AIR POLLUTANTS AND CHRONIC OBSTRUCTIVE PULMONARY DISEASE EMERGENCY DEPARTMENT VISITS OUTCOMES IN SHELBY COUNTY, TENNESSEE

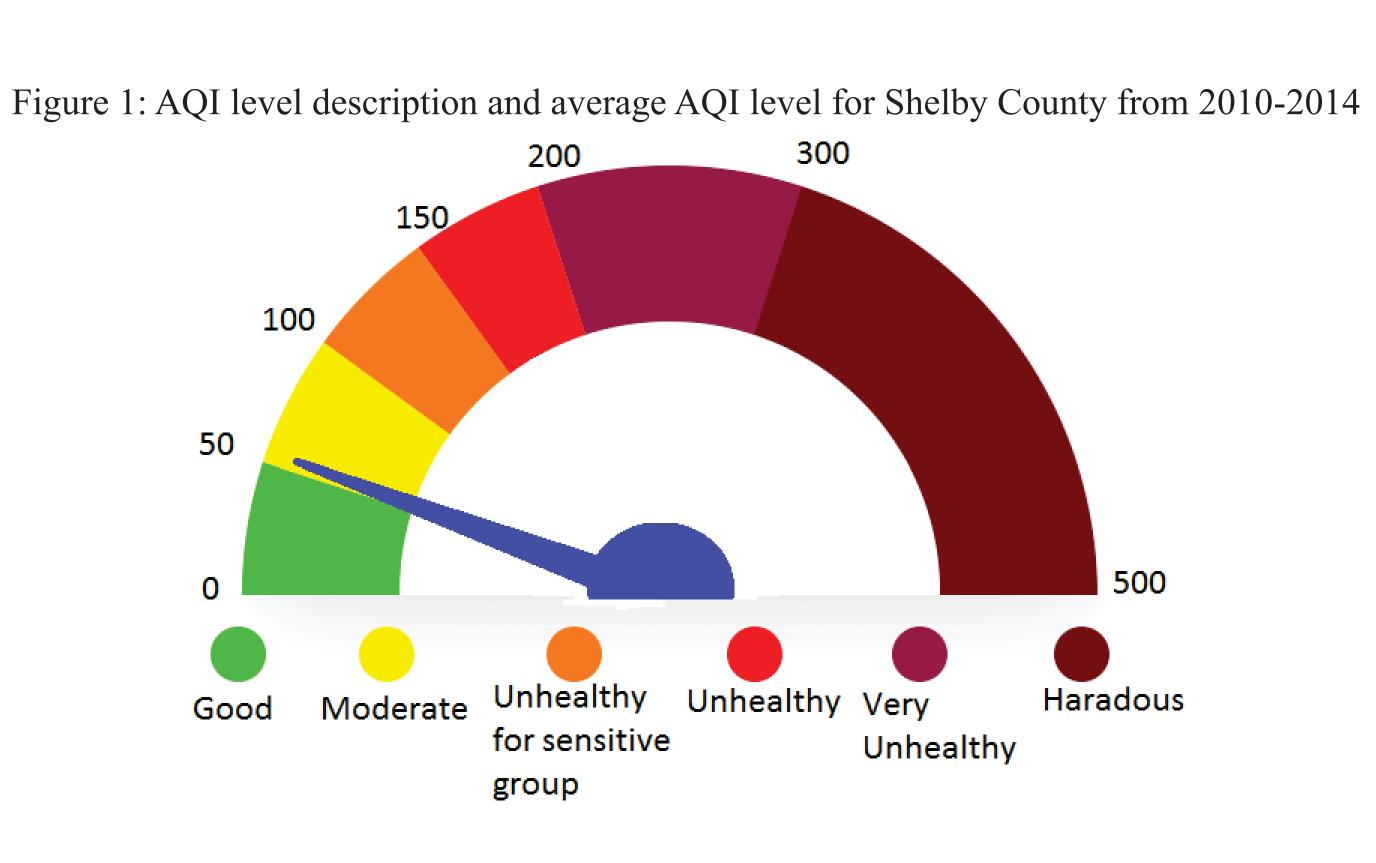


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BACKGROUND

Chronic Obstructive Pulmonary Diseases (COPD) is one of the most common diseases that affect people's health. According to TN Behavior Risk Factor Surveillance System (BRFSS), approximately 488,513 Tennesseans suffer from COPD. 8.4% of male and 10.6% female have COPD symptoms. Elders aged 65 and above have higher chances (16.2%) to experience COPD. Most COPD patients are from food, healthcare, retail trading, and transportation industries. The industry with highest COPD risk is mining (66%). During 2010-2014, there were 87,417 records of Emergency Department (ED) visits and 2,043 deaths due to COPD. In addition, a COPD patient was estimated to visit ED 1.75 times.

Air pollution is a key contribution to premature mortality. (1) Previous studies have identified air pollutants as main factors affecting respiratory diseases. (2)(3) During 2010-2014, the AQI level in Shelby County was considerably good. The average AQI of those five years was 54 with moderate concerns of Ozone (46.2) and PM2.5 levels (45.8). The AQI levels of 52.9% of the days during 2010-2014 were below 50 and were considered healthy. However, there were approximately 20 days each year with AQI levels above 100.

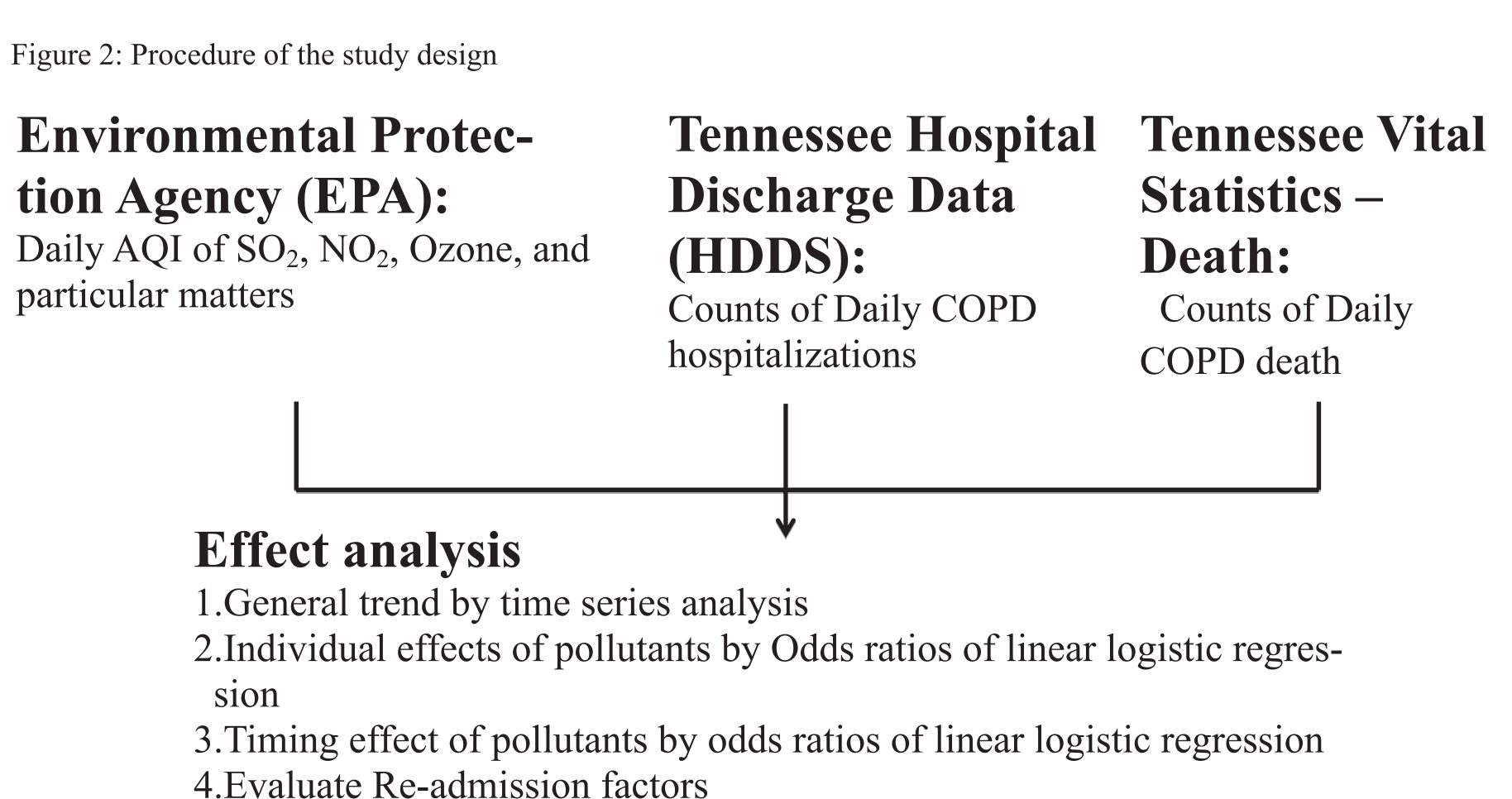


OBJECTIVES

- *Investigate the association between air pollutants and daily COPD ED visits and mortality rates.
- *Evaluate severity and timing effects of air pollution on COPD patients.
- *Estimate the effect of air pollutants on COPD patient of multiple ED admissions.

METHODS

- *Likelihood of daily COPD ED visits and mortality rates were estimated by logistic regressions based on AQI of NO₂, SO₂, CO, Ozone, and particle matters individually.
- *Timing effect were evaluated by moving average (MA) and odds ratios (OR).
- *The association between air pollution and respiratory ED re-visits were estimated by OR.

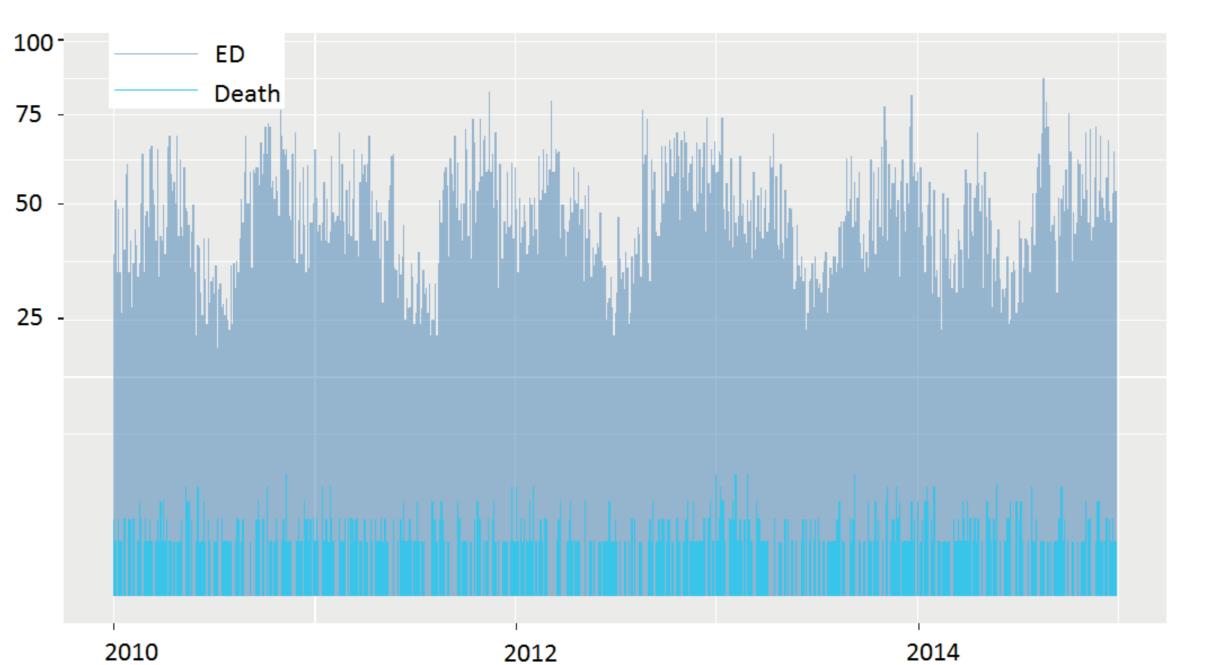


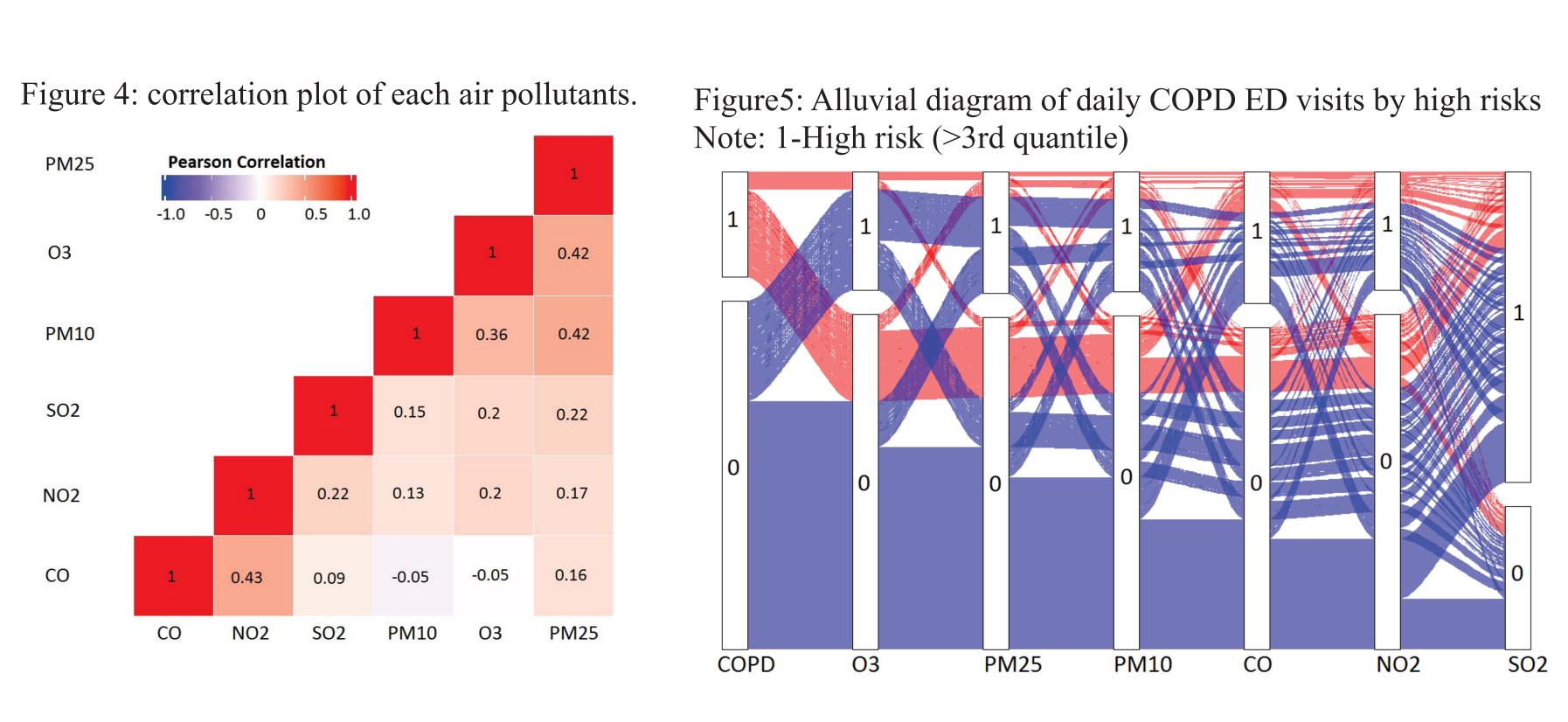
RESULTS

5.Generalized trend by IQR of a linear regression model

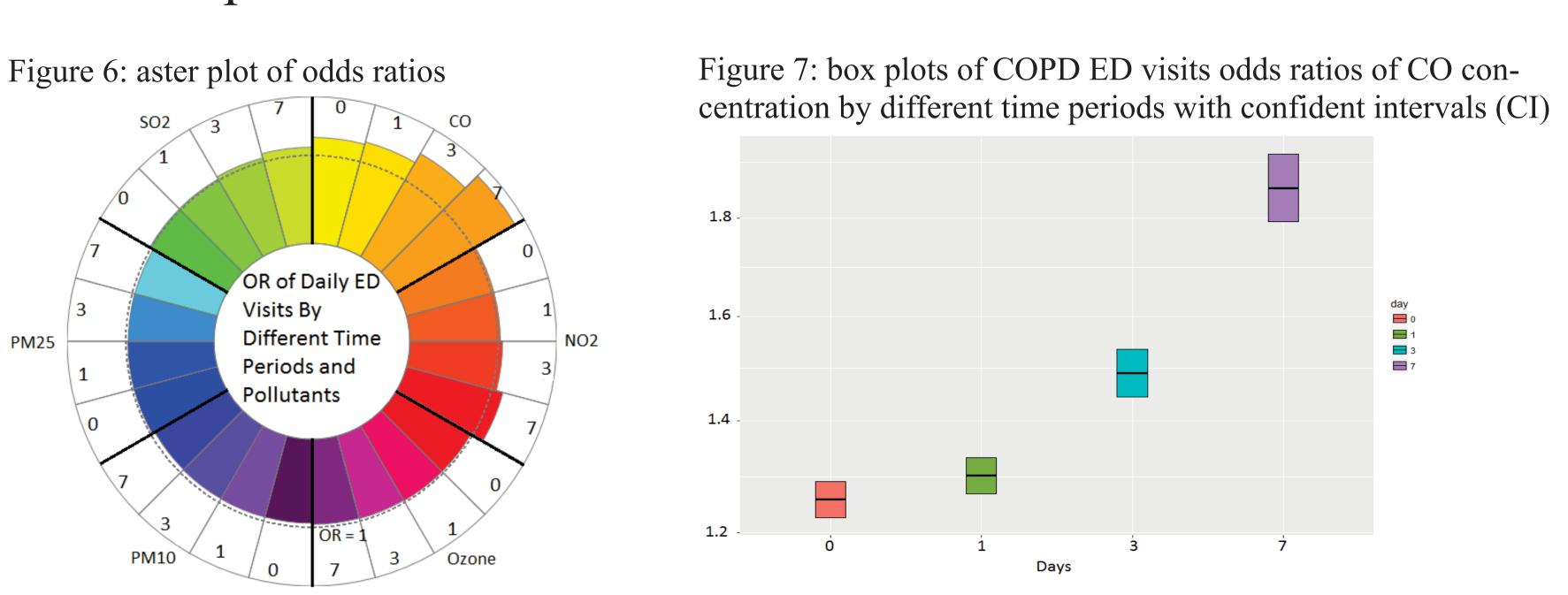
*Summary and Seasonality: On average, there were 47.9 ED visits and less than 2 deaths per day due to COPD. The general trend of daily COPD ED visits with deaths are shown in Figure 3. The daily COPD ED visits maintained stable and suggested a yearly seasonality.

Figure 3: time series plots of daily COPD ED visits and COPD deaths in Shelby County from 2010-2014





- *Independencies of AQIs: Figure 4 is a correlation plot of each air pollutants (evaluated in AQI values). Given low correlations between each other, pollutants can be regarded independent so that partial evaluations of each air pollutant on COPD visits were reasonable.
- *High risks events: In this study, a high risk event is defined as the number of counts above third quantile of all the events. For example, COPD ED visits over 57 and AQI level of PM2.5 over 56 were all defined as high risk events. Figure 5 showed the distribution flows of COPD ED visits divided into high risk levels by each air pollutant.



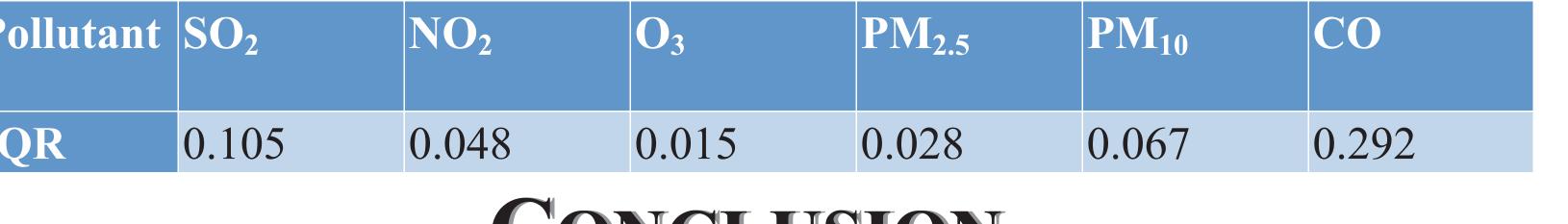
*High likelihoods of CO and NO₂ on COPD ED visits: The likelihoods of COPD ED visits when increasing AQI values of each air pollutant were estimated by logistic regressions individually. In general, CO and NO₂ affected daily COPD ED visits more than other pollutants. One value increase in AQI of CO (OR=1.020) and NO₂ (OR=1.003) were likely to result more COPD ED visits as suggested in Figure 6. If evaluated at AQI levels, such positive relations were more obvious. As the odds ratio of one level increase (from Good to Moderate, Moderate to unhealthy for the sensitive, and etc.) the OR of NO₂ is 1.340 (95%CI is 1.20-1.49) and 1.26 for CO (95% CI is 1.23,1.29).

*Lagging Effects: The timing effects of each air pollutants were estimated at 1-day lag, 3-day MA and 7-day MA. Figure 6 indicated that CO showed an increasing timing effect on COPD ED visits noticeably, which was further supported when estimated the OR at each time intervals by daily Max 8-hour CO Concentration shown in Figure 7.

*Re-admissions: Air pollution was associated to the numbers of patients who had COPD history within 2010 and 2014. Estimated by odds ratios of logistic regressions, Ozone (OR:1.001, 95% CI: 1.000,1.001) and PM10 (OR: 1.005, 95% CI: 1.004,1.006) were more likely to increase COPD re-admissions.

*Factor Contributions: Interpreted by IQR of a multi-variate regression, 1 percentile increase in CO raised the number of all the COPD patients by 29.2% when only listed air pollutants were considered. Details of IQR of other air pollutants were listed in Figure 8.

Figure 8: IQR table COPD ED visits



CONCLUSION

COPD ED visits can be used as an indicator evaluating COPD severity to public health. There are clear associations between air pollutants and COPD ED visits. CO and NO₂ affected ED visits more and showed a lagging effect. Ozone and particle matters presented positive association to COPD re-admission. Similar results were found in Davidson County, TN. The general public, especially COPD patients, should be aware of high risks of air pollution and avoid exposures to air pollutants. Further investigations and preventions should be initialized based on evidences in this study.

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