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New Orleans Area Environmental Quality Test Results

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Endotoxin

Health Effects of Endotoxin

Endotoxin is a biological toxin that is part of the outer membrane of some types of bacteria (gram negative bacteria). Endotoxin causes a powerful inflammatory reaction in humans, especially at high doses, when it causes fever, flu-like symptoms, cough, headache and respiratory distress. Endotoxin in the indoor air is suspected of playing a significant role in "sick building syndrome." The types of bacteria that contain endotoxin can be found indoors in low numbers all of the time. They are increased in situations where there is significant water damage or dampness. Stagnant water and sewage can contain very high levels of endotoxin and can be a source of high exposure.

Bacterial endotoxin exposure at levels found in some workplaces is linked to increased risk of upper respiratory infections, airway inflammation, asthma attacks, chronic bronchitis and hypersensitivity pneumonitis. Infants living in homes with moderately elevated levels of endotoxin in the house dust face an increased risk of developing wheezing. However, other studies have suggested that some exposure to endotoxin may decrease risk of childhood asthma. In contrast to many allergens that are associated with asthma (such as pollen), workers exposed to endotoxin have been reported to develop chronic decreases in lung function that are ultimately not reversible, resulting in chronic obstructive pulmonary disease (COPD). Short-term exposure to endotoxin in the air at levels above 45 endotoxin units per cubic meter (EU/m³) has been linked with decreases in lung function over the course of a single day. One study suggests that longer-term exposures to endotoxin levels as low as 10-28 EU/m³ may be linked with chronic decreases in lung function.

Laboratories with experience working on endotoxin report that in indoor air, levels over 1 EU/m³ are very unusual unless there is a significant water problem leading to growth of gram-negative bacteria. In outdoor air, a California study reported average levels of 0.4 EU/m³ with the peak level reported at 5.4 EU/m³. The authors of the California study concluded that even these levels might plausibly be associated with some increased risk of asthma or respiratory problems.

There are no regulatory standards for endotoxin although some thresholds have been proposed. The Dutch Expert Committee on Occupational Standards of the National Health Council proposed a health-based recommended limit value for workers of 50 EU/m³ over an eight-hour exposure period. In contrast, the American Conference of Governmental Industrial Hygienists (ACGIH) has proposed that any endotoxin level be compared with

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simultaneous background levels. The ACGIH recommends that exposures more than ten times background levels be considered a concern if there are complaints of respiratory symptoms, and that exposures of 100 times background be avoided at all times.

How We Sampled for Endotoxin

We collected air samples for endotoxin analysis in 12 outdoor locations spread across the New Orleans area, including in Uptown/Carrollton, Mid-City, the French Quarter, Lakeview, Gentilly, the Lower Ninth Ward, New Orleans East, Chalmette and Metairie. Nine of these locations had been significantly flooded, while the other three represented areas that were less directly affected by the floodwaters. We also sampled in two indoor locations (in Broadmoor and Lakeview). Both of the indoor locations had been flooded, and one had been partially remediated (drywall had been partially removed and the remaining walls had been scrubbed with bleach).

We collected samples for endotoxin analysis on Teflon filters at a flow rate of 10 liters per minute for 6 hours during daytime hours. Samples were analyzed at the University of California, Berkeley School of Public Health by Charles Perrino, using the Kinetic Limulus Assay, as developed by Dr. Donald Milton of the University of Massachusetts Lowell and the Harvard School of Public Health. Filters were extracted in Triethylamine Phosphate and reacted with the reagent Limulus Amebocyte Lysate. Absorption was measured over time and was compared with a standard dilution of US Pharmacopoeia reference endotoxin. Quality assurance included analysis of reagent blanks and standard solutions with each plate of samples being analyzed; and analysis of laboratory blanks, all of which were less than detectable.

Results of Endotoxin Sampling

The endotoxin levels in the New Orleans communities we sampled ranged from 0.6 endotoxin units per cubic meter (EU/m³) in Read Boulevard East to 8.3 EU/m³ in Little Woods (both of these neighborhoods are in New Orleans East). The average endotoxin level was 4.2 EU/m³. These levels are higher than reported average background levels across the country, which are generally below 1 EU/m³, but are lower than the 10-28 EU/m³ levels that may be linked to long-term changes in lung function. We did not find notable differences between flooded and non-flooded areas or between indoor and outdoor locations, although we had only a limited number of samples so we cannot be sure that there are no areas where the endotoxin levels are high. The average outdoor endotoxin level in flooded areas was 3.9 EU/m³ (nine samples), while the average in non-flooded areas was 4.2 EU/m³ (three samples). Indoors, the average endotoxin level was 5.9 EU/m³ (two samples).

These results are somewhat reassuring in that they do not demonstrate a major health risk from endotoxin exposure at this time. However, we sampled after a spell of dry weather. It is possible that after additional rains, the bacterial growth could increase again and levels could rise. In addition, we were not able to collect very many air samples, so there may be areas that do have high endotoxin levels, especially inside flooded buildings. Alternatively, we do not have pre-flood data for comparison and the observed levels were in the range of the highest outdoor levels reported from California. We note that the endotoxin levels in some neighborhoods were more than 10 times the level in other areas. Following the ACGIH guidelines, this may indicate that potentially hazardous exposures exist in some areas. Indoor levels during renovations could be much higher and are a serious concern. (For complete endotoxin testing results by neighborhood, click [here](#).)

Recommendations

We recommend that people returning to areas of the city where there is water damage should wear respiratory protection -- specifically, an N95 respirator. Respiratory protection is especially important for people doing renovation work.

[Endotoxin Results by Neighborhood](#)

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