Chemical Composition of Airborne PM10 Particles from the Salton Sea Playa: Development and Severity of Asthma in Children under 14 in Imperial County

Maggie Colangelo
Mary Boyes

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Background

The Salton Sea, located in the Imperial and Coachella valleys, was created in 1905 by an accidental breach of Colorado river irrigation canals, leading to the flooding of the Salton desert basin (Pearce, 2003). Originally a fresh body of water, the salinity of the sea gradually increased due to evaporation and agricultural runoff, prompting mass eutrophication, fish die-off and a significant decline in bird population.

Due to the loss of popularity of the Salton Sea as a tourist destination and the importance of water as a resource in desert climates, water flow to the Salton Sea has steadily decreased, culminating in a 2018 water agreement that will reduce input to the sea by 40% (Parajuli & Zender, 2018). The area of exposed lakebed, or playa, has increased as the water recedes (below), leaving heavily polluted Salton Sea sediment at risk for aeolian erosion.

Air Pollution in the Salton Sea Area

The fine particulate matter of Salton Sea playa is a notable source of PM10, which Frie et al. predict will become an increasingly significant proportion of ambient PM10 levels as more of the sea is exposed. As early as 1998, English et al. claimed in their article, “Childhood Asthma along the United States/Mexican Border,” that high levels of PM10, which is defined as particulate matter that is 10 or fewer micrometers in diameter in Imperial County (below) is applied to distinguish the case and control groups. P values (right) and characteristics of the subgroups (bottom) are also shown (Meng et al., 2013).

Impact of PM10 Composition

Airborne pesticides in PM10 form, such as DDT, PCBs, and OCPs, have been associated with respiratory distress and the development of asthma. Repeated exposures to complex chemicals, particularly POPs, such as PCBs and DDT is a significant threat to human health and is particularly threatening to children due to their state of development and vulnerability (Meng et al. 2015). Gupta et al. supports this statement, adding that children are also strongly affected by air pollution due to a high rate of respiration. Persistent organic pollutants are particularly damaging to human health due to their high toxicity and potential for bioaccumulation, and can enter the lungs and bloodstream while in the form of airborne PM10. According to Meng et al., 25 varieties of POPs, including the PCB congener -8, -44, -170 and -99, as well as the organochloride pesticides DDE and HCH, were positively correlated with the development of childhood asthma, demonstrating a relationship between airborne pesticides and later development of childhood asthma. When analyzing the sera of childhood asthma cases against the control group, Meng et al. found that as the concentrations of these chemicals in sera increased, so did the levels of childhood asthma (below, top).

Concentrations of target compounds (left) in sera of case-control groups. Different chemical classes are grouped by horizontal lines within the figure, whereas a vertical line is applied to distinguish the case and control groups. P values (right) and characteristics of the subgroups (bottom) are also shown (Meng et al., 2013).

Ambient PM10 and Asthma

The health concern with the most potential impact and academic attention is the potential association between PM10 and the incidence of childhood asthma, due to the high mortality and rising morbidity of childhood asthma (Akihama, 2006) and the health complications childhood asthma causes in adults (Fletcher, 2010).

These dust-borne air pollutants will have a notable effect on children due to their immaturity and high respiration rate (Gupta et al., 2016). Both the particle size of PM10 (Clark et al., 2010) and presence of dust-borne persistent organic pollutants (POPs) (Meng et al., 2015), have been linked to the development of childhood asthma, suggesting that not only will children be notably more affected by the increasing level of ambient air pollution, but will also be more likely to develop childhood asthma, which according to Fletcher et al., is a condition with long-term effects on overall health.

Conclusion

The recession of the Salton Sea and the subsequent exposure of playa will increase the rates of development of asthma in children in the Salton Sea area and Imperial County. The airborne sediment will cause a strong negative change in respiratory health due to the fine particle mass (PM10) and high levels of persistent organic pollutants sourced from agricultural runoff, such as DDT and PCBs, among other elemental components such as copper.

References


