Emergence of chronic obstructive pulmonary disease as an epidemic in India

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Chronic obstructive pulmonary disease (COPD), hitherto underdiagnosed in India, is now recognized in 4-10 per cent of adult male population of India and several other Asian countries. The Regional COPD Working Group for 12 Asia Pacific Countries and Regions used a COPD prevalence model and estimated an overall prevalence rate of 6.3 per cent with a range from 3.5 to 6.7 per cent. The smoking associations with COPD were high from most countries i.e., 2.65 in India, 2.57 in China and 2.12 in Japan. In a large, multicentric study from India, the population prevalence of COPD was 4.1 per cent of 35295 subjects with a male to female ratio of 1.56:1. Almost all forms of smoking products such as cigarettes and ‘bidis’ used in different States were found to be significantly associated with COPD. In non-smokers, especially women, exposures to indoor air pollution from domestic combustion of solid fuels was an important factor. More significantly the exposure to environmental tobacco smoke (ETS) was an established cause for COPD. The odds ratio for risk from ETS exposure in non-smokers (1.535) was on significant during both the childhood and the adulthood. On an average, an Indian COPD patient spent about 15 per cent of his income on smoking products and up to 30 per cent on disease management. Tobacco smoking was also the most frequent cause of chronic cor pulmonale which occurred as a long term complication of COPD both amongst men and women.

Key words Air pollution - chronic bronchitis - chronic cor pulmonale - chronic obstructive pulmonary disease - environmental tobacco smoke - solid fuel combustion - tobacco smoking

Chronic obstructive pulmonary disease (COPD) is a major cause of health care burden worldwide and the only leading cause of death that is increasing in prevalence\(^1\). In the United States, it accounts for a morbidity of 4 per cent and lists as the fourth leading cause of death\(^1\). Globally, COPD by 2020, is expected to rise to the 3\(^{rd}\) position as a cause of death and at 5\(^{th}\) position as the cause of loss of disability adjusted life years (DALYs) according to the baseline projections made in the Global Burden of Disease Study (GBDS)\(^2\). The largest increase in the tobacco related mortality is estimated to occur in India, China and other Asian countries\(^2\).

Although most of the available data on the disease are reported from the Western world, it is
being equally recognized from Asia and Africa. Unlike Europe and the United States, the Asian continent is rather large and heterogenous with marked disparities in social and health care infrastructure in different countries. While some of the countries have very high fiscal indices, the others are either poor or in different stages of economic development. Although these factors are likely to significantly affect the disease prevalence, COPD, interestingly is a problem of great magnitude in almost all these countries. Considering a large population of the world residing in these regions, an epidemic of chronic respiratory disability is genuinely feared.

India can be projected as a classical example with reference to the rising burden of chronic diseases. In a recent estimate, the burden from chronic diseases was estimated to account for 53 per cent of all deaths and 44 per cent of DALYs lost in 2005. Chronic respiratory disease was shown to account for 7 per cent of deaths and 3 per cent of DALYs lost. This was obviously an underassessment since there was inadequate information available on COPD. Information now available on COPD from India is bound to tremendously expand this burden. Reports from several other Asian countries are equally alarming.

Tobacco smoking remains the most important risk factor identified as the cause of COPD and chronic respiratory morbidity. It can be safely assumed that the risk morbidity and mortality from COPD in the next two decades in the Asian and the African regions is directly attributable to the continued increase in tobacco smoking. The tobacco epidemic is already surging in Asia and therefore one hopes to see more of COPD in the years to come. Exposures to environmental tobacco smoke (ETS) from smokers, exhausts of solid fuel combustion and ambient air pollution are some other risk factors in nonsmoker individuals.

**Definition of COPD**

COPD is now known as a distinct clinical entity with more consistent or consensus definitions in most international guideline documents such as the Global Initiative for Chronic Obstructive Lung Disease (GOLD). But the confusion remains in the minds of medical practitioners especially at the primary care levels. The overlap between asthma and COPD is generally difficult to resolve and several patients are diagnosed and classified as ‘asthma’, a term which a primary care physician finds easier to understand and explain to the patient. Even in Japan, the term COPD was officially recognized only in 1995.

COPD is primarily described by its prototype chronic bronchitis (CB) in most epidemiological studies. This was attributed to the difficulties in measuring airway obstruction in the field. Peak expiratory flow (PEF), measured in some studies had been used to classify chronic bronchitis as simple (CB, S) and obstructive (CB, AO), or classify the two together as COPD. As per current practices, COPD continues to be used interchangeably with chronic bronchitis in the prevalence studies for its ease and a more practical assessment of the burden and/or risk factors. The term COPD in this article reflects similar meanings and interpretation. However in clinical practice, one always attempts to make a distinct diagnosis and demonstrate the presence or absence of airways obstruction.

**The COPD burden**

Although the data from most of the Asian countries are patchy, it clearly points towards a huge burden (Table I). Using a mathematical model to estimate the prevalence of COPD, the combined prevalence in 12 Asia-Pacific countries and regions was 6.3 per cent which was higher than the overall rate of 3.8 per cent as extrapolated from WHO data for this region. The
total burden was estimated at 56.6 million patients of moderate to severe COPD. This could perhaps be an overestimation but clearly points to a problem of pandemic proposition. There were no estimates on COPD prevalence for India and other countries of the Indian subcontinent in this report. But the field data from India reflect the similar trends.

India: COPD in India has been recognized and investigated with the help of small surveys conducted in different populations for the last 40 yr. Prevalence rates varying from about 2 to 22 per cent in men and from 1.2 to 19 per cent in women have been shown in different reports. Unfortunately, the number of published reports are rather small. We had earlier reviewed the population studies on COPD prevalence from India which were reported in the three time periods of up to 1970, between 1971-1990 and after 1990. Most of these studies were conducted with the help of an interview or a questionnaire while a few had used PEF assessment as well. It was however difficult to make an extrapolation to calculate the national burden. A median prevalence of 5 per cent in men and 2.7 per cent in women was calculated which accounted for a total burden of 8.15 million male and 4.21 million female patients in a population of 944.5 million in 1996. A study from urban Kashmir points to a higher prevalence of 7.55 per cent in smokers and 10.56 per cent in people living in poorly ventilated houses. But these studies have suffered from a lack in the uniformity of disease definition, design and methodology (Table II). More importantly, almost invariably, the statistical analyses were merely descriptive without any consideration to the influence of disease and confounder variables. Of the few studies which were reported in the last three decades, the COPD prevalence was reported about twice as common in men than women with a mean smoking association of over 82 per cent.

Some of the important conclusions made were the observations that the median rates of COPD prevalence before 1970 and after 1990 did not change but the total burden had increased tremendously because of an increase in the total population. Although the prevalence rates reported from south India were earlier considered as lower, almost similar findings were reported in population survey on 9946 inhabitants from rural south India, i.e., a prevalence of 40.8/1000 for males and 25.5/1000 for females. Incidentally, most of these reports were conducted either in the northern States around Delhi or in south India in Tamil Nadu. Hardly any information on the disease is available from the rest of India.

We now have got data on the population prevalence from a multicentric study sponsored by the Indian Council of Medical Research (ICMR). Till date, this is the largest and the most appropriately conducted field study on asthma and COPD which provides analytic data on prevalence as well as on the risk factors. Field surveys utilizing uniform methodology with a standardized and validated questionnaire were conducted in both the urban and rural populations at four large centers i.e., Bangalore, Chandigarh, Delhi and Kanpur on a total sample of over 73000 individuals. Of the 35295 adult subjects of over 35 yr of age, COPD was diagnosed in 4.1 per cent individuals with a male to female ratio of 1.56 to 1 i.e., a prevalence of 5.0 per cent among men and

<table>
<thead>
<tr>
<th>Country</th>
<th>Population studied</th>
<th>COPD (%)</th>
<th>Smoking association Smoker : nonsmoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>India6</td>
<td>35295 &gt; 35</td>
<td>4.1</td>
<td>2.65</td>
</tr>
<tr>
<td>China8</td>
<td>9243 &gt; 18</td>
<td>7.8**</td>
<td>High</td>
</tr>
<tr>
<td>Korea9</td>
<td>2343 &gt; 40</td>
<td>10.9**</td>
<td>2.12</td>
</tr>
<tr>
<td>Thailand11</td>
<td>3094 &gt; 60</td>
<td>7.11</td>
<td>High</td>
</tr>
<tr>
<td>Iran20</td>
<td>4636 &gt; 35</td>
<td>4.65</td>
<td>High</td>
</tr>
</tbody>
</table>

Superscript numerals denote reference numbers
*Estimated; **Airflow limitation (FEV1/FVC < 70%)
3.2 per cent in women. There were some variations in prevalence rates depending upon the place of residence and socio-economic grouping but significant differences were observed based on the habit of smoking and exposures to combustion of solid fuels and environmental tobacco smoke.

COPD is also an important economic burden on the patient and the health care infrastructure of the country. It was shown in a community based study on one thousand families that a family with one or more smokers as its member(s) spent a significant extra expenditure on health care and suffered with greater morbidity indices such as the number of lost school days for the children and loss of work efficiency. Similarly, in an assessment of costs of management amongst 423 COPD patients, each patient was shown to spend on an average, up to 15 per cent of his annual income on smoking products and up to about 30 per cent on disease management. In the same report, the zero median direct expenditures by patients for several items clearly reflected the burden on the exchequer since the costs were borne by the State and/or charitable institutions.

Other Asian countries: Reports on COPD prevalence are now pouring in from different Asian countries. We have limited information on the problem of COPD in China in the published English literature, but it is likely to be similar to that of a volcano which threatens to erupt any time. China, like India, has got a huge population of over one billion people, thereby accounting for a large burden in terms of absolute numbers. There are inadequate epidemiological data on the burden. The prevalence was reported as 26.2 for males and 13.7 for female per thousand population in the GBDS study but only 4.21 and 1.84 per thousand for men and women respectively in another survey. Utilizing a statistical model, the prevalence of COPD was estimated as 65/1000 which was almost 2.5 times greater than that in the WHO study. The total burden

<table>
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<tr>
<th>Authors</th>
<th>Population group</th>
<th>Age distribution (yr)</th>
<th>Subjects No. &amp; Sex</th>
<th>Method of diagnosis</th>
<th>COPD (%) Prevalence</th>
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<td>Joshi et al (1975)</td>
<td>Punjab (Ind)</td>
<td>17-64</td>
<td>4270 M &amp; F</td>
<td>Questionnaire</td>
<td>12.5 M &amp; F</td>
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<td>Bhattacharya et al (1975)</td>
<td>U.P. (R)</td>
<td>30-70+</td>
<td>629 M &amp; 511 F</td>
<td>Questionnaire</td>
<td>6.7 M &amp; 4.5 F</td>
</tr>
<tr>
<td>Thiruvengadam et al (1977)</td>
<td>Madras city (U)</td>
<td>5-60+</td>
<td>408 M &amp; 409 F</td>
<td>Interview</td>
<td>1.9 M &amp; 1.2 F</td>
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<tr>
<td>Vishwanathan &amp; Singh (1977)</td>
<td>Delhi (U)</td>
<td>5-94</td>
<td>552 M &amp; 441 F</td>
<td>Questionnaire</td>
<td>8.0 M &amp; 4.3 F</td>
</tr>
<tr>
<td>Radha et al (1977)</td>
<td>New Delhi (U)</td>
<td>3-60+</td>
<td>1087 M &amp; 1011 F</td>
<td>Questionnaire &amp; PEF</td>
<td>8.1 M &amp; 4.6 F</td>
</tr>
<tr>
<td>Malik SK (1986)</td>
<td>Chandigarh (U)</td>
<td>15-65+</td>
<td>2121 M &amp; 2251 F</td>
<td>Questionnaire &amp; PEF</td>
<td>5.5 M &amp; 2.9 F</td>
</tr>
<tr>
<td>Jindal SK (1993)</td>
<td>Punjab (U)</td>
<td>15-70+</td>
<td>1475 M &amp; 1329 F</td>
<td>Questionnaire &amp; PEF</td>
<td>5.0 M &amp; 2.7 F</td>
</tr>
<tr>
<td>Ray et al (1995)</td>
<td>Tamil Nadu (R)</td>
<td>30+</td>
<td>4857 M &amp; 5089 F</td>
<td>Questionnaire</td>
<td>4.1 M &amp; 2.5 F</td>
</tr>
</tbody>
</table>

Superscript numerals denote reference numbers; PEF, peak expiratory flow; U, urban; R, rural

*Bangalore, Chandigarh, Delhi, Kanpur
in China was assessed as 38.2 million patients. In a recent publication on impact of tobacco on lung health in China, the estimated COPD morbidity was reported at over 3 per cent or 25 million people, of whom 72 per cent were smokers. This estimate is almost double than that for India. Over two-thirds of all smoking related deaths in China were attributed to COPD, lung cancer and tuberculosis.

Japan in Asia is among the most developed countries of the world. But the problem of COPD is quite significant and alarming. Incidentally, COPD was not mentioned in Japanese government statistics until 1995. The increase in cigarette consumption reported between 1955 to 1974 resulted in a significant increase in number of deaths from COPD since 1980. In the more recent reports, it was suggested that there was a high degree of underrecognition of COPD. In the Nippon COPD Epidemiology Study, prevalence of airflow limitation was reported in 10.9 per cent of 2343 subjects age ≥40 yr on clinical, and spirometric indices. In another study in 56 primary care settings, a group of 1040 patients were analysed for the presence of airway obstruction of which 27.0 per cent were found to have FEV₁/FVC < 70 per cent. On analysis of the questionnaires completed by the participating physicians for 194 subjects with positive screening tests, 81 per cent were detected to suffer from COPD - 61 per cent with moderate to severe disease implying that the COPD management in Japan in the primary care settings appeared to be poor.

There are a few reports from South Asian countries and regions such as Thailand, Hong Kong, Singapore and Korea on one or the other aspect of COPD epidemiology, all pointing towards a high burden of COPD. A stratified multi-stage, clustered national sample was studied in Korea in conjunction with the second Korean National Health and Nutrition Examination Survey of 9243 adults of over 18 yr of age. COPD was reported in 17 per cent of Korean adults of over 45 yr of age which accounted for a very heavy population burden. In metropolis Bangkok, the prevalence of COPD among 3094 individuals of over 60 yr age was 7.1 per cent with an incidence rate of 3.63 per cent; and a distribution of 5.6 : 2.2 : 1 of mild : moderate : severe COPD. An unexpectedly high incidence rate compared with prevalence was considered as a warning message by the authors.

Warning signals are also available from several other Asian countries of both the Far East as well as the Middle East regions either directly about the increasing burden of chronic respiratory disease or indirectly about non communicable diseases which would essentially include COPD besides other diseases. Respiratory symptoms of chronic bronchitis in Iran were reported in 4.65 per cent of 4636 adults aged 35 yr or more. A high prevalence of respiratory morbidity from both asthma and chronic bronchitis was reported from Israel, Turkey from the Middle East regions of Asia. A high mortality risk from smoking associated diseases including chronic bronchitis represented a loss of 22 yr of life expectancy in Taiwan. Reviews of data from national health reports and programmes from countries such as Singapore and Bahrain have also stressed upon the increasing problem of chronic diseases.

Risk factors

Several risk factors have been reported in different epidemiological studies. Tobacco smoking is the most important identifiable factor in almost all the reports. Male sex, advancing age, lower socioeconomic grouping and urban residence are also associated with an increased occurrence of COPD. Exposures to ETS and exhausts of fuel combustion are also important especially amongst nonsmoker patients and women.

Tobacco smoking: There has been a marked increase in tobacco consumption in Asia. In several Asian
countries, the prevalence of smoking is more than that in the US and the UK. Smoking was reported in more than half of the male subjects of Taiwan, Philippines, Japan, Vietnam and China although less than 5 per cent of female population smoked in most of these countries but for Japan and Philippines. Tobacco smoking in India in different States and regions is highly variable from 13.3 to 59.4 per cent in men and 0.2 to 22.0 per cent in women. In our most recent multicentric study, the prevalence of ever smoking was present in 28.5 per cent of 37682 men and 2.1 per cent of 35923 women of over 15 yr of age.

The rise in COPD incidence has paralleled the graph of tobacco smoking throughout the world. The same trend is visible in the Asian region. The huge Chinese problem is directly related to production and consumption of tobacco which is highest in China. The estimated per adult consumption increased by 260 per cent between 1970-1972 and 1990-1992. In the past two decades, more than 34.8 million cartons of cigarettes were produced and 34.7 millions sold annually. The prevalence of smoking in about 67 per cent males and 4 per cent of females of over 15 yr of age was also amongst the highest in China. The authors feared that the peak of smoking induced diseases was still to come. In India, smoking association with COPD was reported in 82.3 per cent of male patients on an average in an analysis of several population studies. In our recent multicentric study, the smoker : nonsmoker ratio in COPD patients was 2.65 : 1. Similar associations are reported from other countries (Table I). Most studies also support a strong dose relationship i.e., an increasing risk of COPD with the amount and duration of smoking.

There are several different forms of tobacco products indigenously available in India and other Asian countries. ‘Bidi’ is a popular smoking product of Indian cottage industry in which crude tobacco (0.15 - 0.25 g) is loosely packed in a hand-rolled, dried leaf of tendu tree (Diisopyros melanoxylon) and is smoked as a cigarette. It varies from 4 - 7.5 cm in length and is available in bundles of 8-24 bidis. ‘Chutta’ is a product similar to a bidi but smoked in a reverse fashion with the burning end kept inside the mouth. Other popular method is to put tobacco in a clay container or a ‘chilum’ similar to a pipe and smoke either directly or drawing the smoke with the help of a long tube passing through a water container (i.e., hubble-bubble or ‘hukkah’) - a habit especially common among the elderly and in the Middle East. COPD is reported among smokers of almost all those different forms of tobacco products. Bidi smoking, in particular, is a more common habit than cigarette smoking in India. The COPD prevalences among bidi and hukkah smokers were 8.2 and 9.5 per cent with odds ratio of more than 2.6 in each case and both the prevalence rates as well as the odds ratio were significantly more than those for cigarette. Bidi smoking of more than 2.5 pack years was more commonly associated with chest symptoms and airways obstruction than cigarette smoking.

Environmental tobacco smoke exposure: ETS exposure among nonsmoker subjects, in particular women and children, is rather common in many Asian countries. ETS exposure, an important cause of nonspecific respiratory symptoms, is responsible for an aggravated morbidity in patients of asthma. But the role of ETS exposure in causing COPD is not established as yet. Parental smoking is reported to result in a small but statistically significant decline in FEV1 in school aged children. We have not found any past report demonstrating a direct causal relationship of ETS exposure with COPD. But a significant prevalence of COPD, inspite of a relatively low prevalence of smoking in women eludes to the role of ETS exposure in addition to exposure to domestic combustion of solid fuels. This is strongly supported by our field data. The odds ratio of 1.535 for household ETS exposure does
clearly implicate its role in COPD in nonsmoker individuals. ETS exposure during adulthood was found to have significant relationship with occurrence of COPD. A high odds ratio for risk with ETS exposure during both childhood and adulthood together pointed towards a cumulative effect of a long term exposure. The ETS exposure infact was found to be a stronger risk factor than the exposure to solid fuel combustion.

**Solid fuel combustion:** Indoor exposure to domestic combustion especially the solid (or biomass) fuels such as the dried dung, wood and crop residue is reported as an important cause of chronic bronchitis and COPD in women in studies from India, Nepal, China, South Africa, Turkey and some other countries. Respiratory symptoms in India were reported in 13 per cent of nonsmoking women involved in domestic cooking. Exposure to solid fuel combustion is also shown to be an additive risk factor along with ETS exposure in causing COPD. Chronic cor pulmonale frequently resulting from COPD progression is reported to be common in women who are otherwise nonsmokers but have got prolonged household exposure from early life to domestic cooking in the kitchens especially in the poorly ventilated houses.

**Outdoor air pollution:** Ambient air pollution in metropolitan cities has been frequently blamed for chronic respiratory morbidity. This is particularly important in Asian countries where urban air pollution is high. Respiratory symptoms of chronic cough, phlegm and dyspnoea which were assessed along with air quality data in a cross-sectional study among 4171 randomly selected residents of Delhi, were found to be more common in the higher pollution zones. In another study from Delhi, the emergency room visits for COPD were found to increase by 24.9 per cent on account of higher than acceptable levels of pollutants. Air pollution, resulting from dusts and smoke of different occupational and industrial units is also responsible for COPD in chronically exposed populations. Presence of tobacco smoking in the exposed individuals further compounds the problem.

**Other risk factors:** Male sex and an increasing age are identified as risk factors in most studies from Asia. This relationship may also be attributed to the greater prevalence of smoking amongst men and cumulative effects of smoking and other exposures with age. Low socio-economic status and infections have been listed as additional risks especially from countries with less developed economies. Alpha 1, anti-trypsin deficiency, is an important cause of emphysema in Europe and the United States. This is however not a significant finding in the Asian continent as assessed in occasional reports from China, Japan and India. Airway hyper-responsiveness has been also implicated as a risk factor and there is a strong belief among many Asian investigators that COPD is common in poorly managed asthmatics who may also smoke and/or exposed to other risk factors. There are no data to support the belief.

**Natural history**

The natural history of COPD in the developing countries is likely to differ on account of the differences in the smoking habits, environmental exposures, diagnostic delays, inadequacies of management and concurrent infections such as tuberculosis. The disease severity staging in Indian guidelines is classified in three stages vis-a-vis four stages as per the GOLD recommendations. This may have important educational implications in understanding and interpreting the natural course. Though information is available on the development of COPD in smokers and the effects of smoking on lung function decline, morbidity and mortality in COPD in the Western literature, the longitudinal studies on natural history of COPD in the Asian...
region are singularly missing. Although COPD is a progressive disease, its natural history is highly variable. It is significantly affected by the severity of airflow obstruction, concurrent infections and acute exacerbations, presence and continuation or removal of the risk factors. In particular, tobacco smoke and environmental exposures significantly influence the rate of progression and outcome.

Tobacco smoking remains the overwhelmingly important risk factor to cause the continuing deterioration of lung function and disease progression in COPD. Smoking is a powerful inducer of inflammation and also alters the repair mechanism. The higher the smoking intensity, the greater is the decline in FEV\textsubscript{1}. Fletcher and Peto\textsuperscript{56} have drawn elegant linear graphs based on mean of many individual courses and showed that compared to their age-matched, nonsmoker control subjects, the smokers showed a continued and steep FEV\textsubscript{1} decline to disability and death while quitting smoking, significantly retards the rate of decline\textsuperscript{55}. But not all patients with COPD follow this classical course and a much higher proportion of smokers develop COPD than the commonly believed figure of 15-20 per cent if they continue to smoke\textsuperscript{17}. Genetic factors may also contribute to the heterogeneity of response to tobacco smoke\textsuperscript{57}.

The clinical course of COPD is characterized by a variable number of acute exacerbations which may be rather frequent. Exacerbations often result from acute lower respiratory tract infections and sometimes from excessive pollutant exposures or other respiratory and systemic insults. Exacerbations may adversely affect the natural history by causing an increase in respiratory and systemic morbidity, increased rate of lung function decline, systemic effects and premature mortality\textsuperscript{58,59}. Each exacerbation may also result in structural alterations contributing to the irreversibility of airway obstruction\textsuperscript{59,60}. While early and comprehensive management with antibiotics, anti-inflammatory drugs and other supportive drugs may help in reducing morbidity and mortality of an acute exacerbation, no disease modifying drug is available as yet\textsuperscript{61}. Therefore, emphasis is placed on primary and secondary prevention especially by reducing smoking and other noxious exposures\textsuperscript{17,54,61}.

Other infections and exposures may also intervene the course of COPD. Pulmonary tuberculosis was considered as a strong predictor of COPD in a study from South Africa\textsuperscript{44}. It is also an important cause of chronic pulmonary function impairment\textsuperscript{62}. Presence of smoking in patients with

**Table III.** Distribution of 427 patients of chronic cor pulmonale of both sexes based on their smoking history

<table>
<thead>
<tr>
<th>Cor pulmonale secondary to COPD</th>
<th>Smoker (S)</th>
<th>Non smoker (NS)</th>
<th>S : NS ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>192</td>
<td>186, 96.9</td>
<td>6, 3.1</td>
</tr>
<tr>
<td>F</td>
<td>48</td>
<td>20, 41.7</td>
<td>28, 58.3</td>
</tr>
<tr>
<td>Both</td>
<td>240</td>
<td>206, 85.8</td>
<td>34, 14.2</td>
</tr>
<tr>
<td>Other causes*</td>
<td>89</td>
<td>42, 47.2</td>
<td>47, 52.8</td>
</tr>
<tr>
<td>M</td>
<td>98</td>
<td>2, 2.0</td>
<td>96, 98.0</td>
</tr>
<tr>
<td>F</td>
<td>187</td>
<td>44, 23.5</td>
<td>143, 76.5</td>
</tr>
</tbody>
</table>

*Bronchiectasis = 82, chronic pulmonary tuberculosis = 61, Kyphoscoliosis = 12, Obesity-hypoventilation = 12, Occupational and other diffuse lung diseases = 20
residual damage to the lungs resulting from tuberculosis is likely to aggravate the lung function and disease progression. Similarly, HIV infection has been shown to accelerate the development of emphysema in smokers63.

Limited information is available from India on a field study on follow up of COPD after a 10 yr period of initial assessment19. PEF was shown to decline significantly in asymptomatic smokers and more steeply in the symptomatic subjects with CB, AO. A longitudinal cohort study is now in progress at our Centre for the past 7 yr and the results will be available in the next 3-4 yr.

Chronic cor pulmonale: An important complication in the natural history of COPD is the development of pulmonary hypertension and chronic cor pulmonale. Pulmonary hypertension in COPD is usually moderate, progresses slowly and is associated with shorter survival64,65. There is a transitory increase in pulmonary artery pressures during an acute exacerbation, but the increase tends to persist after repeated exacerbations. Besides smoking cessation, long term oxygen therapy is the only treatment that slows down the progression of pulmonary hypertension64.

The classical syndromic presentation of a ‘blue bloater’ remains a common case material for an undergraduate medical student in the third world countries. In the past, the syndrome was more frequently described in women in India who were extensively exposed to domestic smoke from cooking fuels47,66. But most of the subsequent reports point towards a higher incidence in males with tobacco smoking as the more common cause in both the sexes67. Solid fuel combustion is perhaps an additional factor to smoking. But there is a relative paucity of published information on the subject in the recent literature. Data available on this condition support the crucial role of tobacco in causing chronic cor pulmonale. In our own analysis of 427 adult patients admitted with diagnosis of chronic cor pulmonale of over 30 yr of age seen in a 10-year period (unpublished data), tobacco smoking was the most important factor when the disease was secondary to COPD in both men and women (Table III). In non-COPD categories such as bronchiectasis, kyphoscoliosis and others, the history of smoking was not necessarily available.

In conclusion, as per general clinical observation, the prognosis of COPD in the developing countries is somewhat worse than that in the developed countries of Asia. Low socio-economic conditions, poor diet, environmental pollution and childhood infections are not only responsible for the development of COPD but also for continued decline in lung function, disease complications and an early mortality. There is a need to generate data to support these assumptions. Disease management and control is a major challenge. Pharmacological interventions and rehabilitative programmes are known to improve prognosis and quality of life of these patients. But tobacco cessation strategies are crucial to prevent as well as arrest the development of COPD. Fortunately, governments of several Asian countries have already started adopting such measures to achieve the goals7-10,20.

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