A Summary: China Air Quality Research

The influence of outdoor and indoor air pollution on acute respiratory response of school children in China – Dr. Marilyn Black, ULI with Collaborators from:

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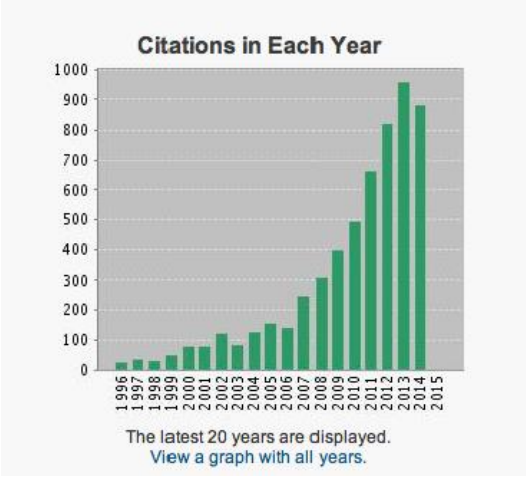
Introduction

China has a population of over 1.3 billion people with approximately 300 million school children under the age of 16, making up ⅕of the world's children. Concerns regarding the adverse health effects from air pollution are escalating with increased risk of mortality and morbidity in respiratory and cardiovascular diseases. Clean air is a basic requirement for life, but China's rapid economic growth, urbanization, and large population present a significant air pollution challenge. Children spend over 85% of their time in their homes and schools where the indoor air quality is influenced by both the outdoor air and household products and furnishings in the home. Because of their time indoors and their physiological differences from adults, children are more susceptible to adverse effects of indoor pollution. Recent studies also indicate that air pollution is connected childhood cognitive development. Decreased exposure to air pollution may be linked to improved childhood developmental scores and brain development. In China to date, there is limited data on indoor air exposure and children's health and sound scientific studies are needed.

The graph below indicates the exponential increase in scientific discussion on the concern of "China and Air Pollution."



Industrialized regions of China suffer from pollution levels that are well above documented health standards set by the World Health Organization (WHO). This is particularly true for both ambient fine particulate matter ($PM_{2.5}$) as well as ozone. Human exposure to both of these pollutants occurs not only outdoors, but also indoors since outdoor pollutants infiltrate indoor spaces. In addition to outdoor pollutants that find their way indoors, there are also indoor sources of particulate matter and VOC's that influence human health. Primary indoor sources of pollution include cooking related emissions, cleaning product use, and chemical emissions from building materials and furniture. The synergistic impact of indoor and outdoor pollution exposure on human health is relatively unknown. More importantly, the key components of air quality that impact human health may be dominated by outdoor pollutants, indoor pollutants, or some combination of both. Given the relatively large amount of time spent indoors, it is important to understand the sources and specific indoor air pollution components that influence human exposure, and adverse health outcomes. This information can lead to mitigative strategies for improved health outcomes. China is a unique location to study the impact of high concentrations of both indoor and outdoor pollutants on human health; particularly due to a population that is increasingly more affluent and moving to newly built indoor environments.

Approach

A research study will develop scientific data to understand the influence of indoor air pollutant exposure on the health of school age children in China. A key component of the proposed efforts will be to compare homes that have interventions (i.e. filtration of indoor air) to clean indoor air, to those that do not. The study will take place over an approximate one-year period near either Shanghai or Beijing, both locations that are characterized by extremely high ambient pollutant concentrations. Beijing and Shanghai also experience substantial shifts in ambient temperature throughout the seasons resulting in a range of indoor heating/cooling depending on the time of year, and therefore representing a broad range of indoor climate control. Both locations also experience high PM concentrations throughout the year, as well as elevated levels of ozone during the summer. Our study design will involve following ~30 school children with sampling indoors and outdoors. Half of the homes will have defined air cleaners and the others will not. At all locations, we will measure indoor and outdoor concentrations of particulate matter, ozone, and select VOC's including aldehydes. For particulate matter ($PM_{2.5}$) we will also measure specific chemical components associated with acute respiratory response in humans (i.e. metals, reactive oxygen species and trace organic compounds) as well as ultrafine particle concentrations. The measurements will allow us to assess the sources of PM both indoors and outdoors, as well as the contributions of outdoor pollutants to indoor concentrations. In addition, we will use personal exposure monitors to determine time-integrated exposures to a variety of indoor pollutants including formaldehyde and other VOC's. A key component of this study will be looking at non-invasive biomarkers in children's urine that are indicators of respiratory inflammatory response. Additional complimentary measurements will be made including exhaled NO (eNO), which is a marker for acute oxidative stress, and lung function.

Overall, the results of this study will yield information on the impacts of both PM and specific VOC exposures on the health of children. They will also determine the extent to which indoor

emissions, as well as outdoor pollutants that penetrate indoors can influence acute respiratory response in children. Another key result will determine the extent to which interventions (specifically air cleaning) aimed at reducing indoor pollutants actually influence acute health response in children.

Expected Outcomes

Knowledge outcomes of this work include the following. This information can enrich the dialogue and advance interventions for minimizing the health risk of air pollution on children's health.

1. Determine the relative importance of fine particulate matter (PM), particulate matter components, VOCs, and aldehydes on acute health responses in children.
2. Quantify the effectiveness of indoor air cleaning systems on particulate matter (PM) concentrations, PM composition, and VOC concentrations.
3. Estimate the relative contributions of outdoor pollutants to indoor pollutant concentrations for schools with and without air cleaning systems.
4. Quantify the indoor air cellular and a-cellular biological activity, and sources of particulate matter both with and without an air cleaning system.
5. Determine the effectiveness air cleaning on reducing acute effects of air pollution on children.