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Exposure to particulate matter and risk of amyotrophic lateral sclerosis: A case-control study in Northern Italy

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Background

Amyotrophic lateral sclerosis (ALS) is progressive neurodegenerative disease with still unknown etiology. Role of occupational and environmental risk factors has been investigated, including outdoor air pollutants, which have been recently associated to an excess disease risk. We carried out a case-control study in order to assess if environmental exposure to particulate matter ≤10 µm (PM_{10}) may increase ALS risk

Methods

We recruited patients referred to the Modena Neurology Unit between 1994-2015 and controls from the Modena province population. Using a validated geographical information system-based dispersion model, we geocoded subjects' addresses of residence at the time of diagnosis and we estimated outdoor air PM_{10} levels for each subjects.

We computed odds ratio (OR) and 95% confidence interval (CI) of ALS according to increasing PM_{10} exposure, using an unconditional logistic regression model age- and sex-adjusted.
We also modelled the relation between annual average PM_{10} levels and ALS risk using restricted cubic splines with three knots (10, 50 and 90 percentiles) and adjusted for sex and age.
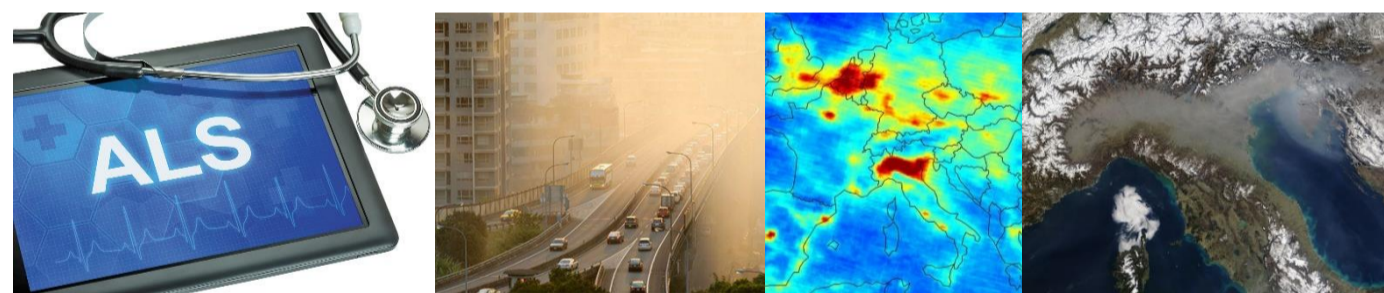
Table 1. Baseline characteristics of study population.

	ALS cases	Controls	All subjects
	N (%)	N (%)	N (%)
All subjects	52 (100)	80 (100)	132 (100)
Sex			
Men	31 (59.6)	39 (48.8)	70 (53.0)
Women	21 (40.4)	41 (51.2)	62 (47.0)
Age			
Mean (SD)	58.2 (12.6)	52.8 (15.4)	54.9 (14.5)
< 65 years	35 (67.3)	59 (73.8)	94 (71.2)
≥ 65 years	17 (32.7)	21 (26.2)	38 (28.8)
PM_{10} levels	Mean (SD)	Mean (SD)	Mean (SD)
Average µg/m³	5.1 (5.0)	5.3 (4.6)	5.2 (4.8)
Maximum µg/m³	37.2 (22,5)	39.4 (21.3)	38.6 (21.7)

Abbreviations: ALS, amyotrophic lateral sclerosis; N, number of subjects; PM, particulate matter; SD, standard deviation.
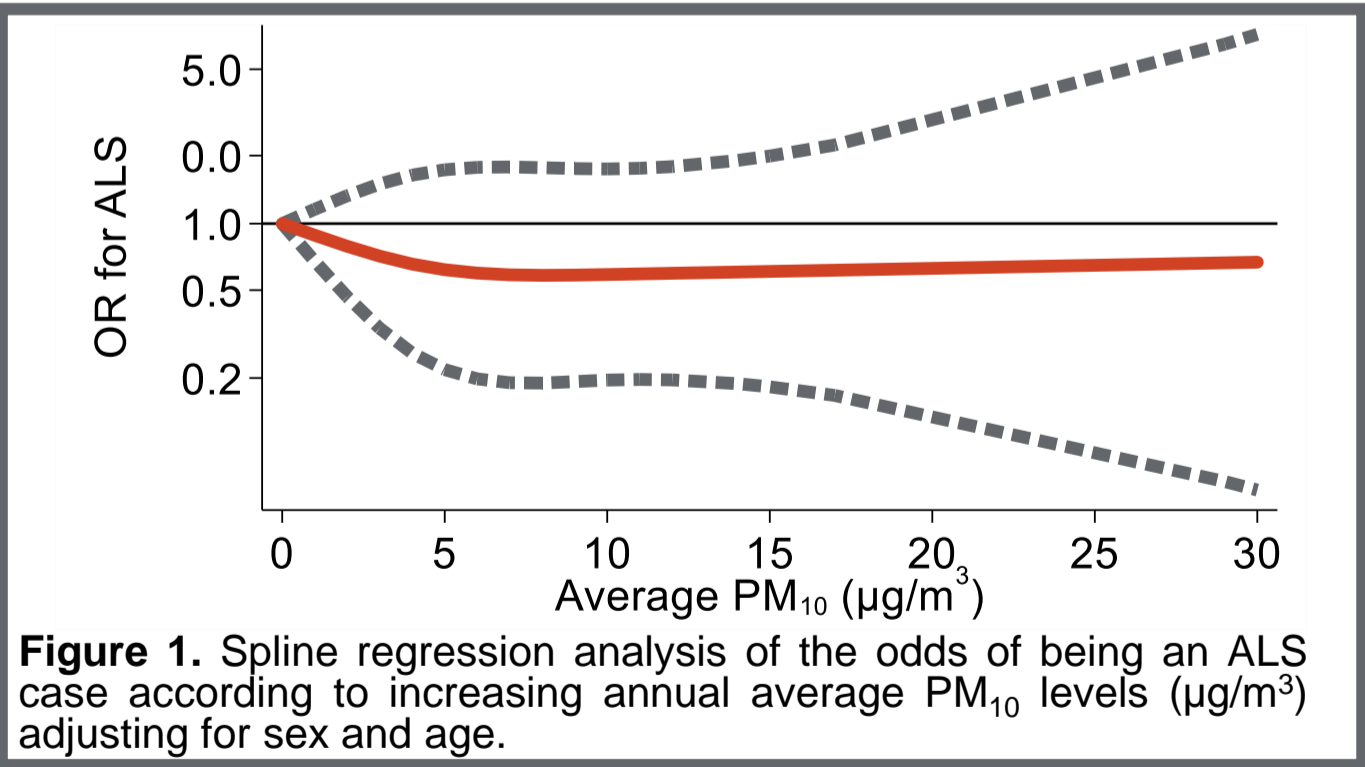
Results

For the 132 study participants (52 cases/80 controls), mean of annual average and maximum PM_{10} levels were 5.2 and 38.6 µg/m³, respectively. Using fixed cutpoints at 5, 10 and 20 of average annual PM_{10} levels, compared with subjects <5 µg/m³, we did not find evidence for an excess ALS risk associated with PM_{10} exposure, since OR was 0.87 (95% CI 0.39-1.96), 0.94 (0.24-3.70), and 0.87 (0.05-15.01) at 5-10, 10-20 and ≥20 µg/m³, respectively. Using maximum annual PM_{10} levels, we found an excess ALS risk for subjects exposed at 10-20 µg/m³ (OR = 4.27, 95% CI 0.69-26.51) compared with exposure below 10 µg/m³, although the risk tended to decrease at higher PM_{10} levels, with OR of 1.49 (0.39-5.75) at 20-50, and 1.16 (0.98-4.82) at ≥ 50 µg/m³.

Table 2. Odds ratio (OR) and 95% confidence interval (CI) of ALS risk in relation to exposure to outdoor air pollution.

PM_{10} categories	Cases/Controls	OR[1]	(95% CI)
Annual average PM_{10}			
< 5 µg/m³	30/45	1.00	-
5 - 10 µg/m³	17/28	0.87	(0.39 - 1.96)
10-20 µg/m³	4/6	0.94	(0.24 - 13.70)
≥ 20 µg/m³	1/1	0.87	(0.05 - 15.01)
Annual maximum PM_{10}			
< 10 µg/m³	4/8	1.00	-
10-20 µg/m³	6/4	4.27	(0.69 - 26.51)
20-50 µg/m³	28/40	1.49	(0.39 - 5.75)
≥ 50 µg/m³	14/28	1.16	(0.98 - 4.82)

[1]Adjusted for sex and age. PM, particulate matter.

Figure 1. Spline regression analysis of the odds of being an ALS case according to increasing annual average PM_{10} levels (µg/m³) adjusting for sex and age.

Conclusions

Our findings do not suggest that PM_{10} exposure is associated with ALS risk. However, some evidence of an increased risk at maximum annual exposure levels, although statistically imprecise, suggests the need of further investigations, also considering the high PM_{10} levels characterizing Northern Italy.