Update-Exposure to dust events and hospitalizations in West Texas cities: The human health consequences of dust

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West Texas, including the High Plains and Chihuahuan Desert, is one of the dustiest regions in the United States, with dusty weather observed on average 29 days per year in Lubbock and 22 days per year in El Paso in recent decades.[1] Although soil dust, being a "natural" substance, may have originally been thought to be relatively benign in comparison to anthropogenic air pollutants, in the last few decades, multiple studies have clearly shown that human exposure to windblown dust is associated with adverse health effects, particularly respiratory disease and cardiovascular disease.[2] Two recent studies in West Texas cities, El Paso and Lubbock, have revealed a statistically significant increase in hospital admissions for wide ranges of additional conditions in the days following dust events.

Herrera-Molina et al. investigated whether dust exposure in El Paso and Lubbock was associated with significant increases in hospitalizations on the day of the exposure and up to seven days afterward.[3,4] Both studies analyzed hospital data from 2010 to 2014, which included a period of extreme drought and dust. In both cities, neurodegenerative diseases (Parkinson's, Alzheimer's, Huntington's, and dementia), respiratory diseases, and coronary atherosclerosis had statistically significant increases in hospitalizations at various periods after dust events, with significant increases in Associated Diseases (the aggregation of hospital admissions for all causes each associated with at least 5% of hospitalizations) after dust days as well.

The highest risk ratios overall in Lubbock were for hospitalizations for neurodegenerative diseases on the day of a dust event, defined in part by the occurrence of high concentrations of fine particulate matter ($PM_{2.5}$). Studies in several other cities have found an association between $PM_{2.5}$ air pollution and neurodegenerative conditions. Cristaldi et al. wrote, "exposure to $PM_{2.5}$ promotes neuroinflammation processes because, through breathing, the particles can reach the nasal epithelial mucosa and transferred (sic) to the brain through the olfactory bulb. Furthermore, exposure to $PM_{2.5}$ has been associated with an increased expression of markers of neurodegenerative diseases (e.g., alpha-synuclein or beta-amyloid), which can contribute to the etiopathogenesis of neurodegenerative diseases."[5] Fine particulate matter has also recently been identified as a risk factor for dementia[6] since it may affect cognitive function by neuroinflammation due to systemic inflammation or oxidative stress. However, previous studies of $PM_{2.5}$'s association with neurodegenerative disease were conducted in cities in which the particulate matter was not comprised primarily of soil dust: the finding that it is associated with dust exposures in dust-dominated cities such as Lubbock broadens concern. We echo Cristaldi et al.'s observation that "the potential cellular and molecular mechanisms of $PM_{2.5}$ leading to neurodegenerative disease remain not entirely clear, and further studies need to be carried out on the topic."[5]

In addition to respiratory disease, atherosclerosis, neurodegenerative, and associated diseases associated with dust at both cities, in El Paso there were significant increases in hospitalizations for Valley fever, genitourinary diseases (acute kidney failure, urinary tract infection, excessive or frequent menstruation, pyelonephritis), injuries and poisonings, chemotherapy, circulatory system conditions (ICD-9 group 7), birth complications, and septicemia observed at various time points shortly after the occurrence of dusty weather. Analysis of hospitalizations in Lubbock showed additional statistically significant increases in asthma, acute respiratory diseases, mental disorders (bipolar, schizophrenia, unspecified episodic mood disorders, and unspecified psychosis),

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cerebrovascular diseases, strokes, neoplasms, diseases of the blood (ICD-9 group 4), and musculoskeletal and connective tissue diseases in the days immediately following dust events. The differences in the conditions found associated with dust in Lubbock and El Paso could be attributed to differences in the physical and chemical nature of the dust particles, with particles in El Paso being derived from the Chihuahuan Desert and the large urban area contiguous with Ciudad Juarez, Mexico. In contrast, Lubbock's dust originates predominantly from the surrounding Llano Estacado plains and the associated agricultural industry. Other dusty cities may have different weather patterns, soil chemistries, soil biota, agricultural cropping systems, and different local industries releasing particulate matter. These differences will result in different dust compositions, resulting in different human health effects from dust exposure through different pathophysiological pathways of exposure to different particulate mixtures of materials.

El Paso data on PM_{10} (airborne particles [10 μm and smaller] which best represent dust) were available and used for the study, but only $PM_{2.5}$ (airborne particles [2.5 μm and smaller] which represent the finest dust) data were available in Lubbock. Therefore, we used a different method to select dust event days in each city. Due to differences in the weather and air quality measurement data available in the two cities, the definitions of dust exposure used for the Lubbock and El Paso studies differed. The lack of standardized protocols to identify and quantify dust exposure could result in inconsistent documentation of dusty weather conditions[7] and different conclusions regarding dust's health effects in other locations,[8] which can be due to the difference in soil and aerosol composition. Climate change is increasing dust levels in the Plains[9] and is projected to greatly increase the public health consequences of dust in the Southwest.[10] Given the increasing evidence of the human health consequences of dust and the potentially looming increase in dust-associated diseases, more consistent monitoring of dust levels should be implemented across the western USA, not just in the major cities where detailed measurements are now available.

Our research team is currently investigating the health effects of dust in other West Texas cities, including Amarillo and Midland, and evaluating the potential health effects of thunderstorms, which have been shown to impact other cities in the USA and across the globe. We are also determining the incidence of coccidioidomycosis (Valley fever), caused by the soil-dwelling fungus *Coccidioides* and potentially associated with dust and wind in West Texas. We actively welcome collaborations with other researchers and students.

Keywords: Hospitalization, dust, particulate matter, Texas, Lubbock, El Paso, environmental health

Note: Studies by Herrera-Molina et al.[3,4] were performed according to the guidelines of the Declaration of Helsinki and human subjects research approval from the Institutional Review Board at the University of Texas at El Paso, permit 00001224.

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