The Impact of Radon Gas on Pulmonary Cancer in Albania

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Abstract in English
This Article shows real cases of patients with Pulmonary Cancer admitted and treated in University Pulmonary Hospital of Tirana `Shefqet Ndroqi` during three last years : 2013-2014-2015. All data are confirmed from Statistics division of University Pulmonary Hospital of Tirana `Shefqet Ndroqi`. All data are compared with international standard data of potential possibilities of causing Pulmonary Cancer by gas Radon, in Albanian population during these three years of study to the smoking and non-smoking people.
Is known the importance of gas Radon to cause of Pulmonary Cancer to the smoking and non –smoking people.
As for internationally standard data, Pulmonary Cancer is caused by gas Radon in proportion of 3 people about 1.000 to the contingent to the smoking people, and in proportion of 0.7 people about 1.000 people to the contingent of non-smoking people.
All data extracted from statistics office of University Pulmonary Hospital of Tirana `Shefqet Ndroqi` during three last years : 2013-2014-201, are compared with 0.4 pCi/L(picocyri/liter) that is lowest level of gas Radon Concentration that can be potentially cause Pulmonary Cancer of 3/1000 to the smoking people and of 0.7/1000 non-smoking people.

This Article do presents differences about real patients with Pulmonary Cancer admitted and treated during years 2013-2014-2015 with Pulmonary Cancer can be caused theoretically in Albania population by Gas Radon to the smoking people and non smoking people.
Actually in Albania are not referred systematically data of gas Radon levels and do not have any official data about Risk of Pulmonary Cancer from gas Radon levels to the quarters and apartments where live the habitants .
Paediatric age is not included in this Study because in that age have found not any case of Pulmonary Cancer during these three years included in our study.
All cases, really and theoretically cases, are divided in two group-ages: 15-64 years and, above 65 years. Are represented really cases admitted in University Pulmonary Hospital divided in habitants from villages and from cities; represented all cases admitted in University Pulmonary Hospital divided in males and Females.
Are highlighted during years 2013-2014-2015 in Albania respectively 492-564-604 cases with Pulmonary Cancer, compared respectively with 2333.5-2451.8-2329.3 could be cases theoretically with Pulmonary Cancer, caused with lowest levels of gas Radon that cause Pulmonary Cancer to the smoking and non-smoking people as well.
Statistically have been big differences between really cases admitted in Hospital, and theoretically cases ($p<0.001$) during three years.
Although differences between really Pulmonary Cancer of the women and theoretically Pulmonary Cancer caused by gas Radon were not significant ($p<0.1$).
That does it mean that are various problems that influence in causing of Pulmonary Cancer by gas Radon and do cause statistically big differences between really cases and theoretically cases ($p<0.001$). These various problems can be: delayed diagnostics of patients with Pulmonary Cancer, lack of gas Radon measure equipment, lack of data base of gas Radon levels of habitant area in Albania, etc.

Key Words: Pulmonary Cancer; Radon - ^{222}Rn; 1 pCi/L=37 Bq/m^3

(Picokyri, Bequerel - measuring unit).

Objectives

-The objectives of this study are related to the impact of Radon gas in causing Lung Cancer in smoking and non-smoking patients and those who have quit smoking.

-Evaluation of the impact of Radon gas on Lung Cancer by age groups 15 - 64 years and over 65 years, excluding the age group in which no cases of Pulmonary Cancer were found,

-Assessment of the damages caused by Gazi Radon noticing the hospitalized patients with Pulmonary Cancer in the Sanatorium Hospital from the city and from the village during the years 2013, 2014, 2015.

-Use of international standards in increasing the estimation of the number of patients with Pulmonary Cancer caused by Radon Gas in smokers and non-smokers, to determine the theoretical number of persons who may be affected by Lung Cancer in these two age groups based on the number exact population in the three years taken into study: 2013-2014-2015.

Background

Studies on the level of Radon gas in Albania are few. The only studies that have been done by Eng. Luan Qafmolla, engineer at the Institute of Nuclear Studies, Tirana, entitled `` Monitoring of Radon (222Rn) Indoor Gas, Drinking Water and Soil``, Luan Qafmolla1, Shyqyri Arapi2, Safet Dogjani3), so they are made for Radon gas levels 222, in nuclear waste. The other study was conducted by a group of engineers from the Institute of Nuclear Studies in collaboration with doctors of the Institute of Public Health in 2003, entitled: (`` Results Of The National Survey On Radon indoors in Albania`` referring to the AIP conference (Conf Proc. 1203, 672 (2010); http://dx.doi.org/10.1063/1.3322533, Kozeta Bodea, Elida Bylykua, Florinda Cfarkua, Irena Mucollarib and Manjola Shytib. It has been noticed from these studies that the gas level of Radon 222 has increased levels in Tirana, Ballsh, and Çorovodë in relation to other cities measured with FRITRA-2 monitor.

The maximum levels allowed by the `National Commission on Radiation Protection` based on EC / IAEA (European Union and International Atomic Energy Agency) documents for Radon gas are:
-for old dwellings up to: 400 Bq / m3 (Bequerel / m3)
-for new apartments up to: 200 Bq / m3 (Bequerel / m3)
-for the level of Radon gas in Water up to: 2.5 Bq / l - 10 Bq / l,
-for the level of Radon gas in the ground up to: 22.2 kBq / m3
US and Europe measure radon radioactive gas levels with different indicators: 1 pCi / L = 37 Bq / m3.
(Monitoring of Radon (222Rn) Indoor Gas, Drinking Water and Soil`, Luan Qafmolla1, Shyqyri Arapi2, Safet Dogjani3).(`Measuring of Radon concentration in the Radioactive Centralaste Centralized Facility in Albania` in 2001, Luan Qafmolla)
In this paper, the level of Radon gas inside the apartments was estimated in 173 apartments in 10 areas of Albania for a period of 90 days, it was observed that the level of Radon gas fluctuated between 200-400 Bqm. Measured with the Radtrack detector performed by the Center for Applied Nuclear Physics. ("Results of The National Survey On Radon indoors in Albania`` referring to the AIP conference (Conf. Proc. 1203, 672 (2010); http://dx.doi.org/10.1063/1.3322533, Kozeta Bode[a], Elida Bylyku[a], Florinda Cfarku[a], Irena Mucollari[b] and Manjola Shyti[b]),

A digital radon detector

Some Characteristics and Features of Radon Gas

25.[1] ``Monitoring of Radon ($^{222}$Rn) Gas indoor, Drinking Water and Soil``, Luan Qafmolla[1], Shyqyri Arapi[2], Safet Dogjani[3]
26.ISHP&Instituti I studimeve Berthamore,`` Results Of The National Survey On Radon indoors in Albania`` referuar konferencën e AIP (Conf. Proc. 1203, 672 (2010); http://dx.doi.org/10.1063/1.3322533, Kozeta Bode[a], Elida Bylyku[a], Florinda Cfarku[a], Irena Mucollari[b] and Manjola Shyti[b.]
1.Alavanja MC, Lubin JH, Mahaffey JA, Broënson RC. Residential radon exposure and risk of lung cancer in Missouri. American Journal of Public Health 1999; 89(7):1042–1048.[PubMed Abstract]
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Radon is a radioactive gas found in nature which can be found in the indoor environment both at home and at work. Radon gas is one of the most important causes of Lung Cancer and Respiratory Cancer after the other most important cause that is smoking. Radon gas is estimated to cause around 3-14% of all Pulmonary cancers depending on its average level locally. Radon gas is more likely to cause Lung and Respiratory Cancer in non-smoking patients, but it is also the primary cause of Lung

and Respiratory Cancer in non-smoking patients. The lower the levels of Radon gas concentration, the lower the risks for Lung and Respiratory Cancer, but it is not yet known how low the level of Radon gas concentration should be in order not to caused Cancer.
Radon is the fifth radioactive element discovered in 1900 by Friedrich Ernst Dorn, after Uranium, Radium, and Polonium.
Radon gas is produced from the dissolution of Radium 226 which is found in Uranium ore, phosphate rocks, clay shales, metamorphic rocks such as granite, and ordinary rocks such as limestone.
Radon gas has no stable isotopes and has 36 isotopes that have atomic mass from 193-228. The most stable isotope is Rn222 which is the derivative of the decomposition of Ra226 and U238
Atmospheric Radon gas concentrations are measured in Becquerel per cubic meter Bq / m3, and SI, while in the US they are measured in picocyri per liter - pCi / L); 1 pCi / L = 37 Bq / m3.
Average domestic and indoor exposure is 48 Bq / m3 but varies; while outside the buildings are 15 Bq / m3 ..
Because the half-life of Radon gas is 3.8 days, removing or isolating the source would significantly reduce the risk within a few weeks. Another method of reducing gas levels Radon modification of building ventilation. In general, the concentration of Radon gas inside buildings increases when their ventilation decreases. In a well-ventilated place, the concentration of Radon gas tends to reach the concentration that is found in buildings 10 Bq / m3 (1 to 100 Bq / m3). "A Citizen's Guide to Radon". www.epa.gov. United States Environmental Protection Agency. October 12, 2010. Retrieved January 29, 2012.
Brief Overview
Radon is a chemical element with the symbol Rn and atomic number 86, it is a radioactive gas, colorless (Sometimes it is green or red in the exhaust pipes. Sometimes it is green or red in the exhaust pipes.), Odorless , tasteless, produced naturally by the decay (dissolution) of Radium. Radium is the decomposition product of Thorium and Uranium which are the most common radioactive materials found on earth. It is a highly stabilized isotope and has a half-life of 3.8 days.
Table 1.

Periodic Table of the Elements (https://www.google.com/#q=mendeleev+periodic+table).

[27.] *"A Citizen's Guide to Radon". www.epa.gov. United States Environmental Protection Agency. October 12, 2010. Retrieved January 29, 2012.*

7.Harley NH, Robbins ES. Radon and leukemia in the Danish study: another source of dose. Health Physics 2009; 97(4):343–347.[PubMed Abstract]

8.Krewski D, Lubin JH, Zielinski JM, et al. A combined analysis of North American case-control studies of residential radon and lung cancer. Journal of Toxicology and Environmental Health, Part A 2006; 69(7):533–597.[PubMed Abstract]

9.Lagarde F, Falk R, Almrén K, et al. Glass-based radon-exposure assessment and lung cancer risk. Journal of Exposure Analysis and Environmental Epidemiology 2002; 12(5):344–354. [PubMed Abstract]

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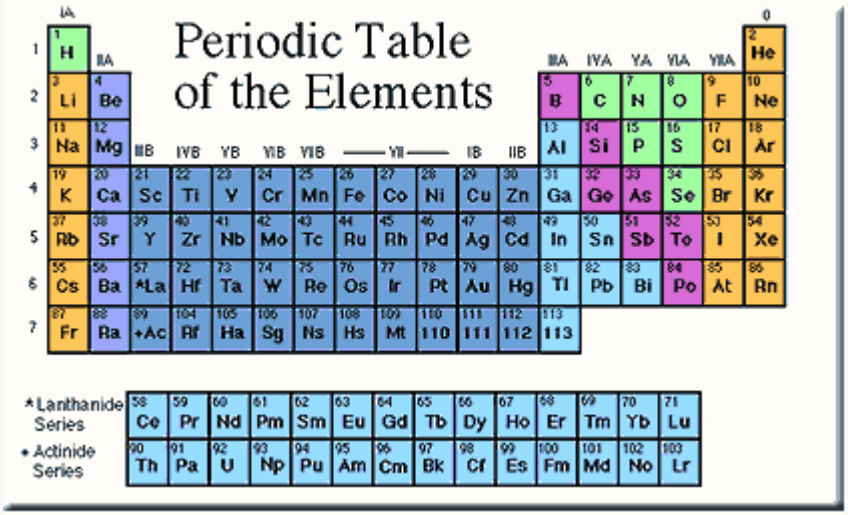
11.National Research Council. Committee on Health Risks of Exposure to Radon: BEIR VI. Health Effects of Exposure to Radon. Ëashington, DC: National Academy Press, 1999.



Like all other intermediate elements of dissolution chains, Radon gas is easily inhaled. Thus Radon gas occurring in the environment is responsible for most public exposures to radioactive ionization. This is the single largest contributor of the individual dose to the individual and is highly variable as the dose varies from country to country. Despite the short half-life, some of the Radon gas obtained from natural decomposition pathways can accumulate in higher concentrations than normal inside buildings, especially in the lower parts of buildings, such as foundations, lower floors of the building, due to of its density. This can also happen in waters when water comes from terrestrial sources, such as some spring water or hot springs.

Epidemiological data have clearly shown a link between inhalation of high concentrations of Radon gas and the incidence of Pulmonary Cancer. Thus Radon gas is considered the most significant pollutant that affects the air quality inside the building and home worldwide. According to the US Environmental Protection Agency (EPA), Radon gas is the second most common cause of Lung Cancer after Smoking. 21,000 people in the US die of Pulmonary Cancer each year from smoking, and 2,900 people from Non-Smoking Lung Cancer (https://en.wikipedia.org/wiki/Radon).

Accumulation in Buildings.

Typical exposures to settlements and inside buildings are approximately 100 Bq / m3 (2.7 pCi / L) of Radon gas. Radon enters buildings directly from the ground (ground) through the lower levels of the building that is in contact with the ground. High levels of Radon in water supply devices can increase the level of Radon gas in the air of homes. Typical Radon gas entry points inside buildings are cracks in the solid foundations of the building, at the connecting points of structures, cracks and gaps around service pipes, cavities inside walls and water supply equipment. Radon gas concentrations in the same localization can also vary within the 1 hour period by different factors. Also the concentration of Radon gas in a room of a building can be very different from the concentration in the neighboring room. (Toxicological profile for radon, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with U.S. Environmental Protection Agency, December 1990).

Table 2 Data from Existing Reports.

Concentration Scale Concentration in Nature		**Examples of Radon Gas**
Bq/m^3	**pCi/L**	
		Concentration of Radon gas on the shores of the oceans-1 Bq/m^3.
1	~0.027	Concentration of Radon gas traces over the ocean and over the Antarctic -0.1 Bq / m3.
		Radon gas concentration in outside air -10 to 30 Bq / m3..
10	0.27	Based on observations Global Radon gas concentration around homes -39 Bq / m3.
		Typical home concentrations in many countries have adjusted to -200–400 Bq / m3. When the reference level is 4 picocuries radon per liter of air (150 Bq / m3), then actions are unnecessary. A continuous exposure of 230 Bq / m3 for a period of 1 year corresponds to 1 WLM (monthly working level) . The allowed
100	2.7	

		concentration in Uranium mines is 1,220 Bq / m3 (33 pCi / L)
1,000	27	Very high concentrations (> 1000 Bq / m3) that are found in houses built with and that has uranium up to 20 picocuries radon per liter of air (800 Bq / m3) or even higher, then the homeowner needs said to take measures to remove Radon gas.
10,000	270	Air concentrations in unventilated galleries such as Gastein Healing Gallery reach up to 43 kBq / m3 (about 1.2 nCi / L) with a maximum value of 160 kBq / m3 (about 4.3 nCi / L).
100,000	~2700	About 100,000 Bq / m3 (2.7 nCi / L) has been found in Stanley Watras foundations.
1,000,000	27000	Concentrations reaching 1,000,000 Bq / m3 are found in unventilated Uranium mines
5.54 × 10^{19}	~1.5 × 10^{18}	*Theoretical Limit of Radon Spirum Gas is: (222Rn) at 100% concentration (1 atmosphere, 0 ° C); 1,538 × 105 curies / gram; 5.54 × 10 Bq / m3.*

(Zdrojewicz, Zygmunt; Strzelczyk, Jadëiga (Jodi) (2006). "Radon Treatment Controversy, Dose Response". Dose-Response. 4 (2): 106–18. doi:10.2203/dose-response.05-025.Zdrojeëicz. PMC 2477672 . PMID 18648641.)

(Toxicological Profile for Radon, Table 4-2 (Keith S, Doyle JR, Harper C, et al. Toxicological Profile for Radon. Atlanta (GA): Agency for Toxic Substances and Disease Registry (US); 2012 May. 4, CHEMICAL, PHYSICAL, AND RADIOLOGICALiNFORMATION.) Retrieved 2015-06-06).

Recognition of Radon gas as a source of Disease and Cancer.

As early as the 16th century, Paracelsius and Agricola described it as a chronic disease in miners. In 1879 at a miners' inspection in Schneeberg Germany, Hertin and Hesse identified these diseases in miners as Lung Cancer (ATSDR 2008). After 1970, Radon and its derivatives were widely

recognized as a potential problem in Europe and Scandinavia as a source for Lung Cancer (NIOSH).

Dose of Radon That May Cause Lung Cancer

The EPA (US Environmental Protection Agency) estimates that exposure to high values of Radon is one of the leading causes of death in the US. The EPA estimates that the recommended guidelines for the risk of Lung Cancer due to Radon exposure are 4 pCi / L (1 pCi / L = 37 Bq / m3.). This dose in the environment or in water causes Lung Cancer in:

-1% of non-smokers

-3% for those who have quit smoking

-5% for smokers

These estimates may vary Group at-risk populations. In assessing the risk from Radon at home or in offices with the same concentrations, one should look not only at the accessories but also their way of life. For example, higher levels of Radon are found on the lower floors of houses. (Radon Toxicity: Who is at Risk ?, Agency for Toxic Substances and Disease Registry, 2000).

Consequences on Human Health

Ionizing radiation causes the formation of free radicals which cause genetic damage and cell damage which increase the rates of morbidity including Cancer.

The decay products of Radon 222 (Rn 222) are classified by the International Agency for Research on Cancer (IARC) as a carcinogenic agent in humans, and as a gas that can be inhaled causes cancer. of lungs especially in people exposed to increased concentrations over stable periods of time

("Known and Probable Carcinogens". American Cancer Society. Retrieved 2008-06-26).

Lung Cancer ranks first in terms of Cancer deaths in general.

Among Non-smokers Lung Cancer is the No.1 cause of death.

Three main Causes of death from Lung Cancer			
Men		**Women**	
Lung Cancer	33%	Lung Cancer	24%
Prosthate Cancer	12%	Prosthate Cancer	-
Colorectal Cancer	10%	Colorectal Cancer	11%

Lung Cancer is the deadliest cancer of all Cancers - survival up to 5 years is 10% -14%.
(Http://www.radonseal.com/radon-health.htm).
The most intense radiation from Radon derivatives occurs within the first hours when Polonium and Bismuth are rapidly decomposed into Radioactive Bullet-210, and then continue at a slower decay until Bullet2016. ½ the life of these nucleotides is over 22cjet, If a person is exposed to Radon 75% of its derivatives in the lungs lead particles will become harmless after 44 years. When alpha particles damage the cell, it takes a minimum of 5 years and in many cases 15-20 years or more to transform this cell into Pulmonary Cancer. population. Lung Cancer studies have therefore been done in miners exposed to Radon and in radiological research, animal research, and cellular research.
Only a few people exposed to Radon will develop Lung Cancer, but the risk of Cancer can in some cases last a lifetime. Children and young people are more at risk of developing cancer during their lifetime.

Ways to Eliminate Radon Ionizing Radiation
The main ways to reduce the amount of Radon gas accumulation in the home are:
-Increased Ventilation in the lower basal and underground pillars of the building;
-Improving the ventilation of the house and avoiding the transportation of Radon Gas from the basement to the rooms of the house,

-Installing the crankcase system (suction pump) for Radon Gas in the basement of the house
-Installing positive pressure or a device with positive ventilation systems.
According to the EPA (US Environmental Protection Agency), the method of reducing Radon Gas `` primarily remains the ventilation system and the fans that draw Radon gas from the basement of the house and the basement and take it out, which is called active sub-slab depressurization, active soil depressurization.
("A Citizen's Guide to Radon". Www.epa.gov. United States Environmental Protection Agency. October 12, 2010. Retrieved January 29, 2012.)

List of Occupations Endangered by Radon Exposure
- Excavators
- places where fish grow
- Miners
- hospitals
- Natural caves
- Natural gas and oil pipelines
- Warehouses where nuclear waste is stored
- Oil Refineries
- Phosphate fertilizer plants
- Fossil waste plants (combustion products are released into the air)

Radium contaminated sites with Radium
- Underwater tunnels and tunnels in general
- Water treatment plants (in moments during ventilation

(EPA 2003; Field 1999; Fisher et al. 1996)

Risku ndaj Kancerit të Pulmonit
Risku i Kancerit Pulmonar nga ekspozimi ndaj Radonit vlerësohet midis 10-20 herë tek personat të cilët janë duhan pirës të krahasuar me ata që nuk janë duhanpirës.
Radoni mund të shkaktojë rreth 14% të numrit të pacientëve me Kancer Pulmoni (EPA 2009b).
Sipas OBSH (WHO 2005) Kanceri i Pulmonit i shkaktuar nga Radoni përfshin nga 6%-15% të numrit të pacientëve më Kancer Pulmoni.

Sipas Këshillit Kombëtar të Akademise së Shkencave Natyrore, arrin në përfundimin se Radoni është shkaku i dytë madhor i Kancerit të Pulmoneve pas Duhanit (NAS 1999) dhe (NRC 1999; EPA 2003).
Risku tek Fëmijët të ekspozuar ndaj duhanit është rreth 20 herë më i lartë se tek të rriturit.
Risku tek fëmijët të Ekspozuar ndaj Radonit është rreth dy herë më i lartë se tek të rriturit ndaj të njëjtës dozë.(NRÇ 1999; Darby 2005; Krewski et al 2005).
Njerëzit që jetojnë në shtëpi që nuk ajrosen dhe nuk largohen ndotësit dhe nuk dalin për shkak të pamundësisë, janë më të rrezikuar nga Radoni.
Risk-u i Kancerit të Pulmonit për shkak të ekspozimit ndaj Radonit është 10-20 herë më i madh tek njerëzit që janë duhanpirës të krahasuar me ata që nuk janë duhanpirës
(http://www.atsdr.cdc.gov/csem/csem.asp?csem=8&po=7)
 Afërsisht 1 në 15 shtëpi në SHBA ka nivele Radoni mbi ato të rekomanduara nga OBSH dhe EPA, pra 4 picocuries per liter (pCi/l) (148 Bq/m³) (EPA (February 2013). "Radiation information: radon". EPA.)

Mechanism of Cancer Radon Action in the Body.
Once Radon gas is inhaled from the lungs, it is easily digested in the blood and circulates throughout the body until it is expelled from the body through the lungs or skin. Because ½ the life of Radon 222 is 3.8 days many Radon atoms leave the body before they disintegrate.
Most harmful due to radioactivity are Radon atoms that decompose into radioactivity and the so-called
Radon `daughters` derived from the metal particles of Lead, Polonium, and Bismuth. The accumulated radioactivity in the airways is in direct proportion to the levels of Radon at the level of 4 pCi / L, so about 600,000 particles are trapped in the lungs every hour.

34."A Citizen's Guide to Radon". www.epa.gov. United States Environmental Protection Agency. October 12, 2010. Retrieved January 29, 2012.

(EPA (February 2013). "Radiation information: radon". EPA.)
12.U.S. Environmental Protection Agency (January 2009). A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family From Radon. Retrieved October 18, 2011.
13.Radon Toxicity: Ëho is at Risk?, Agency for Toxic Substances and Disease Registry, 2000.
14.Proctor, Robert N. The Nazi Ëar on Cancer. Princeton University Press, 2000 p. 99 ISBN 0691070512.
15.Edelstein, Michael R., Ëilliam J. Makofske. Radon's deadly daughters: science, environmental policy, and the politics of risk. Roëman & Littlefield, 1998, pp. 36–39 ISBN 0847683346.
16.Samet, J. M. (1992). "Indoor radon and lung cancer. Estimating the risks". The Western journal of medicine. 156 (1): 25–9. PMC 1003141 . PMID 1734594.
22.Ministry of Health Albania, `Global Youth Tobacco Survey` CDC,who, 2007, Tirana, Albania

Table 4 Radon Risk Assessment for smokers and non-smokers (Modified from EPA 2009)

Level of Radon	**If 1,000 persons who are smokers would have been exposed to these levels of Radon during their lifetime then….**	**- What to do: - - Stop smoking - - And ... ..**
20 pCi/L	About 260 persons can be with Lung Cancer	Tidy up your Home
10 pCi/L	About 150 persons can be with Lung Cancer	Tidy up your Home
8 pCi/L	About 120 persons can be with Lung Cancer	Tidy up your Home

4 pCi/L	About 62 persons can be with Lung Cancer	Tidy up your Home
2 pCi/L	About 32 persons can be with Lung Cancer	Consider adjusting the house to 2 and 4 pCi / L
1.3 pCi/L	About 20 persons can be with Lung Cancer	Adjusting the house to the 2 pCi / L level is difficult
0.4 pCi/L	**About 3 persons can be with Lung Cancer**	Adjusting the house to the 2 pCi / L level is difficult
0 pCi/L	Calculated Lack of Risk	Impossible to adjust because they are equal to Radon levels outside in the environment.

Level of Radon	**If 1,000 non-smokers would be exposed to these levels in their lifetime, then …….**	**WHAT TO DO: Avoid smoke and...**
20 pCi/L	About 36 people may have Cancer	Tidy up your Home
10 pCi/L	About 18 people may have Cancer	Tidy up your Home

8 pCi/L	About 15 people may have Cancer	Tidy up your Home
4 pCi/L	About 7 people may have Cancer	Tidy up your Home
2 pCi/L	About 4 people may have Cancer	Consider adjusting the house to 2 and 4 pCi / L
1.3 pCi/L	About 2 people may have Cancer	Adjusting the house to the 2 pCi / L level is difficult
0.4 pCi/L	**On average less than 1 person (0.7) may have Lung Cancer**	Adjusting the house to the 2 pCi / L level is difficult
0 pCi/L	Calculated Lack of Risk	Impossible to adjust because they are equal to Radon levels outside in the environment.

(Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for injury Prevention and Control Reports.
* Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).

** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for injury Prevention and Control Reports).
(https://www.epa.gov/radon/health-risk-radon).

Pulmon deposition depends on whether the particles are attached to the dust or tobacco or loose. The latter are deposited deeper in the Pulmon, and this explains the type of Radon-induced deep lung cancer in non-smokers.
Radon daughter particles emit alpha and beta and gamma radioactivity. Alpha particles do not penetrate more than 1 mm deep into the tracheo-bronchial and Pulmonary tree and mainly into epithelial cells. The ionizing radiation concentration of heavy alpha particles is more damaging and explains more than 85% of Pulmonary damage.
Daughter particles that emit beta radiation go even deeper into the body up to 1-2 cm deep into human tissue.
Daughter particles that emit Gamma rays have more energy than x-rays and pass throughout the body to the outside of the body. As they are distributed throughout the body they have less concentration and consequently are less harmful.
Carcinogens cause damage to chromosomes and DNA molecules contained in the cell nucleus. Even an alpha particle can cause great damage to the genome that DNA of the cell including mutations and transformations. In this case it can be said that there is no dose of harmless Radon. The passage of an alpha particle has the potential to induce a cancerous growth of the cell which the particle does not kill directly because it does not enter the cell, but by damaging the surrounding environment the alpha particle produces chemical radicals inside the cell which damage DNA.

Other diseases caused by Radon.
Radon's radioactive daughter particles have been observed to occur in concentrations 10 times higher in non-smokers with Alzheimer's and Parkinson's disease than in people who have not had a history of past neurological disease.

It has been observed that the geographical distribution of mortality from Parkinson's is higher in US states that have high Radon potential. However the Risk is much lower than Lung Cancer.
In cases of taking Radon by the gastrointestinal tract. It has been observed that there are also cases of Stomach cancer. In the US there are 20 deaths from Stomach Cancer per year which is 1,000 times lower than mortality for Lung Cancer
Treatment. Lung Cancer treatment is done only with surgery. Without surgery the disease is incurable.
Survival after 5 years is 10-15%. http://www.radonseal.com/radon-health.htm.
The most common physiologically pathological type of Lung Cancer was adenocarcinoma in both smokers and non-smokers.

Purpose of the Study

This study aims to highlight the dangers of Radon Gas in causing Lung Cancer in both non-smokers and non-smokers and non-smokers and to note the ratio of hospitalization of patients with Radon-induced Lung Cancer with the number of Lung Cancer patients who smoke and who have smoked but quit smoking.
This study considers patients with Pulmonary Cancer thought to be caused by Radon222 gas in relation to Lung Cancer caused by smoking, relying mainly not on direct measurement of Radon gas but on the possibilities of causing Radon Pulmonary Cancer in Albania according to scientific information on the risk of causing Pulmonary Cancer by Radon Gas.

Patients and Materials

Inpatients with Dg. Lung Cancer in the last three years 2013, 2014, 2015. Statistical materials are taken from the data of the University Hospital (Pulmonary Diseases) `Shefqet Ndroqi`, Tirana.
In these data confirmed by the University Hospital of Pulmonary Diseases, I divided the patients into three main age groups, excluding the child age group 0-15 because with this diagnosis there were no hospitalizations: 15-44 age group which is the youngest age and more productive at work, middle age group 45-64 middle age group but also

productive at work, and the period when menopausal physiological changes begin for women and andropause for men which may affect the increase of morbidity; and the third age group of old age over 65 in which morbidity and mortality increases to Cancer of any kind even more so and to Lung Cancer.
Characteristic was that there were no patients under 15 with Dg. Lung Cancer.
For 2013, a total of 492 inpatients were included in the study and of these according to the table were 412 males and 80 females; divided according to three main age groups 15-44 years old 45-64 years old and over 65 years old, were hospitalized respectively with Dg.Pulmonary Cancer: 25 men and 3 women, 208 men and 39 women and 179 men and 38 women.
For 2014 were taken in study with Dg. Pulmonary cancer had a total of 564 patients, of whom 468 male and 96 female patients were hospitalized. Of these, according to the age group 15-44 years old, 45-64 years old, and over 65 years old, respectively, were hospitalized: 13 males and 7 females, 207 males and 45 females, and 248 males and 44 females.
For 2015 were taken in study with Dg. Lung Cancer A total of 604 patients were admitted to the University Hospital for Pulmonary Diseases and of these 502 patients were male and 102 patients were female; Of these, according to the age group 15-44 years old, 45-64 years old, and over 65 years old, respectively, the hospitalizations are presented in the following figures respectively: 11 males and 2 females, 119 males and 23 females, and 205 males and 47 females.
According to the written anamnesis in these patients the vast majority of these patients were smokers, but the data that were from the cards were incomplete. For this reason we have relied on this paper in the international data of persons affected by Lung Cancer due to smoking.

Methods

The patients included in the study are patients with Pulmonary Cancer Diagnosis with the relevant code (iCD-9 -162), hospitalized in the University Hospital (Pulmonary Diseases) `Shefqet Ndroqi`, during the last three years, ie the years: 2013, 2014 2015.
The number of patients and their cards have been verified through the assistance provided by Dr. Sofiela Telo, Statistician of the Statistics

Archive of the University Hospital (Pulmonary Diseases) `Shefqet Ndroqi.

Given that 86% of patients with Lung Cancer are caused by smoking according to international studies: while other causes are:

- Exposure to Raddon gas 6% -13%
- While Exposure to certain other chemicals, household clothing or various asbestos appliances, Air Pollution, Previous Pulmonary Diseases Past Cancer Treatments, decreased immunity - occupy about 1-8% of Lung Cancer cases.

(http://www.cancerresearchuk.org/about-cancer/type/lung-cancer/about/lung-cancer-risks-and-causes#lLYExA7gLLMgzcG7.99)
(http://www.cancerresearchuk.org/about-cancer/type/lung-cancer/about/lung-cancer-risks-and-causes)
(https://www.drugs.com/health-guide/adenocarcinoma-of-the-lung.html).

This study is based on statistical data obtained from the University Hospital of Pulmonary Diseases and some international data on which the paper is based to achieve comparative results and relevant conclusions.

In table no. 1, Radon Gas is presented in Mendeleev's Table (Periodic Table of the Elements) in which it occupies the place No. 86 with yellow color, without color without taste, and inert gas.

In table no. 2, shows the degree of concentration of Radon gas in Nature measured in Bq / m3 - becquerel per / m3, or in pCi / L - picokyri / liter. This table shows that the highest concentrations of Radon gas are found in the Uranium mines -1,000,000 Bq / m3, and the lowest concentrations are found in the Antarctic surface - 0.1 Bq / m3.

In table no. 3, there are three most dangerous types of Cancer in Men and Women where the first place for Mortality is Pulmonary Cancer where one of the most dangerous factors in causing it is Radon Gas.

In table no. 4, entitled `` Radon Gas Risk Assessment for smokers and non-smokers (Modified from EPA 2009), has the basic international data on which the theoretical data are built which show the possibilities of affecting the population from Lung Cancer from the concentration of Radon gas in Dwellings. The lowest chance of causing Lung Cancer from Radon Gas to Smokers and non-smokers according to the table taken

as standard given in this study is 0.4 pCi / L and at this level of Radon gas concentration can get Pulmonary Cancer -3 people smoking per 1000 inhabitants; while according to the table can get Pulmonary Cancer - 0.7 non-smokers per 1,000 inhabitants. Below these levels, for both smokers and non-smokers it is impossible to cause Lung Cancer but the cause cannot be ruled out if the influence of this radioactive gas is prolonged over time or increases over different periods of time.
Also in this table it can be seen that levels at 20 pCi / L (and more) in smokers can cause Lung Cancer up to 260 people per 1,000 inhabitants; while in non-smokers the same levels, ie 20 pCi / L (and more) can cause Lung Cancer in 36 people per 1,000 inhabitants.
Also in this table with international standard data are given recommendations on how to increase the increased level of Radon from the minimum 0.4 pCi / L that causes Lung Cancer, a level which is taken as a comparative base level in this paper and up to high levels 20 pCi / L (and more) which capture large contingents of the population.

20.Dr. Roland Shuperka, Prof. Klement Shteto, WHO, 2001, `Tobacco is the Big Killer`, I.SH.P. Tirana
21.WHO, `Screening Test for Substance Use Tobacco, Alcohol, Drugs, ASSIST`, 2010,
17.Dr. Sofiela Telo, Statistician of the Statistical Archive of the University Hospital (Pulmonary Diseases) `Shefqet Ndroqi.
23.Biological Effects of ionizing Radiation VI report, Health Effects of Exposure to Radon (NAS 1999, and (NRC 1999; EPA 2003)

In tables no. 5-6-7-8-9 (as will be analyzed below), the number of patients by age group, by urban and rural residence, the number of patients operated on for Lung Cancer in relation to the operated patients in the surgery of the University Hospital of Pulmonary Diseases (Sanatorium) which are taken in the study, as well as the number of inhabitants of the Republic of Albania in 2013, 2014, 2015, and the percentage of the most affected age groups and treated in hospital for Cancer Pulmonary, and the theoretical possibility of Pulmonary Cancer from the effect of Radon gas based on the standards of probability of

affect of residents by age groups taking into account smokers and non-smokers in the Republic of Albania in all three years.
These data are presented in more detail in tables no. 10-11-12-13. Table No.10 and Table No.11 present comparative data in relation to the population aged 15-64 and over 65 in relation to two international indicators as a minimum of Radon gas per 1000 inhabitants, in residential buildings which can cause Lung Cancer (minimum is 0.4 pCi / L), which in cases of smokers can cause Lung Cancer in 3 inhabitants per 1000 inhabitants and in cases of non-smokers can cause Lung Cancer in 0.7 inhabitants per 1000 inhabitants (this can be seen in Table No. 4).
In table no. 12 and 13, it is noticed the total theoretical impact from Lung Cancer on male smokers and non-female male smokers based on international standards could be according to table No.12 in both age groups together is respectively: 2110 / 224.5 (2333.5) -2013 , 236 / 2210.8 (2451.8) -2014, and 262.5 / 2066.8 (2329.3) -2015.

Full Description of Materials and Patients

Having no exact data on patients with Dg.Pulmonary Cancer caused by Radon gas we have used the deductive method to find persons with Dg. Lung Cancer caused by Radon gas. Based on international data, standard standards for causing Pulmonary Cancer in smokers and non-smokers from Radon gas in Albania, comparing them with real data extracted from the archive of the University Hospital of Pulmonary Diseases (Sanatorium).
The main data come from the foreign literature which mentions that Treatment of Lung Cancer caused by Radon and in smokers is done only with Surgery. Without surgery the disease is incurable. Survival after 5 years is 10-15%.
(http://www.radonseal.com/radon-health.htm. (Krewski D, Lubin JH, Zielinski JM, et al. A combined analysis of North American case-control studies of residential radon and lung cancer. Journal of Toxicology and Environmental Health, Part A 2006; 69 (7): 533–597).
In extracting the results we are based on the data of the literature and the data obtained from the Pulmonary Diseases Hospital (Sanatorium) for the years 2013-2014-2015, presented in tables no. 1, 2, 3, 4, 5. 6, 7, 8.

These scientific data on the Risk of Lung Cancer caused by Radon Gas in non-smokers and smokers are as follows.
Given that according to the EPA,
-The risk of Lung Cancer for smokers is about 90% (86%), or from 62 people in 1000 population will die from Lung Cancer,
- The risk of Lung Cancer for non-smokers but also due to the synergistic effects between Radon gas and Tobacco, is in relation to 7 people in 1000 population will die from Lung Cancer ("A Citizen's Guide to Radon". Www. epa.gov. United States Environmental Protection Agency (October 12, 2010. Retrieved January 29, 2012),
-According to WHO (WHO 2005) Radon Cancer Caused by Radon includes from 6% -15% of the number of patients with Lung Cancer,
- While according to EPA, Radon can cause about 14% of the number of patients with Lung Cancer (EPA 2009b).
-The risk of Lung Cancer due to exposure to Radon is 10-20 times higher in people who are smokers compared to those who are not smokers (http://www.atsdr.cdc.gov/csem/ csem.asp? csem = I = 8 & 7).
-Approximately 1 in 15 homes in the US has Radon levels above those recommended by WHO and EPA, ie 4 picocuries per liter (pCi / l) (148 Bq / m^3) (EPA (February 2013). "Radiation information: radon". EPA).
This study is based on the above data, taking the lowest possible level of Radon gas that can cause Lung Cancer:
- to non-smokers level which according to table no. 4 is: 0.4 pCi / L, less than 1 person (0.7) may have Lung Cancer,
- to smokers according to tables no. 4 is: 0.4 pCi / L, 3 people can have Lung Cancer per 1000 people.
Making the necessary calculations based on people with cancer hospitalized in 2013, 2014 2015, we can note these results as follows.
In the following table No.9, the population of the Republic of Albania for the three years under review is presented: the year 2013-2014-2015 as well as the population of the age group 15-64 years and over 65 years for the three years. Age 0-15 years has not been considered because there has been no case of Lung Cancer in this age group for these three years. These data are taken from the Statistical Yearbook of INSTAT for the respective years 2013-2014-2015 corrected from the Mundi index and cia world factbook data as follows. The argument is that without knowing an

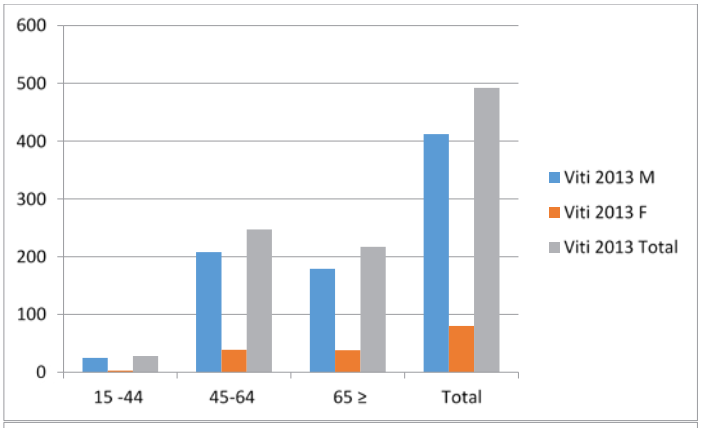
accurate statistical data no accurate results can be drawn for the impact of Radon gas on this article.

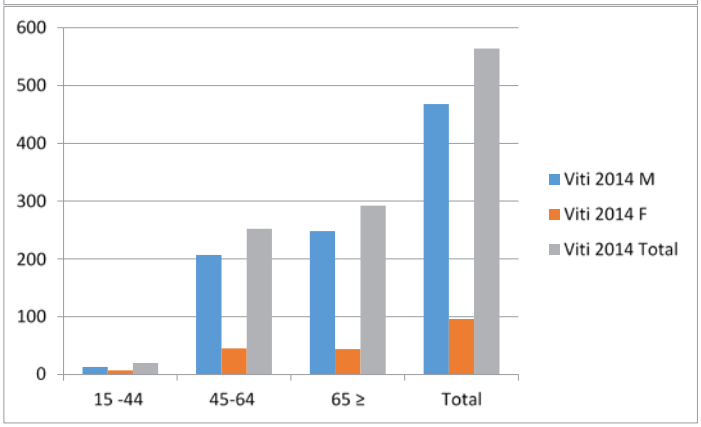
Results

Table No. 5 presents the cases of Pulmonary Cancer hospitalized for the years 2013-2014-2015 by age group and by gender. In this table are three age groups 15-44 years old, 45-64 years old, and over 65 years old.
It is noted that according to age groups, the most affected by Lung Cancer is the age group of 45-64 years respectively: 247 cases (208/39) for 2013, 252 cases (207/45) for 2014, and 142 cases (119 / 23) for the year 2015. Regarding the third age group over 65 years old, it is noticed that in 2014 and 2015 there are more cases than the age group 45-64 years old for the years 2014 and 2015 respectively: 217 cases (179/38) for the year 2013, 292 cases (248/44) for 2014, 252 cases (205/47) for 2015. The tendency is to increase the number of lung cancer diagnosed and treated in hospital from 2013-2014-2015 respectively 492- 564-604 rast.

Table 5

Diagnosis Code :ICD-9 -162	**Year 2013**				**Year 2014**			
Lung cancer hospitalized	**Age in years**	**M**	**F**	**Total**	**Age in years**	**M**	**F**	**Total**
Age in years	15 -44	25	3	28	15 -44	13	7	20
	45-64	208	39	247	45-64	207	45	252
	65 ≥	179	38	217	65 ≥	248	44	292
	Total	412	80	**492**	Total	468	96	**564**





36.EPA (February 2013). "Radiation information: radon". EPA.
32."A Citizen's Guide to Radon". www.epa.gov. United States Environmental Protection Agency. October 12, 2010. Retrieved January 29, 2012),
8.Krewski D, Lubin JH, Zielinski JM, et al. A combined analysis of North American case-control studies of residential radon and lung cancer. Journal of Toxicology and Environmental Health, Part A 2006; 69(7):533–597).
19.Institute of Statistic of Albania- INSTAT, Statistical Yearbook 2013, 2014, 2015.

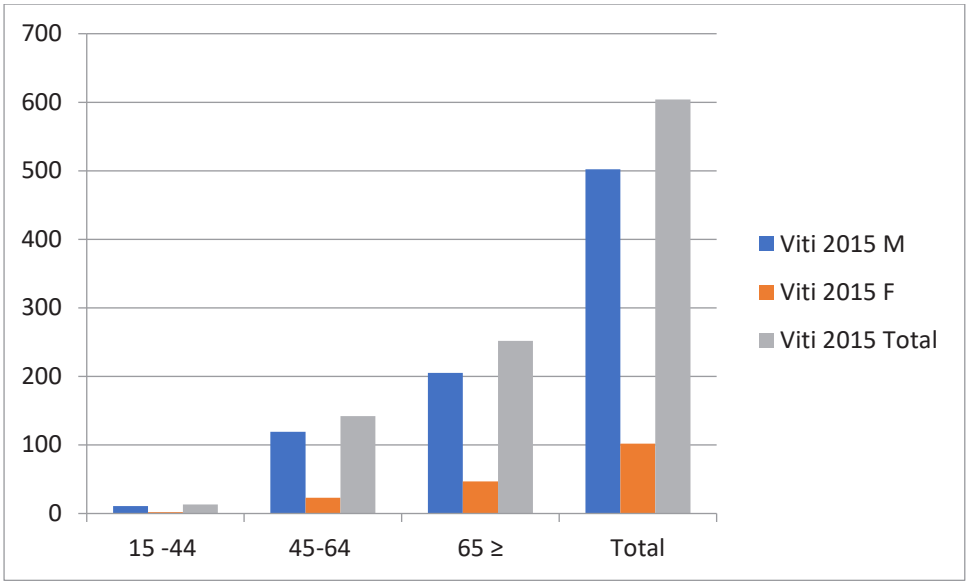


Table No.6 presents the cases of Pulmonary Cancer in the three years 2013-2014-2015, dividing them into urban and male and female peasants. It is noted that the most frequent cases of Pulmonary Cancer in these three years were among men: 492, 564, 604 with a slight increase in 2014, and 2015, and less among the villagers respectively: 311/101, 321/147, 312/190, with a relatively small or constant progressive increase, in 2014 and 2015.

In the case of the male-female ratio, it is noticed that the number of females in relation to the number of males among the three years is smaller respectively 80-96-102 with an increase in 2014 and 2015. The cancer ratio among females in the city and in the village during these three years is respectively 54/26, 64/32 /, 64/38 indicating that there is more lung cancer among women living in the city.

Table No.6

Diagnosis Code :ICD-9 -162	**2013**			**2014**			**2015**		
Lung cancer hospitalized	**M**	**F**	**Total**	**M**	**F**	**Total**	**M**	**F**	**Total**

Citisen	311	54	365	321	64	385	312	64	376
Peasant	**101**	**26**	**127**	**147**	**32**	**179**	**190**	**38**	**228**
Total	412	80	**492**	468	96	**564**	502	102	**604**

Tables No. 7 and No. 8 present the results of Cancer Patients operated on in thoracic surgery at the University Hospital of Respiratory Diseases. In Table No.7 the surgical treatment of respiratory pathologies in general is greater in number than the Lung Cancer in particular which is being discussed. There are no data for 2013, and for 2014 there are 466 cases of thoracic surgery and of these with pulmon ectomy are 185; whereas for 2015, 454 thoracic surgeries were performed and out of these 195 surgeries with pulmon ectomy which cannot tell us whether the surgeries were for Pulmonary Cancer or not.
Table No.8 shows the surgical treatment of Pulmonary Cancer in addition to pulmonon ectomy and lobectomy. The cases operated with Pulmonary Cancer and Lobectomy according to the years are: Pulmonectomy / lobectomy and total for 2013 10 / 26-36 cases; for 2014 the cases with surgical treatment Pulmonectomy / lobectomy and total are: 17 / 44-61 cases; for 2015 the cases with surgical treatment Pulmonectomy / lobectomy and total are: 3 / 41-44 cases. If we analyze carefully, it is noticed that the cases with lob ectomy are more preferred for the lung Cancer surgery in relation to the lung and the incision. Cases with pulmononectomy may have been caused by delays in treatment of Lung Cancer.

Treatment of Lung Cancer with Surgery	**Year 2013**	**Year 2014**	**Year 2015**
Thoracic surgery	?	466	454
Pulmonectomy surgery	?	185	195

Table Nr.8

Treatment of Lung Cancer with Surgery	Year 2013	Year 2014	Year 2015
Pulmonectomy	10	17	3
Lobectomy	26	44	41
Total	**36**	**61**	**44**

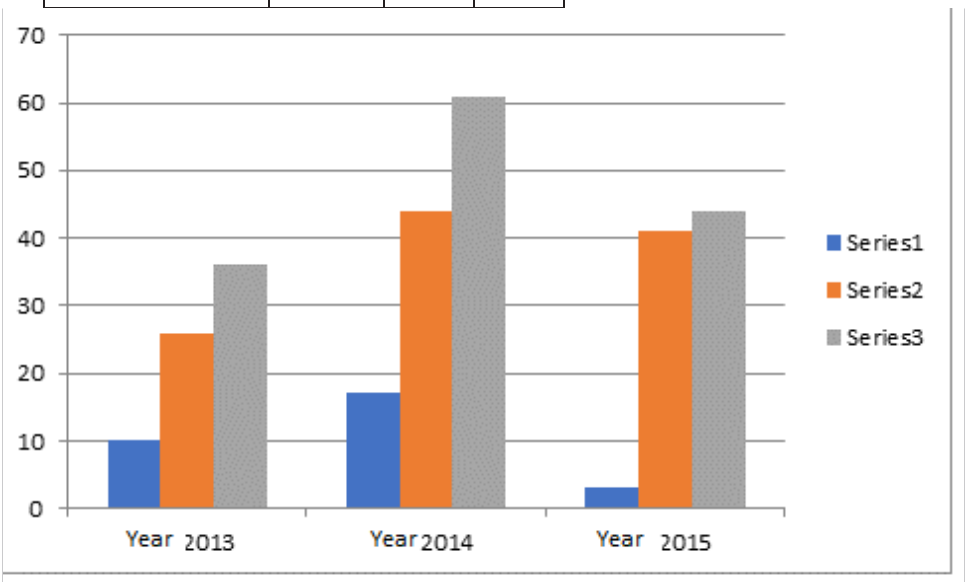


Table Nr.9 shows No. of the inhabitants of the Republic of Albania in the years 2013-2014-2015 as well as two main age groups 15-64 years and over 65 years and the ratio they occupy in relation to the population. These data have been obtained from several sources to determine the exact population in these three years to make calculations based on international data on the risk of Pulmonary Cancer may have in the Albanian population as a cause of Radon gas, and the risk opportunities in smokers and non-smokers from the presence of this gas in the Albanian population. It can be seen from the table that the Albanian population during these three years taken in the study has changed a little for various reasons where the two main reasons are: emigration, low birth rate. Respectively, the population according to the data of INSTAT, CIAFAKT, are for the years 2013-2014-2015: 2.897-2.893-2.889

inhabitants. The ratio of ages 15-64 and over 60 respectively in these three years are: 69% / 108% for 2013; 70% / 11.1% for 2014; and 68% / 10.5% for 2015. This ratio has not changed during these years. These two age groups most affected by Lung Cancer and presented in the previous tables are explained in the following tables.

able nr.9

Year	Nr. Residential population	Age 15-64 years	%	Age over 65 years	%
2013	2.897.000	2.007.621	69	312.881	10.8
2014	2.893.000	2.104.000	70	333.791	11.1
2015	2.889.000	1.970.297	68	302.751	10.5

http://www.nationmaster.com/country-info/profiles/Albania/People; "Albania People Stats", Nation Master. Retrieved from http://ëëë.nationmaster.com/country-info/profiles/Albania/People; www.indexmundi.com/albania/demografic; www.instat.gov.al/media25779/femra_dhe_meshkuj/dem/pdf; Cia world factbook 2015 Vjetari Statistikor 2013, 2014, 2015.

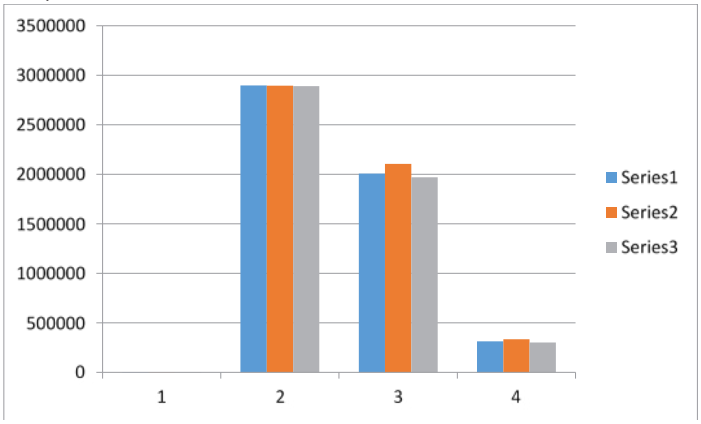


Table No.10 and Table No.11 present comparative data in relation to the population aged 15-64 and over 65 in relation to two international indicators:

- first with the minimum Radon gas per 1000 inhabitants, in residential buildings which can cause Lung Cancer (minimum is 0.4 pCi / L), which in the case of smokers can cause Lung Cancer in 3 inhabitants per 1000

inhabitants and in the case of non-smokers it can cause Lung Cancer to 0.7 inhabitants per 1000 inhabitants (this can be seen in Table No. 4).

- According to these data, it has been established that individuals who are exposed to Radon Cancer can theoretically be affected by Pulmonary Cancer in the minimum possible amount of Radon gas that can cause Pulmonary Cancer per 1000 inhabitants. In the case of smokers the incidence is 3 persons per 1000 inhabitants, and in the case of non-smokers the minimum exposure to Radon gas that can cause Lung Cancer is 0.7 inhabitants per 1000 inhabitants. - The second international indicator is the most accurate standard percentage of smokers in Albania according to these indicators which are presented in Table no. 11.

24.Cia world factbook 2015

19.Institute of Statistic of Albania- INSTAT, Vjetari Statistikor 2013, 2014, 2015.
www.instat.gov.al/media25779/femra_dhe_meshkuj/dem/pdf
18.OBSH, World Health Statisitics, 2014; "Albania People Stats", NationMaster. Retrieved from
http://www.nationmaster.com/country-info/profiles/Albania/People;
www.indexmundi.com/albania/demografic

Table nr.10

Radon + Smokers Likelihood of Lung Cancer: 0.4 pCi / L, 3 people per 1000	**Radon + Smokers Lung Cancer Probability: 0.4 pCi / L, 3 people per 1000**	**Radon + Smokers Lung Cancer Probability: 0.4 pCi / L, - 3 people per 1000**	**Radon + Smokers Lung Cancer Probability: 0.4 pCi / L, - 3 people per 1000**

5% - F-over 65 years	48%-M-over 65 years	5% - F-15-64 years	48%-M-15-64 years
23.5	225	150.5	1204.5
25	240	157.4	1262.4
22.5	217.5	192	1182
Radon + NO-Smokers Lung Cancer Probability: 0.4 pCi / L, 0.7 persons per 1000	**Radon + NO-Smokers Likelihood of Lung Cancer: 0.4 pCi / L, 0.7 persons per 1000**	**No-Smokers**	
		15-64 years	**Over 65 years**
15-64 years	**Over 65 years**		
632	98.5	903.001	140.794
662	105	946.011	150.203
620	95.3	886.633	136.237

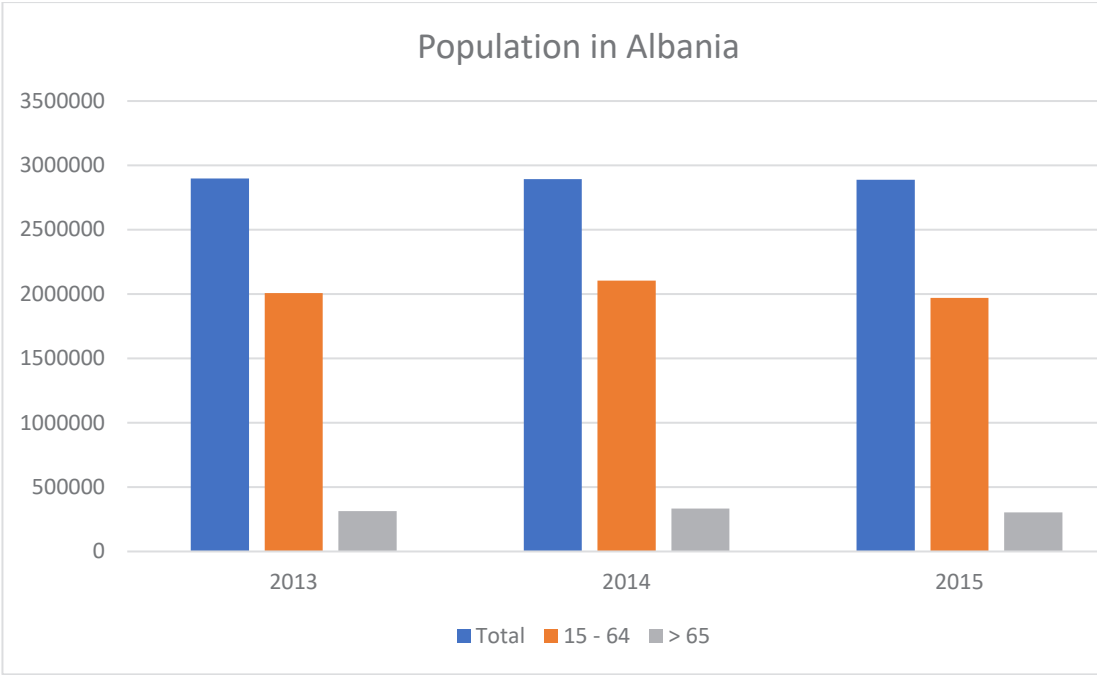
Smoking in Albania is in the following figures: Male 48% and Female is 5%. In this table is also placed the number of the population during the years 2013-2014-2015 which is fully divided by 50% according to the male and female population to find the exact number of female and male smokers. Based on these figures we have found these results in Albania for smokers and their theoretical possibilities to be affected by Lung Cancer in relation to Radon gas pollution of these patients. The results based on these standard data are according to table No.11: for ages 15-64 years the percentage of smoking in Albania based on the number of population according to the years 2013-2014-2015 is respectively for women (it is 5% of the female population but and likely to be at risk of Lung Cancer in the presence of Radon gas): 50,191-51,512-47,812 persons, with a decreasing tendency; while for men for the years 2013-2014-2015 it is respectively (it is 48% of the male population but also likely to be at risk of Lung Cancer in the presence of Radon gas): 401.524-420.801-394.001persons, also with a decreasing tendency.

Regarding male and female smokers for the age group over 65 years, the results are as follows for the years 2013-2014-2015 respectively for Women: 7,811-8,135-7,058 port smokers endangered by Radon gas levels with a slight tendency to decrease; and for Men over 65 for the years 2013-2014-2015 the results are: 75.121-80.002- 72.231 smokers port endangered by Radon gas levels.

Table no. 11

Year	Total population of Albania	Age 15-64 years in Albania	Age over 65 years in Albania	% of Smoking according to WHO			
				F - 15-64 years	M- 15-64 years	F- over 65 years	M- 65 yea
				5%	48%	5%	48%
2013	2.897.000	2.007.621	312.876	50.191	401.524	7.811	75.
2014	2.893.000	2.104.000	333.786	51.512	420.801	8.315	80.
2015	2.889.000	1.970.297	302.749	47.812	394.001	7.058	72.

Also, in table no. 11, according to WHO data, (World Health Statistics 2014)
(Smoking: 40% Male and 5% Female)


Population in Albania
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
2013
2014
2015
Total
15 - 64
> 65

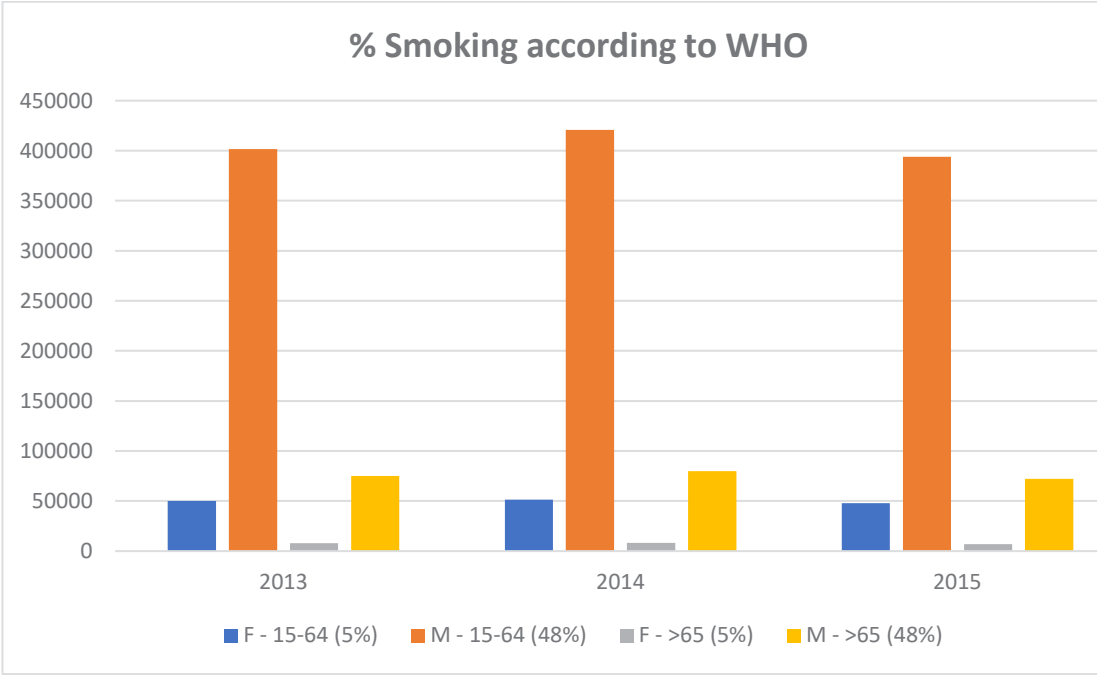

% Smoking according to WHO
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
2013
2014
2015
F - 15-64 (5%)
M - 15-64 (48%)
F - >65 (5%)
M - >65 (48%)

Table No.12 presents the theoretical total potential for the number of individuals who may be affected by Pulmonary Cancer in Albania compared to the patients actually affected in these three years taken in the study.

It is observed that there is a difference between real Pulmonary Cancer during the three years taken in the study and caused by smoking under the influence of Radon gas in smokers and non-smokers with those presented theoretically based on the potential risk of Radon Gas in the population Albanian (for whom we have no real data in patient records nor data from controls with Radon gas meters in apartments during these years).

Statistical data are taken from standard data obtained from the literature and international health organizations in the world such as WHO, Ciafact, etc., and from data obtained from INSTAT, IPH, and the University Hospital of Pulmonary Diseases `Shefqet Ndroqi`, Tirana (Sanatorium), for Pumonar Cancer and their comparison to really see what can happen or what has happened and what is the future of Pulmonary Cancer in Albania. According to the presented data, it is noticed that during the years 2013-2014-2015, 492-564-604 persons were ascertained and hospitalized in the University Hospital of Lung Diseases, respectively.

Regarding the ages 15-64 and over 65 together, in Albania, the theoretical possibility (total theoretical) of lung cancer for non-smokers given the minimum standard of exposure which is 0.7 persons / 1,000 male inhabitants and female together 15-64 years old and over 64 years old is for the years 2013-2014-2015 respectively: 730.5 (632 +98.5) -716 (662 + 105) -715.5

(605 + 95.3) persons. The trend remains a small decline. If you look at the real patients who have been hospitalized with Lung Cancer, it can be seen that the number of people who could theoretically be affected with the real ones has a not insignificant difference.

18.OBSH, World Health Statisitics, 2014

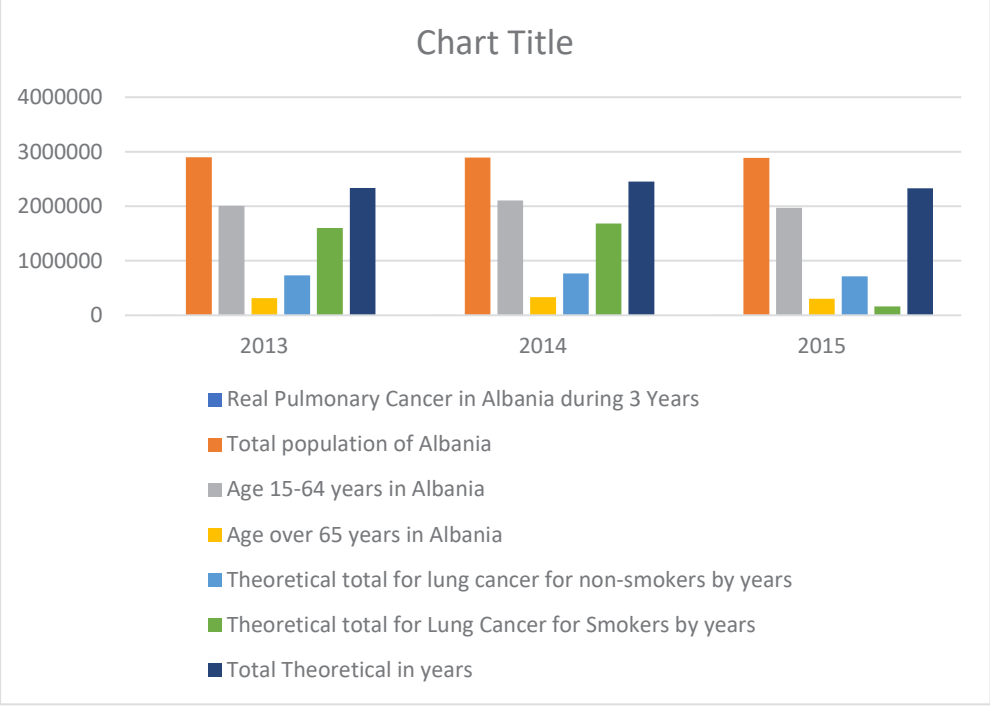
We can see in this table that the number of patients who may be affected by Pulmonary Cancer during the three years taken in the study given the standard of Pulmonary Cancer exposure caused by the levels (lowest possible that could cause Cancer Pulmonary) of Radon gas which is 3 persons / 1000, are respectively for smoking women (5% smoking in the Albanian female population) 15-64 years old: 23.5-25-22.5; and for those over 65 years of age are: 150.5-157.5-192. So it is noticed that Pulmonary Cancer in the presence of Radon gas in Smokers is higher at the age of 65 and with an increasing tendency. In the male smoking population during the years 2013-2014-2015 (48% of the male population is smokers) the following data appear for the population aged 15-64: 1204.5-1262.4-1182 persons; while for those over 65 years old: 225-240-217.5 persons.
There is a big difference between the possibility of causing Theoretical Cancer by Radon Gas in non-smokers and smokers in these three years in relation to the real Lung Cancer hospitalized in the University Lung Hospital (Sanatorium) respectively for the years 2013-2014-2015 : 492-564-604 real people hospitalized with Lung Cancer compared to 2333.5-2451.8-2329 people who could get Lung Cancer theoretically based on international standards of Lung Cancer caused by Radon gas.

Table no. 12

Year	Real Pulmonary Cancer in Albania during 3 Years	Total population of Albania	Age 15-64 years in Albania	Age over 65 years in Albania	Theoretical total f cancer for non-smo years from Radon gas (0.7 / 1000 inhabita
2013	**492**	2.897.000	2.007.621	312.876	730.5
2014	**564**	2.893.000	2.104.000	333.786	767
2015	**604**	2.889.000	1.970.297	302.749	715.3

15-64 years	over 65 years
632 (F31.5/M600.5)	98.5 (18.5/80)
662 (F34/M628)	105 (F20.1/M80.4)
620 (F31/M589)	95.3 (F17/M78.3)

5% - F- over 65 years	48%-M- over 65 years	5% - F-15- 64 uears	48%-M- 15-64 years
23.5	225	150.5	1204.5
25	240	157.4	1262.4
22.5	217.5	192	1182

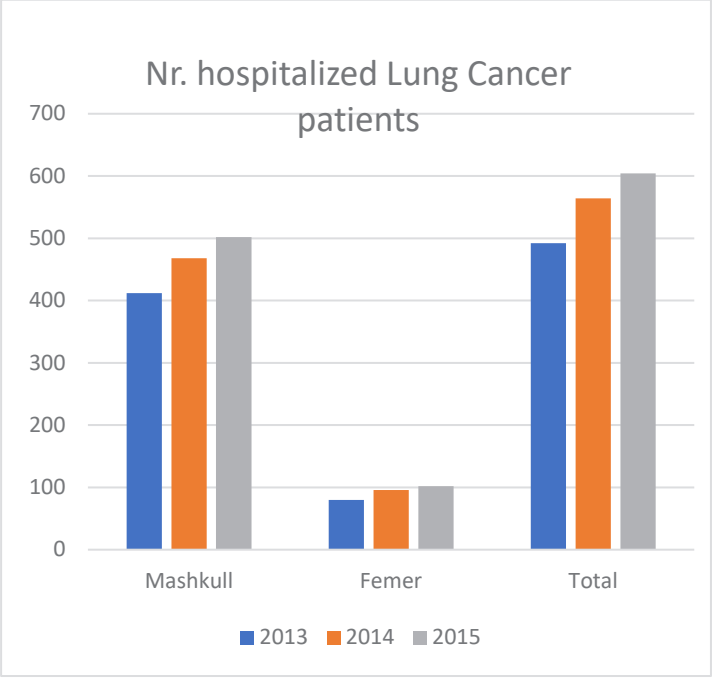


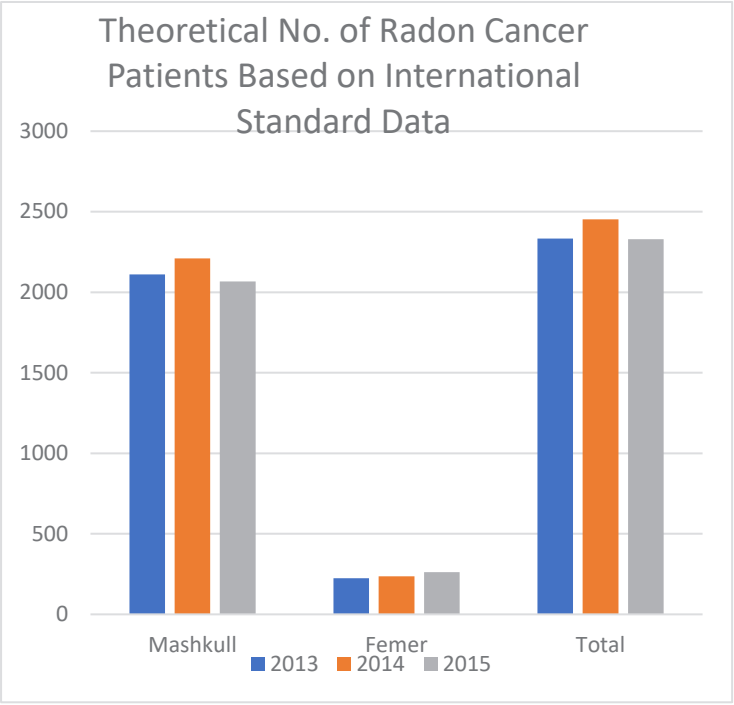
In Table no. 13, compared to the male / female ratio actually affected and hospitalized which are presented in table No.6 we can see that for the years 2013-2014-2015 which is in both age groups together: 412/80 (492) -2013, 468/96 (564) -2014, 502/102 (604) -2015, there is an increasing tendency of Pulmonary cancer actually during these three years.
While the total theoretical impact from Lung Cancer on male smokers and non-female male smokers based on international standards can be

according to table No. 12 in both age groups together is respectively:
2110 / 224.5 (2333.5) -2013,
236 / 2210.8 (2451.8) -2014, and 262.5 / 2066.8 (2329.3) -2015.

Table No.13

Years taken into study	Nr. hospitalized Lung Cancer patients			Theoretical No. of Radon Cancer Patients Based on International Standard Data		
	M	F	Total	M	F	Total
2013	412	80	492	2110	224.5	2333.5
2014	468	96	564	2211	236	2451.8
2015	502	102	604	2067	262.5	2329.3





Discussions and Statistical Analysis

In this study, the differences between patients actually affected by Pulmonary Cancer during these three years with the theoretical possibilities of exposure to Radon Cancer caused by Radon gas in smokers and non-smokers is large ($p < 0.001$). This may be related to low Radon gas levels in village homes, lack of Radon gas measurements with relevant equipment, quality level of Pulmonary Cancer diagnosis, and health education of the population for this nosology.

These data also show that the knowledge of this dangerous cause like Radon gas in causing Pulmonary Cancer which ranks first among other Malignant Cancers like Prostate Cancer and Breast Cancer presented in **table no.** 3, it is necessary, and appropriate policies should be promoted to prevent damage from this dangerous gas causing Lung Cancer.

It is observed that Pulmonary Cancer mostly affects young and middle-aged 15-44, 45-64 years with a slight upward trend ($p < 0.1$) in the three years taken in the study, while ages over 65 years in a number of patients with Lung cancer has a slight growth trend ($p < 0.1$) over the years but is constant **(Tab.5).**

Regarding the rural and urban population, when it comes to living in the village or in the city, it is noticed that in the urban population there are more cases of Pulmonary Cancer than in the village. The tendency for Cancer is increasing for both rural and urban areas during the three years studied, but the increase is not significant ($p < 0.1$). By gender Pulmonary cancer affects more men than women both in urban and rural areas and here the difference is significant ($p < 0.001$) **(Tab No.6).**
The operations performed at the University Hospital of Pulmonary Diseases in Tirana show an increase in Surgical operations to remove Cancer from the Pulmonary and the increase is significant in total for the operations: Pulmonectomy and Lobectomy together ($p < 0.001$), while for pulmonary ectomy operations not kadife major mdeje in 2016 has fewer pulmonectomy for Lung Cancer than lobectomy. This indicates that people with Lung Cancer are diagnosed earlier and therapy tends to be easier to do lobectomy than pulmonectomy, accompanied by other therapeutic procedures **(Tabs No. 7 and No. 8).**
In this study, Pulmonary Cancer caused by the main causes Radon and smoking, is taken in relation to the exact population of the Republic of Albania and the population of the Republic of Albania according to the Census and International data in these three years there is no significant increase in causes and the reasons explained above; emigration and birth rate reduction **(Tab No. 9).**
Given the standard data of table no. 4 on the possibility of causing Pulmonary Cancer per 1,000 persons in smokers and non-smokers respectively 3 persons / 1,000 inhabitants, comparing them with the smoking population in males and females which according to WHO 2014 data for Albania were 48 % of men and 5% of women (WHO, World Health Statistics, 2014), also compared with the age group 15-64 years and the age group over 66 years during the three years taken in the study, found that the theoretical number of smoking patients in the presence of Radon gas that could be affected by Lung Cancer for men is respectively for three years (2013-2014-2015), for age group over 65 years: 225-240-217.5me with a $p < 0.1$ non-significant. For Women it is respectively for three years (2013-2014-2015), for the age group 15-64 and over 65: 23.5-25-22.5 with a $p < 0.1$ not significant.

For the age group 15-64 years in relation to the age group over 65 years for men the theoretical number of potentially affected by Lung Cancer theoretically caused in the presence of Radon gas, is for men the highest for the three years respectively: 1204.5 -1262.4-1182 with a p <0.01 ie significant; whereas for women the theoretical number of those affected in the three years is respectively: 150.5-157.4-192, ie a significant difference p <0.001.

In the case of non-smokers in whom the risk of lung cancer is 0.7 per 1,000 inhabitants, compared with the smoking population in men and women which according to WHO data for 2014 in Albania were 48 % of men and 5% of women, also compared to the age group 15-64 years and the age group over 66 years during the three years taken in the study, were found that the theoretical number of Non-smoking patients in the presence of Radon gas that can to be affected by Lung Cancer in total males and females is respectively for three years (2013-2014-2015), for age group over 65 years: 98.5-105-95.3 where the difference is not significant in age group p <0.1, and for age group 15-64 years respectively for all three years in total male female respectively is: 630-662-620. The difference is not significant p <0.1. But the difference between the two age groups is significant between the two age groups in favor of the age group 15-64 years p <0.001 **(Tab No.10).**

In **Tab Nr.11** we can find the number of smoking population of the Republic of Albania according to the percentages of WHO (WHO, World Health Statistics, 2014) which in the three years taken in the study has no increase among males (p <0.1), and among females (p <0.1), but the difference is certainly significant in the male-female ratio (p <0.001).According to **Tab No.12**, a comparative assessment was made between the real cases hospitalized with Pulmonary Cancer in the Republic of Albania in the three years taken in the study which were presented with 492 cases for 2013, 562 cases for 2014 and 604 cases for 2015. in relation to the population in these three years, respectively, and the theoretical possibility of being affected by Lung Cancer in the presence of Radon gas, for non-smokers (0.7 / 1000 inhabitants) and smokers 3/1000 inhabitants.

The total differences for smokers likely to be affected by Lung Cancer in the presence of Radon gas are respectively by years: 1603.5-1684.8-1614 persons with a p <0.001, ie a significant difference.

29.Toxicological Profile for Radon, Table 4-2 (Keith S, Doyle JR, Harper C, et al. Toxicological Profile for Radon. Atlanta (GA): Agency for Toxic Substances and Disease Registry (US); 2012 May. 4, CHEMICAL, PHYSICAL, AND RADIOLOGICAL INFORMATION.) Retrieved 2015-06-06).

30Toxicological profile for radon, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with U.S. Environmental Protection Agency, December 1990)

31.Radon Toxicity: Who is at Risk?, Agency for Toxic Substances and Disease Registry, 2000)

33."Known and Probable Carcinogens". American Cancer Society. Retrieved 2008-06-26

The total differences for non-smokers likely to be affected by Lung Cancer in the presence of Radon gas are respectively by years: 730.5-767-715.3 persons with a p <0.001, ie a significant difference in relation to Pulmonary Cancer that actually has occurred in Albania.

The differences are not significant, ie with p <0.1 in relation to the cases that actually occurred and were hospitalized in the University Pulmonary Hospital, in cases when it comes to theoretical (possible) Lung Cancer for non-smokers for the age group 15-64 years (males and females in total) respectively by years: 632-662-620, and for those over 65 years of age (males and females in total) respectively: 98.5-105-95.3.

Also presented in tab No. 13 are summarized the results presented above in which the significant differences (p <0.001) between the actual Cancer hospitalized and operated in the Hospital with possible Lung Cancer caused by Radon gas over the years for year 2013 - actually 492 with 2333.5; for 2014- actually 468 with 2451.8; for 2015 actually 604 with 2329.3 persons.

While real Pulmonary Cancer in the three years taken in the study compared with possible Cancer in the presence of Radon gas in women has a non-significant difference p <0.1 (224.5-236-262.5 persons).

Here may be influenced by several factors such as:

-statistical data missing over the years which is the most vulnerable medicine,
- Lack of accurate and periodic measurements of Radon gas levels in dwellings in the Albanian territory,
-Inaccurate and delayed diagnosis of Lung Cancer in regional, private, possibly tertiary university hospitals,
- Delayed presentation of patients to be diagnosed
- duration of the impact of Radon gas on persons exposed to it in their homes,
-presence of persons living in ground floor dwellings, basements, near mines, etc.

However, the big differences in relation to the real impacts from Pulmonary Cancer with those that could occur based on the standards presented above according to the WHO, and other health organizations through projects for the prevention and treatment of Pulmonary Cancer, show that in this cancer nosology greater efforts to clarify real Radon gas levels in Albanian homes as well as investments in preventative measures. It can be said that significant differences ($p < 0.001$) in the results obtained in the study, relate to the problems presented above as the qualitative level of diagnosis of Pulmonary Cancer, with the health education of the population for this nosology, the lack of measurements of Radon Gas levels with relevant equipment in urban and rural areas, etc.

The advantages of the Study lie in the advantage that it shows the possibility of theoretical exposure to Lung Cancer and the preventive measures that can be taken. The study was conducted to present the danger of Radon gas in causing Lung Cancer in the smoking and non-smoking population.

The limitations of this study lie in the impossibility to perform direct measurements with Radon gas measuring devices in a systematic way in the inhabited areas in cities and villages of Albania, but presents the theoretical possibility of Pulmonary Cancer in its presence based on international standard figures. .

Conclusions.

- Lung Cancer caused by Radon Gas in both Smokers and Non-smokers is a more common phenomenon than known in Albania in terms of the causes of Lung Cancer,

- The tendency of Pulmonary Cancer in Albania due to the presence in the dwellings and places of residence of the population is in a slight increase not significant, but that must be confirmed with Radon measuring devices (digital radon detector).
- In addition to Smoking, many factors influence the development of Radon-associated Lung Cancer from Radon:
- Age during exposure
- prolongation of exposure
- Radon concentration as a function of age and duration of exposure
- Time spent at home (bedtime, work time, and home and office recreation) and Radon concentrations at home, in the office, on transport routes
- water sources, if it is well water has a large amount of Radon, the upper floors can be influenced much more than the lower ones (eg, from rain showers)
- Climate and Weather during the year in cold weather Radon levels are often higher than in winter and lower in summer.
- Static time of year - are the times when Radon derivatives stick to dust particles and can be added during these months and the time elapsed after the start of exposure. (Biological Effects of Ionizing Radiation VI report, Health Effects of Exposure to Radon (NAS 1999, and (NRC 1999; EPA 2003).

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