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 fatal neurodegenerative disease with still unknown etiology. Some environmental and occupational risk factors have been proposed, including air pollution, as suggested by recent studies. We carried out a case-control study in order to assess ALS risk due to environmental exposure to particulate matter ≤10μm (PM_{10}).

Methods

We recruited ALS patients referred to the Modena Neurology Unit between 1994-2015 and a reference group sampled from the population of Modena province. Using CALINE4 dispersion model, we estimated outdoor air PM_{10} levels at the geocoded subjects' residence address at the time of diagnosis. We computed odds ratio (OR) and 95% confidence interval (CI) of ALS according to increasing PM_{10} exposure, using an unconditional logistic regression model adjusted for age and sex. We also modelled the relation between PM_{10} levels and ALS risk using restricted cubic splines with three knots at 10th, 50th and 90th adjusting for sex and age.

Results

For the study 132 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 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. When using maximum annual PM_{10} levels, we found an excess ALS risk for subjects exposed at 10-20 μg/m³ (OR=4.27, 0.69-26.51) compared with exposure below 10 μg/m³. However, risk decreased with further exposure increase at 20-50 (OR=1.49, 0.39-5.75), and ≥50 μg/m³ (OR=1.16, 0.98-4.82).

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.

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.

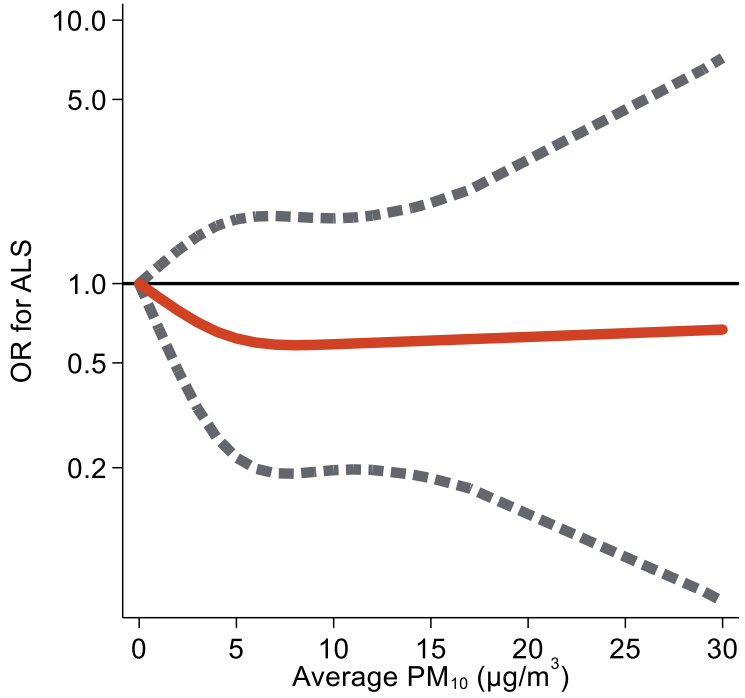

Figure 1. Spline regression analysis of the odds of being an ALS case according to increasing annual average PM_{10} levels (μg/m³) adjusting for sex and age.

Conclusions

Our findings do not suggest that PM10 exposure is associated with ALS risk, even at the high levels of exposure characterizing a Northern Italy province. However, the statistically imprecise increased risks associated with maximum annual exposure levels suggest the need of further investigations.

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