**Traffic-Related Air Pollution and Asthma among Children in Toronto, Canada**

Research Proposal

Assignment 2

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**Introduction**

Asthma, a disease characterized by breathlessness and wheezing, is the most common chronic disease in children worldwide.1 Various studies have shown that the disease is associated with exposure to air pollution.2,3 In the Canadian context, this is an issue of importance because air pollution levels are rising and thus, the risks of childhood asthma in Canada are increasing as well. A number of studies conducted in regions including Vancouver, Edmonton, Windsor, Hamilton, and Québec have identified air pollutants associated with the disease.4-8 However, few studies have investigated this in Canada’s largest and most populated city, Toronto. As a result, public health action regarding air pollution and asthma in Toronto may be ineffective since it is unknown whether findings in other regions apply to the city.

For this reason, I propose a case-control study which will focus on the following research question: In children aged 6 to 12 years old living in Toronto, how do traffic-related air pollution exposures at home and at school differ among those who have asthma and those who do not?

The study will recruit children with and without physician-diagnosed asthma as determined by health records and caregiver reports. Interviews completed by caregivers and data from monitoring sites will be used to measure pollution exposures at home and school. Once conducted, the results from this study will inform and guide public health action for effective prevention and control of asthma among children in Toronto.

**Study Design Rationale**

As mentioned earlier, the proposed study will have a case-control design. While this design has its advantages, there are also disadvantages that arise from its retrospective nature. Firstly, using a case-control design may result in poor information because caregivers must rely on memory to recall information about their child’s exposure to air pollution. Caregivers may only remember certain details about their child’s exposure, which would produce poor information for analysis. Secondly, a case-control design would increase the study’s vulnerability to bias, including recall bias. For example, caregivers of children with asthma may have a greater likelihood of recalling their child’s air pollution exposures since monitoring air quality could prevent their child from asthma attacks. However, recalling this information may not be as easy for caregivers of children without asthma because they are less likely to monitor air quality since their child does not have asthma. Hence, this would bias the study results. Lastly, using a case-control design would not establish a temporal relationship between traffic-related air pollution and asthma among children. This is because asthma is established prior to establishing exposure to air pollution. Therefore, a temporal relationship between traffic-related air pollution and asthma cannot be inferred.

Despite these disadvantages, a case-control design was selected because it is advantageous in answering the research question. Precisely, it has the ability to provide information on multiple risk factors regarding traffic-related air pollution that are associated with asthma. Examples of risk factors include exposure to nitrogen dioxide or ozone. For each of these risk factors, researchers could determine how exposure differs in children with and without asthma and therefore, answer the research question. In addition, case-control studies are also advantageous because they require a shorter period of time and less money compared to cohort studies. This would allow improvements to be made to existing public health policies and programs in a timelier manner and at a lower cost.

**Study Participants**

The study population will consist of children aged 6 to 12 years old in Toronto. The decision to exclude children under the age of 6 was taken from a study held in Vancouver. The study justified that children under the age of 6 often experience wheezing due to rapid lung growth and are thus easily misdiagnosed for asthma.4 Including this age group would potentially bias the results. Therefore, this age group will be excluded from the study population.

Participants will be recruited from various clinics in Toronto. Before a child can be considered a potential participant, caregivers must provide written informed consent first. Once consent is obtained, caregivers will be asked to complete a telephone interview that will collect information about potential asthma symptoms the child may have experienced or asthma medications that the child has used. Participants will then be classified as cases or controls using this information and health care records. Eligible cases are defined to be clinically diagnosed with asthma by at least two physicians as indicated by health care records or discharged from a hospital with asthma diagnosis. This definition of a case is currently being used across Canada in public health institutions.5 Furthermore, children must have visited a health care facility within the past year as stated on health care records and must have reports of asthma symptoms or asthma medication use within the past year as stated by caregivers. For controls, the eligibility criteria include the absence of physician-diagnosed asthma and at least one visit to a health care facility within the last year as indicated by health care records. This definition was based off of a definition used in another case-control study.9

**Exposure Measurement**

Traffic-related air pollution exposures will be measured using two methods, namely through telephone interviews with caregivers and monitoring sites situated near the homes and schools of children. Traffic-related pollution is of interest since vehicle emissions are a large source of pollution in Toronto. For the first method, caregivers will be asked about their child’s exposure to traffic-related air pollution through a telephone interview. Some interview questions may include whether any members of the household smoke, whether there is a family history of respiratory diseases such as asthma, or whether the child lives near a busy road. These questions will help define a child’s exposure status as well as provide clues about potential confounders.

For the second method, estimates of specific air pollutants will be measured through monitoring sites from the Canadian National Air Pollution Surveillance network, as done by other studies in Canada.5-7 Monitoring sites of interest include those that are situated near the homes and schools of children since children tend to spend most of their time inhaling air from these locations.10 These sites will provide data on pollutants such as nitrogen dioxide, carbon monoxide, sulfur dioxide, ozone, and particulate matter, which were investigated for their association with childhood asthma in studies outside of Toronto.2-8

Then, participants will be classified based on exposure. Since all participants will be exposed to pollution to some degree, the unexposed group will be the group of participants with the lowest exposure to traffic-related air pollution. This group is defined to have little vehicle emission exposure near home and/ or school as stated by caregivers and low measurements of pollutants from monitoring site data. On the contrary, the exposed group is defined to have moderate to high exposure to vehicle emission near home and/ or school and moderate to high measurements of pollutants from monitoring site data. The exposed group can also be further classified into those with moderate exposure and high exposure to traffic-related air pollution.

**Bias & Confounding**

The following section will provide methods to reduce potential sources of bias and confounding.

Selection bias could occur if there are differences in characteristics between children who were given consent to participate versus those who were not. For instance, children with consent may come from higher socioeconomic backgrounds compared to those who were not. Caregivers of children with lower socioeconomic backgrounds may have restricted from giving consent because they simply do not have time to participate in interviews. To reduce this source of bias, a small cash incentive could be provided to those who participate in exchange for their time. This would encourage caregivers of low socioeconomic status to provide consent, thus creating a more representative population of study participants and reducing selection bias.

Measurement bias could occur if researchers ask questions in an inconsistent manner during interviews. Inconsistency in asking questions could cause caregivers to interpret questions differently which could distort the results. To reduce this, interviewers could be supervised during interviews to ensure quality assurance. Supervisors could provide a list of questions to interviewers that will be read to interviewees exactly as worded. Supervisors will ensure that the interview proceeds without too much deviation from the protocol. This method could reduce inconsistency in question asking between interviews and therefore reduce measurement bias.

One possible confounding variable in this study is whether a child lives with a family member who smokes or not. Studies show that children who live with family members who smoke have higher risks of wheezing and asthma compared to those who do not.11 Therefore, study participants who live with family members who smoke could show signs of asthma regardless of their exposure to traffic-related air pollution. To eliminate such confounding, study participants could be stratified based on whether they live with a family member who smokes or not. This would prevent the confounding variable from affecting study results.

**Conclusion**

Overall, the proposed case-control study will determine the differences in traffic-related air pollution among children aged 6 to 12 years old with and without asthma in Toronto in 2019. Study results will help to inform and guide public health action for effective prevention and control of asthma among children in Toronto.

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