ABSTRACT

COPD is a major public health problem, especially in the developing countries. It is a chronic inflammatory airway condition associated with episodes of acute deterioration of symptoms called exacerbations. This study was conducted to identify the seasonal pattern in the frequency and outcome of hospital admissions due to COPD exacerbations in all age-groups. It is a retrospective, observational hospital-based study, which was conducted in three tertiary care hospitals in Karachi, Pakistan (JPMC, AKUH and LNH) for a period of two years (2010-2011). Data was collected from Hospital Records Department through patients discharge files of those who had a primary diagnosis of COPD. Seasonal trend, outcome of hospital admission and patient profile was taken into account when hospitalized. The results demonstrated that there was a sharp rise in admissions in autumn season which peaked in winter. Age and sex-specific rates showed that out of total 1,227 patients, most admitted were males (82.64%)(p=0.001), in age group 65 and above (62.34%)(p=0.001). There were total 161 expired cases (13.12% of all hospitalized patients). Cardiac (17.4%), hypertension (16.77%) and arthritis (18.0%) were found to be most common associated diseases. From this study we have concluded that in Karachi acute exacerbation of COPD is more common in the winter season especially in the male adults and age group of above 65 years so, active measures and patients education programs should be made more effective to decrease the present burden of acute exacerbated COPD.

Keywords: weather; respiratory; illness

1. Introduction

COPD is a major public health problem. Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory airway condition associated with episodes of acute deterioration called exacerbations [Mackay A, 2011]. These exacerbations are among the most common causes of medical admissions in UK [British Thoracic Society, 2006]. Much of the morbidity and mortality are related to these acute exacerbations of COPD [Seemungal TA, 1998; Soler-Cataluna JJ, 2005] making it the fourth leading cause of morbidity and mortality in the United States [Morbidity and.., 2007]. An estimated 12.5 million people in India suffer from COPD [Jindal SK, 2001]. It is also the second most common chronic respiratory disease after pulmonary tuberculosis [Chandra D, 2009].

COPD is correlated with both increased systemic and airway inflammation and may be triggered by bacterial and respiratory viral infections and can also be precipitated by
environmental factors which include air pollution, second hand smoke and seasonal variations [Mackay A, 2011]. These exacerbations are especially important because they have been shown to derive lung function decline in various different studies [Donaldson GC, 2002; Kanner RE, 2001]. Lung function cannot recover completely after an exacerbation [Makris D, 2007] additionally; patients who have frequent exacerbations have a reduced quality of life [Miravitlles M, 2004; Spencer S, 2004; Osman IM, 1997]

Acute exacerbations of COPD are important events to both patients and healthcare service providers. Acute exacerbations are characterized by recent onset of deterioration in patient’s clinical and functional states caused by worsening of COPD [Min J. Joo, 2007]. These acute events lead to increased medical utilization, outpatient department visits, emergency department visits and hospitalizations which all contribute to the overall burden of the disease [Min J. Joo, 2007]. It is also projected to rank fifth by 2020 as a worldwide burden of disease [Rabe KF, 2007].

The common discernment among patients and physicians alike is that COPD is more active during winter with increased frequency of admissions due to exacerbations but there is no epidemiological data from around our country to validate this idea. Because acute exacerbations of COPD is one of the commonest reason for hospital admissions worldwide [Mannino DM, 2009; Sullivan SD, 2000; Skrepnek GH, 2004], determining and understanding of seasonal patterns is particularly important for selecting appropriate treatment, prognostication, and resource allocation by health care agencies. This study was therefore conducted to measure the seasonal distribution and frequency of hospitalizations due to acute exacerbations of COPD at tertiary care hospitals JPMC, AKUH and LNH in Karachi, Pakistan and to depict the seasonal differences in patient’s characteristics and outcomes.

2. Materials and methods

A Retrospective, hospital based study was conducted to assess the seasonal patterns in hospital admissions due to acute exacerbation of COPD in Jinnah Post Medical Centre (JPMC), Liaquat National Hospital (LNH), and Agha Khan University Hospital (AKUH), Karachi for a two year period from January 1, 2010 to December 31, 2011. Data was collected from hospital Records Department, through patient’s discharge file of those who had a primary diagnosis for COPD.

All those patients were included in the study that had a primary admission diagnosis of COPD irrespective of the gender, race, or residence. All the patients who were not been treated in JPMC, AKUH, and LNH were excluded from the study. Admissions were restricted to those who made to the ward and the intensive care units. Emergency department and out patient visits were excluded from the study.

The official records of patients were used to fill a structured Performa. This Performa was divided into four parts. The first part included socio demographic variables such as age and sex. The variable of age was further divided into three age groups (0 to 18 years, 18 to 40 years, 40 to 65 years and above 65 years). The second part included month of admission, month of discharge and year of admission. The third part was related with mode of disposition of patient. The variable of disposition was further divided into four different sub groups (died, discharge, LAMA or shifted). The fourth part included the comorbidities associated with chronic obstructive pulmonary disease patients. Climate data was obtained from Pakistan Meteorological Department and analyzed. As for seasonal variations in
hospital admissions, the winter season was defined as Mid of December-February; the summer season was defined as Mid of April-June and October, the spring season was defined as March-Mid April, the monsoon season as July-September and the autumn season as November-Mid December according to the weather and climatic data previously obtained. Provided the patients were on the optimal treatment, any pronounced increase in hospitalizations during different season of the year in relation with age and gender of patients were analyzed.

**Statistical analysis**

All the analyses were performed using SPSS program version 16.0. For the comparison of categorical variables, Chi-squared test was performed. A p-value of <0.005 was taken as significant for all the analysis done in this study. Descriptive statistics were performed as appropriate, including frequencies for variables mean ± standard deviation and cross tabulations.

**Ethics**

Before starting the study, proper permission was taken from all the Head of the Departments’ of all Chest Medicine Wards’ of the three hospitals’ from which data were retrieved for use in this study.

**3. Results and discussion**

There were total 1,227 patients analyzed during two year period (2010-2011). Over the two year study period, it was observed that after a trough in the months of September and October (summer), there was a sharp rise in admissions in early December (autumn) which peaked in the months of January and February (winter; Figure 1). There was an average of 34 admissions per month during the study period analyzed.

![Figure 1: shows the number of monthly hospitalizations for Chronic Obstructive Pulmonary Disease.](image)
When stratified by gender, the number of hospital admissions for males were (N=1014; 82.64%) and for females (N=213; 17.35%). This clearly illustrates that males were more commonly affected due to COPD exacerbations and had significantly higher hospital admissions every month throughout the study as compared to females (p=0.001) (Figure 2).

The sex ratio for COPD hospital admissions is about 476 male admissions for 100 female admissions. The distribution of age for COPD related hospital admissions are illustrated in Figure 3 which shows admissions for age group 0 to 18 years (N= 0); for age group 18 to 40 years(N=71; 5.78%); for age group 40 to 65 years (N=391; 31.86%); and for age group of above 65 years (N=765; 62.34%). This clearly shows patients of age group above 65 years of age were more frequently affected due to COPD exacerbations in each month during the study period (p=0.001) followed by age-group of 40 to 65 years, with the age group of 18 to 40 years and 0 to 18 years, contributing the least (Figure 3). The mean age for COPD related hospital admission was found to be 65 years with the standard deviation of 1.93.

Figure 2: Shows the COPD hospitalizations by month and gender.

Figure 3: Shows the COPD hospitalizations by month and age group.
The overall mortality rate observed during two year period is shown in Figure 4. There were 161 expired cases (13.1% of all hospitalized patients). The number of expired cases predominantly increases in the age group of above 65 years with higher predilection towards the male gender.

Figure 4: Shows the mortality by gender and age-groups.

Three hundred and sixteen patients (25.75%) had one or more associated disease(s). The 8 most frequent diseases as an associated condition among chronic obstructive pulmonary disease patients are shown in (Table 1). By far, cardiac diseases (congestive heart failure, cor pulmonale and ischemic heart diseases etc) (17.4%), hypertension (16.77%) and arthritis (18.0%) were the most commonly associated diseases. Diabetes mellitus (14.2%) and gastrointestinal diseases (15.5%) accounted for a good proportion as an associated condition. Lung cancer, bacterial pneumonia and hyperlipidemia also accounted upto a lesser amount.

Table 1: Most frequent diseases (out of 316) as an associated condition among chronic obstructive pulmonary disease patients.

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Frequency (N)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>55</td>
<td>17.4</td>
</tr>
<tr>
<td>Hypertension</td>
<td>53</td>
<td>16.77</td>
</tr>
<tr>
<td>Bacterial Pneumonia</td>
<td>27</td>
<td>8.54</td>
</tr>
<tr>
<td>Lung Cancer</td>
<td>12</td>
<td>3.79</td>
</tr>
<tr>
<td>Arthritis</td>
<td>57</td>
<td>18.0</td>
</tr>
<tr>
<td>Diabetes</td>
<td>45</td>
<td>14.2</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>18</td>
<td>5.69</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>49</td>
<td>15.5</td>
</tr>
</tbody>
</table>

The mean daily temperatures and relative humidity in Pakistan Meteorological Department, during the months of the study are illustrated in (table 2).
COPD exacerbations: epidemiology and impact on patient's outcome

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Table 2: Shows the mean daily temperatures and relative humidity in Pakistan Meteorological Department, during the months of the study.

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Daily Temperature (°C)</th>
<th>Mean Relative Humidity At 0000 UTC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2011</td>
<td>2010</td>
</tr>
<tr>
<td>Jan</td>
<td>20.5</td>
<td>19.9</td>
</tr>
<tr>
<td>Feb</td>
<td>23.1</td>
<td>22.0</td>
</tr>
<tr>
<td>Mar</td>
<td>26.9</td>
<td>27.7</td>
</tr>
<tr>
<td>Apr</td>
<td>29.9</td>
<td>30.5</td>
</tr>
<tr>
<td>May</td>
<td>32.2</td>
<td>32.3</td>
</tr>
<tr>
<td>June</td>
<td>32.2</td>
<td>31.5</td>
</tr>
<tr>
<td>July</td>
<td>31.3</td>
<td>31.5</td>
</tr>
<tr>
<td>Aug</td>
<td>30.3</td>
<td>30.2</td>
</tr>
<tr>
<td>Sept</td>
<td>29.6</td>
<td>30.2</td>
</tr>
<tr>
<td>Oct</td>
<td>29.3</td>
<td>29.9</td>
</tr>
<tr>
<td>Nov</td>
<td>25.0</td>
<td>25.1</td>
</tr>
<tr>
<td>Dec</td>
<td>21.3</td>
<td>19.6</td>
</tr>
</tbody>
</table>

COPD patients are at risk of their symptoms becoming suddenly worse causing a clinical condition termed as exacerbation. Mild exacerbations may be treatable by the patients themselves or by their GP, but one-fifth are severe enough to result in admission to the hospital. Overtime, these admissions are increasing. These admissions are higher in the winter season when patients are at most risk for exacerbations. The winter peaks may be higher in some years than others but the timing of the peak is usually the same. COPD admissions fall back during the spring and summer season and then start to increase again during autumn.

We collected the meteorological data in order to define the winter and summer seasons along with other seasons. The study was performed at multiple hospitals with a large sample size. In a rundown, we identified significant seasonal differences in the frequency and outcomes of hospital admissions for AE-COPD. There was a marked rise in admission starting with a trough in November and ending with a peak in February of the following year. One of the largest published study [Chen L, 2000] examining seasonal patterns of hospital admissions for AE-COPD was carried out in the northwest region of the United States. The authors identified a seasonal pattern of admissions which was almost identical to the one identified in our study with a trough in November and a peak in February and March of the following year. In the studies from Asia (Hong Kong) [Yap FH, 2004], the authors studied the seasonal pattern of hospital admissions due to AE-COPD caused by viral influenza among patients aged over 65 years. They reported a peak in admissions in the first few months of the year followed by a gradual decline towards the end of the year. These observations and the findings from the present study suggest that seasonal influenza may be responsible for these findings.

In contrast to these studies from Asia and North America, studies performed in the United Kingdom [Hansell A, 2003] and Europe had consistently reported more admissions/longer length of hospital stay and mortality during the winter and autumn months. The period from November to March appears to be the most active, with a lull during the intervening months of April to October which is consistent with our study. A variety of factors may be responsible
for different patterns of COPD admissions in different geographic regions of the world. These are environmental factors which include ambient air pollution, second hand smoke and low temperature (winter season); viral infections among which Respiratory syncytial virus (RSV), Influenza, and Rhinovirus occur more frequently and bacterial infections for which three most common species implicated in COPD exacerbations are Haemophilus Influenzae, Moraxella Catarrhalis, and Streptococcus Pneumoniae. KO and colleagues [Ko FW, 2007] also reported a positive association between hospital admissions for acute exacerbations of COPD in Hong Kong and the air pollutants SO2, NO2, O3, PM10, and PM2.5, especially during the winter months.

Low temperatures are associated with exacerbations of COPD. The COPD exacerbations are more widespread in the winter months with lower temperatures and may be more severe, as small but significant falls in lung function in COPD patients occur with a reduction in outdoor temperature during winter [Donaldson GC, 1999]. The mechanisms behind these observations are not clearly understood but may relate to the general number of increase in the chest infections and increasing prevalence of respiratory viruses in low temperature winter months and/or increased susceptibility to upper respiratory tract virus infections in cold weather. COPD patients are particularly at risk from chest infections which in turn cause their symptoms to become worse. Also, these hospitalizations are specifically high in winters that have a high incidence of flu [Heath Factsheet; Seasonal Variation In COPD]. In children, respiratory syncytial virus (RSV) outbreaks cause a significant increase in hospital admissions during the winter season [Lyon JL, 1996] and increased RSV activity has been observed when temperatures are decreased [Meerhoff TJ, 2009]. In general, cold air in winter season may cause patients’ airways to become narrower, while air pollution, heat and humidity can cause breathing difficulties in the summer season thus precipitating an exacerbation.

The results obtained showed the greater rates of hospital admissions in the male sex as compared to the female sex which is consistent with international epidemiology of COPD [Stang P, 2000]. It is well recognized in cross sectional prevalence studies that the higher visit rates among males are due to that they are more frequently involved in smoking habits and occupational exposure as compared to females [Anto JM, 2001]. Moreover, it has been documented that the effect of smoking is more pronounced in males because males start smoking at an earlier age taking into account the higher rate of inhalation than females [Stang P, 2000]. However, overall hospital visits rates among females have been attributed to the increase in the incidence of smoking among females [Prescott E, 1998]. On the other hand, cooking with biomass fuel among females develop severe disease with many features of COPD due to smoking [Feenstra TL, 2001; Ramirez-Venegas A, 2005] and a slight average reduction in the lung function. Genetic causes like cystic fibrosis and alpha-1 antitrypsin deficiency and family history were not responsible for any of the COPD exacerbation cases according to patients’ record, therefore there is decreased frequency of COPD exacerbations in age group of less than 40 years of age.

Hospitalization due to acute exacerbation of COPD with respect to age group showed primarily higher number of visits in the age group of above 65 years which is in accordance with the international literature [Rivera RM, 2003]. This may be attributed to the increased vulnerability of their respiratory airway to environmental triggers which can be explained by their decreased immunological defense of the body. Also the increased duration of smoking and occupational exposure is highly responsible for acute exacerbations of COPD.
4. Limitations

Care was taken to bind the number of limitations in our study. Some of the limitations need to be described while interpreting the findings which are as follows: we relied on the physician diagnosis of emphysema and chronic bronchitis because high resolution computed tomography and spirometry were not available in all our patients. This may have resulted in some inaccuracies in patient selection. Also, retrospective study design was used, significant differences in admission decision making may have existed among individual physicians.

5. Conclusion

The study contributes to our understanding of seasonal variation of COPD related hospital admissions occurring in Karachi, Pakistan. As the exacerbations of COPD are preventable health conditions with predictable seasonal patterns indicated in the study, health service programs for awareness should be initiated for the prevention of the disease based on seasonal and specific population demands.

6. References


24. Heath Factsheet; Seasonal Variation In COPD; Health forecasting at the Met Office; http://www.metoffice.gov.uk/health


