Risk Factors Associated with Forced Expiratory Volume (FEV1) and Asthma Frequency in the Southern California CHS Study

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Background

- Studies have shown that air pollution can impact lung function in children.[1]
- The Southern California Children's Health Study (CHS) collected data on 1,000 students in cohort E to investigate the impact of pollution on lung function.
- Here, we analyze this data to find air pollution and non-air pollution risk factors associated with forced expiratory volume in one second (mL) (FEV_1) and asthma. We also explore whether these risk factors differ by ethnicity.

Methods

- We built a multiple linear and logistic regression model for FEV_1 and asthma, respectively, and built further models for each stratifying by ethnicity.
- Each model was adjusted for age, race, sex, obesity, and neighborhood.
- We built the models by adding potential risk factors, one at a time, to the base model. We kept variables in the final model who showed stronger association (whether significant or not) with the outcome, even after adjusting.
- Finally, we performed model diagnostics on the FEV_1 models to check the linear assumptions.

Table 1: Characteristics of the study sample

Variable (unit)	Mean (SD)
Age (years)	15.25 (0.61)
Height (cm)	166.21 (8.59)
Weight (kg)	64.68 (15.99)
BMI (kg/m^2)	23.33 (5.06)
FEV_1(ml)	3695.20 (693.94)
FVC(ml)	4262.17 (849.09)
Sulfate (ug/m^3)	1.37 (0.25)
Nitrate (ug/m^3)	2.36 (0.45)
Ec (ug/m^3)	0.82 (0.07)
Dust (ug/m^3)	1.11 (0.33)

Variable	Total (%)
Race	
Asian	47 (4.7)
African American	20 (2.0)
Caucasian	436 (43.6)
Mixed	131 (13.1)
Others	233 (23.3)
Unknown	133 (13.3)
Male	483 (48.3)
Female	517 (51.7)
Wheeze = yes	120 (12)
Wheeze = no	873 (87.3)
Obesity = true	97 (9.7)
Obesity = false	903 (90.3)
Home Built (year)	
1960s to 1970s	293 (29.3)
1980 or later	219 (21.9)
Before 1960	263 (26.3)
Unknown or Missing	225 (22.5)

Variable	Total (%)
Town	
Anaheim	93 (9.3)
Glendora	187 (18.7)
Long Beach	56 (5.6)
Mira Loma	114 (11.4)
Riverside	112 (11.2)
Santa Barabara	155 (15.5
San Dimas	139 (13.9)
Upland	144 (14.4)
Parent's education	
Didn't graduate high school	171 (18.3)
Graduated high school	153 (16.3)
Some college	323 (34.5)
Graduated college	151 (16.1)
Some graduate level	138 (14.7)

Table 2: Risk Factors Associated with FEV_1

	All Subjects Slope (p-value)	Hispanic Subjects Slope (p-value)	Non-Hispanic Subjects Slope (p-value)
pm25	61.12 (*0.03773**)	80.69 (*0.06622*)	72.47 (*0.07847*)
Education – Grade 12	17.72 (*0.78387*)	67.28 (*0.34938*)	-501.39 (*0.02427**)
Education – Some post high-school	137.53 (*0.02981**)	132.55 (*0.07558*)	-251.93 (*0.23125*)
Education – 4 years of college	183.78 (*0.01510**)	291.41 (*0.00872**)	-231.05 (*0.27637*)
Education – Some post-graduate	131.76 (*0.08295*)	74.77 (*0.50887*)	-220.86 (*0.30119*)

Model adjusted for sex, age, obesity, neighborhood, and race.
* indicates a p-value significant at 0.05

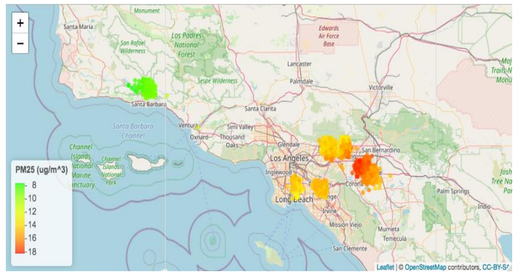

Figure 1. Particulate matter concentration with aerodynamic diameter less than 2.5 micrometers (ug/m^3) by neighborhood.

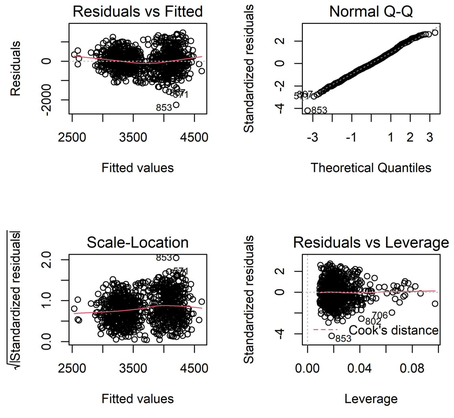

Figure 3. Model diagnostic plots for the full FEV_1 model testing linear assumptions.

We created similar diagnostic plots for the stratified models. The necessary assumptions of all models were met.

Table 3: Risk Factors Associated with Asthma

	All Subjects Odds Ratio (p-value)	Hispanic Subjects Odds Ratio (p-value)	Non-Hispanic Subjects Odds Ratio (p-value)
ec	4722.01 (*0.0709*)	1652.43 (*0.2238*)	92.76 (*0.57638*)
Education – Grade 12	1.38 (*0.3273*)	1.16 (*0.6819*)	2.23 (*0.44734*)
Education – Some post high-school	1.65 (*0.1172*)	1.35 (*0.4365*)	1.70 (*0.59547*)
Education – 4 years of college	2.20 (*0.0316**)	1.55 (*0.3026*)	2.32 (*0.40677*)
Education – Some post-graduate	2.03 (*0.0522*)	1.82 (*0.2523*)	1.72 (*0.59531*)

Model adjusted for sex, age, obesity, neighborhood, and race.
* indicates a p-value significant at 0.05

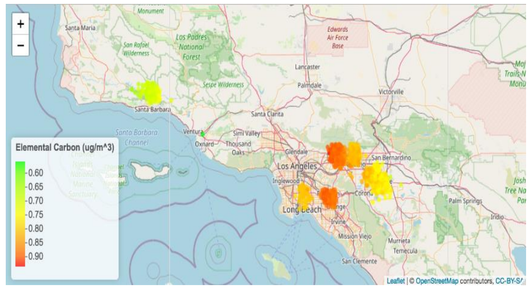

Figure 2. Elemental carbon particle concentration (ug/m^3) by neighborhood.

Results and Conclusions

FEV_1
- Pm25 and parental education are significantly associated with FEV_1.
- For a one unit increase in pm25, there is an increase of 61.25 mL of mean FEV_1 (p = 0.04).
- Generally, an increase in parental education is associated with an increase in mean FEV_1 up until 4 years of college.

Asthma
- Elemental carbon and parental education are significantly associated with asthma.
- For a one unit increase in elemental carbon, the odds of having asthma increase by 4722.1 (p = 0.07).
- Generally, an increase in parental education is associated with increased odds of having asthma.

Acknowledgements: This project was funded under the Summer Institutes in Biostatistics (SIBS) program of the National Heart, Lung, and Blood Institute grant # R25HL147236, with additional support from the Keck School of Medicine of USC, USC Norris Comprehensive Cancer Center grant # P30CA014089 and National Institute of Environmental Health Sciences Center, grant # 5P30ES07048. Special thanks to Fatimata Sanogo for her guidance in creating this poster.

Citation: 1. Götschi, T., Heinrich, J., Sunyer, J., & Künzli, N. (2008). Review Article: Long-Term Effects of Ambient Air Pollution on Lung Function: A Review. *Epidemiology, 19*(5), 690-701. Retrieved July 13, 2021, from http://www.jstor.org/stable/25662616

Disclaimer: Note that the results on this poster are based on a dataset that includes only a non-representative sample from the actual Southern California Children's Health Study. Hence, it is solely intended for instructional purposes and should not be used to draw definitive (and substantively meaningful) conclusions about actual study objectives.