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**Session A16:** Air Pollution and Pediatric Asthma

**Abstract Presentation Time:** May 20, 10:15 a.m. PST

**Location:** San Diego Convention Center, Room 30 A-B (Upper Level)

**Ozone Exposure at Birth Increases Risk of Asthma Development**

ATS 2018, San Diego, CA – A long-term study of the health of Canadian children has found that exposure to ozone (O<sub>3</sub>), a common air pollutant, at birth was associated with an 82 percent increased risk of developing asthma by age three. The study, which was a 10-year follow-up to the 2006 Toronto Child Health Evaluation Questionnaire (T-CHEQ), was presented at the 2018 American Thoracic Society International Conference.

“Our findings show that the hazard ratios for ozone measured at birth as a single pollutant showed statistically significant higher risks for development of asthma, allergic rhinitis and eczema,” said lead author Teresa To, PhD, senior scientist, Child Health Evaluative Services at The Hospital for Sick Children (SickKids), Toronto, Ontario, Canada. “The results of our study are important because the study examines the effect of pollution on health outcomes in early childhood, and has the longest longitudinal follow-up of a cohort of school-aged children in Canada.”

A hazard ratio is a statistical formula used to determine risk.

For this part of the T-CHEQ study, 1,881 children were followed from birth to 17 years of age, on average. Amongst these children, 31 percent developed asthma, 42 percent had allergic rhinitis and 76 percent had eczema. An 82 percent higher risk of developing asthma was associated with each 10 parts per billion, or ppb increase in exposure to ozone at birth. A similar risk was not observed in association with exposure to nitrogen dioxide or PM<sub>2.5</sub>, a type of pollutant.

The researcher team took annual average concentrations of pollutants from fixed monitoring stations across Ontario. They assigned these measurements based on study participants’ postal codes at birth. Development of asthma, allergic rhinitis and eczema were determined based on any records of health

services used for these conditions. The researchers adjusted for variables such as parental history of asthma and early home exposure to pollutants.

Some studies have shown that ozone depletes antioxidant activity and increases indications of inflammation in the respiratory tract fluid lining and affects lung growth.

“We examined O<sub>3</sub> and NO<sub>2</sub>, as well as particulate matter PM<sub>2.5</sub> and ultrafine particulates (UFP - not discussed in this abstract), because these are the key pollutants that have been suggested in the literature to exacerbate asthma, diabetes, hypertension and chronic obstructive pulmonary disease (COPD),” said Dr. To, who is also a professor in the Graduate School of Public Health at the University of Toronto. “It is well supported by research findings that short-term and long-term exposure to NO<sub>2</sub> and particulate matter can increase asthma exacerbations, respiratory symptoms, hospitalizations and even mortality. Similarly, short-term exposure to O<sub>3</sub> can decrease lung function and increase the risk of respiratory infections in children.”

Children are at a higher risk because their lungs and other respiratory organs are smaller, and they spend more time in outdoor physical activities that make them breathe faster and more deeply. Poor air quality may have a larger impact on them.

“The quality of air in Ontario, Canada is relatively good on most days of the year, yet we observed an adverse effect on health outcomes in children who were exposed to air pollution at birth and in early life,” said Dr. To. “This has significant implications for other countries that have higher levels of pollution. It is well established that short-term exposure to pollutants such as ozone can decrease lung function, exacerbate asthma and increase the risk of respiratory infections. There is now mounting evidence that long-term exposure can lead to disease progression, such as from asthma to COPD and could increase the risk of death.”

The World Health Organization (WHO) 2016 report on air pollution and health indicated that 92 percent of the world’s population lives in places where air quality levels exceeded WHO limits. According to WHO, one in eight deaths in the world is a result of air pollution exposure, making air pollution the single largest global environmental health risk.

“Air pollution isn’t only one or a few countries’ problems, but rather a global public health concern,” Dr. To said. “While there are individual actions one can consider to reduce exposure to air pollutants, it also requires action by public authorities at the national, regional and international levels. Reducing air pollution could save millions of lives.”

**The study was funded by Health Canada and the SickKids Foundation.**

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**Abstract Number:** 10834

**Title:** Association of Air Pollution with Incidence of Asthma , Allergic Rhinitis and Eczema: 10-Year Follow-Up of the Toronto Child Health Evaluation Questionnaire (T-CHEQ) Study

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**Rationale:** There is growing evidence for a role of air pollution in the development of childhood asthma and other allergic diseases. In this follow-up study to the 2006 Toronto Child Health Evaluation Questionnaire (T-CHEQ) study, our objective was to examine the associations between ambient nitrogen dioxide (NO<sub>2</sub>) and ozone (O<sub>3</sub>) exposures at birth and incidence of asthma, allergic rhinitis and eczema in childhood through adolescence.

**Methods:** In the 2006 T-CHEQ study, 5,619 children aged 5-9 were recruited from randomly-selected public schools in Toronto, Ontario. T-CHEQ participants were included in this study if they were born in Ontario and gave consent to have their health card number used for data linkage. Baseline questionnaire data were linked to health administrative databases housed at the Institute for Clinical Evaluative Sciences. Yearly mean values of NO<sub>2</sub> and O<sub>3</sub> were acquired from air pollution fixed monitoring stations across Ontario and assigned to participants based on their postal codes at birth, using inverse distance weighting. The primary outcome was incidence of physician-diagnosed asthma, measured using a validated health administrative definition. Secondary outcomes included incidence of allergic rhinitis and eczema, measured by any health services use for these conditions. Participants were followed from birth until outcome, March 31, 2016, or loss-to-follow-up. Multivariable Cox proportional hazard regression models were used to estimate the associations between air pollutants and outcomes, while adjusting for important confounding variables, such as parental history of asthma and early-life home exposures.

**Results:** The cohort contained 1,881 children (48% boys) who were followed from birth for an average of 13 years. Almost one third (31%) of children developed asthma during the study period (Table 1). The average age at asthma incidence was 3 years. A 10-unit increase in exposure to O<sub>3</sub> at birth was associated with an 82% increased hazard of asthma (HR: 1.82; 95%CI: 1.05, 3.18), while exposure to NO<sub>2</sub> was not associated with asthma (HR: 1.02; 95%CI: 0.53, 1.98) (Table 1). Similarly, for both allergic rhinitis and eczema, a 10-unit increase in O<sub>3</sub> was associated with increased hazard of disease, while NO<sub>2</sub> was not associated.

**Conclusion:** In Ontario, ambient air exposure to O<sub>3</sub>, but not NO<sub>2</sub>, was associated with a significantly increased risk of incident asthma, allergic rhinitis and eczema. This suggests that improving air quality and increasing awareness about the risks of air pollution may have beneficial effects on the prevention of asthma and other allergic disease development in childhood and adolescence

**Table 1.** Results of unadjusted and adjusted Cox proportional hazard regression for the association between air pollutants (NO<sub>2</sub> and O<sub>3</sub>) and asthma, allergic rhinitis and eczema (N=1,881).

Outcome	N (%)	HR (95% CI)	P value	Adjusted HR (95% CI)	P value
Asthma	581 (30.9)	-	-	-	-
NO <sub>2</sub>	-	0.88 (0.49, 1.57)	0.67	1.02 (0.53, 1.98)	0.95
O <sub>3</sub>	-	<b>1.62 (1.02, 2.57)</b>	<b>0.042</b>	<b>1.82 (1.05, 3.18)</b>	<b>0.034</b>
Allergic Rhinitis	783 (41.6)				
NO <sub>2</sub>	-	0.78 (0.47, 1.28)	0.32	0.91 (0.52, 1.60)	0.74
O <sub>3</sub>	-	<b>1.64 (1.09, 2.45)</b>	<b>0.017</b>	<b>1.83 (1.13, 2.95)</b>	<b>0.013</b>
Eczema	1429 (76.0)	-	-	-	-
NO <sub>2</sub>	-	1.05 (0.72, 1.54)	0.81	1.32 (0.85, 2.06)	0.21
O <sub>3</sub>	-	<b>1.35 (1.01, 1.80)</b>	<b>0.044</b>	<b>1.50 (1.05, 2.14)</b>	<b>0.025</b>

**Abbreviations:** NO<sub>2</sub> – nitrogen dioxide; O<sub>3</sub> – ozone; HR – hazard ratio; CI – confidence interval

**Notes:** Hazard ratios are per 10 unit increase in exposure; multivariable models adjusted for: age, sex, parental education level, income adequacy, number of people in household, low birthweight, breastfeeding, enrollment in childcare, whether child was born within 3 weeks of due date, home exposures during first year of life (damp spots, use of gas to cook or heat, exposure to environmental tobacco smoke, pets, roaches and mould) and parental history of asthma and atopy; *P*<.05 considered statistically significant (indicated in bold).