Prevalence and Spatial Epidemiology of Chronic Obstructive Pulmonary Diseases in an Industrial Town of India: An Interim Analysis

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Abstract:
Chronic Obstructive Pulmonary Diseases (COPD) is the fourth leading cause of death worldwide. The worldwide prevalence of the disease in 1990 was 9.34/1000 men and 7.33/1000 women. True burden of disease estimation for COPD in India is not available. The known risk factors for COPD include tobacco smoking, smoke producing fuel, environmental pollutants and industrial air pollutants including fibre dust generated from textile industry. However, due to lack of data, the exposure-outcome relationship between air pollutants and COPD is not well established. Further, literature on micro-level understanding of impact of air pollutants on prevalence of COPD is scarce, particularly in developing countries. Therefore this study was conducted to estimate the burden of COPD and its association with air pollutants in an industrial town of northern India. We are presenting an interim analysis of the data in this paper.

Methodology: A cross sectional questionnaire based survey was carried out in the city of Ludhiana to screen for cases of COPD. Clinical examination and portable spirometry were used for confirmation of diagnosis of COPD. Geocoding of cases was done using Trimble Juno SA handheld device. Air quality data was obtained from the website of Punjab State Pollution Control Board. Spatial analysis was performed to see any association between air pollution and clustering of cases of COPD.

Results: So far 17637 persons have been

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screened 3899 households. Overall prevalence of COPD was 3.5/1000 adult population. Prevalence in industrial and non-industrial area were 4.87/1000 and 1.71/1000 adult population respectively. Spatial clustering of cases was analysed using nearest neighbour index. Significant clustering of cases was observed in industrial area (NNI=0.82, p <0.01). Association with air pollutants if any, will be presented during the meeting.

**Conclusion:** Prevalence rates of COPD in industrial area are very high, suggesting that residences should be far removed from industrial clusters to protect health of the workers.
Introduction

Chronic Obstructive Pulmonary Diseases (COPD) is the fourth leading cause of death worldwide. Low and middle income countries shoulder much of the burden of COPD\(^1\). The global prevalence of the disease in 1990 was 9.34/1000 in men and 7.33/1000 in women\(^2\). COPD is a major public health problem in India also. By 2016 it is expected that there will be 22.2 million cases in the country. However, burden of disease estimation for COPD in India is not available and the current prevalence is not well understood\(^3\). McKay et al recommended that accurate estimates of current/future disease prevalence are required for optimal strategies to mitigate growth and effects of disease to be devised and thorough standardized prospective studies are required in various sub populations.

Literature search shows that more often studies are based on hospital data or data collected from small geographical areas covering a very small population. Even district or state level estimations are absent from published literature. From 1964 to 1995, studies conducted in male population of northern India showed prevalence between 2.12 to 9.4%, and in females in the same area from 1.33 to 4.9%. The corresponding values from south Indian population were 1.4 to 4.08% and 2.55 to 2.7%. These studies having spread over 30 years do not really reflect the true epidemiological profile of COPD in India, it also points at the incompleteness of data as well as its lack of representativeness in terms of geographical and environmental heterogeneity which significantly determines the distribution of COPD. Murthy & Sastry, based on these studies, in 1995, in their background paper for NCMH projected 147 lakh male and 75.1 lakh female patients of COPD in 2016. However the authors state that precise estimates of COPD cannot be done due to absence of data and mortality rate among COPD patients is not available\(^3\).

In order to fill up this gap in knowledge about true estimates of prevalence of COPD, we conducted this study to determine the prevalence of COPD in a district which has industrial, urban and rural habitations. In this paper we present data of interim analysis of this ongoing study.

Materials and Methods:

The study was carried out in Ludhiana district of Punjab. A cross sectional community based survey was conducted. So far survey has been completed in industrial area and partially in urban residential area of the city. In all selected colonies, door to door survey was carried out for identifying persons suffering from COPD. Screening of cases was done by using a validated questionnaire developed by Jindal et al\(^4\). Based on the questionnaire based screening, all suspected cases were confirmed by spirometry and prescriptions, if any, available with a patient from a qualified physician or hospital. GOLD guidelines based on spirometry were used for confirmation of diagnosis of COPD\(^5\).

Maps of surveyed areas were obtained from Survey of India and additional information was obtained online. The location of each patient was geocoded using Trimble Juno SA handheld GPS device. Data was managed using Microsoft Excel spreadsheet.
ESRI ARC GIS10.2 was used for creating digital maps and carrying out spatial statistical analysis. Spatial epidemiology of COPD is being presented in this paper.

**Results**

In Industrial area of Ludhiana, 1999 households were surveyed covering a total population of 9509 and in Urban area, 8128 persons were surveyed in 1900 households in urban residential areas of the city. Surveyed area along with location of cases is shown in Map 1.

In all 56 confirmed cases of COPD were identified, of which 40 were in industrial area and 16 in urban residential areas. The overall prevalence was 3.17/1000 population. The respective prevalence rates in industrial and non-industrial area are 4.20/1000 and 1.96/1000. This difference is statistically significant (p < 0.008). The colony wise prevalence is depicted in Map 2.

Map 1: Map of Ludhiana showing surveyed area and location of cases
Map 2: Colony wise prevalence of COPD in Ludhiana

Map 3: Density Mapping of COPD
Continuous monitoring of air quality monitoring data is not available for Ludhiana, however cross sectional one time data is available from 15 sites, collected in February – March 2013 as shown in Map 4.

**15 Sites Air Quality Monitoring: 2013**

![Map 4: PM2.5 levels at 15 monitoring sites](image)

PM$_{2.5}$ data was obtained from Environmental quality monitoring reports of 43 critically polluted areas 2013$^6$. Etio-pathologically, PM$_{2.5}$ being the most important indicator of association between air quality and COPD, the results of PM$_{2.5}$ kriging are shown in Map 5.
This study is being conducted to determine the prevalence of COPD in an industrial town of north India. The overall prevalence was found to be 3.17/1000 total population. Other studies in similar population groups have taken the denominator to be above 35 years or 40 years of age. In our study we found cases as young as 31 years of age, so after adjusting for age, the prevalence in our study was found to be 6.9/1000 which is much less than what has been reported in previous studies. Jindal et al in a multicentric study reported a prevalence of 4.1%. But this study is only questionnaire based and covers population over 35 years of age. One of the center for this study is Chandigarh, located about 100 km South-East of Ludhiana, which has socio-culturally similar population, but separate prevalence rate is not reported in the study. Further this study was conducted in 2005, over 9 years the prevalence of an environment related disease may change. For the same reason, we did not attempt to compare our findings with other studies conducted in in 1990s or even earlier.

However, the in our study probability of underreporting cannot be ruled out. The difference in density of cases between industrial and non-industrial area is evident in the maps. Prevalence calculated in different colonies also suggested that cases are more densely located in colonies in industrial areas as compared to urban areas.
Thereby implying that COPD cases are more concentrated in industrial zones and industrial pollutants may have a more detrimental effect on respiratory health of residents compared to environmental pollutants generated from vehicular emission in residential areas of the city. However, this needs to be substantiated with more data based evidence.

In spite of limited scope of interpretation, we looked at the 2013 PM2.5 data available from 15 sites and created an interpolation map with simple kriging. But it failed to show any pattern of association with respect to aggregation of cases. A better understanding may be developed once we have collected data from remaining urban and rural areas of the Ludhiana district.

**Conclusions**

It is very likely that high concentration of cases of COPD will be found in residential neighborhoods of air polluting industries, particularly where PM$_{2.5}$ concentration is high. Detailed mapping of COPD cases will help estimate true burden of COPD as well as determination of location of cases, which will help in better management and planning of prevention for COPD.
References:


