Pollution Increases Hospital Admissions, Even In Semi-Rural Areas: It Is Not Just In Big Cities And More Needs To Be Done

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Introduction

Air pollution is a major public health concern, estimated to cause 16% of global deaths, and 40,000 UK deaths/annum. Although pollution is still seen as a 'big city' problem, smaller towns are just as vulnerable. We aimed to determine whether air pollution in Tayside contributed to cardiovascular disease hospital admissions over an 18 year period.

Methods

We conducted a retrospective cohort study using record linkage of routinely collected healthcare records from Ninewells Hospital, Dundee, and Perth Royal Infirmary, from 2000 to 2017. Hospitalisation events were linked to daily PM10, NOX, NO2 and NO levels extracted from government public data. Admission data was aggregated for day, and a distributed lag model was used to estimate risk ratios, adjusting for temperature, humidity, public holidays and day of week. A linear association between pollution and admission was assumed, and a lag structure was modelled with a natural cubic spline with two degrees of freedom (df). The knots in the lag space were set at equally spaced values in the log scale of lags. Temperature and humidity were included using a natural cubic spline with five df, with knots at equally spaced values in the log scale.

Table 1. Risk of hospital admission in Dundee and Perth per 10µg/m^3 increase in pollution exposure. Any cardiovascular reason (CVD); heart failure (HF); myocardia infarction (MI); and acute limb ischaemia (ALI)

Pollutant	aRR (95% CIs)			
	Any CVD	HF	MI	ALI
PM10	1.025 (1.012-1.039)	1.042 (1.012-1.073)	1.015 (0.979-1.052)	1.004 (0.945-1.067)
NOX	1.013 (1.011-1.015)	1.016 (1.011-1.020)	1.010 (1.005-1.015)	1.016 (1.005-1.026)
NO2	1.055 (1.045-1.064)	1.076 (1.051-1.101)	1.043 (1.023-1.063)	1.064 (1.023-1.106)
NO	1.024 (1.019-1.029)	1.029 (1.020-1.038)	1.019 (1.009-1.029)	1.029 (1.009-1.050)

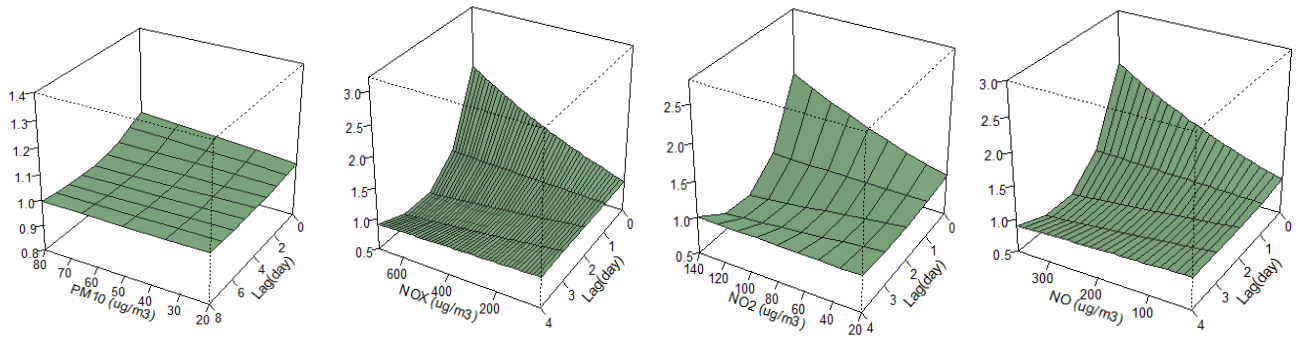

Fig 1. Exposure-lag-response models for CVD hospital admissions and pollution

Table 2. Risk of hospital admission in Dundee and Perth for highest pollutant quartile (Ref: lowest quartile). Any cardiovascular reason (CVD); heart failure (HF); myocardia infarction (MI); and acute limb ischaemia (ALI)

Pollutant	aRR (95% CIs)			
	Any CVD	HF	MI	ALI
PM10	1.079 (1.036-1.124)	1.037 (0.969-1.109)	1.026 (0.943-1.117)	1.019 (0.855-1.213)
NOX	1.184 (1.137-1.233)	1.226 (1.121-1.340)	1.159 (1.064-1.263)	1.287 (1.079-1.536)
NO2	1.179 (1.133-1.228)	1.252 (1.148-1.366)	1.157 (1.062-1.261)	1.311 (1.101-1.561)
NO	1.189 (1.142-1.239)	1.260 (1.150-1.380)	1.178 (1.080-1.286)	1.355 (1.134-1.619)

Results

Pollution was assessed as an increase of 10µg/m^3 (Table 1) and as quartiles (Table 2). There was a significantly increased risk for any cardiovascular (CVD) admission or heart failure (HF) admission following exposure to PM10, NOX, NO and NO2 pollution. This association was seen for both an increase of 10µg/m^3 PM10, NOX, NO and NO2 pollution (Table 1), and when assessed as quartiles (Table 2). Hospital admissions for acute limb ischemia (ALI), and myocardial infarction (MI) were associated with higher NOX, NO and NO2 levels, but not PM10 pollution. Increased risk of CVD hospitalisation was associated with exposure to high levels of pollution on the day of admission, but not with a lag response (Fig 1). There was no increased risk of CVD death following exposure to air pollution in Dundee and Perth. We estimate that if pollution levels were reduced, there would be a 10% reduction in cardiovascular hospital admissions (n=8803 less/annum).

Conclusions

This study shows a significant increase in cardiovascular admissions on high pollution days in the semi-rural area of Tayside, Scotland. More needs to be done on a Local Government level to reduce pollution levels.