

OVID	Full Text	
err	Help	Logoff
errerr		



EPIDEMIOLOGY

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errerr | err [Browse Table of Contents](#) err

err | err | err | err | err

Links



[Catalogo Biblioteca ISS](#)
[Internet Resources](#)

Outline

- [Abstract](#)
- [Subjects and Methods](#)
 - [Study Population and Participation Rate](#)
 - [Questionnaire](#)
 - [Allergy Tests](#)
 - [Assessment of Exposure](#)
 - [Statistical Analyses](#)
- [Results](#)
- [Discussion](#)
- [References](#)

Graphics

- [Table 1](#)
- [Table 2](#)
- [Figure 1](#)
- [Table 3](#)

Recent History

Exposure to Motor Vehicle...



Exposure to Motor Vehicle Traffic and Allergic Sensitization

[Original Articles]

Wyler, Catherine¹; Braun-Fahrländer, Charlotte¹; Künzli, Nino¹; Schindler, Christian¹; Ackermann-Lieblich, Ursula¹; Perruchoud, André P²; Leuenberger, Philippe³; Wüthrich, Brunello⁴; the Swiss Study on Air Pollution and Lung Diseases in Adults (SAPALDIA) Team

From the ¹Institute of Social and Preventive Medicine, University of Basel; ²Department of Internal Medicine, University Hospital Basel; ³Department of Pneumology, University Hospital Lausanne; and ⁴Allergy Unit, Department of Dermatology, University Hospital Zurich, Switzerland.

Submitted April 12, 1999; final version accepted December 14, 1999.

Address correspondence to: Charlotte Braun-Fahrländer, Institute of Social and Preventive Medicine, University of Basel, Steinengraben 49, CH-4051 Basel, Switzerland. The Swiss Study on Air Pollution and Lung Diseases in Adults (SAPALDIA) is part of Swiss National Research Program 26A supported by the Swiss National Science Foundation (Grants 4026-28099 and 3200-042532.94/1) and by the Federal Office of Education and Science. SAPALDIA Basel is part of the European Community Respiratory Health Survey.

Abstract

We examined the association between the presence of an allergic sensitization and seasonal allergic diseases or symptoms and the exposure to road traffic in Basel, Switzerland. Traffic counts at the domiciles of subjects ranged from 24 to 32,504 cars per 24 hours, with a median of 1,624. To investigate the relation of road traffic and allergies, we matched the data of the traffic inventory of Basel with those of the 820 participants of the SAPALDIA study (Swiss Study on Air Pollution and Lung Diseases in Adults), ages 18–60 years, who had completed a detailed respiratory health questionnaire and had undergone allergy testing (skin prick tests and serologic examinations). We observed a positive association with a sensitization to pollen that was most pronounced among persons with a duration of residence of at least 10 years. The odds ratios (adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy) for cars, contrasting four exposure categories with the lowest quartile as referent category, were 1.99 [95% confidence interval (CI) = 0.91–4.38], 2.47 (95% CI = 1.06–5.73), and 2.83 (95% CI = 1.26–6.31). These results suggest that living on busy roads is associated with a higher risk for a sensitization to pollen and could possibly be interpreted as an indication for interactions between pollen and air pollutants. We did not, however, find a similar relation between motor vehicle traffic and hay fever or seasonal allergic symptoms, and we saw no trend

that increasing traffic exposure was associated with a rise in sensitization rates to indoor allergens.

Various studies have shown that air pollution can exacerbate symptoms [1](#) or reduce the dose of allergen needed to evoke an allergic response in persons with an already existing allergic disease. [2,3](#) But there also exist indications that air pollution may induce an allergic sensitization. Evidence for this hypothesis primarily results from a series of animal studies. Both nitrogen dioxide (NO₂) and diesel exhaust seem to have an effect on the atopic status of guinea pigs and mice, [4–8](#) and results from *in vitro* experiments with human bronchial epithelial cells point in a similar direction. [9](#)

A possible effect of air pollutants on atopic sensitization could also be due to modifications of aeroallergens in ambient air. Several researchers have reported that NO₂ and diesel exhaust carbon particles can interact with pollen grains or allergen-bearing particles and, in turn, increase their allergenicity. [10–14](#)

The results of epidemiologic studies investigating the relation of road traffic and allergies, however, are contradictory. A Japanese study has found that the prevalence rate of self-reported seasonal allergic rhinitis was highest among people living near a motorway lined with cedar trees. [15](#) Similarly, Weiland *et al*, [16](#) and Duhme *et al*, [17](#) who studied school children in two German cities, have observed that an increase in the frequency of truck traffic on the street of residence went along with a rising prevalence of allergic rhinitis. Concordant with these results are the recent findings of Ciccone and colleagues. [18](#) A small pilot study conducted in Germany suggested that children who spent more than 1 hour daily on a busy street were more likely to be sensitized to pollen than were other children. [19](#) In contrast to these results, a series of other epidemiologic studies found no relation between road traffic and allergies. [20–22](#)

A weakness of these epidemiologic studies is the lack of objective markers for both traffic exposure and allergic diseases. Therefore, in the present study, we investigated whether there is an association between the exposure to motor vehicle traffic on the street of residence and the prevalence of atopic sensitization in a sample of adults by using objective measures for exposure and outcome.

Subjects and Methods ☐

Study Population and Participation Rate ☐

Basel-Stadt is an urban area with about 200,000 inhabitants, located in the northwestern part of Switzerland. In 1991, it was one of the eight areas that participated in the cross-sectional part of the Swiss Study on Air Pollution and Lung Diseases in Adults (SAPALDIA). [23–25](#) Martin *et al* [26](#) have described the methods of SAPALDIA elsewhere. The present study is based on the 1,075 (60%) Swiss participants of the Basel sample of SAPALDIA. The core questionnaire health assessments were identical to those of the European Community Respiratory Health Survey (ECRHS), [27](#) and SAPALDIA Basel was also a certified ECRHS center. In total, 948 (88.2%) of the study participants of the SAPALDIA center in Basel underwent allergy testing (skin prick tests and serologic examinations; see below), and for 820 (76.3%) we obtained additional information on the traffic density (private cars and trucks) at their home address.

To evaluate the representativeness of our final study population, we compared it with those 255 individuals without a complete dataset. For age, sex, and level of education, we did not observe any difference, but the excluded subjects reported hay fever and pollen-related symptoms more frequently. They did not, however, differ much with respect to the level of traffic exposure, based on a comparison of the final study

population and the 128 of 255 subjects with information on traffic counts.

Questionnaire

In correspondence to the ECRHS, SAPALDIA included a computer-supported interview. It covered questions on the personal and family history of respiratory and allergic diseases, on the home and work environments, and on active and passive smoking. We included the following variables in the present analyses: *current hay fever*, which required an affirmative answer to the question “Did you have hay fever this year or last year?”; *seasonal rhinitis or conjunctivitis symptoms*, defined as having at least one affirmative answer to the questions “When you are near trees, grass or flowers, or when there is a lot of pollen about, do you ever get a runny or stuffy nose or start to sneeze?” and “Do you ever get itchy or watering eyes?”; and *seasonal asthma symptoms*, which included at least one affirmative answer to the following questions: “When you are near trees, grass or flowers, or when there is a lot of pollen about, do you ever start to cough?”, “Do you ever start to wheeze?”, “Do you ever get a feeling of tightness in your chest?”, and “Do you ever start to feel short of breath?”. We performed the interviews throughout the year.

Allergy Tests

We assessed the sensitization to eight common aeroallergens (timothy grass, pellitory-of-the-wall, and birch pollen; house dust mite; cat and dog epithelia; and the molds *Alternaria tenuis* and *Cladosporium herbarum*) by skin prick tests using Phazet steel lancets (Kabi-Pharmacia, Uppsala, Sweden). [25](#) Additionally, we carried out a serologic screening test (Phadiatop, CAP FEIA system; Kabi-Pharmacia, Uppsala, Sweden).

We defined a *sensitization to any allergen* as a positive result in the Phadiatop test or at least one positive skin prick test reaction to any of the eight aeroallergens tested or

both. A *sensitization to pollen* included at least one positive skin prick test reaction to the pollen of timothy grass (*Phleum pratense*), pellitory-of-the-wall, or birch, and a *sensitization to any indoor allergen* required at least one positive skin prick test reaction to house dust mite or cat or dog epithelia. We did not incorporate *A. tenuis* and *C. herbarum* in either of the latter two subcategories, because these molds cannot be assigned to the group of outdoor or indoor allergens unambiguously.

Assessment of Exposure

To determine the participants' exposure to traffic at their domicile, we matched the data of the traffic inventory of the canton Basel-Stadt to each participant's home address. This inventory contains information on average numbers of cars and trucks per hour passing a given address. Separate numbers are available for daytime (6 am to 10 pm) and nighttime (10 pm to 6 am). These data are based on a traffic model taking into account road capacities (that is, the size and maximum speed allowed on the road) and the quantity of commuter traffic as assessed in the National Census of 1980. This model is validated and updated by traffic counts every 3–4 years. The first complete inventory dates from 1987, and in the present analyses we used the most recent version, from 1994. [28](#)

Statistical Analyses

We aimed the statistical analyses at assessing potential associations between traffic exposure and the presence of an allergic sensitization or allergic diseases and symptoms.

First, we carried out univariate descriptive analyses of exposure and outcome variables. Second, we considered several different parameters containing information

on the study participants' socioeconomic status, family history of allergies, diseases and living conditions in childhood (for example, number of siblings), present living conditions (for example, year of construction and size of house), indoor air pollution (for example, gas stove or heating device) and work place exposure. The three variables educational level, smoking behavior (nonsmoker, smoker, or ex-smoker), and number of siblings turned out to be associated both with the presence of atopy and the traffic density, and we included them in multivariate logistic regression models. Several authors [29,30](#) have previously described an inverse association between the prevalence of an atopic sensitization and the number of siblings. In addition, we controlled for age (by a cubic polynomial) and sex of the study participants as well as their family history of atopy. We performed the regression analyses with the traffic counts categorized into quartiles; owing to a cluster of identical traffic counts between the first and second quartiles, it was not possible to divide the sample into four identical categories. For each sample considered, we also computed covariate-adjusted prevalences in the different categories of traffic exposure by inserting the respective sample mean of each covariate other than traffic exposure into the logistic regression model and varying the level of exposure. We then included the traffic counts as a continuous variable and obtained an approximately linear relation between the logit of the prevalence of a "sensitization to pollen" and the traffic frequency when considering the latter on a logarithmic scale. We used locally weighted regression (LOESS) to assess and graphically represent this relation. On the assumption that our measure of exposure might be more valid for women and long-term residents, we stratified by duration of residency (with a cutoff of 10 years, which lies between the mean and the median) and by gender. We carried out all calculations with the software packages SAS version 6.12 and S-PLUS version 4.0.

Results

The mean age of the study participants was 41.1 years (standard deviation = 11.9 years), and 49.1% of the subjects were female. The prevalence of an allergic sensitization varied greatly depending on the allergens tested: 38.4% (315 per 820) were sensitized to any allergen, 25.5% (209 per 819) to pollen, and 14.5% (118 per 815) to any indoor allergen. The prevalence of allergic manifestations was 21.8% (178 per 818) for current hay fever, 33.3% (273 per 820) for seasonal rhinitis or conjunctivitis symptoms, and 13.0% (107 per 820) for seasonal asthma symptoms. The traffic counts at the domiciles of the study participants ranged from 24 to 32,504 cars per 24 hours, with a median of 1,624 and a mean of 3,707. For trucks, the counts ranged from 0 to 4,744 per 24 hours, with a median of 104 and a mean of 296 trucks per 24 hours.

To investigate a possible association between motor vehicle traffic and allergic conditions, we determined crude and adjusted odds ratios of an atopic sensitization for different exposure categories, with the lowest quartile as referent category. We saw no trend that increasing traffic exposure was related to a rise in sensitization rates to any allergen or any indoor allergen. People living at locations with an intermediate or high traffic density, however, were more likely to be sensitized to pollen than people living on quiet roads. The analyses yielded the highest odds ratios for the association between traffic exposure and a sensitization to pollen, but there was no indication of a clear dose-response relation ([Table 1](#)).

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Table 1. Crude and Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure* Crude OR estimates.† Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.‡ Referent category.

When we stratified the data by duration of residence, again sensitization to pollen showed the highest odds ratios. Individuals who had been living at their domicile for at least 10 years showed odds ratios ranging from 1.99 [95% confidence interval (CI) = 0.91–4.38] to 2.83 (95% CI = 1.26–6.31) for increased exposure to cars, and a comparable picture emerged for exposure to trucks. Moreover, there was some suggestion of a growing risk with increasing frequency of cars (Table 2).

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Table 2. Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure Stratified by Duration of Residence* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.† Referent category.

We also performed the multivariate logistic regression analyses including the logarithmically transformed traffic counts as a continuous variable. The qualitative differences we observed were similar to the previous results. We found no association with sensitization rates to any allergen or any indoor allergen. For subjects with a long duration of residence and the prevalence of a sensitization to pollen, however, we found an average odds ratio of 1.19 to be associated with a doubling in the number of cars per 24 hours (95% CI = 1.03–1.38) and of 1.14 for a doubling in the number of trucks per 24 hours (95% CI = 1.02–1.28). When we did the analyses for men and

women separately, the corresponding odds ratios were 1.11 (95% CI = 0.90–1.37) and 1.30 (95% CI = 1.04–1.63), respectively.

Figure 1 shows the relation between the natural logarithm of the odds ratio of pollen sensitization and the natural logarithm of car frequency as estimated by locally weighted regression. We observed an increase in the odds ratio over the full range of exposure with an S-shaped deviation from linearity in the middle range of exposure to traffic counts.

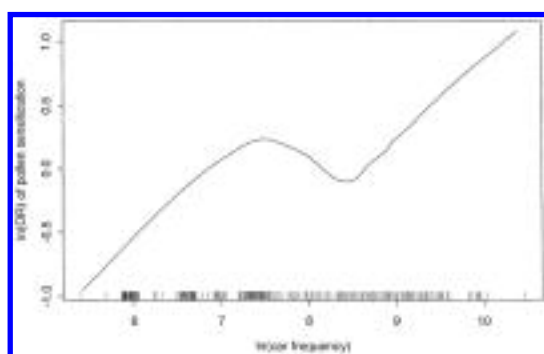


FIGURE 1 Association between $\ln(\text{OR})$ (OR = odds ratio) of sensitization to pollen and $\ln(\text{car frequency})$ in subjects having lived in the same house for at least 10 years; results of a generalized additive model in which the functional relation with $\ln(\text{car frequency})$ was estimated using locally weighted regression with a window span of 0.7 and in which the influence of sex, age, smoking, education, family history of atopy, and number of siblings was controlled.

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To investigate the clinical relevance of these findings, we studied the relation between traffic exposure and hay fever, as well as pollen-related rhinitis and asthma symptoms. For these outcomes, however, we did not observe a clear association with traffic exposure (Table 3).

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Table 3. Adjusted Odds Ratios (OR), Confidence Intervals (CI), and Adjusted Prevalences of the Association between Hay Fever and Seasonal Rhinitis or Asthma Symptoms and Traffic Exposure Stratified by Duration of Residence* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.† Referent category.

Discussion

Our findings suggest that traffic exposure is associated with a sensitization to pollen. The association was more pronounced among people with a long duration of residence. We evaluated whether the S-shaped deviation from linearity seen in [Figure 1](#) might be due to confounding by one of the variables assessed in our study, but because we saw this “trough” in all of our sensitivity analyses, we consider it to be unlikely that one specific, uncontrolled confounder might have caused it. On the other hand, chance alone may not be a sufficient explanation either. Hay fever and pollen-related rhinitis and asthma symptoms were not associated with motor vehicle traffic, nor could we observe such a relation for a sensitization to any allergen or any indoor allergen.

The fact that a sensitization to pollen and not a sensitization to any indoor allergen appeared to be associated with traffic exposure is especially interesting in connection with research done on interactions between pollen and air pollutants. *In vitro*, gaseous pollutants such as NO₂, SO₂, and CO seem to modify the allergenic proteins held in the pollen grain wall, and Ruffin and co-workers [11](#) have suggested that this modification might increase the potential of the pollen grains to cause allergic disease. Also, Behrendt and colleagues [13](#) have found that pollen collected from trees near roads with heavy traffic had particulate matter adhering to them, whereas pollen from park trees did not. The same team also carried out experimental studies and concluded that *in vitro* exposure of pollen grains to particles changed the morphologic structure of the

pollen, which, in turn, could induce a local allergen release. [14](#) Knox and co-workers, [12](#) on the other hand, have observed that under *in vitro* conditions, certain allergen-bearing particles could bind to diesel exhaust carbon particles, leading to a concentration of many allergens on one particle. In the natural environment, such an accumulation could increase the potential of these allergen molecules to sensitize individuals. Thus, exposure to motor vehicle traffic may be increasing sensitization to pollen in comparison with other allergens, without increasing the overall prevalence of sensitization at all.

A small pilot study conducted in Nordrhein-Westfalen (Germany) supports the findings of these experimental studies. In line with our results, Krämer and colleagues [19](#) have observed a positive association between road traffic and a sensitization to pollen. The authors had asked the parents of 6-year-olds about their children's daily exposure to motor vehicle traffic and found that children who spent more than 1 hour daily on a street with motor vehicle traffic were more likely to be sensitized to pollen (as assessed by radioallergosorbent test) than other children.

In the present study, we did not observe much of an association between road traffic and hay fever or seasonal rhinitis, conjunctivitis, or asthma symptoms, which limits the clinical relevance of our results. This finding contrasts with the findings of epidemiologic studies in Germany [16,17](#) and Italy, [18](#) which did observe an association between the traffic density on the street of residence (especially the frequency of truck traffic) and the prevalence of allergic rhinitis. Other studies, however, failed to find a relation between motor vehicle traffic and hay fever [20,22](#) or doctor's diagnosis of allergy. [21](#) The studies identifying a positive association between road traffic and allergies all used self-reported measures of exposure, so an information bias could have readily occurred. A positive relation of traffic exposure with a sensitization to

pollen but not with clinical symptoms could, theoretically, be due to a “healthy resident” effect; that is, individuals with allergic symptoms might have chosen to move away from busy streets. Alternatively, subjects may have been sensitized but have not spent sufficient time at or close to their homes during heavy traffic times to have had symptoms. A cross-sectional study such as ours has serious limitations for testing this hypothesis. The fact, however, that the relation between traffic exposure and a sensitization to pollen was stronger in those who had been living at the same address for more than 10 years and was slightly enhanced in females, who might spend more time close to their homes, argues in favor of a real effect. In this context, it would have been informative to stratify by job status as well, but because the percentage of unemployed people is low in Switzerland, the analyses were hampered by the small size. Although early childhood is an important time span for the induction of an atopic sensitization, [31](#) our results indicate that environmental exposure in adulthood may still be relevant. Alternatively, residency at the same address for more than 10 years may be correlated with childhood exposure.

We examined whether the results of our study could be due to selection bias. We observed little difference with regard to exposure between those we included and those we did not include in the final study population; thus, we consider selection bias to be an unlikely explanation for our results.

Misclassification of exposure could have resulted from our use of the traffic density at the home address as an indicator for exposure to motor vehicle traffic. This parameter cannot serve as an accurate measure of total exposure, because adults spend a substantial fraction of their time outside their homes, at their work places, or in transit. For most persons, however, exposure at home is an important constituent of overall exposure and may serve as a reasonable proxy measure of total exposure. It is also

conceivable that those living on busy roads may have additional exposures at their work places. The observed relation between traffic and pollen sensitization may therefore in part be due to additional exposures and not just to traffic exposure at home. Self-reported work place exposure to airborne irritants, however, was not among the predictor variables strongly associated with atopy in our preliminary univariate analyses.

Alternatively, living on a street with high traffic exposure might be correlated with additional lifestyle factors leading to an atopic sensitization, which we have not adjusted for in the analyses. Uncontrolled confounding is therefore another possible bias that we cannot completely rule out. Nevertheless, we tested more than 30 potential confounders and included those showing an association with both exposure and outcome in the logistic regression analyses. Moreover, we observed a stronger association between traffic exposure and a sensitization after inclusion of these potential confounders.

Although we stratified for the duration of residence, we only used one set of exposure parameters, namely the 1994 version of the traffic inventory of the canton Basel-Stadt. According to the agency for air hygiene of Basel, however, traffic density within the city of Basel remained fairly constant over the past 10 years but increased considerably on the highways surrounding the city.

We used traffic density as a proxy measure for traffic-related air pollution. Traffic density has a relatively strong correlation with NO_2 , and there is evidence that the traffic density is even more highly correlated with primary air pollutants such as NO and CO [32](#) and with particle number counts. [33](#) The association between traffic counts and particulate matter less than 10 μm in aerodynamic diameter, however, seems not

to be pronounced. In Switzerland, most cars are powered by gasoline, whereas trucks tend to be powered by diesel fuel. Because in our data the frequencies of cars and trucks were highly correlated (correlation coefficient = 0.88), however, we could not achieve a clear-cut separation of these two types of motor vehicles in the statistical analyses.

Important misclassification of disease is unlikely, because we used information from serologic examinations and skin prick tests to assess sensitization rates. The results of skin prick tests, however, may be influenced by fieldworker performance, which could lead to some nondifferential misclassification of disease. [34,35](#)

In conclusion, the results of our study indicate that living on busy roads might confer a higher risk for a sensitization to pollen, but we did not observe an association between traffic density at the home address and prevalence of a sensitization to indoor allergens or hay fever and seasonal allergic symptoms.

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Keywords: air pollution; allergies; pollen; traffic density

Accession Number: 00001648-200007000-00015

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Table 3

TABLE 3. Adjusted Odds Ratios (OR), Confidence Intervals (CI), and Adjusted Prevalences of the Association between Hay Fever and Seasonal Rhinitis or Asthma Symptoms and Traffic Exposure Stratified by Duration of Residence

	Current Hay Fever							Rhinitis or Conjunctivitis Symptoms						Asthma Symptoms					
	Duration of Residence <10 Years				Duration of Residence ≥10 Years			Duration of Residence <10 Years			Duration of Residence ≥10 Years			Duration of Residence <10 Years			Duration of Residence ≥10 Years		
	N	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*
Cars per 24 hours																			
24–710†	174	1.00		17.2	1.00		18.4	1.00		33.9	1.00		32.1	1.00		13.1	1.00		12.1
711–1,620	227	1.09	0.53–2.24	18.5	1.78	0.90–3.53	27.5	0.86	0.46–1.59	30.4	1.37	0.74–2.56	39.4	0.58	0.24–1.39	8.0	1.56	0.70–3.51	17.7
1,621–5,250	213	1.19	0.59–2.43	19.9	0.90	0.41–1.96	16.8	0.80	0.43–1.48	29.1	0.69	0.34–1.40	24.6	0.63	0.27–1.48	8.7	1.31	0.53–3.25	15.3
5,251–32,504	206	0.92	0.44–1.94	16.1	1.15	0.56–2.38	20.6	0.91	0.49–1.71	31.8	1.12	0.58–2.14	34.6	0.72	0.30–1.70	9.8	0.66	0.25–1.73	8.3
Trucks per 24 hours																			
0–20†	192	1.00		17.0	1.00		18.7	1.00		36.3	1.00		31.2	1.00		12.9	1.00		11.3
21–100	217	1.33	0.66–2.66	21.4	1.84	0.92–3.67	29.8	0.70	0.38–1.28	28.5	1.44	0.78–2.68	39.6	0.74	0.33–1.69	9.9	1.84	0.82–4.11	19.0
101–360	203	0.93	0.45–1.95	16.1	0.89	0.41–1.93	17.0	0.63	0.34–1.17	26.3	0.90	0.46–1.74	28.9	0.44	0.17–1.12	6.1	1.33	0.55–3.19	14.4
361–4,744	208	1.02	0.49–2.12	17.3	1.07	0.51–2.23	19.7	0.92	0.50–1.70	34.5	1.08	0.57–2.03	32.8	0.80	0.35–1.85	10.6	0.85	0.34–2.15	9.7

* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.

† Referent category.

Table 3. Adjusted Odds Ratios (OR), Confidence Intervals (CI), and Adjusted Prevalences of the Association between Hay Fever and Seasonal Rhinitis or Asthma Symptoms and Traffic Exposure Stratified by Duration of Residence* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.† Referent category.

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Previous Page
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Table 2

TABLE 2. Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure Stratified by Duration of Residence

	Any Allergen								Pollen						Any Indoor Allergen					
	Duration of Residence <10 Years				Duration of Residence ≥10 Years				Duration of Residence <10 Years			Duration of Residence ≥10 Years			Duration of Residence <10 Years			Duration of Residence ≥10 Years		
	N	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	OR*	95% CI	Prevalence (%)*	
Cars per 24 hours																				
24–710†	174	1.00		46.2	1.00		29.4	1.00		22.8	1.00		12.2	1.00		21.0	1.00		10.4	
711–1,620	227	0.70	0.39–1.24	37.4	1.44	0.76–2.73	37.5	1.25	0.65–2.42	27.0	1.99	0.91–4.38	21.6	0.46	0.21–1.01	10.9	0.98	0.40–2.40	10.2	
1,621–5,250	213	0.80	0.45–1.42	40.6	1.30	0.65–2.60	35.1	1.24	0.64–2.39	26.8	2.47	1.06–5.73	25.5	0.56	0.27–1.19	13.0	1.20	0.47–3.11	12.3	
5,251–32,504	206	0.63	0.35–1.15	35.2	1.44	0.75–2.80	37.5	0.89	0.45–1.77	20.9	2.83	1.26–6.31	28.2	0.59	0.27–1.26	13.4	1.03	0.41–2.61	10.7	
Trucks per 24 hours																				
0–20†	192	1.00		41.5	1.00		27.4	1.00		23.0	1.00		12.1	1.00		17.8	1.00		10.5	
21–100	217	1.01	0.57–1.78	41.7	1.67	0.89–3.15	38.6	1.35	0.71–2.56	28.8	2.25	1.05–4.83	23.6	0.48	0.21–1.07	9.4	1.02	0.43–2.46	10.8	
101–360	203	1.02	0.57–1.82	42.1	1.74	0.90–3.37	39.7	1.15	0.60–2.22	25.6	3.06	1.39–6.73	29.6	0.99	0.48–2.06	17.7	1.26	0.51–3.11	12.9	
361–4,744	208	0.68	0.38–1.24	32.7	1.49	0.78–2.83	35.5	0.85	0.43–1.66	20.2	2.32	1.07–5.06	24.2	0.67	0.31–1.47	12.7	0.87	0.35–2.18	9.3	

* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.

† Referent category.

Table 2. Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure Stratified by Duration of Residence* Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.† Referent category.

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FIGURE 1

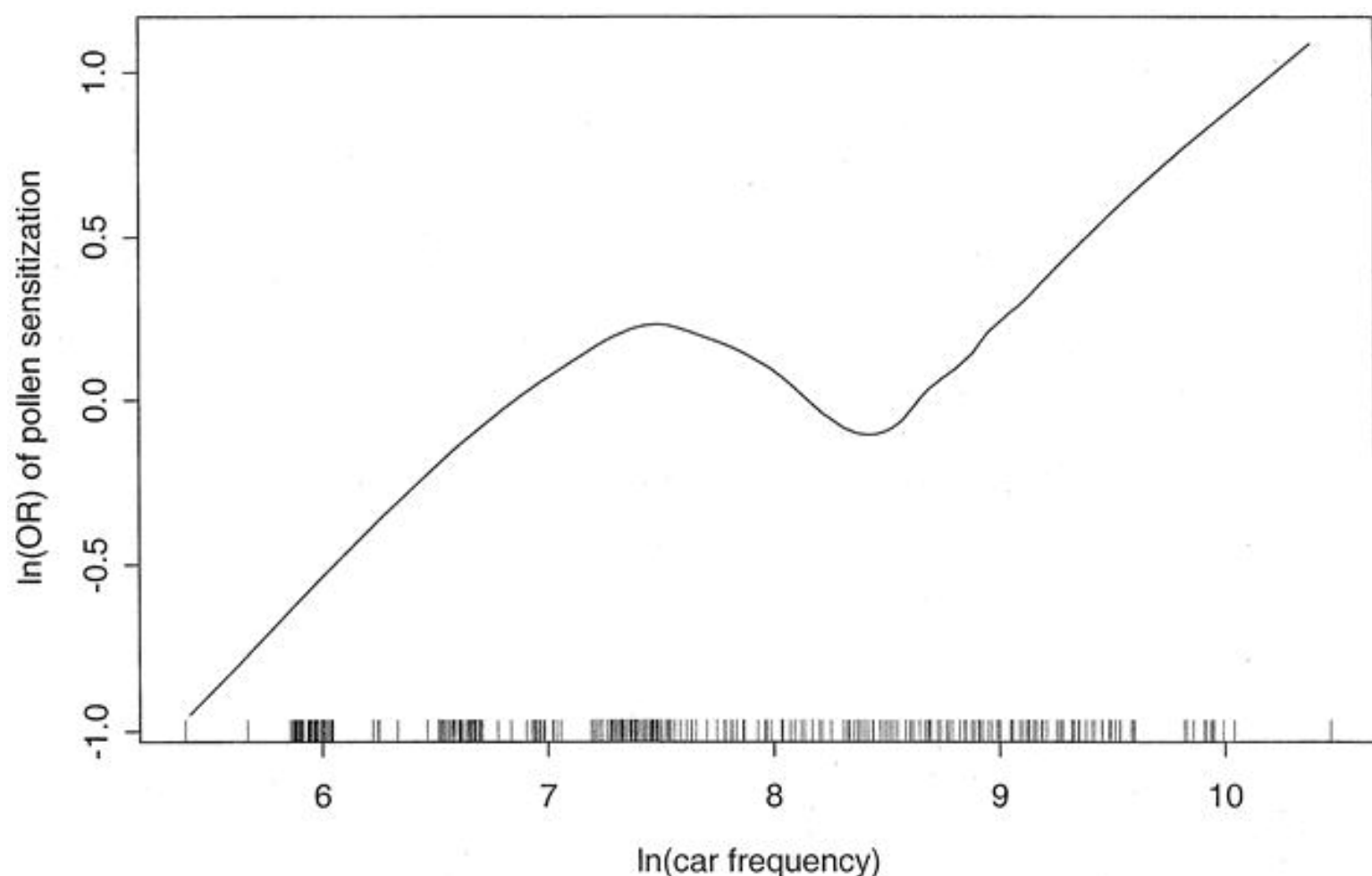


FIGURE 1 Association between $\ln(\text{OR})$ (OR = odds ratio) of sensitization to pollen and $\ln(\text{car frequency})$ in subjects having lived in the same house for at least 10 years; results of a generalized additive model in which the functional relation with $\ln(\text{car frequency})$ was estimated using locally weighted regression with a window span of 0.7 and in which the influence of sex, age, smoking, education, family history of atopy, and number of siblings was controlled. *From:* Wyler: Epidemiology, Volume 11(4).July 2000.450-456

O
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Table 1

TABLE 1. Crude and Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure

	Any Allergen						Pollen					Any Indoor Allergen					
	N	Crude OR*	95% CI	Adjusted OR†	95% CI	Prevalence (%)†	Crude OR*	95% CI	Adjusted OR†	95% CI	Prevalence (%)†	Crude OR*	95% CI	Adjusted OR†	95% CI	Prevalence (%)†	
Cars per 24 hours																	
24–710‡	174	1.00		1.00		37.5	1.00		1.00		18.0	1.00		1.00		15.9	
711–1,620	227	1.01	0.67–1.51	1.02	0.67–1.55	37.9	1.41	0.88–2.25	1.53	0.93–2.51	25.1	0.71	0.40–1.24	0.69	0.39–1.23	11.6	
1,621–5,250	213	0.98	0.65–1.47	1.06	0.69–1.63	38.9	1.44	0.90–2.32	1.63	0.99–2.71	26.4	0.88	0.51–1.53	0.87	0.49–1.53	14.1	
5,251–32,504	206	0.91	0.60–1.38	0.95	0.62–1.47	36.4	1.36	0.84–2.20	1.49	0.89–2.47	24.6	0.82	0.47–1.43	0.84	0.47–1.49	13.6	
Trucks per 24 hours																	
0–20‡	192	1.00		1.00		34.4	1.00		1.00		17.7	1.00		1.00		14.2	
21–100	217	1.29	0.86–1.92	1.36	0.90–2.06	40.8	1.60	1.02–2.54	1.74	1.08–2.82	27.3	0.77	0.44–1.37	0.78	0.43–1.39	11.4	
101–360	203	1.23	0.82–1.85	1.34	0.88–2.05	41.2	1.54	0.97–2.46	1.71	1.04–2.80	26.9	1.20	0.71–2.06	1.20	0.69–2.08	16.6	
361–4,744	208	0.94	0.63–1.42	1.02	0.66–1.56	34.0	1.24	0.77–1.99	1.36	0.82–2.24	22.7	0.84	0.48–1.48	0.87	0.49–1.56	12.6	

* Crude OR estimates.

† Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.

‡ Referent category.

Table 1. Crude and Adjusted Odds Ratios, Confidence Intervals, and Adjusted Prevalences of the Association between an Allergic Sensitization and Traffic Exposure* Crude OR estimates.† Estimates are adjusted for educational level, smoking behavior, number of siblings, age, sex, and family history of atopy.‡ Referent category.

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