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Kawasaki disease linked to wind currents

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Kawasaki Disease (KD) is a severe childhood disease that many parents, even some doctors, mistake for an inconsequential viral infection. In fact, if not diagnosed or treated in time, it can lead to irreversible heart damage. After 50 years of research, including genetic studies, scientists have been unable to pinpoint the cause of the disease.

Now, surprising findings of an international team of scientists organized by Jane C. Burns, MD, professor and chief, Division of Allergy, Immunology, and Rheumatology at the University of California, San Diego School of Medicine's Department of Pediatrics and Rady Children's Hospital-San Diego, suggest that KD cases are linked to large-scale wind currents that track from Asia to Japan and also traverse the North Pacific.

"Our findings suggest an environmental trigger for Kawasaki disease that could be wind-borne," Burns said.

Signs of KD include prolonged fever associated with rash, red eyes, mouth, lips and tongue, and swollen hands and feet with peeling skin. The disease causes damage to the coronary arteries in a quarter of untreated children and may lead to serious heart problems in early adulthood. There is no diagnostic test for Kawasaki disease, and current treatment fails to prevent coronary artery damage in at least one in 10 to 20 children and death in one in 1,000 children.

While seasonality of the disease has been noted in many regions – particularly in Japan, the country of highest incidence for KD – the

search for factors that might contribute to epidemics and fluctuations in KD occurrence has been elusive. A study of KD cases in Japan since 1970 showed three dramatic nationwide epidemics, each lasting several months and peaking in April 1979 (6,700 cases), May 1982 (16,100 cases) and March 1986 (14,700 cases). These three peaks represent the largest KD epidemic events ever recorded in the world.

To investigate a possible influence from large-scale environmental factors, researchers including Daniel R. Cayan, Climate Atmospheric Science and Physical Oceanography (CASPO) at Scripps Institution of Oceanography in La Jolla, and Xavier Rodo and Joan Ballester, of the Institut Català de Ciències del Clima and the Institució Catalana de Recerca (IC3) in Barcelona, Spain, investigated a set of atmospheric and oceanographic measures, which revealed a link to pressure patterns and associated wind flow from the surface to mid-tropospheric atmospheric levels during the summer months prior to onset of the epidemics.

"The Japanese dataset revealed that a low number of KD cases were reported prior to the epidemics, a period coinciding with southerly winds which blew across Japan from the Pacific Ocean during the summer months," said Rodo, the study's first author. "However, the numbers rapidly mounted all over Japan when winds turned and blew in a southwesterly direction. After the peaks, the winds again shifted, blowing from the south when the number of cases again decreased."

"Importantly, subsequent to the three epidemics, years with increased numbers of Kawasaki disease cases in Japan were significantly associated with enhanced local northwesterly winds, as a result of low pressure centered to the north," said Cayan.

To assess whether such variations in wind patterns were associated with KD case fluctuations on the other side of the North Pacific, similar analyses were conducted for San Diego. According to the scientists, the

atmospheric connection from continental Asia to Japan and San Diego is intermittent and can take different routes. However, it was possible from their analysis to identify the major anomalous yearly peaks of KD cases occurring in San Diego from 1994 to 2008 as belonging to two main atmospheric configurations.

In fact, the major fluctuations in KD case numbers in Japan, Hawaii and San Diego were linked to a seasonal shift in winds that exposed Japan to air masses from Central Asia. One key pattern simultaneously exposed Hawaii and California to air masses from the western North Pacific.

"The linkage to the wind currents, which can cross the Pacific in less than one week, may explain why KD case numbers recorded in Japan, San Diego and Hawaii show a nearly synchronized seasonal peak in disease activity from November through March," Rodo said.

Burns reports that the findings could be significant in efforts to isolate the cause of this devastating childhood disease. "It could be that an infectious agent is transported across the ocean by strong air currents developing in the upper troposphere," she said, adding that while this would seem the most plausible explanation for the findings, the role of pollutants or other inert particles must be considered.

These hypotheses are currently being investigated. A research aircraft carrying an engineer from the Catalonian team used a custom-built air sampling apparatus to collect tropospheric air samples from over Japan in March 2011, and the entire biome of the tropospheric dust collection is being sequenced in the laboratory of W.Ian Lipkin, MD, at Columbia University in New York City. Lipkin is one of the leading "molecular detectives" who uses sequencing to find new infectious agents. On the other side of the U.S., teams of pediatric doctors from hospitals from California to Alaska and Hawaii have initiated real-time reporting of KD cases to Scripps Institution of Oceanography via the Web. There, Cayan

and his team are analyzing cases in relation to regional climate and tropospheric wind patterns.

While links between human respiratory disease and large-scale dust transport are well-documented, to date there has been no evidence of long-range wind transport of an infectious agent causing human disease.

Provided by University of California - San Diego