

Exercise 5: *Seasonality, Time Delay, and Disease (20 pts)*

Below are asthma cases per month for the years 1992-1994. The table also includes monthly data for average PM10 level (particulate pollution), average minimum daily temperature, average humidity level, and average wind speed. Using these data, please create a single graph that show the relationship over time among these variables relative to asthma cases. Remember that some of these variables may have to be lagged (+ or -) a month or two. Each factors should have a different line color/symbol. Also remember that you will be using several different scales, I suggest scaling the data so that the differences are not so great (e.g. divide cases by 4 or multiply wind speed by 4). Please answer the questions at the end of the exercise using the graph you produce.

Data Table

Mon/Year	Asthma Cases	Avg PM10	Avg Low Temp	Avg Humidity	Avg Wind Speed
Jan 92	547	46	18	82	8.0
Feb 92	518	52	27	77	8.0
Mar 92	546	30	31	85	7.8
Apr 92	463	32	40	73	7.9
May 92	427	32	47	77	8.6
Jun 92	426	29	53	86	7.9
Jul 92	359	30	57	84	7.5
Aug 92	377	31	54	84	7.2
Sep 92	516	38	49	68	8.0
Oct 92	500	41	37	73	8.0
Nov 92	433	30	22	87	7.8
Dec 92	444	60	12	90	6.7
Jan 93	446	61	15	87	7.2
Feb 93	594	46	18	87	6.9
Mar 93	657	32	30	79	9.3
Apr 93	589	22	35	81	8.9
May 93	529	25	45	84	8.6
Jun 93	471	28	52	76	9.3
Jul 93	389	30	57	80	9.3
Aug 93	588	26	57	81	8.1
Sep 93	711	24	46	83	8.0
Oct 93	599	27	36	83	7.1
Nov 93	578	39	22	83	7.3
Dec 93	720	41	21	78	8.3
Jan 94	652	29	20	76	8.2
Feb 94	524	40	19	82	7.7
Mar 94	603	30	31	73	8.3
Apr 94	483	28	36	78	8.8
May 94	489	26	49	77	9.4
Jun 94	432	30	57	71	7.7
Jul 94	370	31	58	75	7.8
Aug 94	446	30	60	76	7.9
Sep 94	513	28	51	68	7.5
Oct 94	554	23	39	84	7.7
Nov 94	537	34	25	86	8.1
Dec 94	463	37	22	74	7.1

Asthma Information

Compiled April 20, 1999

Centers for Disease Control and Prevention

Preface

Asthma, a chronic airway disorder that afflicts people of all ages and races, is a growing problem in America. Asthma causes considerable discomfort and stress in those affected and is sometimes fatal. Fortunately, with proper management many attacks can be avoided and the burden of asthma significantly reduced.

People with asthma are highly sensitive to their environment. Children with asthma are particularly vulnerable to harmful environmental factors. Fortunately, interventions exist that can prevent and control asthma symptoms. The interventions include, but are not limited to, improving indoor and outdoor environments in which children with asthma live.

Asthma is a chronic disorder of the airways that causes recurrent and distressing episodes of wheezing, breathlessness, chest tightness, and nighttime or early morning coughing. Asthma can be difficult to diagnose and differentiate from other respiratory illnesses.

Pathology of Asthma

Airways are the passages that carry air to the lungs. As the airways progress through the lungs, they become smaller and smaller, like branches of a tree. It is currently thought that asthma produces its effects by leading to airway inflammation and airflow limitation. This inflammation may even be present when a person's asthma is asymptomatic (that is, when the person is not experiencing any symptoms).

When asthma is under control the airways are clear, and air flows easily in and out. When asthma is not under control, the sides of the airways in the lungs become inflamed and swollen. During an attack, muscles around the airways constrict and less air passes in and out of the lungs. The attack is also called an episode or exacerbation and can include coughing, chest tightness, wheezing, and difficulty breathing.

It can be difficult to diagnose asthma in infants, young children, the elderly, smokers, workers exposed to chemical inhalants, people with seasonal asthma, and people with recurrent acute respiratory infections. Regular physical exams that include measurements of lung function and evaluations of a patient's allergic status can help ensure a proper diagnosis.

Epidemiology

Epidemiology is the study of the distribution and determinants of diseases and injuries in human populations. Epidemiologists describe who has a disease in a population and can help identify its causes. Once the cause is understood, interventions can be developed to prevent, manage, and control the disease. The actual cause of asthma is not known, but we do know that asthma attacks can be triggered by exposure to substances called allergens. Allergens are substances to which a person becomes allergic. By avoiding these substances, a person with asthma may avoid having an attack. Some people may be predisposed to acquire asthma, but if they never come into contact with their specific allergic triggers, they may never experience symptoms of the disease.

Asthma Prevalence

The prevalence of asthma is measured as a proportion; that is, existing cases of asthma divided by the total population at a point in time. In 1982, roughly 4% of people younger than 18 years old had asthma. By 1994, this rate had increased to almost 7%, or approximately five million people under the age of 18. Furthermore, from 1982 through 1994, the overall annual age-adjusted prevalence rate of asthma for people younger than 18 years old increased by 72%. Asthma is the most prevalent chronic disease among children, and is the number one reason for school absences.

Race and Prevalence

Blacks report a higher rate of asthma than other Americans. The asthma prevalence rate for black Americans in 1992 was just under 6%, representing almost two million people with asthma. Although blacks report a higher prevalence of asthma, there are actually many more whites who have asthma. The prevalence rate among white was about 5%, which translates to approximately 12 million people. The difference in prevalence among races may be related to differences in such things as socioeconomic status, living conditions, diet, and allergen exposures.

Morbidity

One way we have of quantifying the morbidity or impact on quality of life of a particular illness, is by determining the rate of hospitalizations due to that illness. Rates were consistently higher for children than adults and for blacks than whites. Asthma unnecessarily reduces the quality of life for many people. For example, hospitalizations for asthma cause people to miss school, work, and other activities. With proper disease management, people with asthma can lead healthy, active lives.

Asthma Mortality

In 1995, more than 5000 Americans died from asthma. With proper asthma management, many of these deaths might have been prevented. It is clear that asthma mortality rates have risen markedly over that period of time. Researchers have not yet determined the cause of the increase.

Although there is relatively little difference in asthma prevalence between blacks and whites, there is considerable difference in deaths from asthma by race. From 1979 to 1995, mortality rates have increased in blacks from 7.2 to 16.7 per million population, a 132% increase. During that same period, rates have increased in whites from 1.4 to 3.9, an increase of 179%. Over the entire time period, there have been roughly a five-fold difference in mortality rates between these two populations.

Risk Factors

Risk factors are characteristics of individuals that increase the probability that they will experience a specific disease or condition associated with a disease. Risk factors include genetic predisposition and environmental exposures that can either lead a person to develop asthma or lead a person with asthma to have an attack. Just because a person is at risk for an illness does not mean that he or she will develop the illness. Being aware of the illnesses for which they are at risk may help people take precautions to avoid acquiring those illnesses.

Genetic Characteristics

There are a number of major antibodies, that are found primarily in the blood stream, for example, IgA, IgE, IgG, and IgM. Their main function is to help the body fight off invading organism such as bacteria and viruses. The antibody most associated with asthma is IgE.

Atopy is a genetic factor characterized by the production of circulating IgE in response to common environmental allergens. High levels of IgE in the blood may predict the subsequent development of asthma. If a person has a parent with asthma, he or she is three to six times more likely to develop asthma than someone who does not have a parent with asthma.

Environmental Exposures That Can Lead to the Onset of Asthma

Numerous environmental exposures can lead to the actual onset of asthma. These risk factors, which sensitize the airway and induce asthma, include indoor and outdoor inhaled allergens. Some of the most common indoor allergens are household dust mites, cockroaches, dander from furred or feathered animals, fungi, and pollens. The fraction of asthma cases related to indoor allergens appears to have increased since people have begun to spend more time indoors where homes have been carpeted, heated, cooled, and

humidified. Other exposures that can lead to the development of asthma include aspirin and numerous exposures in occupational settings. Exposure to any of these factors increases the likelihood that a person will become sensitized to them.

Dust mite

Household dust mites produce one of the most common indoor allergens, and exposure to dust mites is a major risk factor for asthma worldwide. There are different types of household dust mites in different geographic areas, but all most commonly reside in carpets, pillows, mattresses, and soft furnishings.

Cockroaches

Cockroach allergy is common in many parts of the country. Extremely high levels of exposure to cockroach allergen in inner cities may help explain the increased rates of asthma hospitalization and death among some urban children.

Fungi

Molds and other fungi are other common indoor allergens. The optimal environment for indoor fungi to grow and cause fungi sensitivity is in dark, damp, and poorly ventilated places such as basements.

Pets and Pests

Furry animals are a common source of allergens. They shed fur and feathers; they leave saliva, urine, and feces. Cats and rodents are potent asthma sensitizers, whereas dogs cause less allergic sensitivity than other mammals. People can become sensitized to urinary proteins from rodents, be they pets or pests.

Pollen

Outdoor allergens include pollens and fungi, both of which are almost unavoidable. Pollens that cause asthma usually come from trees, grass, and weeds. Outdoor fungi are usually molds and yeast that tend to be seasonal. Depending on where you live, the most active fungi season may be during either the hot days of summer or the rainy nights of fall.

Other Environmental Exposures That Can cause an Asthma Attack

Other risk factors increase the likelihood that predisposed people may have an asthma attack. These include smoking and exposure to others' smoke, exposure to indoor and outdoor pollutants, and respiratory infections.

Pollution

Air pollution results from an accumulation of particles in the air and can become serious enough to cause injury or illness to plants and animals. Sources of outdoor pollution include industrial emissions, vehicle exhaust, tobacco smoke, pollen, and allergens from animals and insects. Ground-level ozone, or smog, is a major irritant.

Indoor air pollution includes vapors from household cleaners and from gas stoves that are not properly vented, mold and mildew, animal dander, and environmental tobacco smoke. Each of these pollutants can lead to an asthma attack. Indoor air pollution may have increased since the advent of energy-efficient homes and buildings, thereby increasing the potential for human exposure to allergens and irritants.

Questions:

1. Which (if any) variables did you decide had to be lagged? Why was it necessary to lag these variables? Defend your answer.
2. Which variables show the strongest association with asthma? Why?
3. Which variables did not show an association with asthma? Why?
4. What other variables could (should?) be included to make this data set more complete?