Observations on Tokyo-Yokohama Asthma and Air Pollution in Japan

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The authors visited Japan during February 1963 under the auspices of the Armed Forces Epidemiological Board, on invitation of the U.S. Air Force, to examine the asthma episodes reported among U.S. service personnel. This paper summarizes their observations.

S HORTLY after World War II, possibly as early as 1946, U.S. service personnel stationed in Yokohama, Japan, began suffering sudden attacks of wheezing, coughing, and dyspnea. The attacks occurred mainly at night, particularly in the early morning hours, and were most likely to occur in the fall and winter. Frequently, they occurred simultaneously in a number of people. Relief came promptly when patients left the Yokohama area, and the attacks recurred only if they returned.

These were the earliest observations on a disease that has come to be known as Tokyo-Yokohama asthma.

The first etiological hypothesis was that the illness was bronchial asthma caused by some locally produced allergen. Results of extensive skin testing conducted with extracts made of

Dr. Beard is professor of preventive medicine at the Stanford University School of Medicine and director of the Commission on Environmental Hygiene, Armed Forces Epidemiological Board. Dr. Horton, an epidemiologist, is chief and Dr. McCaldin, a sanitary engineer, is deputy chief of the Field Studies Branch, Division of Air Pollution, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. local pollens and molds indicated that the illness was not of an allergic nature. Since this work was thorough, further investigations along this line appear unnecessary. In addition to the tests, treatment of the cases and detailed medical histories of the patients indicated the illness was not classical bronchial asthma. The patients responded poorly to bronchodilators. Few of the patients had personal or family histories of allergy, and they usually were free of the emotional instability that commonly accompanies asthma. Nearly all of the patients were moderate to heavy cigarette smokers. Acute bronchitis seemed to be unduly frequent in American children in the area, but it did not develop into the illness found in adults (1, 2).

These observations were accompanied by a gradual realization that there were geographic and temporal relations between the occurrences of the attacks and atmospheric pollution. The Yokohama-Kawasaki area, south of Tokyo, then was the only major center of industrial redevelopment in the area, and air pollution from industrial sources was considerable and increasing. The pollution was particularly noticeable in the fall and winter months, with dense concentrations occurring especially in the evening and night. The acute attacks coincided with the periods of concentrated air pollution. One report concluded "there appears to be a correlation between the incidence of this environmental respiratory disease entity, the concentration of air contaminants, and smog formations" (3).

This observation led to the hypothesis that the disease was caused by one or more air pollutants. The hypothesis was reinforced when the disease spread to Tokyo and Zama about the time industrialization increased in those cities. It was also reinforced during the winter of 1962-63 when a decrease in the number of attacks coincided with minimal air pollution. There were few low-level inversions after one that occurred early in December 1962. It was frequently commented on that the winter was the coldest, driest, and windiest in Japan for many years.

A striking correlation between periods of increased illness and unusual air stability accompanied by increased air pollution was found in a detailed study of weather data for the Kanto Plain, which includes Tokyo, Yokohama, and other industrial cities. The number of asthma attacks was determined by the number of hospital admissions, night visits to dispensaries, and personal evaluations at various military installations (4).

A separate weather analysis prepared for the 1961-62 season indicated a bad meteorological and air pollution condition on November 16, 1961, and at that time the Naval Hospital at Yokosuka received many asthma patients.

Recent Studies

The most important recent addition to clinical and epidemiologic knowledge about Tokyo-Yokohama asthma has been specific evidence of pulmonary damage in the patients, as shown by increased pulmonary airway resistance, deficient oxygen uptake, and excess residual lung volume. All increase progressively with prolonged exposure of susceptible individuals (5, 6).

This condition is not subject to rapid change. The acute attacks of wheezing and coughing are superimposed on the pulmonary changes as exacerbations; they may increase or decrease rapidly, thereby accounting for the seasonal and shorter-term changes in patients' conditions.

The patients have limited exercise tolerance, the limit being very severe sometimes. The disability exists even when the more conspicuous symptoms of cough and wheeze are absent; this is true in the summer in Japan and also when the patients are removed from the polluted area. Their pulmonary function remains impaired for months, and improves at a very modest pace when exposure to the pollutants is reduced or discontinued.

In a followup study of evacuated patients, Dr. H. W. Phelps found that improvement was slow, and many of the patients were still abnormal after a year (personal communication).

Other current studies confirm the importance of smoking to the disease, the lack of significant response to bronchodilators, and the relationship with air pollution. Observations indicate that sputum is rarely produced or is present only in minute quantities. In this respect, the disease differs markedly from the usual chronic bronchitis (particularly as described by the British), in which there is copious production of sputum, usually purulent.

Physicians at the Zama Army Hospital put Tokyo-Yokohama asthma patients in a filteredair room, accommodating seven persons, as part of their treatment. Patients do not have to leave the room during their treatment period. An electrostatic air cleaner and two activated charcoal filters circulate and clean the air in the room. The Navy has a similar room in its hospital on the Yokusuka Naval Base. This reduction in exposure to air pollution appears to improve the patient's condition considerably.

Observations show that the interval between arrival in the area and onset of the disease consists of a latent period of 4 to 18 months. Individuals who have suffered from the disease and have left the area for months or years and then returned developed symptoms again almost immediately. This is thought to indicate a sensitization to a specific agent, but might be subject to other interpretations.

The Army is conducting a program to obtain data on the incidence of the disease. Physicians are examining all arrivals 18 years old and older, and questioning them about pulmonary disease. They are equipped to do spirometry, to obtain measurements of residual volume, and to measure blood pH, blood gases, and the effect of controlled exercise. The program will give a baseline measurement that will indicate later changes in the pulmonary condition of



Industrial air pollution in Kawasaki, Japan

personnel, if any occur. It will also provide information on the number of persons who have abnormal pulmonary conditions when they enter the area.

Epidemiology

Little epidemiologic information on Tokyo-Yokohama asthma has been gathered because of the constant rotation of the military personnel.

Age distribution, other than the adult-child contrast mentioned, has not been studied in detail. Sex distribution is also not clearly known, but the disease has been found in wives and women service personnel.

Quantitative information on occurrence is conspicuously absent. Data on the disease are buried in broader diagnostic categories in the statistics that are regularly collected. Some observers believe that many patients with mild or moderate illness ignore or conceal it for a variety of personal reasons and that the foundation may thereby be laid for severe disability later. Others, no less informed, believe that the problem is taken too seriously. A survey indicates a prevalence of between 4 and 5 percent among 186 men at a station about 40 kilometers inland (7).

The geographic spread of the disease and other changes that occurred during the spreading are of considerable interest. The disease was first observed in Yokohama and was apparently limited to that area. In fact, patients were originally sent to Tokyo, Zama, and other stations on the Kanto Plain to recuperate. Since then, the disease has appeared in all U.S. installations on the Kanto Plain. Concurrent with the spread of the disease, industrialization increased rapidly and extended far over the plain. The sources of air pollution, therefore, multiplied and spread in a pattern roughly coinciding with the occurrence of the disease.

There is little information on the presence or absence of the illness in the native population. Japanese physicians who were asked about the illness had seen a similar one, but they had no information on its frequency or distribution among their patients. A few cases have been observed in Japanese wives of servicemen.

Two American physicians who became familiar with the disease during their military service feel certain that they see cases of the disease in their practices in Kobe and Osaka. The clinical and epidemiologic patterns of asthma described in both cities are essentially similar to those of the disease found in the Kanto Plain. However, pulmonary function studies have not yet been done on these patients.

Medical officers who have been stationed in Korea state that the disease has not occurred there. Reports in military files describe an apparently identical illness in Naha and Machinata on Okinawa from 1956 to 1959, but no new cases have been reported there in recent years.

The original observations of an illness of this type in an area of modest size such as Yokohama might well fit an hypothesis that the cause was a substance emitted from a single industrial source. Subsequent knowledge of changes in the geographic distribution of the disease over the years would indicate the greater likelihood of multiple sources of a more general nature.

Air Pollution in Japan

There seems to be general agreement that air pollution from industrialization, power production, and motor vehicles is increasing in Japan. The change has been particularly intense during the last 5 or 6 years. Many urban areas are now highly polluted, and recently there has been much interest in air pollution problems in Japan (8, 9).

In the Toyko area it was possible to observe a marked haze and decrease in visibility late on most afternoons and in the evening. We learned that, because of this, helicopter pilots do not fly in the area after 4 p.m.

The Kanto Plain. The Kanto Plain is a large bowl, about 90 by 130 kilometers, nearly surrounded by high mountains. It is only open to the southeast, where it is bounded by Tokyo Bay. Meteorological conditions are rather unfavorable for the removal of air pollution, particularly in winter.

The area is densely populated and contains a tremendous number of industries of many varieties and sizes. Very large plants are concentrated along the waterfront at Kawasaki immediately south of Tokyo. Manufacturing now extends far from the coast, however. The inland factories are somewhat farther apart, extending across the plain into the foothills.

Osaka and Kobe. The Osaka area somewhat resembles the Kanto Plain in shape. The area is much smaller than that around Tokyo and apparently has even less adequate natural ventilation. It has become heavily industrialized, principally during the last decade. Here, too, there were many and varied sources of pollution. The traffic is somewhat less dense than in Tokyo. Osaka, unlike Tokyo, did not have a favorable winter in 1962–63. It is said that Osaka has very little seasonal variation in pollution because of lack of ventilation, even in summer. Kobe is more favorably situated at the edge of the manufacturing area on a narrow strip between a mountain and a bay.

Measurement of air pollution. For at least the past 9 years, air pollution has been measured at a number of locations in Japan, including the Kanto Plain area. These have included principally measurements of dustfall, sulfation as determined by the lead peroxide method, and to some extent soiling as determined by optical density measures on filter samples.

In 1960–61 dustfall was measured at 296 locations in 28 cities, and sulfation was measured at 288 locations in 25 cities. The highest dustfall value was reported in the industrial city of Wakamatsu, and the highest sulfation value was reported in Kawasaki (8).

In recent years more complex instrumentation has been added and the number of measuring sites increased. The Ministry of Health reports an increasing use of high-volume air samplers for the measurement of airborne particulates. In 1962 these samplers were used at 50 locations (9).

There is now a network of about 70 measuring stations variously equipped in the Tokyo-Yokohama area. These include eight stations making automatic measurements of sulfur dioxide. Many data on the character of air pollution in the area have been accumulated and reported (10-16).

Air pollution research. The Japanese medical profession has shown considerable interest in air pollution effects on the health of people. A number of studies have been carried out in various communities. Most of this material is available only in Japanese. Published studies





have not included much data on chronic respiratory illness, but studies now underway in the Kanto Plain area will include information on chronic respiratory symptoms.

A few studies of effects of air pollution on plants, animals, and materials are being conducted in Japan. Research on methods of measurement of pollution and on meteorological aspects of air pollution is being carried out by government institutes and universities (17, 18).

Information Needed

The important questions to the medical commanders of the three services are those of criteria for evacuation of persons who are suffering from the illness and detection of cases before they become serious. They would also like some means of detecting susceptible individuals to prevent their entering the area. Unfortunately, this is not possible at present.

Despite the work that has been done on this disease, many conspicuous gaps remain in our knowledge of it. The following is by no means a complete list:

1. There is a conspicuous lack of data on the frequency of occurrence of the disease, and therefore the magnitude of the problem cannot be determined. Detailed distribution studies cannot be made without this information.

2. More knowledge of the pathology is needed.

3. Information on the disease in the native population is meager.

4. Very little has been done to relate existing aerometric data to the illness or to make aerometric measurements needed to determine a specific substance or substances that might be producing the illness (except for the search for allergens, such as pollens).

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June 15-19, 1964: American Nurses Association (biennial meeting), Atlantic City, N.J.

June 29–July 3, 1964: National Association of Sanitarians, Philadelphia, Pa.

June 29-July 1, 1964: University of Michigan Conference on Aging. Dr. Wilma Donahue, Chairman, Division of Gerontology, 1510 Rackham Building, Ann Arbor, Mich.

July 8-16, 1964: International Congress of Entomology, London, England.

July 13-18, 1964: World Congress on Prevention of Occupational Accidents and Diseases, London, England.

July 17-21, 1964: Colombian Federation of Odontology, Cali, Colombia, South America.

July 20-23, 1964: American Diabetes Association and International Diabetes Federation, Toronto, Canada.

July 25-29, 1964: American Municipal Congress, Miami Beach, Fla.

August 7-14, 1964: International Congress on the Scientific Study of Mental Retardation, Copenhagen, Denmark.

August 16-20, 1964: American Veterinary Medical Association, Chicago, Ill.

August 19-21, 1964: International Association of Milk and Food Sanitarians, Portland, Oreg.

August 23–28, 1964 (date changed): American Society of Parasitology and American Institute of Biological Sciences, Boulder, Colo.

August 24–27, 1964: American Hospital Association, Chicago, Ill.

August 24-28, 1964: International Conference on Water Pollution Research, Tokyo, Japan. Water Pollution Control Federation, 4435 Wisconsin Ave., Washington, D.C., 20016, or Bernard B. Berger, Public Health Service, HEW South Bldg., Washington, D.C., 20201.

August 24-29, 1964: International Congress of Psychotherapy, London, England. Sixth International Congress of Psychotherapy, 11 Whitehall Court, London, S.W.1, England.

September 27-October 1, 1964: Water Pollution Control Federation, Bal Harbour, Fla.

September 21-26, 1964: International Congress of **Parasitology**, Rome, Italy.

October 4-9, 1964: American Society of Sanitary Engineering, Philadelphia, Pa.

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Conference Calendar

October 4-9, 1964: American Documentation Institute, Sheraton Hotel, Philadelphia, Pa.

October 5-9, 1964: American Public Health Association, New York, N.Y.

October 6-8, 1964: The Cornea: A World Congress, Washington, D.C. Fee \$125, U.S.A. and Canada; \$100, other countries. Executive Secretary, International Eye Bank, Washington Hospital Center, Washington, D.C.

October 7-10, 1964: National Association for Retarded Children, Oklahoma City, Okla.

October 11-16, 1964: Pan American Congress of Ophthalmology, Montreal, Canada. Reservations: Queen Elizabeth Hotel. Any further free paper requests to Dr. John V. V. Nichols, P.O. Box 217, Sta. B., Montreal 2, Canada, and one copy to Dr. J. W. McLean, Cornell Medical Center, New York, N.Y.

October 15-22, 1964: Conference on Research in Medical Education (in conjunction with meetings of Association of American Medical Colleges), Denver, Colo. Association of American Medical Colleges, 2530 Ridge Ave., Evanston, Ill. 60201.

October 19-21, 1964: Association of Military Surgeons of the United States, Washington, D.C.

October 20-22, 1964: American Nursing Homes Association, Miami Beach, Fla.

October 21-25, 1964: International Congress on Cybernetics, Namur, Belgium.

October 26-29, 1964: National Safety Council, Chicago, Ill.

October 26-30, 1964: American Cancer Society, New York, N.Y.

November 7, 1964: American Association of Public Health Dentists, San Francisco, Calif.

November 8–11, 1964: National Rehabilitation Association, Philadelphia, Pa.

November 9, 1964: Conference of State and Territorial Health Officers, Washington, D.C.

November 9-12, 1964: American Dental Association, San Francisco, Calif.

November 10-12, 1964: Conference of State and Territorial Hospital and Medical Facilities Survey and Construction Authorities, Washington, D.C.

December 26-30, 1964: American Association for the Advancement of Science, Montreal, Canada.

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