822	0.01215
11.	Keffi 3	0.01435	0.01301	0.01547	0.01839	0.01390	0.01032	0.01525
12.		0.00673	0.00610	0.00725	0.00862	0.00652	0.00484	0.00715
13.		0.02108	0.01910	0.02273	0.02701	0.02042	0.01515	0.02240
14.		0.01256	0.01138	0.01354	0.01609	0.01217	0.00903	0.01334
15.	Mean	0.01368	0.01240	0.01475	0.01753	0.01325	0.00983	0.01453
16.	Karu 1	0.04575	0.04146	0.04932	0.05862	0.04432	0.03288	0.04861
17.		0.04485	0.04065	0.04836	0.05747	0.04345	0.03224	0.04765
18.		0.04351	0.03943	0.04690	0.05574	0.04215	0.03127	0.04622
19.		0.03498	0.03170	0.03772	0.04482	0.03389	0.02514	0.03717
20.	Mean	0.04227	0.03831	0.04557	0.05416	0.04095	0.03038	0.04491
21.	Karu 2	0.01076	0.00976	0.01161	0.01379	0.01043	0.00774	0.01144
22.		0.00897	0.00813	0.00967	0.01149	0.00869	0.00645	0.00953
23		0.00942	0.00854	0.01015	0.01207	0.00912	0.00677	0.01001
24.		0.01032	0.00935	0.01112	0.01322	0.00999	0.00741	0.01096
25.	Mean	0.00987	0.00894	0.01064	0.01264	0.00956	0.00709	0.01048
26.	Karu 3	0.00090	0.00081	0.00097	0.00115	0.00087	0.00064	0.00095
27.		0.00224	0.00203	0.00242	0.00287	0.00217	0.00161	0.00238
28.		0.00314	0.00286	0.00338	0.00402	0.00304	0.00226	0.00334
29.		0.00359	0.00325	0.00387	0.00460	0.00348	0.00258	0.00381
30.	Mean	0.00247	0.00224	0.00266	0.00316	0.00239	0.00177	0.00262

Table 4: Dose to different organs of the body in Keffi and Karu.

Table 4 shows that the estimated mean D_{organ} values for the lungs, ovaries, bone marrow, testes, kidney, liver and whole body due to radiation exposure and inhalation in different mining points of Plateau State, which was later summarized in table 5 for further interpretation and analysis.

S/ No.	Sample Points	Effective Dose Rate to Sensitive Organs						
		Lungs	Ovaries	Bone Marrow	Testes	Kidney	Liver	Whole Body
1	Keffi 1	0.01132	0.01026	0.01221	0.01451	0.01097	0.00814	0.01203
2	Keffi 2	0.01144	0.01036	0.01233	0.01465	0.01108	0.00822	0.01215
3	Keffi 3	0.01368	0.01240	0.01475	0.01753	0.01325	0.00983	0.01453
4	Mean	0.01215	0.01101	0.01310	0.01556	0.01177	0.00873	0.01290
5	Karu 1	0.04227	0.03831	0.04557	0.05416	0.04095	0.03038	0.04491
6	Karu 2	0.00987	0.00894	0.01064	0.01264	0.00956	0.00709	0.01048
7	Karu 3	0.00247	0.00224	0.00266	0.00316	0.00239	0.00177	0.00262
8	Mean	0.01820	0.01650	0.01962	0.02332	0.01763	0.01308	0.01934

Table 5: Summary of Dose to different organs of the body in Keffi and Karu

Table 5 presented the summary of the evaluated results for D_{organ} values for the lungs, ovaries, bone marrow, testes, kidney, liver and whole body due to radiation exposure and inhalation in different mining points of Plateau State.

Based on the data presented, Keffi has the mean effective dose to lungs of 0.01215 mR/hr with keffi 3 having the highest value of 0.01368 mSv/yr followed by keffi 2 with 0.01144 mSv/yr then keffi 1 having the lowest value of 0.01132 mSv/yr. Meanwhile, Karu has the mean effective dose to lungs of 0.0182 mSv/yr with karu 1 having the highest value of 0.04227 mSv/yr followed by karu 2 with 0.00987 mSv/yr then karu 3 having the lowest value of 0.00247 mSv/yr.

On effective dose to ovaries, Keffi has the mean effective dose to ovaries of 0.01101 mSv/yr with keffi 3 having the highest value of 0.0124 mSv/yr followed by keffi 2 with 0.01036 mSv/yr then keffi 1 having the lowest value of 0.01026 mSv/yr. Meanwhile, Karu has the mean effective dose to ovaries of 0.0165 mSv/yr with karu 1 having the highest value of 0.03831 mSv/yr followed by karu 2 with 0.00894 mSv/yr then karu 3 having the lowest value of 0.00224 mSv/yr.

On effective dose to bone marrow, Keffi has the mean effective dose to bone marrow of 0.0131 mSv/yr with keffi 3 having the highest value of 0.01475 mSv/yr followed by keffi 2 with 0.01233 mSv/yr then keffi 1 having the lowest value of 0.01221 mSv/yr. Meanwhile, Karu has the mean effective dose to bone marrow of 0.01962 mSv/yr with karu 1 having the highest value of 0.04557 mSv/yr followed by karu 2 with 0.01064 mSv/yr then karu 3 having the lowest value of 0.00266 mSv/yr.

On effective dose to testes, Keffi has the mean effective dose to testes of 0.01556 mSv/yr with keffi 3 having the highest value of 0.01753 mSv/yr followed by keffi 2 with 0.01465 mSv/yr then keffi 1 having the lowest value of 0.01451 mSv/yr. Meanwhile, Karu has the mean effective dose to testes of 0.02332 mSv/yr with karu 1 having the highest value of 0.0416 mSv/yr followed by karu 2 with 0.01264 mSv/yr then karu 3 having the lowest value of 0.00316 mSv/yr.

On effective dose to liver, Keffi has the mean effective dose to liver of 0.00873 mSv/yr with keffi 3 having the highest value of 0.00983 mSv/yr followed by keffi 2 with 0.00822 mSv/yr then keffi 1 having the lowest value of 0.00814 mSv/yr. Meanwhile, Karu has the mean effective dose to liver of 0.01308 mSv/yr with karu 1 having the highest value of 0.03038 mSv/yr followed by karu 2 with 0.00709 mSv/yr then karu 3 having the lowest value of 0.00177 mSv/yr.

On effective dose to whole body, Keffi has the mean effective dose to whole body of 0.0129 mSv/yr with keffi 3 having the highest value of 0.01453 mSv/yr followed by keffi 2 with 0.01215 mSv/yr then keffi 1 having the lowest value of 0.01203 mSv/yr. Meanwhile, Karu has the mean effective dose to whole body of 0.01934 mSv/yr with karu 1 having the highest value of 0.04491 mSv/yr followed by karu 2 with 0.01048 mSv/yr then karu 3 having the lowest value of 0.00262 mSv/yr.

Result analysis

Comparison of results with united nation scientific committee on effect of atomic radiation

In this section, the results presented in Table 3 and Table 5 is used to plot charts in order to compare the results of the present study with UNSCEAR.

Comparison of annual effective dose rate with united nation scientific committee on effect of atomic radiation

The data presented in table 3 was used to plot a chart in order to compare the result of annual effective dose rate with UNSCEAR. This chart is presented in figure 3.

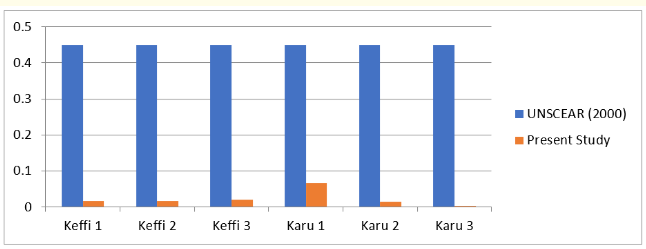

Figure 3: Comparison of Annual Effective Dose Rate with UNSCEAR.

On comparison of Annual Effective Dose Rate with UNSCEAR, it is observed that the Effective Dose for all the areas is found to be low.

Comparison of excess lifetime cancer risk with united nation scientific committee on effect of atomic radiation

The data presented in table 3 was used to plot a chart in order to compare the result of excess lifetime cancer risk with UNSCEAR. This chart is presented in figure 4.

On comparison of Excess Lifetime Cancer Risk with UNSCEAR, it is observed that the Excess Lifetime Cancer Risk was found to be low.

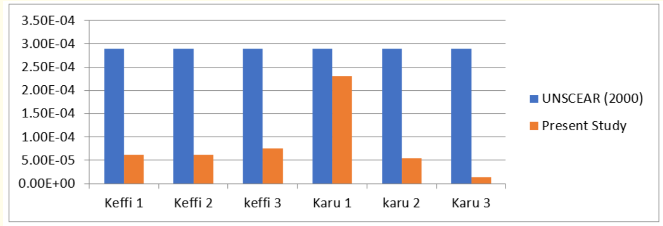

Figure 4: Comparison of Excess Lifetime Cancer Risk with UNSCEAR.

Comparison of dose to different organs of the body with united nation scientific committee on effect of atomic radiation

The data presented in table 5 was used to plot a chart in order to compare the result of Effective Dose to different organs of the body with UNSCEAR. This chart is presented in figure 5.

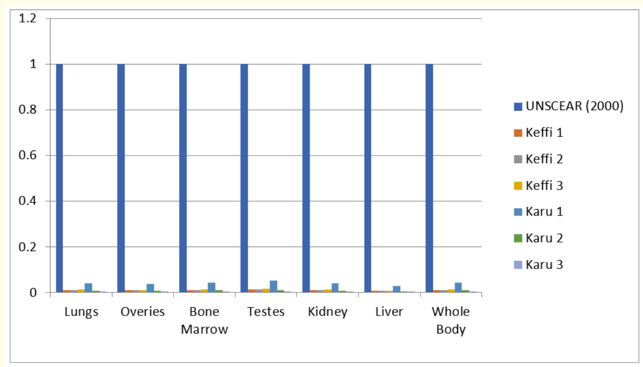

Figure 5: Comparison of Effective Dose Rate to Various Organs (D_{organ}) with UNSCEAR.

On comparison of Effective Dose Rate to various Organs (D_{organ}) with UNSCEAR, it is observed that the D_{organ} was found to be lower compare to UNSCEAR as presented in figure 5.

Discussion

On annual effective dose rate, finding of this study have revealed that the mean annual effective dose rate for Keffi and Karu are 0.03372 and 0.02844 mSv/y respectively, which are lower the value of effective dose of 0.45 mSv/yr as recommended by UNSCEAR and may not cause radiological hazard to the public and workers unless on excessive exposure. This finding on comparison of Annual Effective Dose Rate (AEDR) is in line with the finding of

[13,14]. But not in line with the findings of [15] who investigated the indoor and outdoor ionizing radiation level at Kwali General Hospital, Abuja Nigeria using a well calibrated Geiger Muller counter and found the average annual effective dose rate as 0.750 ± 0.020 mSv/yr and 0.189 ± 0.005 mSv/yr for indoor and outdoor measurements respectively. Also not in line with the findings of [16] who assessed the background ionizing radiations at Biochemistry, Chemistry, Microbiology and physics laboratories of Plateau State University Bokkos using Gamma-scout Radiometer and found the mean annual effective dose rate of the laboratories for indoor and outdoor to be 1.54 mSv/yr and 0.44 mSv/yr respectively.

On comparison of excess lifetime cancer risk, finding of this study have revealed that the mean excess lifetime cancer risk (ELCR) for Keffi and Karu are 0.04956×10^{-3} and 0.09954×10^{-3} which are lower than the value of excess lifetime cancer risk (ELCR) of 2.9×10^{-3} as recommended by UNSCEAR and may not cause radiological hazard to the public and workers. This finding is in line with the finding of [13,14]. But not in line with the findings of [15] who investigated the indoor and outdoor ionizing radiation level at Kwali General Hospital, Abuja Nigeria using a well calibrated Geiger Muller counter and found the average excess lifetime cancer risk as $2.63 \times 10^{-3}$and 0.66×10^{-3} for indoor and outdoor measurements respectively. Also not in line with the findings of [16] who assessed the background ionizing radiations at Biochemistry, Chemistry, Microbiology and physics laboratories of Plateau State University Bokkos using Gamma-scout Radiometer and found the mean excess lifetime cancer risk of the laboratories for indoor and outdoor background radiation level to be 1.54 mSv/yr and 0.44 mSv/yr respectively.

On comparison of Effective Dose Rate to Organs (D_{organ}) values for the lungs, ovaries, bone marrow, testes, kidney, liver and whole body, finding of this study have revealed that the mean D_{organ} values for the lungs, ovaries, bone marrow, testes, kidney, liver and whole body for Keffi and Karu are 0.01215 and 0.01820, 0.01101 and 0.01650, 0.01310 and 0.01962, 0.01556 and 0.02332, 0.01177 and 0.01763, 0.00873 and 0.01308, and 0.01290 and 0.01934 mSv/y respectively, which is lower than the value of effective dose to sensitive organs recommended by the international tolerable limits of 1.0 mSv annually which further stress that the radiation levels do not constitute any immediate health effect on residents of the area. This finding is in line with the finding of [12-16].

Conclusion

This tends to unveil the effect of exposure to radiation on human organs as a result of quarry mining taking place in some part of Keffi and Karu of Nasarawa State. Data in milli Roentgen per hour (mR/hr) were converted to exposure dose rate in micro Sivert per hour (μSv/hr), from exposure dose rate in micro Sivert per hour (μSv/hr) to Annual Effective Dose Rate in milli Sivert per year (mSv/yr), from Annual Effective Dose Rate in milli Sivert per year(mSv/yr) to Excess Lifetime Cancer Risk and also lastly, from Annual Effective Dose Rate in milli Sivert per year (mSv/yr) to Annual Effective Dose Rate to Organs in milli Sivert per year (mSv/yr). From the findings presented, it can be concluded that the background radiation in different mining sites of Keffi and Karu of Nasarawa State is not an issue of health concern except when accumulated by the public over a long period of time which may cause cancer to the members of public on getting themselves approximately seventy years of exposure. It is therefore, advised or recommended that the government stop all the illegal miners from mining and introduce mechanize mining for easy control of the health effects. Also, it is recommended that water and soil sample be taking for elemental analysis to ascertain the effect of the mining activity in these areas through ingestion, since it has no much effects on the populace of the area through inhalation according to this research.

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