ZANCO Journal of Pure and Applied Sciences
The official scientific journal of Salahaddin University-Erbil
https://zancojournals.su.edu.krd/index.php/JPAS

ISSN (print):2218-0230**, ISSN (online):** 2412-3986**, DOI: http://dx.doi.org/10.21271/zjpas**

RESEARCH PAPER

Assessment of Radon Concentration in Blood Samples of Different Kinds of Cancer by Using CR-39 Nuclear Track Detectors

Sardar S. Othman, Zakariya A. Hussein, Najeba F. Salih

Department of Physics, Faculty of Science and Health, Koya University, Koya KOY45, Kurdistan Region - F.R. Iraq

A B S T R A C T:
The goal of this work to measure the radon concentrations in twenty blood samples taken from a cancer patient and healthy group of Erbil governorates, by using CR-39 nuclear track detector. The results obtained showed the average concentrations of radon in blood samples for cancer patients and the healthy group were 19.318 ±3.86 Bq/m^3 and 8.5077 ±1.84 Bq/m^3 respectively. The mean value of radon concentration in the cancer group is higher than in the healthy group. The variation in concentrations of radon in different locations maybe caused due to the variation in the nature of blood samples and nuclei content in this samples. also depending on the allergic reaction of the body to radiation. This increase could be caused by pollution of environment with radioactive materials inclusive uranium, since cancer can be caused by ionization radiation results showed that the all of concentration of radon in blood samples for cancer and the healthy group were less than the global permissibility limiting of the exhibition to radon 200 Bq/m^3 (IAEA, 2010.)This work owes its importance to the fact that it aims at knowing and measuring the radon concentrations in the blood samples and impact it on the cancer in particular

KEY WORDS: Radon, Blood. Cancer. CR-39 NTDs. Erbil.
DOI: http://dx.doi.org/10.21271/ZJPAS.35.2.3
ZJPAS (2023) , 35(2);22-28 .
.

1. INTRODUCTION:

Exposure of Radon is a radioactive gas that emits alpha particles and is a main contributor to the ionizing radiation dose received by the general universal, which enters the body of an exposed humans and then ionizes the body organ and encirclement tissues and different types of Radiation causes cancer (ICRP 2003).Radon gas is one of the most primary alpha emitter because it accounts for half of exposure to natural ionizing radiation (Hussein, 2015). To evaluate the risk of such exposures, the alpha emitter concentration in blood were measured. Exposure to alpha radiation may cause DNA damage and cancer (Ismail & Jaafar , 2010; Tawfiq, 2012).

Ionizing radiation which can damage the living tissue, ionizing radiation is in the form of ions and deposits energy in the cells of the tissues that are it inter out of and high-energy radiation damages genetic materials (deoxyribonucleic acid, DNA) of cells and thus closed their power to divide and reduplicate moreover, after then causes the cancer (Hussein, 2019; Ismail, 2020). Alpha emitter's tracks in blood give a better Understanding of environmental contamination of alpha radiation. Many other studies also measured alpha emitters in blood of cancer patients and found higher alpha emitter concentrations than normal people (Abdul Wahid, 2020). High concentration of radon and its decay production is most known to be dangerous to human health. It is possibly related with various types of cancer and particular with lung cancer different than other radiation (Farhad et al., 2011). Cancer residue the

* **Corresponding Author:**
Sardar S. Othman
E-mail: sardartalabany2@gmail.com
Article History:
Received: 23/08/2022
Accepted: 30/09/2022
Published: 20/04 /2023

major reason of death worldwide (Hussein,et al..2016). The International Agency for Research on Cancer newly predestined that 7.6 million deaths comprehensive are due to cancer, with 12.7 million new cases reported comprehensive each year. A significant chapter of this onus is borne by developing countries; It is listed that 63% of cancer deaths are from developing countries (Sahar, 2021 – UNSCEAR, 2010).

Therefore, many researcher who were study radon and radon progeny concentration in different samples in different countries from the world using solid state nuclear track detectors (Hussein, et al.,2013).The purpose in this study assessment the radon concentration in blood samples of the cancer patient at Erbil governorates using CR-39 NTDs.

2. METHODOLOGY

2.1. Sample collection

The samples were collected from human who have problem with cancer in the Erbil governorate. This investigations were based on a study of on 10 different kids' cancer patients and 10 health people (control). Abnormal samples are obtained from Erbil city (center Nanakaly of cancer), Information of cancer patients and healthy group shown in Table.1. and Table 2.. Three 3 mL blood samples were sterile taken from each person who suffered cancer using the disposable syringe, immediately were transferred to a tube containing ethylene diaminete traacetic acid (EDTA) to prohibit blood coagulation .The samples were protected an ice box (4°C) then transferred to a lab for refrigeration in the fridge at the center of research in Faculty of Science and Health at Koya University. Each sample was given a specific code in order to distinguish them from each other and the samples were stored at 4 °C because the blood must be stockpil at 2–4 °C until analysis process (Adhraa,2019).

2.2 Preparation of fresh blood samples

After collected the blood samples from the patients, the fresh blood samples (3 milliliter) were put in the end PVC tubes. CR-39NTDs which had a thickness of 500 µm, with an area of (1 × 1) cm^2 (Hussein, 2015). All detectors were steady at the top end of PVC tubes have diameter 1.5 cm and its length 6 cm (Adhraa, 2019), as shown in Figure 1, all tubes were stored for about 30 days in research center of physics laboratory [Adhraa et al., 2018]. The chemical etching method contained 6.25N of NaOH, distilled water and water bath were used for warming the etching (6.25 N NaOH) at 70 °C for 8 h (Al-Rakabi, 2016).

The detector is hanged in NaOH by fixing the attached wire, on the cover or at the edge of the beaker, keeping the detector for the requisite time and the solution was shacked regularly during the time of etching.

2.3 Calculation

To measure and investigate the level concentration of radon of each sample, the following relationship was used (Barillon, 1993; Ismail 2004).

$$CRn(Bq.m^{-3}) = \rho/k.t$$

CRn: The concentration of radon ($Bq.m^{-3}$),
ρ: density of the track (track.cm-2),
K: calibration factor 0.031

Radium activity concentration (226Ra) of the samples was calculated using the following equation (Azam, 1995)

$$C^{s}_{Ra}\left(\frac{Bq}{kg}\right) = \frac{C^{a}_{Rn}\, h\, A^{s}}{M^{s}}$$

Where As represents the surface area of the sample and Ms represents the mass of the sample. To measure equilibrium radon activity concentration Ceq ($Bq.m^{-3}$) in the blood was measured by this a following relation (UNSCEAR, 2019) with CRn; radon concentration ($Bq\ m^{-3}$).

$$C_{eq} = C_{Rn}(t)/0.99$$

Lifetime risk (LTR) of exposure of radon concentration, therefore, can be expressed of LTR [ICRP, 1993] by using;

Lifetime risk = CRn × 10-4 × 100%

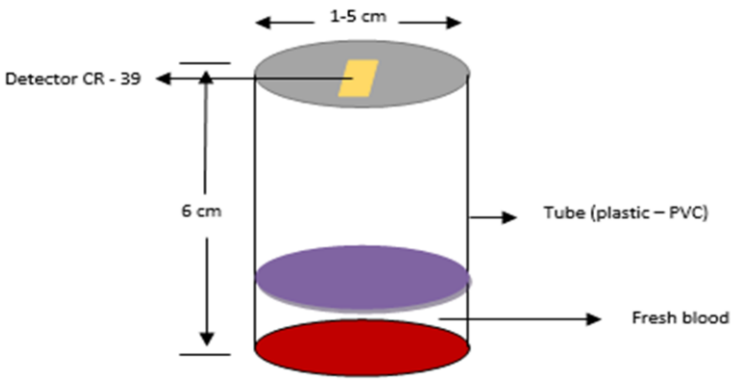
Where CRn is radon concentration.

Table 1: Information of cancer patients

No	Code		Tepe of Cacer	Gender	Location	Age	Smoking
1	C1		Breast	Female	Kasnazan	51	S
2	C2		Leukaemia	Male	Balesan	24	N
3	C3		Brain	Female	Koysanjak	61	N
4	C4		Colon	Female	Kasnazan	30	N
5	C5		Lung	Male	Gwer	20	S
6	C6		Stomach	Female	Hawleri new	32	N
7	C7		Ovary	Female	Soran	38	N
8	C8		Kidney	Female	Tayrawa	44	N
9	C9		Prostate	Male	Mala Omar	71	S
10	C10		Pancreas	Male	Ashty	58	S

Table 2: Information of healthy group

No	Code	Gender	Age	Somking
1	C1	Male	36	N
2	C2	Male	35	N
3	C3	Male	39	N
4	C4	Female	35	N
5	C5	Female	22	N
6	C6	Male	31	N
7	C7	Female	20	N
8	C8	Female	22	N
9	C9	Male	23	N
10	C10	Female	25	N



Table

Figure 1: Diagram of container for measuring radon concentrations

3. RESULTS AND DISCUSSION

The radon concentration, radium concentration, equilibrium radon activity and Lifetime risk were determined in the blood samples of the different cancer patient and healthy group by using the CR-39 detectors see (Table 3 and Table 4). The results showed that the highest rate of concentration of radon in the blood for the cancer patient group was found in C5 (Lung cancer) at 31.73 Bq/m^3, Whereas the lowest rate was founded in sample C9 (Prostate cancer) at 14.03 Bq/m^3, when compared to the control groups ranged between (6.141 to 10.272) Bq/m^3.

In broadly, our data showed that the radon levels in all blood were under the ICRP acceptable limits (200 Bq/m^3) (ICRP 1987).

Table 3: Radon concentration, radium concentration and equilibrium radon activity for cancer patient group

No	Code	Rn (Bq/m^3)	Ra (Bq/Kg)	Ceq (Bq/kg)	LTR
1	C1	25.767	0.501	26.027	0.258
2	C2	26.615	0.517	26.886	0.266
3	C3	19.647	0.382	19.845	0.191
4	C4	30.725	0.597	31.035	0.307
5	C5	31.732	0.604	31.837	0.311
6	C6	16.318	0.317	16.483	0.163
7	C7	15.882	0.309	16.04	0.159
8	C8	27.712	0.538	27.992	0.277
9	C9	14.032	0.273	14.171	0.14
10	C10	15.315	0.298	15.47	0.153
	Average	22.373±3.24	0.433±0.06	22.578±3.72	0.222±0.08

Table 4: Radon concentration, radium concentration and equilibrium radon activity for healthy group

No	Code	Rn (Bq/m^3)		Ra (Bq/Kg)	Ceq (Bq/kg)	LTR
1	C1	10.272		0.044	10.376	0.024
2	C2	8.315		0.036	8.399	0.083
3	C3	10.011		0.043	10.112	0.102
4	C4	9.556		0.041	9.652	0.096
5	C5	7.262		0.031	7.335	0.073
6	C6	6.141		0.026	6.202	0.061
7	C7	6.928		0.031	6.998	0.069
8	C8	7.789		0.033	7.868	0.078
9	C9	10.057		0.043	10.159	0.101
10	C10	8.746		0.088	8.834	0.087
	Average	8.507 ±1.84		0.041 ±0.01	8.593 ±1.92	0.077±0.02

Figure 2 show that the comparing all the obtained results from blood samples (cancer patient and healthy groups). The Radon concentration, radium concentration and equilibrium radon activity for cancer patients is higher than healthy group, alpha rebirth amount in the samples of the blood group with cancer was higher than that from the control group. The cause for this result is that the samples taken from humans with cancer were more influenced by inner irradiation than those in the healthy group

The average radon concentration, radium concentration and equilibrium radon activity for male is higher than female of cancer patients group, as shown in Figure 3. The high levels of radon in men's blood consist of many factors, inclusive the contamination of the water and food they consume in their daily lives. So are environmental factors affecting like pollution of water or soil and inhalation of air pollution

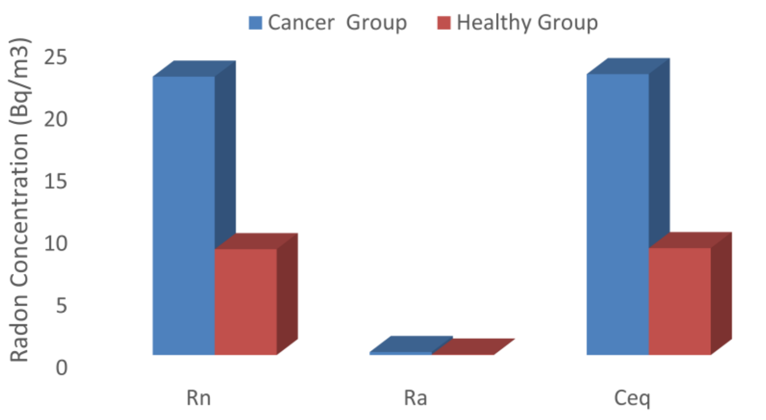


Figure 2: Average of Radon concentration, radium concentration and equilibrium radon activity for cancer and healthy group

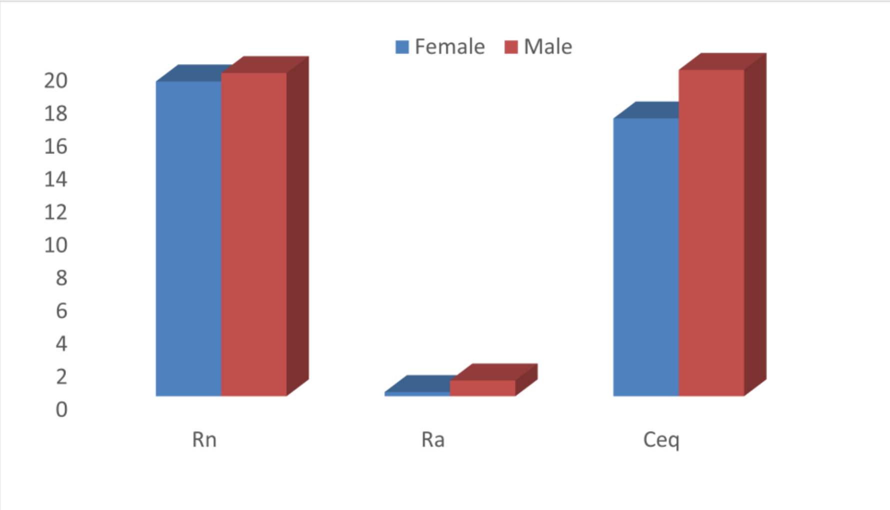


Figure 3: Average of Radon concentration, radium concentration and equilibrium radon activity for male and female of cancer group

Figure 4 showed the relation between the concentration of radon, and life time risk when radon concentration is increase, the life time risk increase, that is the linearity between them.

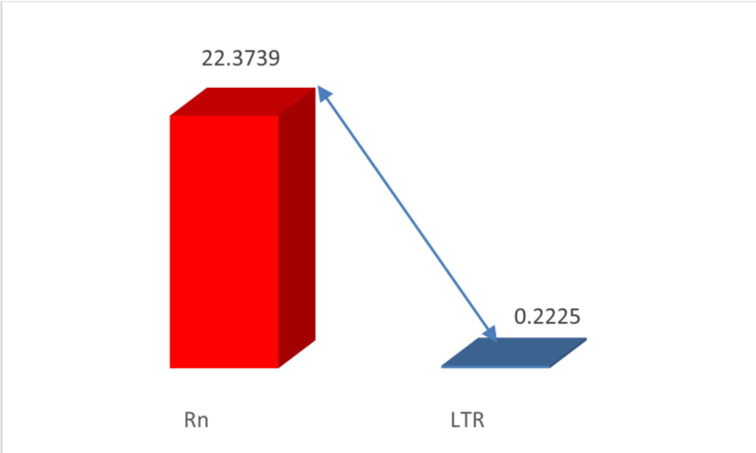


Figure 4: Relation between average of Radon concentration and life time risk (LTR) in blood cancer group

4. CONCLUSION

Radon concentration has calculated in blood for two group cancer and healthy group in Erbil governorate. The result show that the radon concentration in the cancer patient group is higher than in the healthy group. There are several potential factors that could participate to the highest concentration of radon in the blood include including the type of diet and environment, all value of radon concentration in the present study is less than the acceptable limits IAEA. A very significant drop in female patients was compared to those observed to males. It is most serious to calculate the range of radon concentration in the blood well-arranged obtain supplementary data for assessing the impact of environmental radioactivity innuendo for people health.

References

Abdulwahid TA, Alsabari IK, Abojassim AA, Mraity HAA, Hassan AB (2020) Assessment of concentrations of alpha emitters in cancer patient’s blood samples SYLWAN 164.

Adhraa Baqir Hassan, Ahmed Abdul Hadi Mohsen, Hussien Abid Ali Mraity, Ali Abid Abojassim (2019). Determination of Alpha Particles Levels in Blood Samples of Cancer Patients at Karbala Governorate,Iraq. Iran J Med Phys, Vol. 16, No. 1, January.

Al-Rakabi MSK. *Study of radioactivity and radon gas emanation in some Iraqi governorates* (Doctoral dissertation, College of Education AL-Mustansiriyah University) 2015.

Azam A, Naqvi AH, Srivastava DS (1995). Radium concentration and radon exhalation measurements using LR-115 type II plastic track detectors. Nuclear geophysics. ; 6(9):653-4.

Barillon R, Klein D, Chambaudet A, Devillard C (1993). Comparison of effectiveness of three radon detectors (LR115, CR39 and silicon diode pin) placed in a cylindrical device-theory and experimental techniques. Nuclear Tracks and Radiation Measurements. ; 22(1-4):281-2.

Farhad H M., Jaafar M S, Ismail A H., Houssein H.AA. (2011). The effect of laser wavelength in photodynamic therapy and phototherapy for superficial skin diseases. IEEE International Conference on Imaging Systems and Techniques. Pp. 232-236.

Hussein Z. A., Jaafar M. S., Ismail A. H., Battawy A. A. (2013). Radon exhalation rate from building materials using Passive Technique Nuclear Track Detectors. International Journal of Scientific & Engineering Research, Volume 4, Issue 7, July-2013 1276 ISSN 2229-5518.

Hussein Z. A.,Jaafar M. S., Ismail A. H. (2013). Measurements of Indoor Radon-222 Concentration inside Iraqi Kurdistan: Case Study in the Summer Season. Nuclear Medicine & Radiation Therapy, 4:1http://dx.doi.org/10.4172/2155-9619.1000143.

Hussein Z. A. (2015). Measurement of Indoor Radon Concentration in Dwellings of Koya Using Nuclear Track Detectors. International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064.

Hussein Z. A., ,Jaafar M. S., Ismail A. H., Battawy A. A., Karim H. H.,Ismail J. M. (2016). Indoor radon levels in apartments of Erbil city by using long and short term techniques. Tikrit Journal of Pure Science 21 (3) 2016- ISSN: 1813 – 1662.

Hussein Z. A. (2019). Assessment of Natural Radioactivity Levels and Radiation Hazards of Soils from Erbil Governorate, Iraqi Kurdistan..ARO scientific Journal Volume VII, No.1 (2019), Article ID: ARO.10471, 6 pages doi: 10.14500/aro.10471

IAEA (2010) International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources Draft Safety Requirements IAEA Safety Standards for protecting people and the environment.

ICRP (1987) (International Commission on Radiological Protection). Lung Cancer Risk from Exposures to Radon Daughters, publication 50, Ann. ICRP. 17 (1) p.38-51.

ICRP (1993) (International Commission on Radiological Protection), Protection against 222Rn at home and work, Publication 65, Ann of ICRP. 23-210-

ICRP (2003) Biological Effects after Prenatal Irradiation (Embryo and Fetus). ICRP. Publication 90 for the International Commission on Radiological Protection. Pergamon.

UNSCEAR (2019) United Nations Scientific Committee on the effects of Atomic Radiation 2019 report.

Ismail A. H, Hussein Z. A., Yaba S. P. (2020). Investigation a relation between radioactivity concentrations of 40 Potassium (40K) in tooth and the various ethnic groups and its impacts on the rate of tooth damage. Environmental Nanotechnology, Monitoring & Management. *14 (2020) 100385*.

Ismail A H., (2004). Measurement of Radon Activity concentration in Iraqi Kurdistan Soil by Using CR-39 Nuclear Track Detectors. ” M.Sc Thesis. Salahaddin University-Erbil. IRAQ

Ismail A H., Jaafar M S, (2010). Relationship between radon concentration, ventilation rate and male infertility: A Case study in Iraqi Kurdistan. International Journal of Low Radiation. Vol.7, No.3, Pp.175-187

Sahar AA, Rana R.Al-A, Ahmed NG, Mohammed MTA (2021). Radioactivity Assessment in the Sediments Samples of Tigris River, Baghdad, Iraq. IOP Conf. Series: Earth and Environmental Science 779:1-18, doi:10.1088/1755-1315/ 779/1/ 012050.

Tawfiq N, Ali L, Al-jobbery H (2012) Uranium concentration in human blood for some governorates in Iraq using CR-39 track detector. J Radioanal Nuc Chem 295:671–674.

UNSCEAR (2010) Nations, New York United Nations Scientific Committee on the Effects of Atomic Radiation, volume I: sources, Annex B: exposures of the public and workers from various sources of radiation. United Nations, New York

.