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Pulmonary Function Studies In Farmers To See Exposure To Crop Residue Burning Trends In The Disease Burden Of Lung Cancer Attributable To Pm 2.5 Exposure In Punjab

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Abstract
Inhalation of biomass fumes over a long time leads to Proliferation and fibrotic changes in the lungs. Early recognition of this damage provide an important clue to insure good health. About 84mt. (23.86%) of the stubble burnt on field each year immediately after harvest. Ambient air pollution increases the risk of respiratory mortality. PM 2.5 Particulate concentration makes the air quality Air pollution responsible for lung cancer has changed from household air pollution to Ambient Air Pollution. The study has been conducted for comparison of lung function 200 farmers who were burning the stubble each season and 200 persons (controls) who were living far from burnt fields hence not exposed to the pollution produced by stubble burning (between 20-50 years of age group) purpose of the study is to bridge up the gap between the previous knowledge about the effects of stubble burning on lungs, as not much studies has been conducted on the farmers of Punjab. The Pulmonary function tests in farmers showed decline in the values of FVC, FEV_1, PEER, $FEF_{0.2-1.2}$.
PM 2.5 is known to cause epigenetic and Microenviromental alterations in lungs which cause cancer. The paddy crop residue burning contains the PM 2.5 which cause the repeated irritation to the respiratory mucosa and hence it is now established that repeated crop residue burning by farmers in Punjab is most potential cause of lung cancer.

Keywords: *PM 2.5, Ambient Exposure, Lung cancer, PEFR, FEV_1, COPD, Indoor Air Pollution.*

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I. Introduction

Respiratory infection are among the leading causes of death and disability globally. Respirable aerosol particles released by agricultural crop residue burning (ACRB) practiced by farmers in all global regions are potentially harmful to human health.[1]

Concentration of suspended particulate matter (SPM), sulphur dioxide (SO_2), Nitrogen dixodie (NO_2) and particulate matter of less than 10 and 2.5um (PM 10 and PM 2.5) were measured by using high volume sampler (HVS) and cascade Anderson impactor results show that rice crop residue burning increases the Pollution level in the Ambient air and PFT's undergo a significant decreases in their respective value.[2]

Chronic Pulmonary disease (COPD) is common inflammatory diseases of the airways characterized by airflow obstruction that is not fully reversible. it is most often caused by smoking.[3]

Respiratory symptoms like cough, dypnoea, wheeze, sorethreat, Haemoptosis were more common its study groups as compared to control groups.[4]

Study of Rice straw burning products as guinea pig lungs demonstrated that Rice straw burning products on guinea pig lungs demonstrated that Rice straw burning products (RSBP) induced pulmonary emplysematous lesions are progressive. With subsequent smoke exposure together with the sensitization of the lungs.[5]

Inhalation of Biomass fumes over a long time leads to proliferation and fibrotic changes in lungs. The ventilatory tests like PEFR, FEV showed highly significant decline in the Rural women.[6]

Evidence has suggested that exposure to Environmental or microbial bio-diversity in early life may impact subsequent lung function and allergic disease risk.[7]

Health study on Irish farmers indicate a high prevalence of respiratory symptoms and lung function abnormalities.[8]

Spirometric studies in healthy Punjabi males of urban and Rural areas between 20-50 years of age group showed a highly significant decrease in PEFR, $FEF_{0.2\%-1.2\%}$ and FEF 25%.[9]

A comparative study of Pulmonary function tests in healthy Punjabi working females and non working females shows significant decline in lung function like FVC, FEV_1, PEFR in working females.[10]

The Possible risk factors for emphysema in Active farmer lung (FL) were a longer duration of exposure to organic dusts and at higher level.[11]

Evaluation of Respiratory symptoms and lung function disord of farmers and non farmers in Yazad province showed a highly significant reduction in respiratory capacity in the farmers group.[12]

Ambient Air pollution increases the Risk of respiratory mortality.[14]

What to do with crop residue left in fields at the end of growing season is literally a burning issue. Some farmers prefer the inexpensive approach of setting the stubble ablaze but repeated burning is not good for the soil, and resulting smoke is a health hazard, although many studies have measured the particles released into the air by crop burning fewer have isolated the effect of the smoke an lung function New research have shown the lasting effects on the children's lung function.[13]

Indiscriminate use of Pesticide like organophosphate, organochlorine, carbonate and pyrethroid poses various health hazards to human nervous, respiratory, endocrine, reproductive and immune systems[15].

Assessment of Pulmonary functions tests among rice mill workers showed statistically significant decrease in FEV_1, FVC and $FEV_{1\%}$ in study group.[16]

Adverse effect of aersol particles on lung dysfunction among paddy farmers in Purworeja, central Java, Indonesia showed healthrisk for lung dysfunction due to farming duration.[17]

Stubble burning has been reckoned among the major contributor of air pollution in South Asia. It is a significant resource of gaseous pollutants such as carbondioxide (CO_2) carbon monoxide (Co) , Nitrogen oxide (NO_2), Sulfaroxides (SO_2)and methane (CH_4) as well as particulate matters (PM_{10} and $PM_{2.5}$) Causing serious damage to human health and Environmental.[18]

Study of respiratory function outcome in farmers using pesticide mixtures and the farmers doing organic farming shows highly significant decline in FEV_1 and PEFR.[19]

Crop burning adversely affects air quality and consequently human health.[20]

The link between Agricultural activities and respiratory disease puts farmers at risk of exposure of particulate matter, potentially reducing lung function.[21] Ambient Air pollution impairs, lung function development in children particularly in industrial areas.[22]

Burring of fire crackers during Diwali, a major festival in India, as the cause of poor winter air in India.[23]

Respirable mercury particulates and other chemical constituents in festival aerosols in Delhi showed PM_{10} loads and chemical compounds during episodic emission Deepawali.[24]

Assessing the immediate effect of COVID-19 Lockdown as Air quality in Delhi the results indicate the lowering of $PM_{2.5}$ PM_{10} and No_2 concentration in the city.[25]

Farmers Perspective to mitigate crop residue burning in Haryana State of India reveals that availability of less time between the two crops was found the major constraints.[26]

Farmers had significantly lower values for the pulmonary function test variables FVC, FEV_1, and maximum mid expiratory flow rate. [27]

Air pollution responsible for lung cancer has changed from household air pollution to ambient air pollution.[28]

Particulate Matter (PM) in outdoor pollution was recently designated a group I carcinogen by the international agency for research on cancer (IARC). The determination was based on the evidence regarding the relationship of $PM_{2.5}$ and PM_{10} to Lung cancer risk.[29]

II. Material & Methods

The study was conducted among 200 farmers who used to burn the reside crop seasonally and 200 controls who live far away from the fields. The Age group selected was between 20-50 years of age. The instrument 'MEDSPIROR' was used which is computerised spirometer, Judged to be healthy on the criterion of no exertional dysponea/general debility, H/o current/past/cardiorespiratory disorder or frequent cold, obvious sign of malnutrition, no obesity, H/o smoking and a detailed physical examination was carried out and Hb. Concentration was done.

The lung function test, were suggested by Gandevia and hugh jones and cotes. The procedure were quite simple from patients point of view only two maneouver were required to accumulate all test data i.e. a forced vital capacity and maximum voluntary ventilation. All gas volumes are corrected to B.T.P.S. (body temperature ambient pressure and saturated with water vapour) automatically by the Instrument. Pulmonary function tests were carried out in standing position, height as measured in centimetres weight was measured in Kilograms, body surface area was read from'Nomogram' Dobous and Dobous.

In the procedure of lung function a nose clip was attached to the subject and a clean mouth piece was inserted into the breathing tube, two maneavers were performed.

1) Forced vital capacity test: subjects were instructed to take maximum inspiration and then place mouth piece firmly in mouth and performed, maximum expiration.

2) Maximum voluntary ventilation test procedures: After rest of five minutes the subject was asked to breathe as rapidly and deep as possible in and out from the mouth piece. MVV test was run for 12 seconds. Results were taken on the build in printer containing all the patient information and calculated value of all the 14 parameters.

Statistical Analysis

The various statistical considerations used and were mean standard deviation and correlation coefficient and regression equation was evaluated by constructing ANOVA table

III. Results

Anthopometric Parameters in Cases and control are shown in table showing mean SD, 't' value 'p' value and significance. The values for FVC and PEFR show highly significant (Table 2 & 4). The values for FEV_1, and $FEF_{0.2\text{-}1.2}$ shows statistically significant. (Table 3 & 5)

Table 1 Comparison of Anthropemetic Parameters in study and control groups

PARAMETERS	STUDY (MEAN±SD)	CONTROAL (MEAN±SD)	T	P	SIG.
Age (years)	33.18±9.37	31.54. ±9.45	1.75	>0.05	NS
Weight (kg)	60.33 ± 11.81	61.22±10.38	0.84	>0.05	NS
Height (cm)	167.90 ±6.21	167.28 ± 6.79	0.91	>0.05	NS
FVC	2.01 ±0.60	3.12 ± 0.40	15.28	<0.01	**HS**
$EFV_{0.5}$	1.91 ± 0.58	1.98 ±0.57	1.28	>0.05	NS
FEV_1	5.33 ± 1.90	5.77 ± 1.88	2.31	<0.05	**S**
FEV_3	3.11 ± 0.68	3.18 ± 0.60	1.34	>0.05	NS
PEFR	9.377 ± 6.052	7.670 ± 3.976	2.728	<0.01	**HS**
$FEF_{25\text{-}75}$	3.19 ± 1.17	3.18 ± 1.14	0.11	>0.05	NS
$FEF_{0.2-1.2}$	5.33 ± 1.90	5.77 ± 1.88	2.31	<0.05	**S**
$FEF_{25\%}$	2.87 ± 0.13	2.35 ± 1.41	1.68	>0.05	NS
$FEF_{50\%}$	3.74 ± 1.37	3.83 ± 1.41	0.61	>0.05	NS
$FEF_{75\%}$	1.66 ± 0.89	1.77 ± 0.96	1.23	>0.05	NS
$FEV_{0.5}$/FVC	0.61 ± 0.51	0.61 ± 0.74	0.21	>0.05	NS
FEV_1FVC	0.85 ± 0.09	0.852 ± 0.10	0.39	>0.05	NS
FEV_3/FVC	99.40 ± 2.41	99.28 ± 2.83	0.83	>0.05	NS
MVV	108.34 ± 37.87	113.54 ± 31.43	0.80	>0.05	NS

S: Significant, HS: Highly Significant, NS: Non Significant

Table 2 mean ± Sd value and significance of FVC

	Mean ± SD	t value	Significance
Study group	2.01± 0.60	15.28	<0.01
Control	3.12 ± 0.40		HS

Table 3 mean ± Sd value and significance of FEV_1

	Mean ± SD	t value	Significance
Study group	5.33 ± 1.90	2.31	<0.05
Control group	5.77 ±1.88		S

Table 4 mean ± Sd value and significance of PEFR

	Mean ± SD	t value	Significance
Study group	9.377 ±6.052	2.778	<0.01
Control group	5.77 ±1.88		HS

Table 5 mean ± Sd value and significance$FEF_{0.2-1.2}$

		t value	Significance
Study group	5.33 ±1.90	2.31	<0.05
Control group	5.77 ±1.88		S

III. DISCUSSION

India being the largest agro Economic of the world produces around 500 million tons of crop residue annually most of which is burnt on farm.[20]

About 84 mt. (23.86%) of the stubble is burnt on field each year immediately after harvest. The disastrous haze observed over india during winter season has been linked to stubble burning as it coinicides with the burning periods (Oct-Nov) ACQ reaches at its poor levels. The health effects of air pollution ranges from skin and eye irritation to severe neurological, cardiovascular and respiratory diseases, asthma, chronic obstructive pulmonary etc. And also increase in mortality rates.[18]

Ambient air pollution is associated with lung function and COPD, particles with diameter between $2.5\mu m$ and $10\,\mu m$: PM coarse and (NO_2) Nitrogen dioxide concentration with FEV in one second (FEV), forced vital capacity with higher conc. Of $PM_{2.5}$, PM_{10} and NO_2 but not with PM $coarse_{14}$.

PM 2.5 particulate concentration makes the air quality worse in the after math of Diwali on account of fire crackers.[23]The PM aersoal sample shows particulate mercury (Hg P), Elemental carbon (EC), organic carbon (OC) the loadings were higher of PM 10. The metal oxides were K>AL>S>CL>Ca>Fe and Ba, mg and Ti PM_{10} Conc. Suggesting its emission from conc. of sulphur containing raw material of Fire Crackers cause decrease in AQI and respiratory illness.[24]

Air pollution responsible for Lung cancer has changed from household, air pollution to ambient air pollution. $PM_{2.5}$ exposure is more harmful among males and older people.[28]

Particulate matter (PM) in outdoor air pollution was recently designated a group I carcinogen by the international agency for research on cancer (IARC) This determination was linked to the evidence regarding the relationship of PM 2.5 and PM10 to lung cancer risk.[29] Chronic obstructive Pulmonary disease (COPD) in farmers and agricultural works is a common inflammatory diseases of the airways characterized by airflow obstruction that is not fully reversible it is most often caused by smoking.

Rice straw burning (RSB) products induced Pulmonary Emphysematous lesions are progressive with subsequent smoke exposures together with sensitization of lungs.[5]

Decrease in lung volumes by burning of the biomass fuel is due to respirable suspended particulate matter So_2, NO_2, CO_2, Co etc.[6] The cause of decline in the flow volume in subjects is owing to industrial pollution (SO_2, $SO4_2$, NO_2), suspended particulate matter and cumulative dust exposure and exhaust emission of vehicles. There is decline in the lung functions of adults during the burning season.[13]

IV. CONCLUSIONS

Air pollutions is associated with various respiratory disease. India being the largest Agro economics of the world and Punjab is the main crop Grower of India. Most of the farmers are not educated and hence not aware about the other methods or the uses of the remanents of paddy harvest. They consider to prefer burning of Crop residue and that causes the air pollution (in oct. Nov.). Diwali is a major festival of India and in north India especially burning of fire crackers are there in abundance which leads to add in insult that is the Air quality index becomes more poorer. As the PM_{10} and $PM_{2.5}$ levels increases in Air. This causes respiration illnesses among the farmers and the other people's who are exposed to that Air pollution. It is known fact that the $PM_{2.5}$ are very small and can penetrate deeper in Lung tissue and cause irritation and infection in Lungs are there and Proliferative changes occur.

PM 2.5 is known to cause epigenetic and micro-environmental alterations in Lungs which cause cancer.

Previous studies have identified marked associated between particulate matter 2.5 ($PM_{2.5}$) Exposure and increased incidence of Pulmonary disorder $PM_{2.5}$ is a type of air pollutant with a diameter of $\leq 2.5\mu m$ characterized by its small particle size, large surface area and toxin absorption ability. These properties make it possible for $PM_{2.5}$ comparison a mixture of solid and liquid particles including black carbon metals, Nitrate, Sulphate, Polycyclic aromatic hydrocarbons and automatic exhaust particles, $PM_{2.5}$ may trigger asthma, chronic obstructive lung disease COPD and lung cancer through the activation of various signaling pathways.

The Paddy crop residue burning contains the $PM_{2.5}$ which cause the repeated irritation to the Respiratory mucosa and hence it is now established that repeated crop residue burning by the formers in Punjab is causing most potential cause of lung cancer.

To avoid there types of illnesses, irritation, cancer the following is suggested for the crop stubble management:-

1) Incorporation of stubble into the soil
2) Use of stubble as a fuel in the power plants.
3) As a raw material fox pulp and paper industries
4) As a biomass or biofuel production.
5) Generate compost or Biochar
6) As a blend for the production of cement and bricks.
7) Farmers should be made aware about the management of crop residue.

8) Government Aid should be there to the farmers for modern machines and technologies to manage the crop residue in effective way.

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