A Study on Health Effects of Fine Particle Concentrations in Tampere area during 2.5 Years Follow-up

P. Arvela[1], M. Hilli-Lukkarinen[2], J. Lilja[1], J.M. Mäkelä[3],T. Nummi[4] and A.-M. Sepponen[4]

[1] Tampere University of Applied Sciences, Kuntokatu 3, FI-33520 Tampere, Finland;
[2] City of Tampere, P.O.Box 487, Tampere, Finland;
[3] Tampere University of Technology, Department of Physics, P.O.Box 692, 33101 Tampere, Finland;
[4] University of Tampere, Department of Mathematics and Statistic, 33014 University of Tampere, Finland

Introduction

Ambient fine particles are known to affect human respiratory and cardiology health. However, no threshold values for any of the air quality factors to increase diseases in human population are truly known. It is also unclear which pollutants, or combination of pollutants, are the most harmful ones for human population (Pope and Dockery, 2006).

Methods

We measured fine particle concentrations in the city of 213 000 inhabitants and relatively low air pollution level, for a period of 31 months. Particle measurements were conducted using an outdoor ELPI (Keskinen et al., 1992). Sample air of 30 l/min was heated to 30 ℃, and dried (Nafion). The data on number of diagnoses was collected from the municipal healthcare centres of the City of Tampere. Diagnoses were counted from both ICPC-2 and ICD-10 diagnose code groups "all respiratory organ symptoms" and diagnose code groups "all heart diseases". Diagnoses were classified in 4 age groups: under 15 years, 15–65 years, 65–74 years and over 74 years (Table 1.). In heart diseases age groups were 15--65 years, 65--74 years and >74 years.

We added to the data set the frequency of traffic and weather data. We compared the level of air quality parameters to the amount of respiratory and heart diagnoses with lag times of 0–5 days. Finally, we used statistical general additive model (GAM, e.g. Hastie and Tibshirani, 1990) to test which of the factors of this wide dataset actually predict the number of diagnoses most accurately. Although the particle data was collected on-line, hourly averages were calculated for the comparison. Furthermore, since the health diagnoses were available only as daily values, daily averages were derived from all the quantities and submitted to the statistical GAM analysis.

Conclusions

Traffic density, vehicles per hour, was seen to be the most effective factor in the statistical model to explain the number of diagnoses. Of all the variables, it had the highest correlation coefficients with the diagnoses. When the value for the number of vehicles (h^{-1}) was higher than 600 h^{-1}, the number of both respiratory and heart diagnose was seen to be systematically elevated. There is also a clear correlation between the fine particle number concentration and the traffic density. However, the number concentrations of fine particles could not be directly separated from the strong influence of traffic on the number of heart and respiratory diagnoses, and the particle number concentrations did not, in fact, bring any additional contribution to explain the number of diagnoses in GAM model,

The particle mass concentration variables PM2.5 and PM10 had clear effects on respiratory and hearth diagnoses, when the effects of the most important covariates are eliminated. For working aged people PM2.5 had quite clear and immediate effect to both health indicators, but PM10 tends to show more complicated delayed effect patterns. For the respiratory diagnose, age group is an important factor. For younger age group PM2.5 shows no effects, but PM10 and all the fine particle count had effects at lag 5 days. For the older age group (64-74) both PM2.5 and PM10 had some effects with all lags and also fine particles count variables had some immediate effects (lag 0) on respiratory diagnoses.

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