

## **Sugar Cane (*Saccharum officinarum* L) Burning and Asthma in Southeast Louisiana, USA**

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Asthma is a complex disease. It is multifactorial, and that in many but not all cases a genetic predisposition followed by an environmental exposure of some sort is a common component. Asthma is a diffuse, inflammatory chronic airway disease generally associated with hyperactivity to nonspecific bronchoconstrictors, in which eosinophils are prominent among inflammatory cells. The eosinophils and their specific products are responsible in part for bronchial hyperactivity and for airway epithelial damage (Koren 1995). In the United States and many other countries, the prevalence of asthma in both adults and children is rising. There is mounting evidence that air pollutants are involved in exacerbating asthma. Controlled laboratory exposure studies show that specific air pollutants stimulate bronchoconstriction or airway inflammation. Ambient air pollutants may cause nonspecific airway reactivity and inflammation, provoke acute bronchospasm, and enhance the response of allergic asthmatics to specific antigen challenge. Many studies have implicated particulate air pollution as contributing to the incidence and severity of respiratory disease (Pope et al. 1993; Schwartz et al. 1993). A national air quality standard has been set for particulate matter (PM<sub>10</sub>) with an aerodynamic diameter equal to or less than 10 µm. Recent epidemiologic studies have suggested that exposure to PM<sub>10</sub> is strongly associated with morbidity and mortality in the general population and that hospital admissions for bronchitis and asthma were associated with PM<sub>10</sub> levels (Koren 1995). An observation by Bates (1995) indicated that the secondary exposure to a wide range of environmental agents accounts for the prevalence of asthma. Associations between indices of health effects and air pollutants indicate that these are probably playing a role in worsening of asthma. Adverse effects related to sulfur dioxide and nitrous oxide exposures have been documented and fine particulate pollution (PM<sub>10</sub>) is also associated with worsening of asthma. The U.S. Clean Air Act of 1970 provides special consideration to criteria air pollutants including ozone, sulfur dioxide, particulate matter less than 10 µm (PM<sub>10</sub>), nitrous oxide, and lead. Ambient air quality standards for these pollutants are set by the U.S. Environmental protection Agency (EPA) (Koren and Utell 1997).

PM<sub>10</sub> has been shown to be related to increased emergency visits for asthma (Schwartz et al. 1993; Rennick and Jarman 1992), increased medication use (Pope et al. 1993), increased symptoms (Forsberg et al. 1993), and increased hospital admissions for asthma (Thurston et al. 1994). The explanation of the apparent increase in asthma morbidity remains a major challenge. A report by Barnes (1987) indicated that the asthma is probably the only common treatable condition whose prevalence and severity is increasing, and there is evidence from several countries that mortality has risen despite advances in therapy. The regional epidemiological studies will be needed to expand our understanding of this complex disease. Therefore, we decided to look at the prevalence of asthma in Southeast Louisiana.

The term "air pollution" may be applied to everything from black smoke to bad odors to haze, fog or dust. The burning of sugar cane residue after sugar cane harvest contributes significantly to the air pollution in the sugar cane growing areas of Southeast Louisiana. In Louisiana air pollution due to open air burning is estimated to be 21% of total air pollution from all sources (Parker 1970). In 1998, 804 producers in 23 parishes grew sugar cane on 427,930 acres. An estimated 393,700 acres of sugar cane was harvested, with a total production of 1,241,994 tons of sugar (Louisiana Department of Agriculture, 1998). Sugar production per harvested acre was 6,309 pounds.

Sugar production is one of the major industries in Louisiana. Every year during and after the harvest the residue, mainly leaf litter, is burned by open air burning by the sugar cane farmers. This is done for two reasons: 1) to remove fibrous content which would greatly reduce milling efficiency and decrease profits and 2) at 3-10 tons/acre this residue in the field is unmanageable to the farmer. The smoke from this open air burning contains respirable particles less than 10 microns in size (Givens 1996). This open air burning also introduces carbon monoxide and some nitrogen dioxide. A study conducted in California reported an increase in asthma hospitalizations after post harvest rice residue burning. This study reported that rice burning has a statistically significant effect on asthma hospitalization in Butte County, CA (Jacobs et al. 1997). A recent report by Tenenbaum (2000) indicated a possible connection between wheat field burning and asthma in Washington State. Previous research in California, Texas and Illinois demonstrated the role particulate air pollution plays in the exacerbation of asthma (Koren and Utell 1997; Samet et al. 2000). These studies suggested that respirable particulate pollution (PM<sub>10</sub>) is significantly associated with increased pulmonary morbidity and mortality. The current practice of open air burning of post harvest sugar cane (*Saccharum officinarum* L) residue not only affects the air quality, but increasingly the general public is objectionable to this practice.

Southeastern Louisiana is a unique geographic area in the heart of the Mississippi River delta surrounded by Louisiana's wet lands and the Gulf of Mexico. Sugar cane farming, fishing and oil industries are the major sources of income for the many of multicultural population of Southeast Louisiana. The practice of burning sugar cane residue after harvest has been occurring annually in the

southeastern part of Louisiana. Currently, burning is still seen as the most cost-effective method of clearing post-harvest residue from the fields in preparation for the succeeding planting season. A major problem with sugar cane burning is the emission of smoke and other pollutants into the atmosphere and their possible effects on ambient air quality and public health. To our knowledge, minimum health information regarding the effects of sugar cane burning has been compiled at present. Many citizen complaints and air pollution problems are reported to occur during the fall (October through December) sugar cane burning period, when pressure to burn acreage is at its peak and meteorological conditions are usually near their worst for smoke dispersion. The state legislature is currently allowing the open-air sugar cane burning by the farmers to continue because currently there is no established scientific evidence of the contributions of sugar cane burning to the air pollution in this area. This decision by the state legislature needs to be made using more information regarding the health effects related to the inhalation of emissions from sugar cane smoke.

We reviewed the possible effects of sugar cane burning on asthma hospitalizations in six parishes located in Congressional District 3 in Louisiana. These are rural parishes with the largest population (Table 1) of sugar cane growing parishes.

## **MATERIALS AND METHODS**

Our preliminary study is based on the observed number of hospital visitations of patients diagnosed with asthma during years 1998-1999. We chose the Leonard J. Chabert Medical Center (LJCMC) located in the city of Houma in Terrebonne Parish. The demographic statistics of the 6,498 patients are given in Table.2.

We used hospital visitations as an indicator of respiratory problems within the combined six parishes located in Congressional District 3. This ensured that a physician deemed each patient ill enough to require hospital visitation. Daily hospital visitation data were obtained for the years 1998-1999 from the Leonard J. Chabert Medical Center of Houma, LA. Time series analysis and a control chart for count with three standard deviation limits were used to analyze the available observations. We did not design the experiment to connect sugar cane burning and asthma hospitalization; we merely looked at the already existing data from the Leonard J. Chabert Medical Center. We reviewed the possible effects of sugar cane burning on asthma encounters in six parishes. These are rural parishes with relatively large population (Table 1) of sugar cane growing parishes in Louisiana. A major problem with sugar cane burning is the emission of smoke and other pollutants into the atmosphere and their possible effects on ambient air quality and public health.

## **RESULTS AND DISCUSSION**

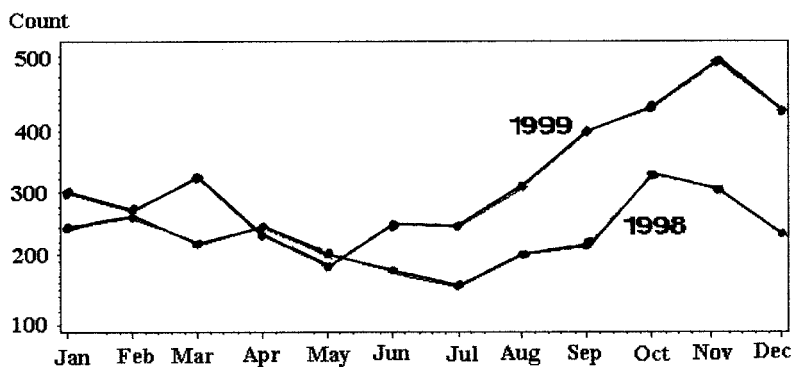
In 1998, the sugar cane was grown on 427,930 acres. An estimated 393,700 acres of sugar cane was harvested. In the study area representing Congressional

**Table 1.** Statistics concerning population and acres of sugar cane farming in Louisiana Congressional District 3.

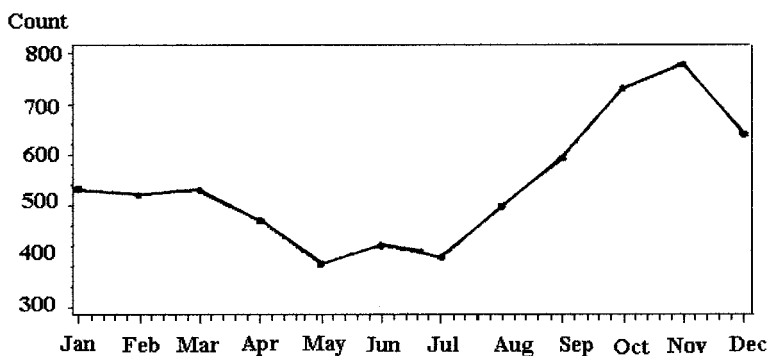
Location	Population		Sugar Cane Farming	
	Count	Percent of La	Acres	Percent of La
Louisiana	4,372,035	100	400,000	100
Congressional Dist3	329,497	7.5	106,900	26.7
Assumption Parish	23,066	0.5	34,900	8.7
Lafourche Parish	89,517	2.1	29,900	7.5
Terrebonne parish	104,910	2.4	9,900	2.5
St. James parish	21,175	0.5	23,800	6.0
St. Charles parish	48,478	1.1	2,200	0.6
St. John parish	42,351	1.0	6,200	1.6

**Table 2.** Demographics of the asthma patients visiting LJCMC during 1998-1999.

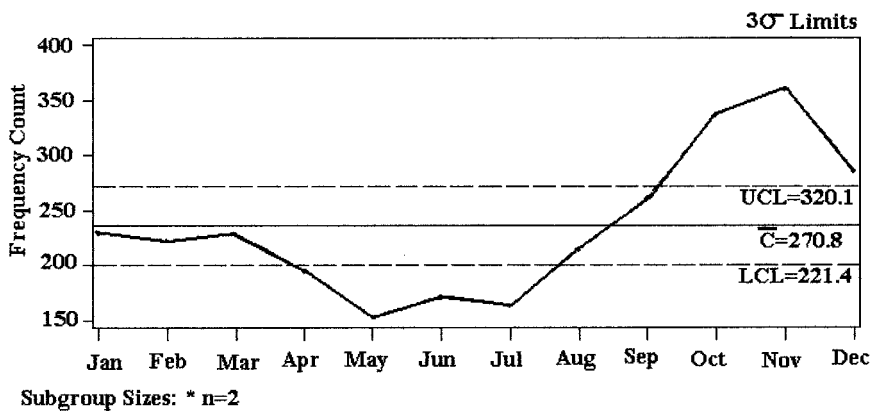
Age Class	Female	Male	Total
0 to 5	594 (36.2%)	1045 (63.8%)	1639 (25.2%)
6 to 10	302 (34.1%)	582 (65.8%)	884 (13.8%)
11 to 15	314 (44.6%)	390 (55.4%)	704 (10.8%)
16 to 19	293 (66.9%)	145 (33.1%)	438 (6.7%)
20 to 29	447 (82.5%)	95 (17.6%)	542 (8.3%)
30 to 39	468 (78.5%)	128 (21.5%)	596 (9.2%)
40 to 49	522 (71.3%)	210 (28.7%)	732 (11.3%)
50 to 59	529 (84.4%)	98 (15.6%)	627 (9.7%)
60 to 69	194 (72.1%)	75 (27.9%)	269 (4.1%)
70 and over	39 (58.2%)	28 (41.8%)	67 (1.0%)
TOTAL	3702 (57.0%)	2796 (43.0%)	6498 (100%)



**Figure 1.** Time series presentations for years 1998 and 1999.



**Figure 2.** Time series presentations for years 1998 and 1999 combined.



**Figure 3.** C-chart for years 1998 and 1999 combined.

District 3, sugar cane was grown on 87,000 acres (Louisiana Department of Agriculture, 1998). There was 100% burning of sugar cane residue after cultivation. The sugar cane-burning season is usually between October to December and sometimes the burning season starts in the middle of September and extends to January of the following year depending upon the yield of sugar cane.

During the 2-year period, there were 6,498 visitations to Leonard J. Chabert Medical Center with asthma as the primary diagnosis, with a mean of 270.8 admissions/month. Females constituted 56.97% of all visitations for asthma during this time. When frequencies were standardized by person-years, infants had the highest rate with 1,639 visitations, and children between 5 to 10 years of age had the second highest rate with 884 visitations (Table 2).

The peak months for visitations during the study period were October through December with approximately 33.06% of all admissions. Admissions slowed in the warmer summer months and then began to rise in the fall. Yearly admissions peaked in 1999. The outcome of interest, daily asthma admissions in the Leonard J. Chabert Medical Center was analyzed using a time series analysis (Figs. 1 & 2). Fig.1 illustrates the trend for the two years, 1998 and 1999. Fig. 2 shows the trend for the two years combined. The trend clearly shows an increase in asthma hospitalization during the sugar cane-burning season, October through December. Fig. 3 shows the average risks (middle line) and three standard deviation confidence limits for monthly average asthma encounters. This figure illustrates that the risk of asthma hospitalization increased in a dose-response fashion with increasing sugar cane burning from October to December months. The monthly average asthma visitations were not significant during non-sugar cane burning months. These observations indicate the hospital visitations of patients with asthma.

Figure 3 shows C-chart (Control chart for count) with three standard deviation limits which indicates that the hospital visitation by asthma patients during the months of October and November are significantly higher than the overall average of 270.8 per month.

We have presented a preliminary study by assessing existing data of asthma admissions in a local hospital. To our knowledge this is the first analysis that has looked at the association between asthma hospital visitations (outpatients and hospitalized) and sugar cane burning. The data clearly show an increase in asthma hospitalizations, which coincide with sugar cane harvest and sugar cane burning. Is this a coincidence? Or is there a connection between sugar cane burning and increase in asthma hospitalizations? These questions will only be answered after a detailed study, which should include weather, pollen counts, and air pollution data from non-sugar cane burning sources.

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