Research Article

A Statistical Analysis of Impact of Risk Factors Causing Lung Cancer among Non-Smokers

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Abstract---Most survey reveals that 40% of cancer deaths are caused by Lung cancer. It is very unfortunate that even the drinking water contaminants may aggravate lung cancer when contaminated water is consumed regularly. Among various carcinogens polluting water arsenic is proved to more hazardous in triggering lung cancer by modifying DNA through genetic mutations. Measure of levels and percentages of carcinogens present in drinking water can direct the research to analyse how the domestic drinking water turns as a killer by causing life threatening problem of lung cancer. The research is carried out with patient data of non-smoking persons who aggravated lung cancer with prolonged usage of arsenic polluted water for drinking and few other factors like childhood pneumonia, genetical history, poor diet and carcinogens in working environment. Chi-square test is performed with non-smoking patient data record and results are evaluated with the discussion of preventive measures.

Keywords---Water Contamination, Arsenic Water, Lung Cancer Prediction, Pneumonia.

1. INTRODUCTION

Long-term exposure to carcinogens will aggravate serious disease called cancer. Lung cancer is a type of cancer affecting one-fourth of the population. In earlier days main cause for lung cancer was observed as smoking and tobacco consuming. Many other risks factors aggravate lung cancer in non-smokers. Long term exposure to workplace carcinogens, coal and wood burning, drinking arsenic polluted water which is taken as prime risk factor in this work. Some other factors considered in this work are childhood pneumonia, poor diet.

Water is the essential source of human resource. The contamination of water directly reflects the contamination of entire environment. Major contaminants are generated by human activity such as chemical waste from industries and naturally emitting gases like 'Radon' which contaminates the underground drinking due to high levels of uranium in rocks and soils this when consumed cause health risk significantly contribute to occurrence of lung cancer. Arsenic is another strongest carcinogen which arrives from natural sources such as volcanos and even from Man-made sources highly contaminates drinking water and manipulate the occurrence of lung cancer with both of its lower and higher concentration levels.

Arsenic as contaminants in domestic usage water not only affects the lungs it also affects skin and bladder causing serious deaths, claims the International Agency for Research on Cancer. Varied research on behaviour of lung and arsenic correlation reveals major cases of lung cancer are caused due to concentration levels of arsenic found high in domestic usage water.

Lung cancer is a highly preventable disease but early symptoms are rare and risk factors are difficult to identify in cases of lung cancer patients. It is strongly believed that only people who are smokers and tobacco consumers may prone to lung cancer but many other factors other than smoking and tobacco consuming may prone to life threatening disease called lung cancer. Few risk factors among non-smokers like consuming high level of

arsenic water, which is causing lung cancer. In many countries both sexes are suffering with lung cancer with the total estimated deaths for cancer in Asian, US (United States) and European countries 25% constitute lung cancer and is the third most cancer deaths.

The further section of the paper is organized as follows. Section 2 summarised the various research works carried in the area of water contaminants as the risk factor for cancer. Section 3 discusses other risk factors in Non-smokers causing lung cancer, section 4 discusses the occurrence of arsenic in water and methods to reduce its level section 5 is the statistical analysis based on the risk factors and chi-square test evaluation, section 6 is the conclusion with cited references.

2. RELATED WORKS

Lin et al [1] presented a research which focus on the study of non-smoking potential risks causing lung cancer mortality. For this study propensity score-mated cohort analysis and logistic regression is used to find the association with lung cancer. Kubík et al [2] investigated the relation between the diet and the lung cancer. Data are collected among the patients and unconditional logistic regression is carried to find the association between the diet and the lung cancer. Seow et al [3] studied about the association between the asthma, allergic rhinitis, atopy and lung cancer. Patients with both asthma and atopy have higher risk of lung cancer. chronic inflammation of air passage among the non-smoking Asian women with its hyper behaviour induce difficult breathing behaviour. Long term problem may aggravate lung cancer. Hirayama [4] presented a study about wives of smokers developing lung cancer and other lung disorders. The husbands smoking habit tend to affect the wives who is near the smoker most of the time. It comes under the passive smoking risks. Omenn et al [5] investigated about the association between the lung cancer and good diet. People eating more fruits and vegetables have no risk of developing cancer. People having high serum and β-carotene have lower risk or no risk of developing cancer.

Ngamwong et al [6] Smoking and asbestos exposure have higher risks of developing lung cancer. Chi-square test is evaluated with patients exposing to asbestos and having regular smoking habit. Long term exposure to asbestos and previous lung disorder also have higher risk of developing cancer. Steinmaus et al [7] investigated about the environmental carcinogens like arsenic polluted water causing lung cancer. High and long -term exposure have associations of developing lung cancer. Consuming lower level arsenic polluted water have lower association with the lung cancer. Ferreccio et al [8] presented a study in chile relating to the arsenic carcinogen. The evaluation of the level of arsenic by reveals that arsenic concentration level is 860mg/l which is considered to be high. Ingestion of inorganic arsenic compounds for a long term will aggravate lung cancer. Smith [9] discussed about the study of arsenic contamination which not aggravate lung cancer but also affect the kidney and bladder. Long -term consumption cause cancer. Various measures to reduce arsenic level is also discussed on this research. Costa et al [10] presented about the exposure hexavalent compound chromium that may cause lung, stomach cancer. Chromate induced cancer also sometimes generate skin tumours.

3. OTHER RISK FACTORS IN NON-SMOKERS

Smoking and tobacco intake is proven to be prime risk factor for developing lung cancer. In this research risk factors other than smoking and tobacco intake which is causing lung cancer are identified and discussed.

1. Genetic factors and Family History

The prime factor to be considered is the family history of positive lung cancer is the top risk factor based on various studies causing early on-set of this disease. Multiple genetic polymorphisms causing underlying lung cancer with the single – nucleotide polymorphisms to identify genetic variations and there is a strong association between the genetic variations and underlying lung cancer.

2. Childhood pneumonia

Childhood pneumonia is related with reduced functioning of lungs when the patient become an adult and air walls get thickened which generate breathing difficulties. Person suffering with both pneumonia and asthma in child hood will have increased chance of developing COPD (Chronic Obstructive Pulmonary Disease).

3. Air pollution

In various parts of Asia air pollution is a primary risk factor for lung cancer in non-smokers specifically women. Air pollution involves coal burning without proper ventilation, burning of wood, burning of solid fuels, usage of unrefined oil like rapeseed oil for cooking. In many cases it is notable and clear that there is positive association between the air pollution and lung cancer. Residing or living near source of air pollution. High exposure to air pollutants is evident to cause lung cancer without any other dependent factors. Outdoor air pollution is one of the prime risk factors listed by the International agency for research on cancer.

4. Poor Diet

Intake of food containing fruits and vegetables at a good proportion will be an effective measure against cancer. Cruciferous vegetables specially very effective against lung cancer. Intake of red meat in high proportion increases the risk of lung cancer. Alcohol consumption and tobacco consumption have high correlation which aggravate lung cancer.

Risk Factors Other Than Smoking Causing Lung Cancer

1. Water contaminants -majorly arsenic
2. COPD
3. Radon and Asbestos exposure.
4. Deficiency of Vitamin A, C, E, β-carotene.
5. Family history and genetical factors.

4. OBSERVING THE OCCURRENCE OF ARSENIC

Arsenic is a natural element that can be found in surroundings air, water, soil, plants and animals. Arsenic can also be generated from the industries and the agricultural sources. Arsenic is a chemical compound.

- Inorganic Compounds (Absence of carbon)-More Toxic form linked to cancer.
- Organic Compounds (occurrence of carbon)- Less toxic and not linked with cancer aggravation.

Water utilized for drinking is an essential source of arsenic exposure which can be kept in control. Drinking water contains high level of arsenic naturally in western countries so US government has adopted methods for testing and identification of level of concentration of arsenic. Water sources like lakes and reservoirs found to have high level of arsenic prolonged usage may cause lung cancer. In early days Pesticides for food crops contains the ingredient called arsenic which when exposed to people working on it caused serious effects on skin and lungs. After observing its ill effects inorganic arsenic compounds are not used as a part pesticides and herbicides. Emission of industries and factories like wood and glass based will emit arsenic polluting the nearby air, water and soil. Fuel burning process also emit lesser quantity of arsenic.

4.1 STRATEGIES TO MEASURE ARSENIC LEVEL IN WATER

Water source arsenic levels are tested and water with high concentration of arsenic are used for washing, bathing etc and water sources with high concentration of arsenic like harvested rain water, surface water can be used for drinking, cooking and agricultural purposes. There are two test models are used which are described further.

4.4.1 Field test kit Model

Water samples are collected from the domestic local water bodies and tested for arsenic concentration using the field test kit if arsenic concentration measurement is less than 10 µg/L then the water is considered to be safe and can be used for domestic purpose.

4.4.2 AAS (Atomic Absorption Spectrograph) Model

Atomic absorption spectrophotometry is popular technique for finding the concentration of arsenic in water. Vapour producing kit is joined with the atomic absorption spectrograph which has an acid channel that contains 10ml hydrochloric acid and a channel for reduction containing sodium borohydride. The drinking water is safe if arsenic in drinking water is 10ppb (microg/l) level. This threshold level is fixed by the WHO (World Health Organization). The graph in Figure 1 shows the arsenic level in drinking water and population exposed to high level arsenic.

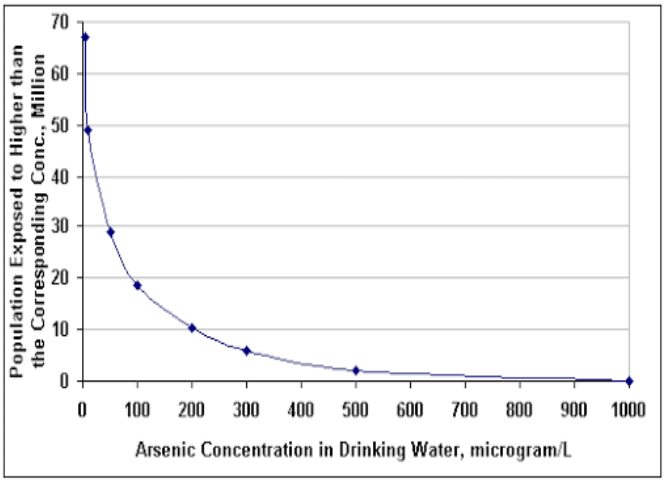

Figure 1. Statistics showing Population exposing to high level of arsenic in drinking water

4.2 STEPS TO CONTROL THE ARSENIC

For prevention and control as an initial step putting an end to further exposure by enabling a way for safe water supply for basic utilization like drinking, cooking and for agriculture purposes. Few ways for reducing the arsenic concentration level in water.

1) From the water source arsenic levels are tested and water with high concentration of arsenic are used for washing, bathing etc and water sources with high concentration of arsenic like harvested rain water, surface water can be used for drinking, cooking and agricultural purposes.
2) As a next step of finding the arsenic levels the water sources like hand pumps and bore wells are painted with varying colours for identification and usage. The idea can be best way to educate people who depend on such water sources.
3) Combining the low arsenic water with high arsenic water thereby maintaining a tolerable level of arsenic.
4) Arsenic can be removed from water by few methods like absorption, exchange of ions, oxidation and few more which can be implemented in household domestic purposes and even can be adopted in centralized water supply sources. Numerous options ae available for household water supplies for removing arsenic based on the cost. Removed arsenic must be disposed properly without affecting the environment.

Industrial exposure is also planned to reduce by future ideas. Proper knowledge and attention of community are the essential factor for reducing the exposure of arsenic. Necessary knowledge about the risks of exposure of arsenic in drinking water, cooking water and irrigation water for the crops should be aware of the community consuming the polluted daily basis. Certain levels of arsenic when consumed may cause arsenic poisoning leading to long standing skin problems.

5. STATISTICAL ANALYSIS BASED ON RISK FACTORS AND CLINIAL DATA

Among total estimated cancers across the country 40% constitute the lung cancer where smoking is taken as the key risk factor. In this research statistical analysis is performed using chi-square method by taking into account risk factors other than smoking and tobacco intake. More than half that is 15-20% of lung cancer mortality is caused by risk factors other than active smoking. Lung cancer originating because of smoking vary from lung cancer caused by other risk factors. Diagnosing from lung cancer is rare in both the sexes. There is an observation by the Cancer Prevention Studies (CPS) that women outnumber men when smoking is not considered as the prime risk factor. In Asian countries like India it is evident that most women are non-smokers but other risk factors like working exposure, poor diet, consuming arsenic polluted water, childhood pneumonia are making women as victim for lung cancer. For the detailed analysis retrospective inspection is performed with 657 patients from 2012 to 2018. The 657 patients are split into two categories based on their sex. Numerical data are grouped as mean ± standard deviation. Chi-square test is performed with categorical data and demographic value based on other risk factors and clinical data. Analysing all the variables by univariate logistic regression.

Table 1. Occurrence of Lung Cancer based on the Risk Factors

Patient ID	Arsenic water consumption	Clinical Condition	Working place Exposure	Family History	Age	Sex	Risks of occurrence of Lung Cancer
1	High	Existence of childhood pneumonia	Nil	Exist	30	Male	High
2	Low	NIL	Nil	Exist	45	Female	Medium
3	Medium	Existence of COPD	Nil	Exist	40	Female	High
4	Low	Nil	High	Nil	44	Male	Medium
5	High	Nil	Nil	Nil	55	Female	Medium
6	Medium	Existence of childhood pneumonia	Nil	Nil	35	Male	High
7	High	Nil	Nil	Exist	65	Male	Medium
8	Low	Previous Lung disorders	Yes	Nil	54	Female	Medium
9	Medium	Asthma	Yes	Nil	51	Male	High
10	High	Existence of Lung disorder	Yes	Exist	37	Female	High

The occurrence of Lung cancer cannot be confirmed with single positive factor. From Table 1 it is shown that consuming arsenic contaminated water alone will not aggravate lung cancer. Two or more risk factors must be positive.

5.1 Chi-Square Test

As initial step of the test various variables is relating the risk factors of lung cancer are screened 1. clinical condition of hay fever, asthma, childhood pneumonia, 2. Exposure carcinogens arsenic concentrated water, hazard chemicals, dusts, pesticides, 3. Diet with deficiency of vitamin A, C, E and β-carotene 4. Family history of cancer.

Table 2. Chi-Square Test Evaluation

Risk factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Carcinogen exposing working condition	1.80	1.10 - 3.28	0.020
Red Meat consumption	2.05	1.19 - 3.53	0.009
Balanced Diet consumption	0.28	0.09 - 0.89	0.020
Poor Diet with no vegetables and fruits	1.88	1.08 - 3.27	0.026
Long term arsenic concentrated water consumption	1.89	1.02 - 3.51	0.043
Long term exposure to burning of wood and coal, occupational hazards with genetical history	15.08	5.54 - 41.08	0.000
Arsenic polluted air	2.26	1.02 - 5.01	0.041
Family history of cancer	2.18	1.67 - 6.08	0.000
Childhood pneumonia	4.17	2.19 - 7.91	0.000
COPD or asthma	4.47	2.49 - 8.05	0.000
Long term Radon exposure	2.79	1.10 - 7.07	0.026
Long term asbestos exposure	5.45	2.84 - 10.45	0.000
Long term consuming of Arsenic polluted water with previous lung disorders	5.57	2.48 - 7.05	0.000

Table 2 illustrates the chi-square evaluation of risk factors causing lung cancer. Differences in the distribution of continuous variables were evaluated using two-sided chi-square test. Odds Ratios (ORs) and 95% Confidence Intervals (CIs) were calculated as estimates of relative risk. Long term exposure to occupational hazard with family history of serious lung disorder strongly associated with lung cancer with (OR=15.08 and p=0.000). Another evaluation is Long term consuming of Arsenic polluted water with previous lung disorders with (OR=5.57 and p=0.000). An inverse relation was found with people consuming balanced diet have no association with the lung cancer with (OR=0.28 and p=0.020). Less association was found with arsenic polluted water consumption with no other factors with (OR=1.89 and p=0.043).

6. CONCLUSION

More than half percentage lung cancer are due to the risk factors other than smoking causing lung cancer mortality. Arsenic polluted water is considered as prime risk factor in this work, its observance and few methods to reduce its level are also discussed. Various other factors along with arsenic carcinogen are identified and studied and simple evaluation is done showing that single positive risk factor alone will not aggravate lung cancer. Two or more factors positive will have strong association with lung cancer. Reducing the exposure to carcinogens with proper diet lung cancer is highly preventable disease.

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