Exposure to polycyclic aromatic hydrocarbons, hair nicotine, normalized vegetation index and lung function in a cohort of outpatient children with asthma

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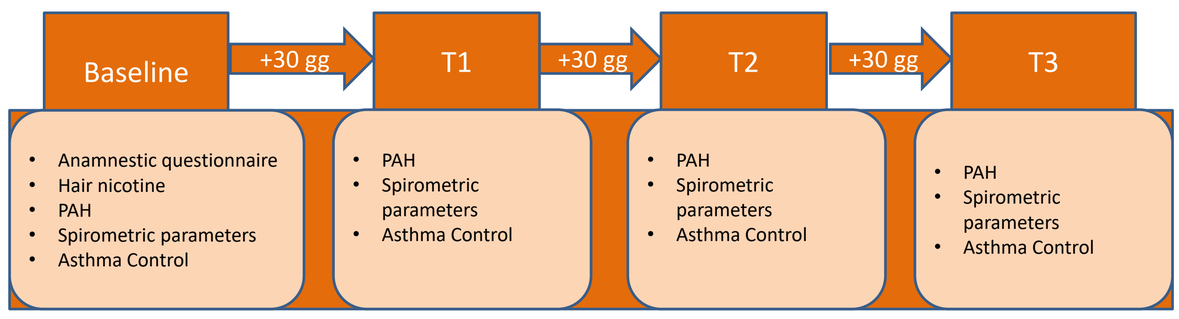
Background

Exposure to secondhand smoke and polycyclic aromatic hydrocarbons (PAHs) have been implicated as risk factors for asthma [1- 2]. Some cross-sectional studies have shown an association between lung function and PAH [3-4]. Other studies have reported positive effects of green exposure on respiratory function [5]. No study has evaluated the effect of combined exposure to multiple factors on the performance of respiratory function in pediatric patients with persistent asthma.

Study design



(clinicalTrial.gov NCT02433275)

Aim

To evaluate in a cohort of children with mild/moderate persistent asthma:
- the distribution of PAH, hair nicotine and NDVI by level of asthma control
- the effect of PAH, hair nicotine and NDVI on spirometric parameters

Methods

50 male and female asthmatic children, 6-11 years old, were followed for 3 months at mean time intervals of one month. The metabolites of PAHs (1-Hydroxynaphthalene, 2-Hydroxynaphthalene, 2-Hydroxyfluorene, 1,9- Hydroxyphenanthrene, 2-Hydroxyphenanthrene, 3-Hydroxyphenanthrene, 4-Hydroxyphenanthrene, 1-Hydroxypyrene) were monthly measured according to guidelines [6]. The level of control (C: controlled, NC: not controlled / partially controlled) was assigned in accordance with the GINA guidelines (http://ginasthma.org). The normalized vegetation index (NDVI) was calculated by satellite acquisition on a 100m buffer for each dwelling. The effects of the considered environmental factors on the longitudinal trend of the spirometric parameters were estimated through a mixed-effect regression model. The model was adjusted for gender, age, height and level of control. Statistical analyses were carried out with the statistical software R (3.5.2); a p-value <0.05 was considered statistically significant.

Results

Table 1 PAH, hair Nicotine, NDVI e spirometric parameters in C vs NC

	C	NC	All	
#	33	17	50	p-value
PAH				
2-Hydroxynaphthalene	6.93 ± 7.79	10.00 ± 8.03	7.97 ± 7.93	**0.022**
1-Hydroxynaphthalene	4.27 ± 8.59	5.60 ± 10.05	4.72 ± 9.03	0.185
2-Hydroxyfluorene	123.58 ± 106.51	142.60 ± 84.68	130.05 ± 99.16	0.204
2-Hydroxyphenanthrene	75.75 ± 83.75	80.91 ± 47.40	77.50 ± 72.94	0.143
3-Hydroxyphenanthrene	72.91 ± 89.40	98.07 ± 56.60	81.47 ± 80.06	**0.013**
1,9-Hydroxyphenanthrene	110.03 ± 103.63	144.67 ± 61.39	121.81 ± 92.30	**0.014**
4-Hydroxyphenanthrene	11.46 ± 15.69	22.22 ± 32.02	15.12 ± 22.85	0.200
1-Hydroxypyrene	97.38 ± 97.22	130.09 ± 79.70	108.50 ± 92.15	0.055
Hair Nicotine	128.22 ± 211.76	251.54 ± 424.91	170.15 ± 302.86	0.395
NDVI	0.18 ± 0.09	0.23 ± 0.14	0.20 ± 0.11	0.386
Spirometry				
FEV1 z-score	0.89 ± 1.65	1.60 ± 2.44	1.14 ± 1.97	0.164
FVC Z-score	1.19 ± 1.61	1.73 ± 2.07	1.38 ± 1.79	0.394
FEF 25-75 score	-0.29 ± 1.18	0.04 ± 1.63	-0.17 ± 1.35	0.231
FEV1/FVC z-score	-0.29 ± 1.03	-0.17 ± 1.04	-0.25 ± 1.02	0.483

Figure 1 NDVI distribution in C

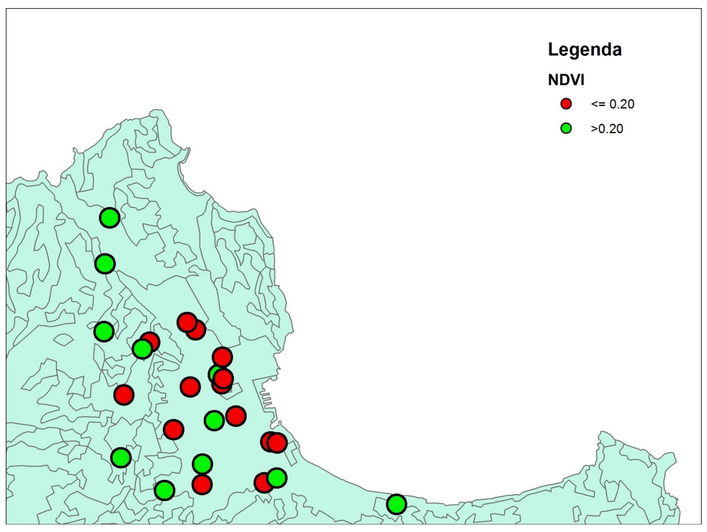


Figure 2 NDVI distribution in NC

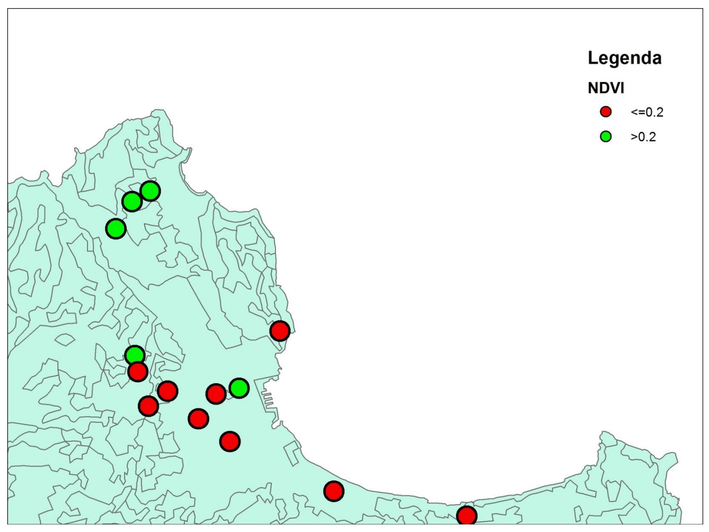


Figure 3 Correlations among PAH and spirometric parameters in C and NC

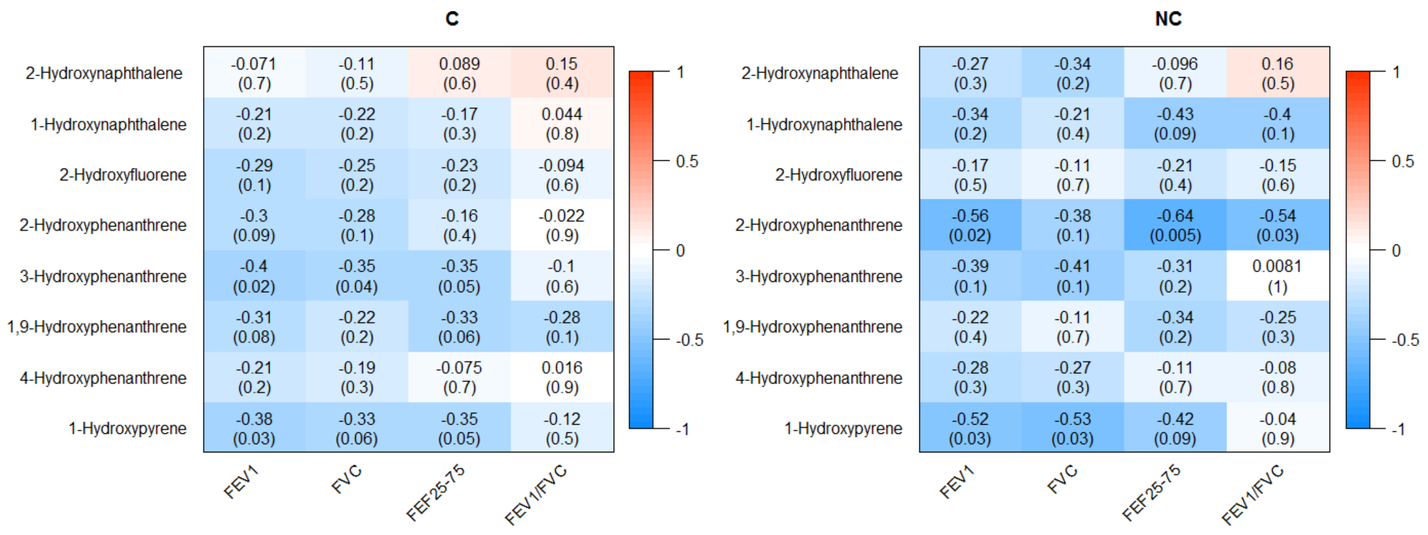


Table 2 Genaralized mixed models on spirometric parameters

	FEV1	FVC	FEF 25-75	FEV1/FVC
IPA				
2-Hydroxynaphthalene	-0.021	-0.044	0.079	0.107
1-Hydroxynaphthalene	-0.064	-0.056	-0.095	-0.069
2-Hydroxyfluorene	-0.485	-0.167	-0.481	**-1.163***
2-Hydroxyphenanthrene	-0.112	-0.083	-0.112	-0.157
3-Hydroxyphenanthrene	-0.411	-0.553	-0.072	0.453
1,9-Hydroxyphenanthrene	-0.098	-0.062	-0.137	-0.353
4-Hydroxyphenanthrene	-0.179	-0.093	0.095	-0.084
1-Hydroxypyrene	1.285	0.963	0.763	1.33
Hair Nicotine	0.444	0.610	-0.096	**-0.671***
NDVI	0.005	-0.020	0.053	-0.302

Conclusions

The results of the study showed that exposure to smoke and PAHs can determine harmful effects on the values of respiratory function parameters.

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