

Research Article

A Comprehensive study of the Relationship between Lung Cancer and Radon Concentration in Babylon Governorate-Iraq

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Abstract

Radon is a naturally occurring radioactive gas that results from the decay of uranium in soil and rocks. Lung cancer is the principal health concern associated with radon exposure. According to the US Environmental Protection Agency (EPA), radon is the second leading cause of lung cancer in this country, and is the leading cause among non-smokers. In current research, the number infections at lung cancer and the radon concentration in Babylon governorate are studied. Number of cancer cases by lung cancer in 2005 are 23 where in 2009; these infections are 77 that percentage up about four times between these periods.

Keywords: Radon, Radioactivity, Cancer

Introduction

Radon as a noble gas is rapidly exhaled after being breathed in; however, radon progeny, combine with other molecules in the air and with particles of dust, and readily deposit in the airways of the lung (Tabassum Nasir *et al*,2012).

Radon emits radiation in the form of alpha particles; once ingested or inhaled, it can cause damage to bodily tissues and organs. Because alpha particles are heavy and short-ranged, they cannot penetrate physical barriers, including clothing and skin. Ingestion is the primary route of exposure to radium in water. Individuals can be exposed to radon in water via inhalation and ingestion, although the primary route of exposure is considered to be inhalation. There is a well-established link between lung cancer and inhalation of radon; ingestion of radon has been weakly linked to stomach cancer (Anssi Auvinen *et al*,2005). The estimated risks of these health outcomes differ by several orders of magnitude: risk of stomach cancer over a lifetime of radon exposure at 1 Bq/m³ is estimated to be 1.9×10^{-9} while risk of lung cancer is 1.3×10^{-4} (Hopke PK *et al*,2000). For this reason, public health programs on radon have been focused primarily on raising awareness and encouraging testing and mitigation of airborne exposures to radon (due to soil gas intrusion) in homes.

The body made up of trillions of living cells. Normal body cells grow, divide into new cells, and die in an orderly fashion. During the early years of a person's life,

normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries. Cancer cell growth is different from normal cell growth, instead of dying, it will continue to grow out of control and form new, abnormal cells also grow into other tissues, making a cancer cell (Bailey-Wilson JE *et al*,2004; Kwak EL *et al*,2010).

In a normal cell, when DNA is damaged, either the cell repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, and the cell does not die, as it should, but goes on making new cells that the body does not need (Kwak EL *et al*,2010). Cancer cells often travel to other parts of the body, where they begin to grow and form new tumors that replace normal tissue. For example, breast cancer that has spread to the liver is still called breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bone is metastatic prostate cancer, not bone cancer. Different types of cancer can behave very differently, such as lung cancer and breast cancer they grow at different rates and respond to different treatments, so that people with cancer need treatment that is aimed at their particular kind of cancer (Hopke PK *et al*,2000).

Lung cancer

In order to understand lung cancer, we must know the normal structure and function of lung.

The lungs are 2 sponge-like organs found in chest. Right lung divided into 3 sections, called lobes. Left lung has 2 lobes and smaller than right lung because the heart takes up more room on that side of the body. When

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breathing in, air enters through mouth or nose and goes into lungs through the trachea (windpipe). The trachea divides into tubes called the bronchi (singular, bronchus), which divide into smaller branches called bronchioles. At the end of the bronchioles are tiny air sacs known as alveoli. Many tiny blood vessels run through the alveoli. They absorb oxygen from the inhaled air into your bloodstream and pass carbon dioxide from the body into the alveoli. This is expelled from the body when you exhale. Taking in oxygen and getting rid of carbon dioxide are your lungs' main functions (Parikh PM *et al*,2011).

Lung cancers can start in the cells lining the bronchi and parts of the lung such as the bronchioles also start as areas of pre-cancerous changes in the lung. The first changes happen in the genes of the cells themselves and may cause them to grow faster (Wender R *et al*,2013).

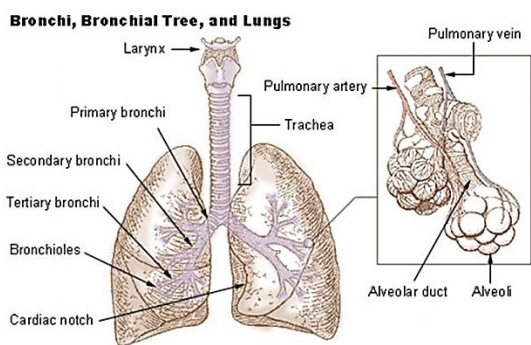


Fig.1: The lung structure (Aberle DR *et al*,2011)

Radon and lung cancer

Outdoors, there is so little radon that it is not likely to be dangerous. Nevertheless, indoors, radon can be more concentrated. When it is breathed in, it enters the lungs, exposing them to small amounts of radiation. This may increase a person's risk of lung cancer. The risk of lung cancer is higher in those who have lived for many years in a radon-contaminated house. The lung cancer risk from radon is much lower than that from tobacco smoke. However, the risk from radon is much higher in people who smoke than in those who don't. Radon levels in the soil vary across the country, but they can be high almost anywhere in general, residential ²²²Rn is regulated by a ²²²Rn concentration action level between 200 and 600 Bq/m³ based on ICRP recommendations. Recently, however, an increase in lung cancer risk has been observed even with exposure levels below 200 Bq/ m³ .In view of such scientific data, WHO proposed a reference level of 100 Bq/m³ (V. Urosevic *et al*,2011; Predrag Ujic *et al*,2010).

The U.S. Environmental Protection Agency (EPA) has proposed a radon concentration 300 pCi/L as limits for dissolved radon. Using of water in the dwellings may result in an enhanced indoor radon concentration levels. Some decay products have relatively long half-life; so the lungs may be able to push it back out before it decays. The range of a 5 MeV alpha particle is approximately 3.5 cm in air, or 0.004 cm in tissue in this case alpha articles are

not considered to be an external hazard because of their inability to penetrate the outer layer of skin (Parikh PM *et al*,2011; Wender R *et al*,2013). The alpha particles emitted from the inhaled ²²²Rn and especially from two of its progenies ²¹⁴Po and ²¹⁸Po radionuclides which have high damaging potential to the lung tissue and are considered to be causative agent for lung cancer in human (Huyam A *et al*,2006). Experiments have confirmed that ionizing radiation affecting bronchial epithelial cells could cause cancer (Tabassum Nasir *et al*,2012).

Recent studies have also showed that children are more susceptible to radiation exposure than adults even for low doses obtained (Jing Chen *et al*,2013).

They have longer latency periods for cancer developing, because they spending more time at home. For these reasons, a special interest has been observed in indoor radon measurements in kindergartens and schools, and the majority of these results have been recently reviewed (Asiye Ulug *et al*,2004; A.F. Maged *et al*,2005).

Experimental Part

Babylon is one of largest governorate in the middle of Iraq is situated on the longitude of 44^o 14' 42" east and 45^o 12' 18" west, as well as on the latitude of 42^o 47' 51" north and 32^o 67' 03" south, its population 1.8 million. In our research, the number of infections of lung cancer and some commonest cancers in Babylon governorate have been selected to achievement this study.

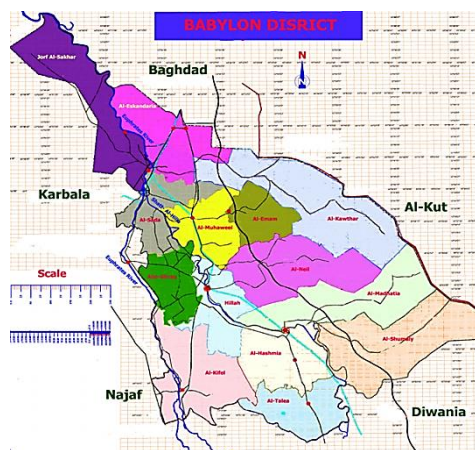


Fig.2: The map of study area

Results and Discussion

From the results illustrated in tables and Figures can be discuss the following

1. Many of the literatures on the relationship between lung cancer and radiation, explained that the main reason for lung cancer after tobacco, is radon gas. The vast increase in lung cancer cases after 2005 is caused by increasing concentration of radon because of wars has been used weapons materials caused the presence of radon in air of the study area see the tables.

Table-1- showing the amount of radon gas concentration in the air of some houses of the districts of the province of Babylon under study

Annual Effective dose μ Sv	\pm S. D	Mean	Region	Sequence
7950	252	318	Hella	1
9424.8	260	374	Al-Mahaweel	2
1713.6	55	68	Al-Hashimiah	3
5317.2	206	211	Al- Mussaib	4

Table -2- The commonest cancers in Babylon districts in 2000

Year	The No. of patients with lung cancer	Female	Male
2005	27	-	-
2006	38	-	-
2007	37	-	-
2008	68	-	-
2009	77	29	48
2010	62	21	41
2011	70	19	51
2012	76	23	53

Table -3- The commonest cancers in Babylon districts in 2001

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	96	21.88	21	3.13	3	10.42	10	64.58	63	Breast	1
100	54	9.26	5	14.81	8	27.78	15	48.58	26	Leukemia	2
100	49	10.2	5	20.41	10	10.2	5	59.18	29	Non-Hodgkin's lymphoma	3
100	42	19.05	8	0	0	11.9	5	69.05	29	Bronchus and Lung	4
100	39	20.51	8	5.13	2	7.69	3	66.67	26	Bladder	5

Table -4- The commonest cancers in Babylon districts in 2002

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	63	20.63	13	4.76	3	15.73	10	58.73	37	Breast	1
100	48	12.5	2	10.42	5	10.42	5	66.67	32	Leukemia	2
100	39	28.21	11	2.56	1	7.69	3	61.54	24	Bronchus and Lung	3
100	41	31.71	13	12.2	5	7.32	3	48.78	20	Non-Hodgkin's lymphoma	4
100	34	39.41	10	5.88	2	11.76	4	52.94	18	Bladder	5

Table -5- The commonest cancers in Babylon districts in 2003

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	66	16.67	11	4.55	3	9.09	6	69.7	46	Breast	1
100	58	18.97	11	13.79	8	13.79	8	53.45	31	Bladder	2
100	56	17.86	10	7.14	4	17.86	10	57.14	32	Bronchus and Lung	3
100	39	17.95	7	15.18	6	12.82	5	53.85	21	Larynx	4
100	37	10.81	4	21.63	8	8.11	3	59.46	22	Leukemia	5

Table -6- The commonest cancers in Babylon districts in 2004

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	68	14.71	10	10.29	7	13.24	9	61.76	42	Breast	1
100	44	15.91	7	13.64	6	6.82	3	63.64	28	Bronchus and Lung	2
100	39	17.95	7	12.83	5	15.38	6	53.85	21	Bladder	3
100	35	22.86	8	11.43	4	8.57	3	57.14	20	Leukemia	4
100	28	14.29	4	7.14	2	25	7	53.57	15	Brain	5

Table -7- The commonest cancers in Babylon districts in 2005

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	118	16.95	20	6.78	8	6.78	8	69.49	82	Breast	1
100	63	22.22	14	11.11	7	6.35	4	60.32	38	Leukemia	2
100	61	19.67	12	16.39	10	11.48	7	52.46	32	Bronchus and Lung	3
100	60	18.33	11	10	6	15	9	56.67	34	Brain	4
100	57	29.82	17	17.54	10	7.02	4	45.61	26	Bladder	5

Table -8- The commonest cancers in Babylon districts in 2006

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	129	16.28	21	11.36	15	6.2	8	65.89	85	Breast	1
100	115	18.26	21	20.87	24	12.17	14	48.7	56	Bronchus and Lung	2
100	110	15.45	17	20.91	23	14.55	16	49.09	54	Leukemia	3
100	84	21.43	18	14.29	12	11.9	10	52.38	44	Bladder	4
100	74	14.86	11	8.11	6	20.27	15	56.76	42	Brain	5

Table -9- The commonest cancers in Babylon districts in 2008

Total		Al- Mussaib		Al-Hashimiah		Al-Mahaweel		Hella		Members	
%	No.	%	No.	%	No.	%	No.	%	No.		
100	157	19.11	30	19.11	30	9.55	15	52.23	82	Bronchus and Lung	1
100	151	19.21	29	15.89	24	7.28	11	57.62	87	Breast	2
100	84	15.48	13	17.86	15	7.14	6	59.52	50	Leukemia	3
100	64	18.75	12	18.75	12	14.06	9	48.44	31	Bladder	4
100	63	12.7	8	19.05	12	7.94	5	60.32	38	Brain	5

2. Table 1 shows there are four times increases in cancer infection rates in the governorate of Babylon and that percentage increases from 23 cases to 77 cases during 2005 and 2009 respectively.

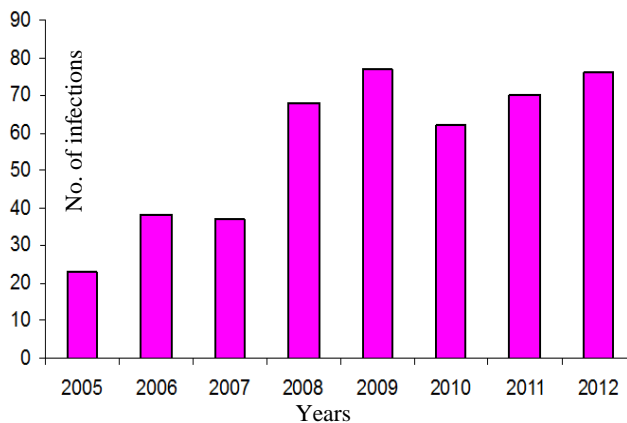


Fig.3: Lung cancer infections in Babylon governorate between 2005 and 2012

In addition, table1 illustrate that the number of females with lung cancer is 29, but the percentage of smoker's women in the Babylon governorate is few, therefore the lung cancer reason in females in radon.

3. The reason may be all from tobacco, so that the increase in lung cancer cans discus by two ways, first, the cases numbers of smokers cannot increase this four time percentage, in the governorate of Babylon. Second even if that the increase in population may be the reason for the

increase of this disease, also, increase the numbers of the population did not have this ratio.

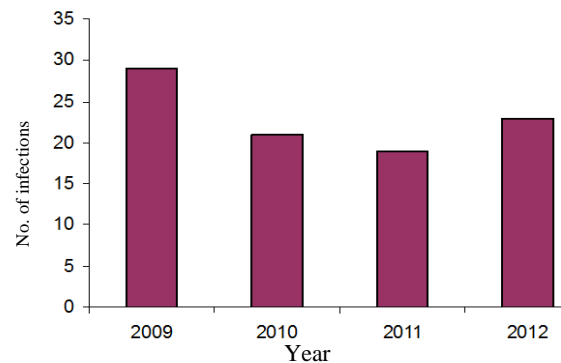


Fig.4: Lung cancer infections for female in Babylon governorate between 2009 and 2012

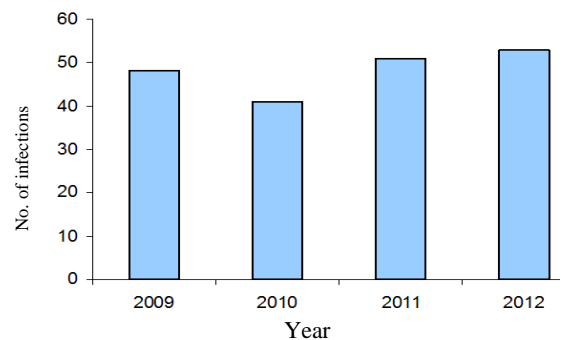


Fig.5: Lung cancer infections of male in Babylon governorate between 2009 and 2012

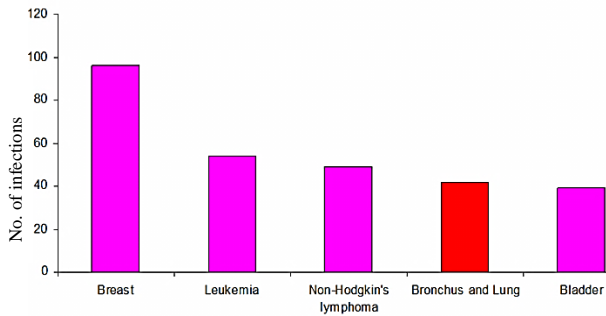


Fig.6: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2000

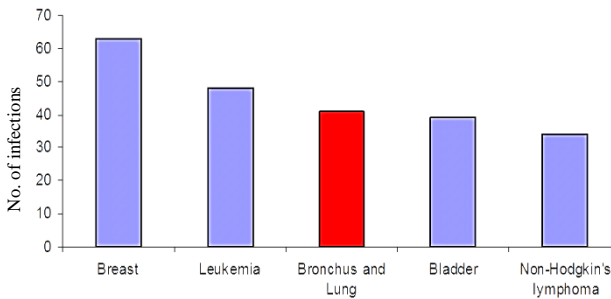


Fig.7: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2001

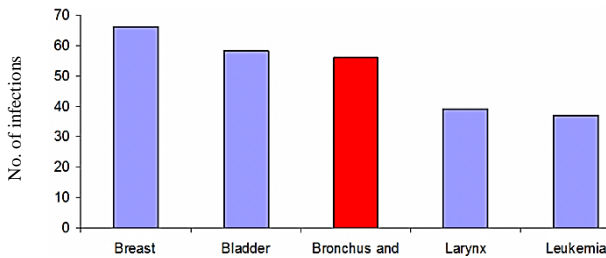


Fig.8: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2002

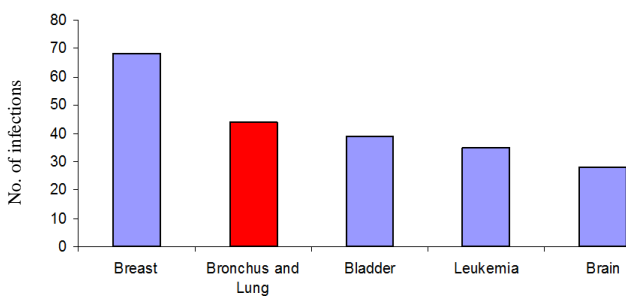


Fig.9: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2003

Discussion and conclusions

The Tables show the commonest cancers in the governorate of Babylon, from the results we can conclude:
 1. Noted from tables the injury rate in breast cancer was 96 cases in 2000, which ranked first in the number of cases of cancer, and the number of cases of leukemia

cancer 54 cases, which is in second place, while the lung cancer was in ranked third and by 42 cases.

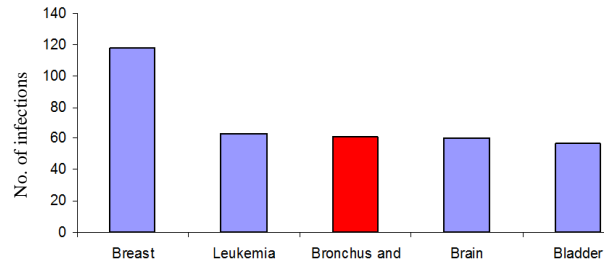


Fig.10: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2004

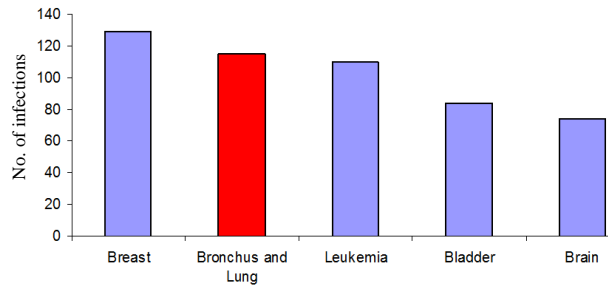


Fig.11: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2005

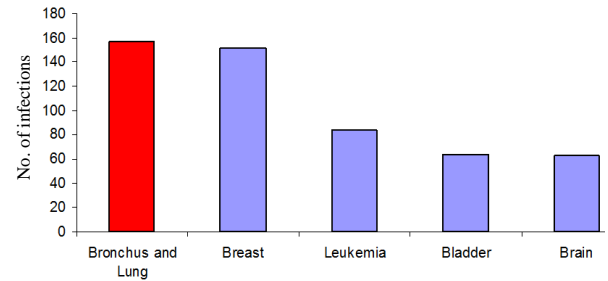


Fig.12: Diagram showed the No. of infections of commonest cancers in some districts of Babylon in 2008

2. In 2001, the statistics, breast cancer 63, leukemia 48 and lung cancer 41 meaning it remained in third place and remain increase Srtaln lung Limited for the years 2002, 2003 and 2004, ranking third. But in 2005, rising to second place to become the number of infections 115.

In 2008, reaching to 157 the number of ranks was the first increase by 3.74 times from the 2000 statistics, while the breast cancer 151, an increase of 1.64 times and 84 leukemia cancer, an increase of 1.5 times. Note that the inhabitants of the governorate of Babylon in 2000 was 1,305,999 and 1,713,949 in 2008, an increase of 1.32 times and this means that the increase in breast cancer, leukemia commensurate with the increase in population, i.e it is increased in the same percentage of natural population increase, whereas the number of infections of lung cancer confirms the results of the study that the increasing was unnatural, and the main reason is to increase the proportion of radon in the soil, water and air two governorates.

The most important radon isotope from a health viewpoint is ^{222}Rn . Its decay products, especially ^{218}Po and ^{214}Po , can have a pronounced adverse effect on lung tissues, leading to lung cancer in many cases. The results in the present work indicate that the area under investigation has different radon concentrations can be helpful in complying new radiation protection regulation to estimate health hazard index due to radiation exposure in Republic of Iraq.

2. increase in the indoor radon levels depends on the total consumption of water in the dwelling, the dwelling size and the air ventilation rate. It has been estimated that 1000kBq/m^3 of radon in tap water would on average results in an increase in the indoor concentration level by 100kBq/m^3 (V. Urosevic et al,2008).

3. lifetime Attributable Risks (LAR) for cancer incidence strongly depends on age of exposure, such that for children exposed to 0.1 Gy dose at age 10 year, the expected lung cancer is twofold higher than that for people exposed to the same dose at age 30 year.

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