

## Association between traffic-related environmental factors and allergy symptoms for children

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### Abstract

*Traffic-related environmental factors (TREF) are a major problem in developed countries, leading to increased atopic sensitivity, allergy symptoms, and diseases. This study shows an association between traffic-related pollutants, distance of road and gas station from the children's daycare center, and allergy symptoms. Data was obtained from the 2018 survey, an ongoing allergic diseases prevalence survey for children aged 4-7 (n=1175). This survey considered 36 public daycare centers, across 6 districts in Seoul. Allergic symptoms were defined as the presence of at least 1 or more allergic diseases (International Study of Asthma and Allergies in Childhood (ISAAC)). TREF was derived from the distance to the nearest main roads and gas stations. Geographic data processing and variable computation were conducted using ArcGIS version 10.2. The odds ratios for allergy symptoms increased by 1.189 (1.235-2.679) times with decreasing distance to main roads and by 1.846 (1.176-2.896) times with decreasing distance to a gas station. This study concludes that main roads and gas-stations near children's daycare centers are related to the allergy symptoms in children.*

**Keywords:** allergy symptoms, main road, gas station, children, geographic

### 1. INTRODUCTION

Allergy symptoms are known to be caused by environmental change such as air pollution [1]. Fine dust particles in the air pollution cannot be easily identified, causing potential damage to the body, such as respiratory problems and asthma [2]. Also early death rates could be higher [3]. Traffic-related air pollution (TRAP) is a major problem in developed countries with evidence showing that it leads to increased atopic sensitivity, allergy symptoms, and diseases [4]. TRAP is known to be more harmful to children who are sensitive compared to adults. Children are exposed to pollutants while their breathing is underdeveloped and breathe more compared to adults, exposing them to greater air pollution [5]. According to one study in France, long-term exposure to air pollution resulted in increased development of atopic dermatitis in children [6]. A study comparing air pollution in two regions of Taiwan showed that higher concentrations of air pollutants were associated with a higher prevalence of allergic diseases [7]. Previous studies on the association between air pollutants, asthma, and respiratory diseases such as carbon monoxide (CO), diesel exhaust particles (DEP), nitrogen dioxide (NO), ozone (O<sub>3</sub>), particulate matter (PM), and sulfur dioxide (SO<sub>2</sub>) [8-10] including Lee et al studies have showed that air pollutants play a role in both the initiation and exacerbation of allergic diseases

[11]. Recently, studies in South Korea showed the effects of TRAP on the aggravation of symptoms in children with allergic diseases [12-15]. The currently accepted hypothesis is that TRAP may be a risk factor for the development and exacerbation of allergic diseases. However, in South Korea, there is a lack of research indicating the relationship between outdoor air pollution and allergic diseases due to the low reliability of the government's air pollution measuring network. One previous study showed inconsistencies regarding the sources of TRAP and correlation with allergic disease [16]. The proximity of road and air pollution exposure facilities using geographic information systems is an indirect means of describing allergy diseases and causal relationships, and traffic contamination can have a variety of risk factors. This study shows an association between traffic-related environmental factors (TREF), road and gas station distance from the children's daycare center, and allergy symptoms. This study could be used as a precaution to identify TREFs in urban areas and reduce childhood allergies.

## **2. EXPERIMENTS**

### Study population

Data came from a 2018 survey. We conducted data collection from March to October 2018 with the cooperation of 36 public day-care centers in Seoul. The prevalence of allergic diseases is an ongoing survey of children aged 4-7 years. We selected 6 daycare centers per district. The survey recruited 36 public daycare centers to cover 6 districts in Seoul. We provided the survey questionnaire to 2,046 children parents, and 1,175 children, and all responded to the survey, excluding 871 children. We re-requested the poorly completed questionnaire to increase the reliability of the data.

### Questionnaire items

The questionnaire consisted of two items: (1) characteristics of study population including sex, age, and area, and (2) allergic symptoms related to atopic dermatitis, asthma, and allergic rhinitis based on the modified International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. The parents completed the written questionnaires. Allergic symptoms were defined as the presence ISAAC at least 1 and more allergic disease (atopic dermatitis, allergic rhinitis, or asthma). Gender and age were also investigated with demographic characteristics.

### Exposure Assessment

The TREF exposure consisted of the following: We computed TREF exposure metrics, including road proximity for main roads and gas station, based on 36 children's daycare center addresses using road/address network data. Road proximity was a categorical variable derived from the continuous distance to the nearest main road of four categories: 0 - 150 m, 150 - 300 m, 300 - 500 m, and > 500 m and gas station distance to the nearest day care center of four categories: 0 - 100 m, 100 - 200 m, 200 - 300 m, and > 300 m. Geographic data processing and variable computations were performed in ArcGIS version 10.2 (ESRI Inc., Redlands, CA, USA).

### Statistical analysis

We analyzed the descriptive statistics for all variables. Trend was represented as "p" to identify the trend of allergic prevalence by age. We analyzed logistic regression analysis to identify the distance and allergy prevalence of public daycare center nearest the main road or gas station and presented the value with the prevalence rate (PR). We analyzed data by using the IBM SPSS Statistics 21.0 software package (IBM Co., Armonk, NY, USA).

### 3. Results

The characteristics of the study population are summarized in Table 1. Of the 1175 children, 50.6% were male, with an average age of 6.17 years.

The area distribution of public day-care centers was 12.1% for Area 1, 14.6% for Area 2, 19.1% for Area 3, 23.4% for Area 4, 21.8% for Area 5, and 9.1% for Area 6. The average public day-care center distance from the main road was 582.30 m (30.00 m – 2500.00 m) and the average public day-care center distance from gas station was 309.59 m (31.00 m – 560.00 m) (Table 1).

**Table 1. Characteristics of the study population**

	n/N	%
<b>Boys</b>	594/1175	50.6
<b>Age (year)</b>	6.17	0.84
<b>Study region</b>		
<b>Area 1</b>	142/1175	12.1
<b>Area 2</b>	171/1175	14.6
<b>Area 3</b>	224/1175	19.1
<b>Area 4</b>	275/1175	23.4
<b>Area 5</b>	256/1175	21.8
<b>Area 6</b>	107/1175	9.1
<b>Day-care center nearest distance from main road (m)</b>	582.30 (SD: 567.14)	30.00 – 2500.00 (Min – Max)
<b>Day-care center nearest distance from gas station (m)</b>	309.59 (SD: 137.80)	31.00 – 560.00 (Min – Max)

In the past 12 months, allergy symptom rate was 57.5%, allergy diagnosis rate was 40.4%, and the treatment rate was 31.3%. The prevalence of allergy according to age was 64.29% at 4 years old, 48.28% at 5 years old, 58.77% at 6 years old, and 59.67% at 7 years old. In the case of allergy symptom diagnosis rate, there was a tendency to increase to 30.95% at 4 years old, 34.48% at 5 years old, 42.60% at 6 years old, and 41.75% at 7 years old ( $p=0.060$ ). And in the past 12 months, allergy symptom treatment rates were highest at 6 years of age, with 26.19% for 4 years, 27.09% for 5 years, 32.57% for 6 years, and 32.38% for 7 years (Figure 1). There was a difference in prevalence between men and women in allergy symptoms over the past 12 months ( $p=0.007$ ). The rates of allergy symptom diagnosis and allergy symptom treatments over the past 12 months were higher in men (Figure 2).

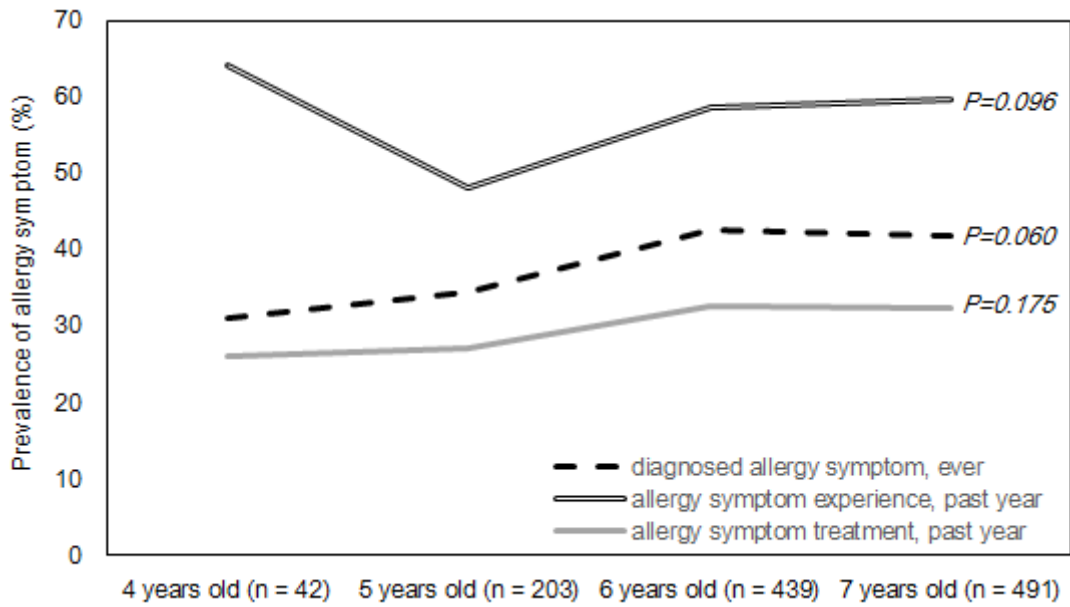


Figure 1. Prevalence of allergy symptoms of the study subjects by age

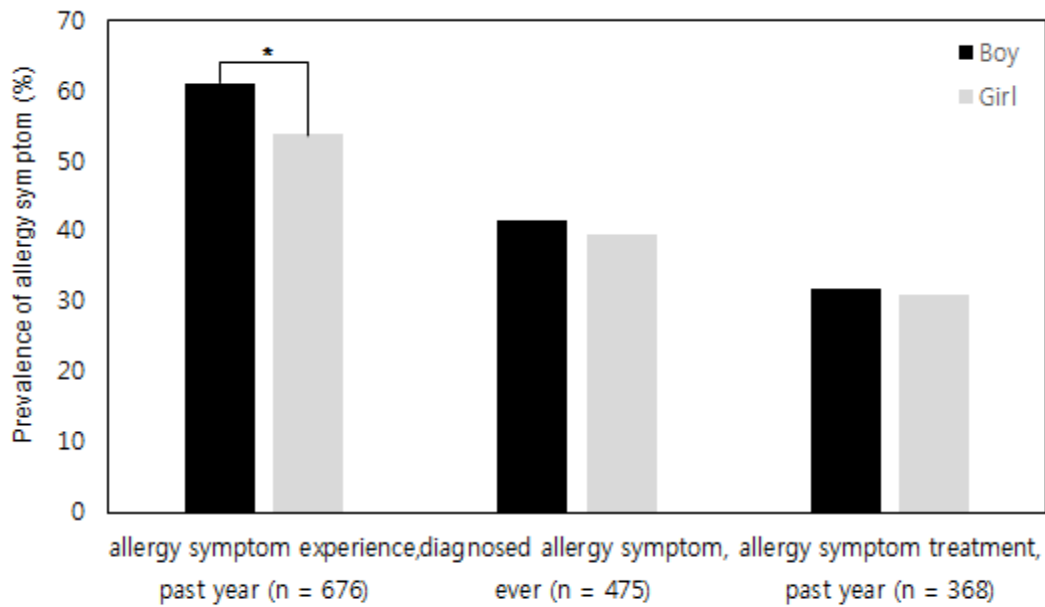


Figure 2. Prevalence of allergy symptoms of the study subjects by sex

When the public day-care center was adjacent to the main road within 150-300m, allergy symptoms were 1.913 times (1.314-2.784) higher in the past 12 months and 1.819 times (1.235-2.679) higher when corrected. ). Allergy symptom diagnosis rate and allergy symptom treatment rate in the past 12 months were not statistically significant, but the allergy diagnosis rate and treatment rate increased when adjacent to the main road. (Table 2)

**Table 2. Adjusted associations between distance from main road and allergy symptom in children**

Distance from main road (m)	Allergy symptom, past year (+)		diagnosed allergy symptom, ever (+)		Allergy symptom treatment, past year (+)	
	Model 1 PR (95%CI)	Model 2 PR (95%CI)	Model 1 PR (95%CI)	Model 2 PR (95%CI)	Model 1 PR (95%CI)	Model 2 PR (95%CI)
<150	1.00	1.00	1.00	1.00	1.00	1.00
150-300	1.913 (1.314-2.784)	1.819 (1.235-2.679)	1.173 (0.829-1.660)	1.169 (0.813-1.682)	1.273 (0.867-1.868)	1.195 (0.803-1.778)
300-500	1.261 (0.877-1.813)	1.268 (0.880-1.829)	1.354 (0.992-1.846)	1.321 (0.961-1.817)	0.685 (0.461-1.019)	0.701 (0.470-1.045)
>500	1.441 (1.020-2.036)	1.352 (0.942-1.939)	0.793 (0.579-1.087)	0.817 (0.588-1.136)	0.871 (0.604-1.257)	0.829 (0.565-1.217)

PR; prevalence ratio, Model 1: Adjusted for sex, age and area Model 2: Adjusted for sex, age, area and distance from gas station

For the allergy symptom diagnosis rates, the prevalence ratio was 1.846 times (1.176-2.896) higher than the public daycare center and the gas station within 100 m, and the treatment rate was 1.718 times (1.085-2.722) higher. Allergic symptoms increased when the public daycare center and TREF were adjacent to one another (Table 3).

**Table 3. Adjusted associations between distance from gas station and allergy symptom in children**

Distance from gas station (m)	Allergy symptom, past year (+)		diagnosed allergy symptom, ever (+)		Allergy symptom treatment, past year (+)	
	Model 1 PR (95%CI)	Model 2 PR (95%CI)	Model 1 PR (95%CI)	Model 2 PR (95%CI)	Model 1 PR (95%CI)	Model 2 PR (95%CI)
>300	1.00	1.00	1.00	1.00	1.00	1.00
200-300	0.810 (0.620-1.058)	0.839 (0.626-1.124)	1.013 (0.774-1.325)	1.075 (0.800-1.445)	0.924 (0.695-1.229)	1.058 (0.775-1.443)
100-200	0.771 (0.536-1.109)	0.795 (0.546-1.158)	0.987 (0.681-1.429)	0.884 (0.601-1.301)	0.779 (0.534-1.195)	0.700 (0.459-1.068)
<100	1.232 (0.780-1.947)	1.300 (0.816-2.071)	1.726 (1.109-2.688)	1.846 (1.176-2.896)	1.169 (1.003-2.445)	1.718 (1.085-2.722)

PR; prevalence ratio, Model 1: Adjusted for sex, age and area Model 2: Adjusted for sex, age, area and distance from main road

#### 4. Discussion

This study investigated the symptoms of allergies of children in 36 public daycare centers in six regions of Seoul and evaluated the distance from the public daycare center by grasping the surrounding road or gas station location. The relationship between the surrounding roads and gas stations and allergic symptoms was also identified. The prevalence ratio of allergic symptoms was found to increase when the centers were adjacent to the main road (round four lane).

In 1173 children recruited from the public daycare centers, allergy symptoms were highest in the past 12 months, followed by allergy symptom diagnosis rates and allergy symptom treatment rates in the past 12 months. These results were identical to the previously reported findings of studies on allergy prevalence.

Allergy symptoms over the past 12 months and allergy symptoms over the past 12 months increased with age, but there was no statistically significant trend. However, this was similar to many previous studies in which the prevalence of allergy increased as the child's age increased. Gender-specific allergy symptoms over the past 12 months also showed a higher prevalence among men than women, as in previous studies.

Allergy symptoms in the past 12 months were 1.819 times (1.235-2.679) higher when located closer to the main road (4 lanes round trip). Domestic studies [12-15] confirmed that air pollution related to transportation exacerbates allergic symptoms in children. In addition, there were reports that the risk of atopy was higher as it was adjacent to the road related to traffic [4]. Children have slower respiratory development and are exposed to more pollutants during breathing than adults, so it is necessary to reduce air pollution exposure [5].

The allergy symptom diagnosis rate was 1.846 times (1.176-2.896) higher in the prevalence ratio of allergic symptoms as it was closer to the gas station. The currently accepted hypothesis is that TRAPs are known to affect the incidence and exacerbation of allergic symptoms, but some studies show no correlation between these [16]. Because children, pregnant women, and the elderly are population groups that are sensitive to TRAP exposure, it is important to reduce exposure to harmful pollutants [4].

If at least one of atopic dermatitis, asthma, and allergic rhinitis was defined, the prevalence of allergy may have been higher than that of other studies because it was defined broadly as allergy symptoms. The purpose of this study was to analyze whether the geographic location of the surrounding roads and nearby gas stations was affected by allergic symptoms. Thus, the analysis did not involve classification into individual allergic diseases. However, to ensure the study sample was representativeness, children aged 4-7 were selected, and daycare centers in the six regions were selected equally.

Although it is necessary to continuously attempt to verify the relevance of each air pollutant and allergic disease concerning transportation, it is also necessary to expand environmental health policies and business scope through the identification of transportation-related facilities (around roads or gas stations) and allergies in the community. I want to be used as data.

#### 5. CONCLUSION

TRAP increases the risk of allergy prevalence through long-term exposure more than short-term exposure. This study can be used to identify TREF in urban areas and reduce childhood allergy symptoms. Therefore, there is a need for regulations that minimize TREF exposure around children's daycare centers.

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