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Body Mass Index (BMI) As Respiratory Health Indicator of School Children During Post-Harvest Crop Waste Season of Burning

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Abstract

In this epidemiological study, Spirometeric and other physical signal of 50 children were observed continuously September 2013 to December 2016 to estimate the effect of fine level of particulate dust ($PM_{2.5}$) released to the ambient air during waste burning of crop episodes on their health. Trends of respiratory health parameters were alarming due to a sharp fall in respiration capacity of children during the waste burning of crop events. Spirometeric parameter of selected candidates were classified according to their respective Body Mass Index values. The children with abnormal BMI category (BMI value < 18 kgm^{-2} and > 22 kgm^{-2}) were affected by 4% to 7% (p-value <0.001) from their baseline values of lung capacity parameters as compared to the normal BMI category (18 to 22 kgm^{-2}) who were affected by 2% to 2.7% (p-value <0.001). Every year, a permanent fall of 1% to 3% (p-value < 0.001) was observed in respiratory related health parameters of abnormal BMI category candidates. These results indicate a strong compliance of respiratory mechanism with Body Mass Index of human subjects during particulate pollution exposure and may support hypothesis of chronic implications in human subjects. Correlations of BMI with fall in respiratory health parameters were established using Mixed effect model of statistics.

Keywords: Waste burning of crop, Fine Particulate matter, Respiratory health, Body Mass Index, Mixed effect Model.

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1. Introduction

According to latest reports from well known agencies like WHO, EPA and pollution control boards, burning of crop waste is a biggest issue in every agriculture sound country [1]. Every year million tons of residue has been generated in the crop lands. This big amount is a burden for field managers to store it for other purposed. Due to lack of resources and related man power. They have no alternate to burn it. They burn it in their fields in an ambient atmosphere. Due to this cause huge amount of toxins in the form of air, and toxic waste are produced. This material harms the all cyclic inhabitants of ecology. In Asia continent this problem is severe. To observe this problem an experimental study has been conducted to see the effect on children [2].

2. Study design

2.1. Selection of sites

The measurement of various scalable signals was carried from September 2013 to December 2016 in the state of agriculture Punjab. A high school in the village Salani (29.51°N latitude and 80.26°E longitude), about 15 kilo meters away from the main urban area of Mandi Gobindgarh has been selected. The sampling site is located very near to the centre of the state. The site is surrounded on all the four sides with agriculture fields. The site map is shown in Fig 2.1.

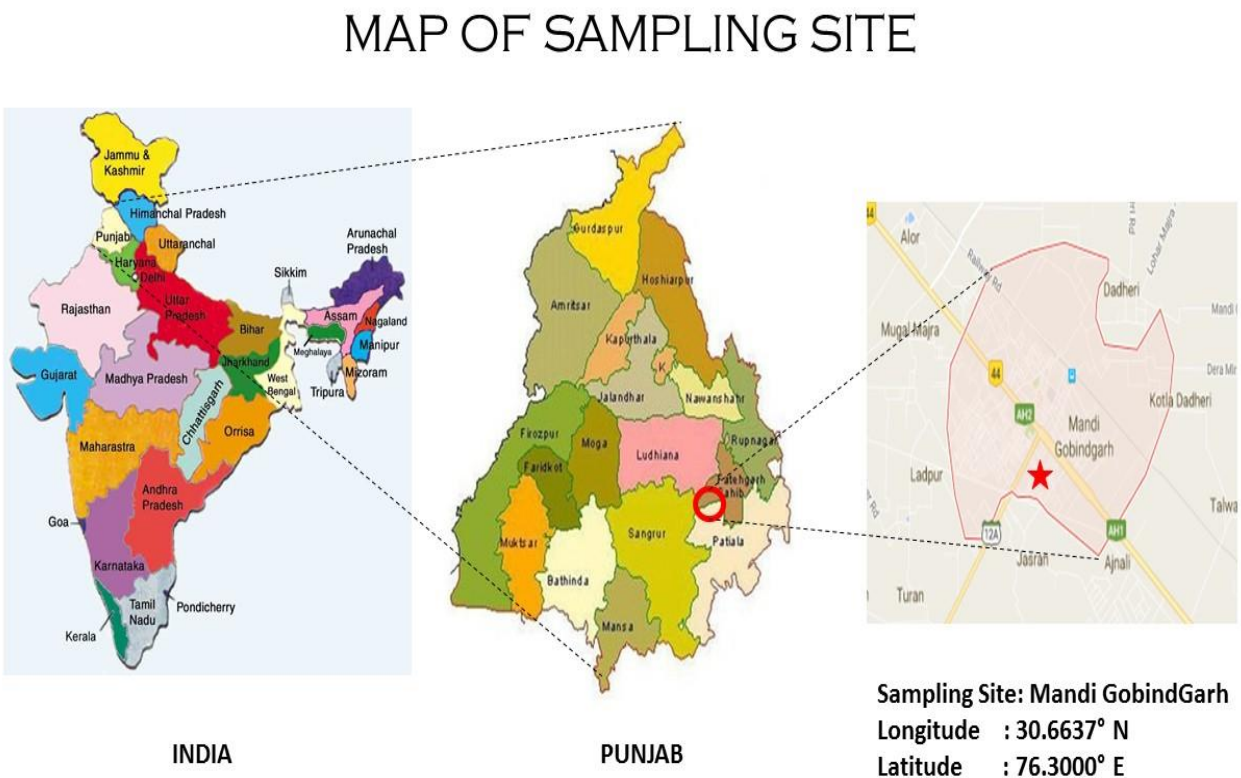

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Figure2.1: Map of location where study was carried out

2.2 Selection of subjects

To carry out study, children were inspected and then after their consent they were selected for entire period of study. It was decided to select fifty studies in numbers to support statistical hypothesis. Before their involving in study, trills were arranged. Every student is asked to perform in these trills. First, they were asked to run for 1000 m. they jump for 2 minutes and then asked to give their spirometeric test if they found normal after 20 minutes of rest. In the beginning 80 students were came forward for the participation but as per resources and time bound monitoring process only 50 were selected [3]. These children were also asked to take their permissions and consents form their respected parents. The spirometeric trails were stated by sampling staff. In the physical measurements, forced vital and peak flow of lungs of selected candidates were measured under proper guidance and surveillance. During sampling, every candidate was monitored non-invasively under the guidance of safeties.

2.3 Statistical analysis

Various mathematical tools were applied on collected sort of data. First the data were arranged in proper format and then grouping of data is being sorted out in different categories like low high and medium BMI. The data were preserved under high soft security for prevention of damage and usage. Data loggers were used for proper records. The data has been arranged in certain bars and chart form for exhaust analysis. The ANOVA, an ANCOVA methods of statistics are used for calculation of categorical differences and regression such as Mixed effect has been put up in line for trends of inclination or dilation. The comparative analysis of regression availabilities was also done and found that the mixed model with non-effect classification is a best method for the study due to good level of adjustment in covariate and confounders and effect modifiers [4.5.6.7]. The excel 2016 and SPSS 21.0 2012 package was used for analytical purpose.

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3. Results and discussion

Results and Discussion

The respiration mechanism has a significant role in cardiopulmonary functioning of human body. Spirometeric parameters like FVC is an indicator to determine the health of endothelial diaphragm whereas PEF is a prime indicator for complications related to chest wall compliances and stiffness. FEV_1 parameters is used to observe the restrictions and strength of ventilation mechanism for wind pipe. Under respiration related clinical trials, it was observed that the malnutrition's and over nutrition's in human subjects under low and high BMI were more prone to cardio pulmonary complications than Normal BMI subjects. There was hardly any evidence to observe the raised level of $PM_{2.5}$ and their effects on physiological parameters such as lungs.

The particulate matter $PM_{2.5}$ were fortnightly measures in the school yard from 2013 to 2016 for six consecutive waste burning of crop seasons in Punjab. The $PM_{2.5}$ level of selected site is shown in Figure 3.1.

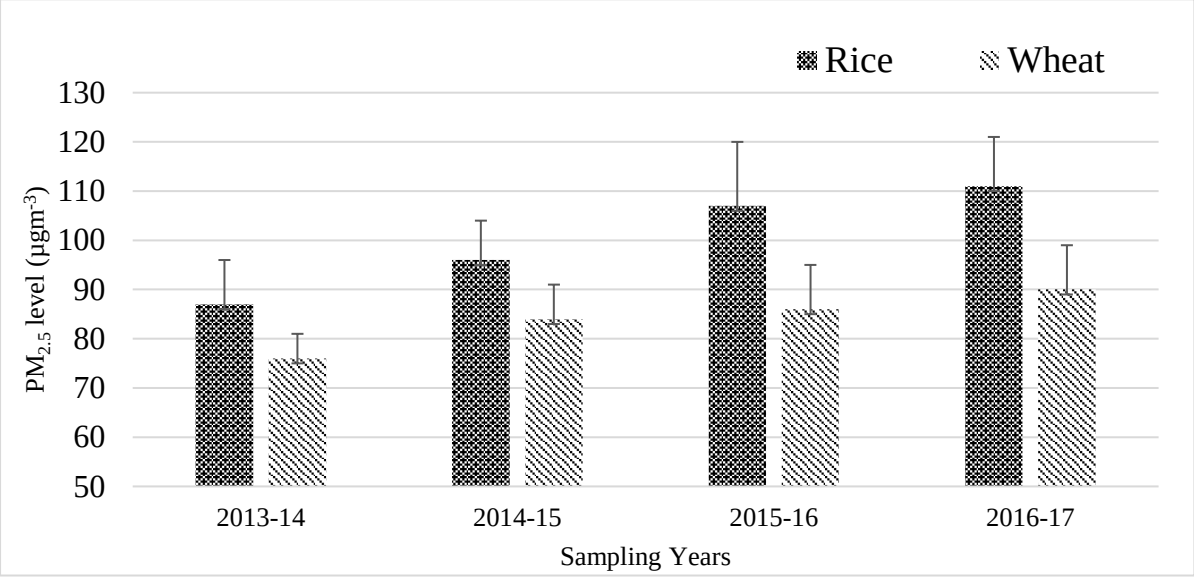

Figure 3.1: $PM_{2.5}$ levels during individual rice and wheat waste burning of crop periods

In rice and wheat crop seasons, the $PM_{2.5}$ levels were significantly raised due to ACRB activity in the region which was observed to be higher by 70% to 134% than permitted levels of local pollution control agencies and NAAQS standards. During 2013-14, the $PM_{2.5}$ level

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was observed to be 87±9 μgm^{-3} in rice crop burning season that was 27% more than the wheat waste burning of crop season (73±7 μgm^{-3}). The difference in $PM_{2.5}$ levels between rice and wheat crop burning seasons were due to poor and unfavourable environmental conditions and are previously discussed by Gupta et al. 2016 and Mittal et al 2013. From 2013 to 2016, there were continuous increment in $PM_{2.5}$ in both seasons by 19% to 97% due to annual average growth of 73 Matric tones in food grains. As per Modis images, dense and stable plumes of smoke were observed in the peak burning seasons in the region. The raised level of $PM_{2.5}$ may burden the physiological parameters. The spirometeric parameters of school going children were also measured during study period.

Physiology of human subjects having NBMI is far more resistant to particulate pollution as compared to the subjects with high BMI and low BMI. In all the three types of human subjects, the female subjects are relatively less resistant (by about 10%) than the male subjects. These observations are seen from the bar charts of FEV_1 and FVC parameters. The trends of FEV_1 and PEF for the year 2015 -16 indicate that the damage in physiology is much more during rice season as compared to that in wheat season. Interestingly, very less difference of about 2%-5% can be seen for the gender bias for subjects with normal BMI. Hence, it can be concluded that the BMI is a very good representative of the human health index with regard to its resistance towards particulate pollution or aerosol pollution in ambient air.

Another analysis of the data on FEV_1 and PEF of human subjects with three different categories of BMI levels i.e., NBMI, HBMI and NBMI is shown for three successive years of sampling as bar charts for the fall in FEV_1 and PEF. The trends in bar chart shows that the subjects with NBMI have always shown resistance to the particulate pollution in the ambient air of Mandi Gobindgarh. The trends in FEV_1 as well as PEF for different categories of human subjects are consistent with time. However, there is an increase of about 3% to 4% in the values after every year. Mandi Gobindgarh is located in south east to the biggest city Ludhiana (Population about 5.3 Million) of Punjab, which might influence ambient air quality of the selected site, as it lies downwind to the Ludhiana city. As seen from the wind roses during waste burning of crop season at the sampling site. The wind is blowing for most of the time from north west to south east directions. The data reported here indicates that the waste burning of crop spikes the PM levels both in rice and wheat seasons.

The human subjects chosen for the study belonged to the lower economic strata of society as the school selected for the study caters to the economically weaker section of the society. It

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has been also seen and reported in our previous study as well that the human subjects with normal BMI belonging to even any different class of society behaved in the same way, i.e., showing resistance to rising pollution of ambient air due to CRB activities. The only difference had been in the ratio of human subjects of normal BMI with respect to high and low BMI. It is alarming that over each successive year, the decrement in the physiology parameters is increasing by about 5%. BMI is established as sensitive index of respiratory health of school children.

Conclusions

It is recommended that while every effort should be done to bring down the fine particulate matter levels, especially during post-harvest season, there is a need to educate the society to maintain their BMI levels in the normal range of BMI so as to develop resistance in the event of increased levels of fine level of dust in air.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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