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Study of Radon Concentration and Lung Cancer Risk in The Right Area of Shirkatt District

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ABSTRACT

During the summer season, in Shirkatt District and by using time integrated passive radon dosimeters containing (CR-39) plastic radon detectors, indoor radon concentration level and lung cancer risks have been measured in 16 sites. The radon concentration ranged between 50.38 and 212.35 Bq/m3 with an average value 103.98 Bq/m3, which lies within the acceptable radon levels (50-150 Bq/m3) recommended by ICRP. Potential alpha energy concentration was varying from 5.4×10-3 to 22.9×10-3 WLM with average value 17.2×10-3 WLM which corresponds to absorption effective dose equivalent 2.4713 mSvy-1in human, It is observed that this value lies within the recommended levels (3-10 mSvy-1) reported by ICRP. The average lung cancer cases per year per 106person were found to be 44.49, there were no inductions of existence of radon problems in this survey.

Introduction

The earth's crust contains trace amounts of U^{238} and $Th^{220,}$ which decay to radon $Rn^{222}$and Thoron Rn^{220}gases respectively, in addition to other particles. Radon $Rn^{222}$is neutral inert radioactive tasteless and odorless gas, its density is 7.5 times higher than air[(1)]. Radon and it's daughters Po^{218},Po^{214},pb^{214}, and Bi^{214} poses a radiation health hazard to the lung through inhalation process, half-life of radon is 3.825 days and half-elimination time from lung 30 min.

Thoron Rn^{220} is often ignored because of its short half- life 55.3 sec and it is generally lower in concentration than Rn^{222} in geological material[(2)].

The indoor radon concentration mainly depend on radon exhalation from surrounding soil, porous building materials achieves a larger relevance in some areas of the world (Italy, Netherlander, and China), where rocks enriched in radon isotopes precursors, are used as building materials, either as sting materials or in a loose from to prepare cements [(3)].

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Concentration of Rn^{222} gas in dwelling have been reviewed and summarized by the (UNSCEAR), for over 20 various countries ,the average radon concentration vary widely from <25 Bqm^{-3} in Netherlands, up to 10000 Bqm^{-3}in Finland[(4)]. Underground mines of uranium and other igneous rocks tend to have high concentration of radon gas.

There was an association between cumulative radon exposure and risk of lung cancer, doses received by inhaling radon or its progeny, caused lung cancer rather than other cancer or other diseases [(5)]. The relative risk of lung cancer increased linearly with increasing cumulative exposure, which measured in terms of working level months (WLM), the average cumulative exposure was 164.4 WLM, this approximately equivalent to living in a house with radon concentration of 2000 Bqm^{-3} for 20y[(6)]. Air sampling for personal dosimeter can be measured by active devices such as surface barrier or passive devices (Solid State Nuclear Track Detectors – SSNTD's), which more suitable for the assessment of radon exposure over long time scales. (SSNTD's) have low costs and more suitable for long-term measurements of radon and its progeny in the environment [(7)].

The main objective of this work was to measure,

under normal living conditions, the concentration of Rn^{222} gas in air, in Shirkatt District dwellings in order to measure the lung cancer risk.

Experimental:-

Sixteen dwelling were chosen to monitored, taking into account their building materials, some types of concrete and iron structure, limestone bricks, and clay bricks. The wall of the dwelling can be often covered with gypson. The materials used at these dwelling probably have uranium content, based on the results of indoor radon. Passive radon dosimeter, used in this work composed of plastic cup 7.0 cm in diameter and 4.6cm in depth, in the cover there is a hole 0.5cm sealed with apiece of sponge with an area 2×2 cm2 and thickness 0.5 cm, this configuration was necessary to ensures that thoron can not reach the detector. The plastic cup contain one CR-39 with area 1×1cm2 fixed to the bottom by double-sided cello-tape, the calibration process for this dosimeters was done by Al-Kofahi et al(8) .

The Right Area of Shirkatt District was divided into 16 sections, for each sections, two dosimeters were placed inside each selected house, in sitting room on the top about 2m above the floor, after an exposure time of 90 days during (2007) in summer season.

The detectors were collected after that time and chemically etched using (NaOH,6N) at 70oC for 4.5 hr (9), tracks of alpha damage were counting by using an optical microscope with magnification of 100X. By using the relation below (10), the concentration of radon gas was determined

$$\frac{c_o t_o}{\rho_o} = \frac{ct}{\rho}$$

where:

co Radon concentration during the calibration process.

c Radon concentration.

ρ0 Surface density of tracks on the calibrated dosimeter.

ρ Surface density of tracks on the exposed dosimeter.

t Exposure time.

t o Exposure time for calibration dosimeter.

To find the effective dose from Rn222progeny, it is necessary to obtain the potential alpha energy concentration (PAEC) of (Rn222) in terms of working level units (WL) (11). First of all we found the concentration of radon in pCi/L units, so the equivalent equilibrium concentration EEC of radon deduced as in eq.

EEC= F×CRn (pCi/L)

Where F is the equilibrium factor, which equal 0.4 indoor, then EEC times 0.01 to find the PAEC (WLM),while WLMY-1 is equivalent to working level WL times factor 40(12). The absorption effective dose equivalent (AEDE) estimated by using the dose conversion factor 5.5 mSvWLM-1, while the lung cancer cases per year per 106 persons based on the risk factor lung cancer induction of 18×10-6 mSv-1 (13,14).

Result and Discussion

The average concentration of radon Rn222 gas for each monitored dwelling is reported in Table (1); Fig (1) shows the histogram of radon concentration in dwellings. The average radon concentration in dwellings was 103.98 Bq/m3, this variation in radon concentration is fundamental related with type of construction and age of the building, the minimum and maximum values for indoor radon concentration were found in AL-Eitha and AL-Kala'a and equal to 212.34 Bqm-3and 50.320 Bqm-3 respectively.

The variable from one region to another due to different concentration of uranium in different regions, these results are within the radon levels (50-150) Bqm-1 which are recommended by ICRP (15),except the first location (al-Eitha) which might be rich with uranium element. The average radon concentration vary widely for many countries, all the studies listed in table (2) (16). Potential alpha energy Concentration PAEC levels rang from 5.4×10-3WLM to 22.9×10-3 WLM within average value of 17.2×10-3 WLM.

This average value corresponds to an absorption effective dose equivalent AEDE value of 2.4713 mSvy-1. ICRP, 1993, report has recommended that the action levels of radon in dwelling should be set within 3-10mSv (17) . It has been observed that all the dwelling monitored for radon concentration shown values within the action levels. According to ours estimations, table (3) shows the radon induced lung cancer risk for all dwelling in Shirkatt District was found and ranges from 21.483 to 90.684 with an average value of 44.490 per 106 persons. In general, these estimates indicated that

the dwelling in District are characterized by low radon exposure dose, so the people who live in those dwelling are subject to relatively low risk factor for radon induced lung cancer.

By comparing the results, its shows the Al-Eitha has the highest concentration in radon levels and this was exposed to allied bombing during the occupation of Iraq. The region (Al-Karia Al-Saakanea , Al-Msehli & Al-Khanoga) are nearest to the Shirkatt Ammunition store and also exposed to the same operations. As a result of these highest concentrations, we expect that these bombs contain some radioactive materials that cause the increasing of radon levels in these regions.

Table(1) Indoor radon Concentration in Shirkatt district

No.	locations	C_{Rn}(Bq.m^{-3})
1	Al-Eitha	212.34
2	Al-Swedan	99.419
3	Al-Kuthranea	90.317
4	Al-Kuthranea Al-Jadeda	96.089
5	Al-Houreea	108.04
6	Shokran	50.764
7	Ba'aja	68.561
8	Al-Taal	96.459
9	Al-Qasaba	62.604
10	Ijmaela	95.756
11	Al-Khuasim	117.149
12	Isbkha	71.114
13	Al-Kala'a	50.320
14	Al-Karia Al-Saakanea	152.995
15	Al-Khanoga	141.969
16	Al-Msehli	149.539
Average		103.98

Table (2) Summarized the major studies of radon concentration

Studies	radon Concentration Bqm^{-3} Average
Stockholm	130
Swedish nation wide	110
S. Finland	220
SW England	60
W Germany	50
Czech Republic	500
Italy, Trento	130
Spain	130
Austria	200
France	140
E. Germany	80
Italy, Rome	110
Present work (P.W.)	103.98

Table (3) Summarized the measurement of radon concentration in PciL-1 .EEC, PAEC.WLMY-1, and mSvy-1 and lung cancer per 10-6 person.

No.	locations	C (pCi/L)	EEC (pCi/L)	PAEC (WLM)	WLM/Y	mSv/y	Lung cancer per 10^6 person
1	Al-Eitha	5.739	2.295	0.0229	0.916	5.038	90.684
2	Al-Swedan	2.687	1.075	0.0107	0.430	2.365	42.575
3	Al-khuthranea	2.441	0.976	0.00976	0.3904	2.147	38.649
4	Al-khuthranea Al-Jadeda	2.597	1.0381	0.0103	0.415	2.285	41.140
5	Al-Houreea	2.920	1.1682	0.0116	0.467	2.57	46.26
6	Shokran	1.372	0.548	0.0054	0.219	1.207	21.739
7	Ba'aja	1.853	0.741	0.0074	0.2965	1.630	29.355
8	Al-Tal	2.607	1.043	0.0104	0.41716	2.294	41.299
9	Al-Kasaba	1.692	0.6769	0.0067	0.270	1.489	26.808
10	Ijmaela	2.588	1.035	0.0103	0.414	2.277	40.995

11	Al-Khuasim	3.1662	1.266	0.0126	0.406	2.786	50.152
12	Isbkha	1.922	0.769	0.00769	0.307	1.692	30.459
13	Al-Kala'a	1.360	0.544	0.0054	0.217	1.1935	21.483
14	Al-Karia Al-Saakanea	4.135	1.654	0.0165	0.661	3.638	65.50
15	Al-Khanoga	3.837	1.534	0.0153	0.614	3.377	60.791
16	Al-Msehli	4.0416	1.6166	0.016	0.646	3.553	63.954
	average			0.0172		2.4713	44.490

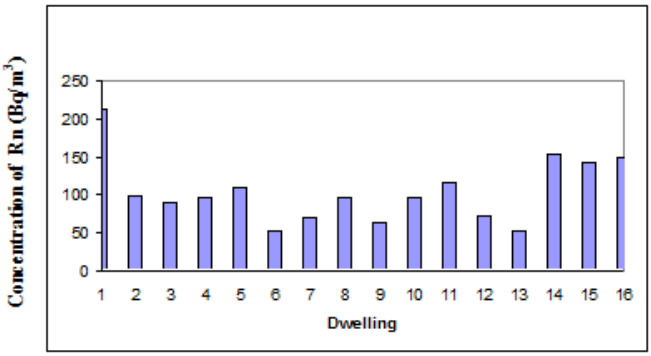

Fig (1) shows the histogram of radon concentration in dwellings in Right area of Shirkatt District.

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دراسة تركيز الرادون وخطر الإصابة بسرطان الرئة في الساحل الأيمن من قضاء الشرقاط

عمار عبد عبدالله **هناء إحسان حسين**

الخلاصة

خلال فصل الصيف ، وفي قضاء الشرقاط وباستخدام المجرع التراكمي الحاوي على الكاشف البلاستيكي CR-39 تم حساب مستوى تركيز غاز الرادون داخل المباني ومستوى خطورة الإصابة بسرطان الرئة في 16 موقع تراوحت فعالية الرادون بين (212.34 –50.320) وبمعدل 103.98 Bq/m3 إن هذه القيم تتفق مع المستويات المسموح بها والتي أوصت بها الوكالة الدولية للوقاية من الإشعاع ICRP (50 - 150 Bq/m3) . إن تركيز طاقة ألفا الكامنة تتراوح بين (22.9×10-3WLM - 5.4×10-3) وبمعدل 17.2×10-3 WLM والتي تقابل جرعة ممتصة مؤثرة مكافئة قدرها 2.4713 mSvy-1 ، من الملاحظ أن هذه القيم تقع ضمن المستويات التي أوصت بها الوكالة الدولية للوقاية من الإشعاع ICRP في تقريرها والتي تنص على أن تكون الجرعة بحدود 3 -10 mSvy-1 . إن معدل خطر الإصابة بسرطان الرئة لكل سنة يساوي 44.49 لكل مليون شخص ، ومن خلال البحث تبين انه ليس هناك مؤشرات على وجود خطر للرادون في المناطق قيد الدراسة.