A Case Control Study to Assess the Risk Factors Associated With Lung Cancer

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Introduction

The incidence of lung cancer is rising dramatically and it is now the commonest cause of mortality and morbidity not only in the industrialised countries, but in developing nations like India as well. In India, lung cancer constitutes 6.9 per cent of all new cancer cases and 9.3 per cent of all cancer related deaths in both sexes. It is the commonest cancer and cause of cancer related mortality in men, with the highest reported incidences from Mizoram in both males and females (Age adjusted rate 28.3 and 28.7 per 100,000 population in males and females, respectively)[1]. The time trends of lung cancer show a significant rise in Delhi, Chennai and Bengaluru in both sexes.

Exposure to tobacco smoke has considerable risk for lung cancer. However in recent times there is rise in cases of adenocarcinoma. Most of these cases are non-smokers[2,3]. This calls for additional investigations to find out other risk factors of lung cancer especially related to adenocarcinoma. Hence this hospital based case control study was undertaken to assess the role of various risk factors that have been so far reported in literature to be associated with lung cancer.

Materials & Methods

Study Design

The study used an evaluative approach with case control design.

Variables

Study variables for the study included risk factors that have been reported to be associated with lung cancer namely smoking, alcohol consumption, diet, occupational and environmental exposure to chemicals, presence of comorbid diseases and family history of lung cancer.

Attribute variables included were age, gender, religion, educational status, family annual income, marital status, type of family, area of residence, type of lung cancer, lung cancer duration and body mass index.

Setting for the study

The study was carried out at Ramaiah Hospitals, Bangalore and Health Care Global (HCG) Hospitals, Bangalore. Ramaiah hospital is a Multi Super Specialty tertiary care hospital. The hospital offers a range of

advanced medical services. Health Care Global Ltd., is a health care organization in Bangalore that offers heath care services for the patients with various cancers.

Sample size : 180 cases (patient with histological diagnosis of lung cancer) and 180 controls (Patients who do not have histological diagnosis of lung cancer)

Sampling technique: Convenient sampling technique was used to select cases and controls.

Inclusion and exclusion criteria:

Inclusion criteria for cases

- Patient aged above 25 years of age
- Histologically diagnosed cases of lung cancer

Exclusion criteria for cases:

- Lung cancer occurred as a result of metastasis.
- Lung cancer cases who are critically ill.

Inclusion criteria for controls

- Patients aged above 25 years of age.
- Not having histological diagnosis of lung cancer.

Exclusion criteria for controls

- Patients with history of receiving radiotherapy in neck and thoracic regions.
- Patient with history of any other cancer.

Development of the tool

After an extensive review of literature and discussion with oncology experts, a structured lung cancer risk assessment questionnaire was developed by the researchers. The questionnaire included risk factors such as smoking, alcohol consumption, diet, occupational and environmental exposure to chemicals, presence of comorbid diseases and family history of lung cancer. In addition information regarding sociodemographic variables of subjects was collected.

Validity : Content validity of the tool was established by inviting suggestions from experts that included three oncologists, a statistician and a nurse expert. There was

100% agreement between the experts on relevance of items included in the tool.

Reliability: The tool was tested for reliability using test-retest method (r =0.82)

Ethical clearance : The ethical clearance for this study was obtained from the ethics committees of the Ramaiah Medical Teaching Hospital and Health Care Global Hospital

Pilot study: Pilot study was conducted at Ramaiah hospital. A total of 18 cases and18 controls were selected for the study. On completion of pilot study it was found that it was feasible to undertake the main study.

Data collection procedure

The data were collected in Ramaiah hospital and Health Care Global Ltd. (HCG), Bangalore, after obtaining formal permission from the concerned authorities. Cases who met inclusion criteria were recruited from the outpatient department and inpatient oncology units of HCG hospital, Bangalore. Simultaneously patients admitted to medical & surgical units of Ramaiah Hospital for various minor reasons were recruited as controls. To screen for absence of active lung disease, controls were subjected to chest x-ray examination.

A total of 180 cases and 180 controls were selected for the study. Three nurses with M.Sc nursing qualification were trained to administer the lung cancer risk assessment questionnaire. Subjects were given detailed information about the study and the informed consent was obtained from all the subjects. Similarly another three nurses with M.Sc (N) qualification administered the research tool for all the controls. Data were obtained by using structured lung cancer risk assessment questionnaire using semi structured interview schedule. Interview with each subject lasted for about 25-30 minutes. Approximately 4-8 subjects (cases & controls) were assessed per day. The collected data were coded and entered in the master sheet

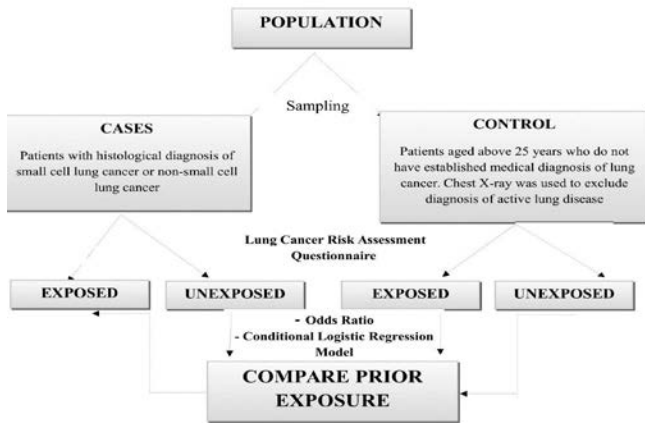(Refer Figure-1 for Schematic representation of data collection procedure).

Figure-1 : Schematic Representation of data collection procedure

Statistical Methods

The data analysis was done by using descriptive and inferential statistics. SPSS (Version 18) was used to analyse the data.

1. Frequency and percentage distribution were computed for socio-demographic characteristics.

2. Association for risk factors between cases and controls was evaluated with Chi-square test and odds ratios at 95% confidence intervals.

3. To find the independent predictors of the disease logistic regression analysis by forward entering procedure was employed.

Results

The collected data were analysed according to the objectives of study. The findings are presented below

I: Socio –Demographic characteristics of Cases and Controls :

Frequency and percentage distribution were computed for socio-demographic characteristics of the subjects. It is observed that majority of the subjects (71.1% cases and 43.8 % controls) were aged more than 55 years. Majority of the subjects (72.8 % cases and 66.3 % controls) were male. Majority of the subjects (85% cases and 85.4 %

controls) belonged to Hindu religion. More than half of the subjects (68.3% cases) had less than one year duration of lung cancer. Most common type of histology was adenocarcinoma of lung (46.1%).

To check the homogeneity between the two groups in terms of sociodemographic profile, chi-square test was computed. It was observed that cases and controls were similar with regards to their gender (*P*=0.5465), religion (*P*=0.083) and type of family (*P*=0.79421). Whereas there was significant difference between their age (*P*=0.0006), educational status (*P*=0.0001), marital status (*P*=0.022), family monthly income (*P*=0.0001) and area of residence (*P*=0.001) **(Table-1)**.

Table1: Socio-Demographic Characteristics of Cases and Controls: n=180+180

Characteristics	Category	Cases f (%)	Controls f (%)	Chi-square value	*P*-value
Age (in completed years)	<55	52 (28.9)	**101(56.2)**	27.2918	**.00001**
	≥55	**128(71.1)**	79(43.8)		
Gender	Male	**131(72.8)**	**114(66.3)**	3.6926	0.5465
	Female	49(27.2)	66(33.7)		
Religion	Hindu	**153(85)**	**152(85.4)**	6.6516	0.083
	Muslim	15(8.3)	24(13.3)		
	Christian	11(6.1)	3(1.7)		
	Jain	1(0.6)	1(0.6)		
Educational Status	No formal education	11(6.1)	47(26.1)	52.5239	**0.00001**
	Primary	36(20)	**51(28.3)**		
	Secondary	43(23.9)	49(27.3)		
	Pre-university	32(17.8)	15(8.3)		
	Graduation & above	**58(32.2)**	18(10)		
Family Annual Income	≤ 2 Lakh	**106(58.9)**	**165(91.7)**	51.9574	**0.00001**
	> 2 Lakh	74(41.1)	15(8.3)		
Marital Status	Single	2(01.1)	13(4.2)	9.5471	**0.022835**
	Married	**170(94.4)**	**163(92.5)**		
	Divorced	2(01.1)	1(0.8)		
	Widow/widower	6(3.4)	3(2.5)		
Type of Family	Nuclear	**142(78.9)**	**144(80)**	0.068	0.79421
	Joint	38(21.1)	36(20)		
Area of Residence	Urban	**107(59.4)**	52(28.9)	42.8007	**0.00001**
	Suburban	22(12.2)	16(8.9)		
	Rural	51(28.4)	**112(62.2)**		
Duration Of Lung Cancer	< 1YEAR	**128(71.1)**	NA*		
	≥ 1YEAR	52(28.9)			
Type Of Lung Cancer	1.SCC*	25(13.9)	NA*		
	2.NSCC**				
	Unclassified	40(22.2)			
	Adeno-carcinoma	**83(46.1)**			
	SqCC***	24(13.4)			

	3.UNCLASSIFIED	08(04.4)			
BMI	Underweight	7(03.9)	21(11.7)	16.9594	**0.00072**
	Normal	**115(63.9)**	**91(50.5)**		
	Overweight	51(28.3)	47(26.1)		
	Obese	7(03.9)	21(11.7)		

*SCC- Small Cell Carcinoma; **NSCC- Non Small Cell Carcinoma; ***SqCC- Squamous Cell Carcinoma; NA: Not Applicable.

II: Relationship between risk factors and lung cancer status :

A. Association between lung cancer and exposure to various risk factors:

Chi-square test and odds ratio (ORs) was used to find association between various risk factors and lung cancer. It was observed that smokers had a more than two times excess risk (OR=2.5) and past smokers had more than threefold significant risk (OR=3.4) compared to non-smokers. Cigarette (OR=5.2) and cigar (OR=5.1) users had a fivefold excess risk compared to non-smokers. With regard to exposure to secondary smoke those who had their spouse smoking had an enhanced risk (OR=1.35), whereas cohabitant smoking, passive smoking at work place had a threefold (OR=3) and two fold (OR=2) risk respectively. With regard to use of tobacco in smokeless form revealed that zarda (OR=3) and snuff users (OR=3) had significant risk for lung cancer.

With regard to alcohol consumption the subjects who had consumed the substances such as rum (OR =7.5), whisky (OR =3.4), wine (OR=2.3) and beer (OR =1.4) had a significant risk compared to the non-drinkers **(Table-2).**

Association Between Exposure To Various Risk Factors And Presence Of Lung Cancer (Crude Odds Ratio)

Table:2 : Risk Factor- Smoking, Tobacco In Smokeless Form & Alcohol Consumption N=180+180

Risk factors	Category	Cases f (%)	Controls f (%)	Chi-square value	P-value	Odds Ratio (95% CI)
Smoking	Yes	84 (46.7)	46(25.6)	17.38	0.00031**	2.5 (1.63-3.97)
	No	**96(53.3)**	**134(74.4)**	df=1		1.0(ref)
Past smokers	Yes	82(45.6)	35(19.4)	27.97	0.00001**	3.4(2.16-5.55)
	No	**98(54.4)**	**145(80.6)**	df=1		1.0(ref)
Present smoker	Yes	06(3.3)	11(06.1)	1.54	0.214	0.5(0.19-1.46)
	NO	**174(96.7)**	**169(93.9)**	df=1		1.0(ref)
Cigarette	Yes	64(35.6)	17(9.4)	35.18	0.00001**	5.2(2.94-9.94)
	No	**116(64.4)**	**163(90.6)**	df=1		1.0(ref)
Bidi smoking	Yes	31(17.2)	32(17.8)	0.019	0.890	0.9(0.55-1.65)
	No	**149(82.8)**	**148(82.2)**	df=1		1.0(ref)
Uses of cigar	Yes	05(2.8)	01(0.6)	2.712	0.100	5.1(0.59-44.21)
	No	**175(97.2)**	**179(99.4)**	df=1		1.0(ref)
Parent smoking	Yes	15(8.3)	45(25)	18.00	0.000022**	0.2(0.14-0.51)
	No	**165(91.7)**	**135(75)**	df=1		1.0(ref)
Spouse smoking	Yes	12(6.7)	09(05)	0.455	0.500	1.3(0.55-3.30)
	No	**168(93.3)**	**171(95)**	df=1		1.0(ref)
Co-habitant smoking	Yes	27(15)	10(5.6)	8.706	0.003**	3.0(1.40-6.40)
	No	**153(85)**	**170(94.4)**	df=1		1.0(ref)
Passive smoking at work place	Yes	37(20.6)	20(11.1)	6.024	0.014**	2.0(1.14-3.73)
	No	**143(79.4)**	**160(88.9)**	df=1		1.0(ref)
Tobacco in smokeless form	Yes	17(9.4)	35(19.4)	7.283	0.007**	0.4(0.23-0.80)
	No	**163(90.6)**	**145(81.6)**	df=1		1.0(ref)
Tobacco with pan	Yes	09(05)	22(12.2)	5.965	0.015**	0.3(0.16-0.84)

	No	**171(95)**	**158(87.8)**	df=1		1.0(ref)
Gutkha	Yes	03(1.7)	05(2.8)	0.511	0.475	0.5(0.14-2.52)
	No	**177(98.3)**	**175(97.2)**	df=1		1.0(ref)
Snuff	Yes	03(01.7)	01(0.6)	1.011	0.315	3.0(0.31-29.44)
	No	**177(98.3)**	**179(99.4)**	df=1		1.0(ref)
Kaddipudi	Yes	01(0.6)	07(3.9)	4.602	0.032**	0.1(0.01-1.13)
	No	**179(99.4)**	**173(96.1)**	df=1		1.0(ref)
Zarda	Yes	03(1.7)	01(0.6)	1.011	0.315	3.0(0.31-29.44)
	No	**177(98.3)**	**179(99.4)**	df=1		1.0(ref)
Alcohol consumption	Yes	44(24.4)	35(19.4)	1.314	0.252	1.3(0.81-2.21)
	No	**136(75.6)**	**145(81.6)**	df=1		1.0(ref)
Rum consumption	Yes	14(7.8)	02(1.1)	9.419	0.002**	7.5(0.03-0.59)
	No	**166(92.2)**	**178(98.9)**	df=1		1.0(ref)
Whisky consumption	Yes	30(16.7)	10(5.6)	11.250	0.001**	3.4(1.6-7.18)
	No	**150(83.3)**	**170(94.4)**	df=1		1.0(ref)
Brandy consumption	Yes	08(4.4)	11(6.1)	0.500	0.479	0.7(0.82-1.82)
	No	**172(95.6)**	**169(93.9)**	df=1		1.0(ref)
Wine consumption	Yes	07(3.9)	03(1.7)	1.646	0.200	2.3(0.60-9.38)
	No	**173(96.1)**	**177(98.3)**	df=1		1.0(ref)
Beer consumption	Yes	07(3.9)	05(2.7)	0.345	0.557	1.4(0.4-4.54)
	No	**173(96.1)**	**175(97.3)**	df=1		1.0(ref)
Country liquor consumption	Yes	05(2.8)	07(3.9)	0.345	0.557	0.7(0.22-2.26)
	No	**175(97.2)**	**173(96.1)**	df=1		1.0(ref)

* *P<0.05,* ***P<0.001*

With regard to the dietary habits, it was noted that consumption of red meat (OR=1.5), fish (OR=4.2) and processed meat (OR=11.6) showed a significant risk for lung cancer compared to the non-eaters of these food item. The consumption of sugar (OR=1.5) and milk (OR=1.6) had marginal risk whereas consumption of vegetables (OR=0.7), wheat (OR=0.7), pulses (OR=0.2), carotenoids(OR=0.2) and eggs(OR=0.5) showed a low risk. The subjects who had a habit of skipping meals (OR

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=1.1) are at marginal risk of developing lung cancer. With regard to use of fuel for cooking, use of gas (OR=2.3), chulha (OR=1.3) and kerosene stove (OR=3.2) showed enhanced risk. The oil used for cooking such as filtered oil (OR=1.8), and rice bran oil (OR=3.8) showed enhanced lung cancer risk. Consumption of ground nut oil (OR=0.4) showed low risk **(Table:3)**.

Table : 3 : Dietary Factors And Lung Cancer N=180+180

Risk factors	Category	Cases f (%)	Controls f (%)	Chi-square value	*P*-value	Odds Ratio (95% CI)
Non vegetarian	Yes	**129(71.7)**	**152(84.4)**	8.579	0.003**	0.4(0.27-0.78)
	No	51(28.3)	28(15.6)	df=1		1.0(ref)
Red meat consumption	Yes	**112(62.2)**	**92(51.1)**	4.525	0.033*	1.5(1.03-2.39)
	No	68(37.8)	88(48.9)	df=1		1.0(ref)
Chicken consumption	Yes	**112(62.2**)	**134(74.4)**	6.213	0.013*	0.5(0.36-0.88)
	No	68(37.8)	46(25.6)	df=1		1.0(ref)
Fish consumption	Yes	73(40.6)	25(13.9)	32.304	0.00001**	4.2(2.52-7.09)
	No	**107(59.4)**	**155(86.1)**	df=1		1.0(ref)
Processed meat consumption	Yes	11(6.1)	01(0.5)	8.621	0.003**	11.6(1.48-91.21)
	No	**169(93.9)**	**179(99.5)**	df=1		
Habit of skipping meals	Yes	50(27.8)	45(25)	0.357	0.550	1.1(0.72-1.84)
	No	**130(72.2)**	**135(75)**	df=1		1.0(ref)
Sugar	Yes	**172(95.5)**	**168(93.3)**	0.847	0.357	1.5(0.61-3.85)
	No	08(4.5)	12(06.7)	df=1		1.0(ref)
Milk	Yes	**175(97.2)**	**172(95.5)**	0.718	0.397	1.6(0.52-5.07)
	No	05(02.8)	08(04.5)	df=1		1.0(ref)
vegetables	Yes	**176(97.8)**	**177(98.3)**	0.146	0.703	0.7(0.16-3.38)
	No	04(2.2)	03(1.7)	df=1		1.0(ref)
Wheat	Yes	**175(97.2)**	**176(97.8)**	0.114	0.736	0.7(0.21-3.01)
	No	05(02.8)	04(02.2)	df=1		1.0(ref)
Pluses	Yes	**176(97.8)**	**179(99.4)**	1.825	0.177	0.2(0.02-2.22)
	No	04(02.2)	01(0.6)	df=1		1.0(ref)
carotenoids	Yes	**173(96.1)**	**178(98.9)**	2.849	0.091	0.2(0.05-1.35)
	No	07(3.9)	02(1.1)	df=1		1.0(ref)
Egg	Yes	**124(68.9)**	**146(81.1)**	7.170	0.007*	0.5(0.31-0.84)
	No	56(31.1)	34(18.9)	df=1		1.0(ref)
Refined oil	Yes	**166(92.3)**	**172(95.6)**	1.743	0.187	0.5(0.22-1.34)

Risk factors	Category	Cases f (%)	Controls f (%)	Chi-square value	P-value	Odds Ratio (95% CI)
	No	14(7.7)	8(4.4)	df=1		1.0(ref)
Filtered oil	Yes	14(7.7)	8(4.4)	1.743	0.187	1.8(0.74-4.435)
	No	**166(92.3)**	**172(95.6)**	df=1		1.0(ref)
Ground nut oil	Yes	24(13.3)	44(24.4)	7.252	0.007**	0.4(0.27-0.82)
	No	**156(86.7)**	**136(75.6)**	df=1		1.0(ref)
Sunflower oil	Yes	**117(65)**	**112(62.2)**	0.300	0.584	1.1(0.73-1.73)
	No	63(35)	68(37.8)	df=1		1.0(ref)
Palm oil	Yes	07(3.9)	22(12.2)	8.438	0.004**	0.2(0.12-0.69)
	No	**173(96.1)**	**158(87.8)**	df=1		1.0(ref)
Rice bran oil	Yes	11(6.1)	03(1.7)	4.756	0.029*	3.8(1.05-14.00)
	No	**169(93.9)**	**177(98.3)**	df=1		1.0(ref)
Use of Gas	Yes	**171(95)**	**160(88.9)**	4.538	0.033**	2.3(1.05-5.36)
	No	09(05)	20(11.1)	df=1		1.0(ref)
Use of Chula for cooking	Yes	65(36.1)	53(29.4)	1.815	0.178	1.3(0.87-2.10)
	No	**115(63.9)**	**127(70.6)**	df=1		
Use of Kerosene stove	Yes	26(14.4)	09(05)	9.146	0.002**	3.2(1.45-7.05)
	No	**154(85.6)**	**171(95)**	df=1		
Use of Coal burning	Yes	04(2.2)	07(3.9)	0.844	0.358	0.56(0.16-1.95)
	No	**176(97.8)**	**173(96.1)**	df=1		

* *P<0.05, **P<0.001*

Exposure to chemicals such as coal (OR=2.2), bleaching powder (OR=2.0) was also found to increase the risk by twofold.

Subjects living adjacent to industrial area (OR=1.2) are also at risk for lung cancer **(Table-4)**.

Table : 4 : Environmental Exposure To Chemicals And Lung Cancer   N=180+180

Risk factors	Category	Cases f (%)	Controls f (%)	Chi-square value	P-value	Odds Ratio (95% CI)
Use of agarbatti at home	Yes	**140(77.8)**	**151(83.9)**	2.169	0.141	0.6(0.39-1.14)
	No	40(22.2)	29(16.1)	df=1		1.0(ref)
Use of mosquito liquid at home	Yes	**131(72.8)**	**132(73.3)**	0.014	0.905	0.9(0.61-1.54)
	No	49(27.2)	48(26.7)	df=1		1.0(ref)
Sulphuric acid	Yes	01(0.6)	08(4.4)	5.584	0.018*	0.1(0.01-0.97)

	No	**179(99.4)**	**172(95.6)**	df=1		
Ether	Yes	01(0.6)	02(1.1)	0.336	0.562	0.4(0.04,5.53)
	No	**179(99.4)**	**178(98.9)**	df=1		
Insecticide	Yes	11(6.1)	40(22.2)	19.212	0.000012**	0.2(0.113-0.46)
	No	**169(93.9)**	**140(77.80**	df=1		
Coal	Yes	05(2.8)	04(2.2)	0.114	0.736	1.2(0.33-4.76)
	No	**175(97.2)**	**176(97.8)**	df=1		
Bleaching powder	Yes	04(2.2)	02(1.1)	0.678	0.410	2.0(0.36-11.18)
	No	**176(97.8)**	**178(98.9)**	df=1		
Living adjacent to industrial area	Yes	15(8.4)	12(6.7)	0.360	0.548	1.2(0.57-2.80)
	No	**165(91.6)**	**168(93.3)**	df=1		1.0(ref)

* *P<0.05, **P<0.001*

Among the occupational exposure carpenters were found to have enhanced risk (OR=1.5) for lung cancer. Other occupations such as electrician, construction worker, cement worker, driver, traffic police, cook, cotton industries and agriculture did not show any association with lung cancer.

Among comorbid diseases subjects having asthma showed a significant risk (OR= 11.65) for developing lung cancer **(Table-5).**

Table : 5 : Comorbid Diseases, Family History And Lung Cancer n=180+180

Risk factors	Category	Cases f (%)	Controls f (%)	Chi-square value	*P*-value	Odds Ratio (95% CI)
Tuberculosis	Yes	02(1.0)	02(1.0)	0.000	1.000	1.0(0.13-7.17)
	No	**178(99)**	**178(99)**	df=1		1.0(ref)
Asthma	Yes	11(6.1)	01(0.5)	8.621	0.003**	11.6(1.48-91.21)
	No	**169(93.9)**	**179(99.5)**	df=1		1.0(ref)
COPD	Yes	04(2.2)	04(2.2)	0.000	1.000	1.0(0.24-4.06)
	No	**176(97.8)**	**176(97.8)**	df=1		1.0(ref)
Family history of	Yes	31(17.2)	00(00)	33.921	0.00001**	_

lung cancer	No	**149(82.8)**	**180(100)**	df=1		

* *P<0.05, **P<0.001*

Adjusted odds ratios (ORs) was computed to remove confounding effects of other variables. Logistic regression analysis was used, where in all the factors that emerged significant earlier were included in the regression model. It was observed that cigarette smokers (OR=4.8, CI-2.50-9.32, P=0.00001) continued to show a high risk for lung cancer compared to non-smokers. Alcohol consumption in the form of rum (OR=7.5, CI=1.48-38.89, P=0.015) too had increased risk compared to non-drinkers.

Consumption of non-vegetarian food such as red meat (OR=2.8, CI=1.69-4.82, P=033405) and fish (OR=4.4, CI=2.45-8.04, P=0.00001) had significant risk for lung cancer. Use of chulha for cooking (OR=2.1, CI=1.25-3.65, P=0.005) showed significant risk for lung cancer. Presence of Asthma (OR=8.1, CI=0.97-68.89, P=0.053) had eight fold risk for lung cancer **(Table-6)**.

Table 6: Association of Risk Factors with Lung Cancer Computed Using Adjusted Odds–Ratio n 180+180

Risk factors	CATEGORY	Cases	Controls	*P*-value	Adjusted odds
		f (%)	f (%)		Ratio (95% CI)
Cigarette smoking	Yes	64 (35.6)	17(9.4)	0.00001**	4.8(2.50-9.32)
	No	116(64.4)	163(90.6)		1.0(ref)
Rum consumption	Yes	14(7.78)	02(1.11)	0.015**	7.5(1.48-38.89)
	No	166(92.22)	178(98.89)		1.0(ref)
Red meat consumption	Yes	112(62.2)	92(51.1)	.033405	2.8(1.69-4.82)
	No	68(37.8)	88(48.9)		1.0(ref)
Fish Consumption	Yes	73(40.56)	25(13.89)	0.00001**	4.4(2.45-8.04)
	No	107(59.44)	155(86.11)		1.0(ref)
Use of Chula For cooking	Yes	65(36.1)	53(29.4)	0.005**	2.1(1.25-3.65)
	No	115(63.9)	127(70.6)		1.0(ref)
Having Asthma	Yes	11(6.11)	01(05)	0.053*	8.1(0.97-68.69)
	No	169(93.89)	179(99.5)		1.0(ref)

* P<0.05, **P<0.001

B. Dose-Response relationship between risk factors and lung cancer

Chi-square test and odds ratio were used to find the dose response relationship between duration of exposure to selected risk factors and presence of lung cancer. It was observed that higher number of cigarettes smoked per day as well as longer duration of smoking were associated with enhanced risk for lung cancer. Similarly increased consumption of rum and consumption for more than 10 years was associated with enhanced risk **(Table-7)**.

Table 7: Dose-Response Relationship For Risk Factors And Lung Cancer

n=180+180

Risk Factors		Cases	Controls	Chi square	*P*-value	Odds ratio(OR)
Number of cigarette/day	NO	116	163			1.0(ref)
	≤ 10	42	11	25.33	0.001**	5.3(2.65-10.86)
	>10	22	06	14.07	0.000176**	5.1(2.02-13.10)
Duration of smoking(in years)	NO	96	134			1.0(ref)
	≤ 10	46	25	11.56	0.001**	2.6(1.47-4.46)
	>10	38	21	9.70	0.002**	2.5(1.39-4.57)
Quantity of rum consumption/day (in ml)	NO	166	178			1.0(ref)
	≤ 30	09	01	6.77	0.032*	9.6(1.21-77.0)
	>30	05	01	2.90	0.012*	5.3(0.62-46.37)
Duration of rum consumption(in years)	<10	04	01	1.98	0.195	4.2(0.47-38.76)
	>10	10	01	7.75	0.024*	10.7(1.35-84.67)

* *P*<0.05, **P*<0.001

Discussion

Tobacco smoking has consistently been demonstrated to be an important etiological factor, though lung cancer occurs in non-smokers also. Considerably higher numbers of Indian patients with lung cancer are non-smokers, compared to the west [2]. The global trend of rise in adenocarcinoma is paralleled in India. Recent studies have reported rising numbers of patients with non-small cell carcinoma (NSCC) of lung with predominant histology as adenocarcinoma[4,5]. In present study too it is observed that majority of the lung cancer patients had adenocarcinoma (46.1%) with squamous cell carcinoma (13.4%) being the second most common histology. It is also interesting to note that more than half of the cases of lung cancer (54.4%) were non-smokers and majority (90.6%) had not used tobacco in smokeless form as well.

The focus of this hospital based case control study was to investigate non-tobacco-related risk factors. The study

examined role of risk factors such as alcohol consumption, diet, cooking methods, occupational and environmental exposure to chemicals and presence of comorbid diseases. We also assessed role of smoking and exposure to secondary smoke as risk factors in this study. The Major risk factors that are found to be associated with lung cancer in this study include presence of asthma (OR=8.1), consumption of alcohol, especially rum (OR=7.5), cigarette smoking (OR=4.8), consumption of fish (OR=4.4) and red meat (OR=2.8) and use of chulha for cooking (OR=2.1).

A recent meta-analysis of studies reporting significant association between asthma and lung cancer reported that the asthma was significantly associated with the increased risk of lung cancer (OR = 1.44; 95% CI 1.31–1.59; $P < 0.00001$; $I^2 = 83\%$)[6]. Findings from a large international case-control consortium indicate that asthma had an inverse association with lung cancer, the association being stronger with an asthma diagnosis five or more years prior to lung cancer compared to shorter[7]. Findings of our study are in agreement with these past studies. Periodic screening and follow-up of patients with asthma may be useful in detecting histological changes at the earliest.

A positive association between lung cancer and alcohol consumption has been suggested by several studies[8-10]. In our study too we found strong association between alcohol consumption and lung cancer (OR=7.5). However it is possible that those who consumed alcohol also smoked since cigarette smoking was found the next major risk factor in this study (OR=4.8). Hence use of alcohol as independent risk factor may need further investigation.

With regards to diet our study shows strong association between lung cancer and consumption of fish (OR=4.4) and red meat (OR=2.8). However a number of epidemiological studies have reported inconsistent findings on the association between meat consumption

and lung cancer[11,12] . A study by Dosildiaz et al (2006) revealed association between consumption of fish and risk of lung cancer with an OR of 1.67 (95% CI 0.99–2.81), an association that extended to both white (OR=1.61 95% CI 0.93–2.79) and blue fish (OR=2.03 95% CI 1.23–3.34). A recent meta-analysis of observational studies has also reported that high intake of red meat may increase the risk of lung cancer by about 35%.[13] However more investigations are required to support these findings.

Indoor air pollution associated with use of biomass fuel has been strongly associated with respiratory diseases and lung cancer especially among women[14-16]. Our study too shows use of chulha for cooking predisposes the user to twofold increase in risk for lung cancer.

The findings of our study show that inclusion of certain foods in everyday diet can help to reduce the risk of lung cancer. These foods include, pulses (OR=0.2), foods containing carotenoids (OR=0.2), ground nut oil (OR=0.4), vegetables (OR=0.7) and eggs (OR=0.5). Studies have reported inverse associations between fruit and vegetable consumption and the age-adjusted and area-adjusted risk of mortality or incidence of lung cancer[17,18]. Studies have also revealed that lower serum levels of beta-carotene are associated with higher risk of lung cancer. It was suggested that increase of serum beta-carotene with dietary intake could lower the risk of lung cancer[19]. A retrospective case control study on behavioural risk factors of breast cancer revealed that ground nut oil consumption showed decreased risk (OR= 0.05,CI=0.02-0.14) for breast cancer[20]. Our study too shows that consumption of ground nut oil has protective effect on lung cancer.

Present study is among one of the few studies conducted in India which focuses on role of risk factors other than smoking and tobacco use for development of lung cancer. Study findings draw specific attention to presence of

asthma as major risk factor for development of lung cancer. Study finding highlight that diet can play crucial role in prevention of lung cancer. Consumption of fish and red meat is found to increase the risk, whereas consumption of pulses, foods containing carotenoids, groundnut oil, vegetables and egg are found to lower the risk of lung cancer. These finding may be very useful guidelines for nurses to provide patient education. Findings of the study are also useful to identify high risk patients and screen them periodically to detect lung cancer at the earliest stages.

Limitation : The matching of the cases and control was not done in this study.

Conclusion

The findings of the study show that presence of asthma, cigarette smoking, alcohol (Rum) consumption, red meat and fish consumption, use of chulha for cooking are strongly associated with increased risk of lung cancer. Inclusion of certain foods is found to lower the risk of lung cancer. These foods include pulses, foods containing carotenoids, groundnut oil and vegetables.

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