Methodological issues in determining the relationship between street trees and asthma prevalence

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The toxicology of CO is very well known to alter oxygen saturation in red blood cells, but only at concentrations that are far above those observed in England during the time period 1996–2004. Exposure to CO at the current criterion concentration (9 ppm) produces carboxyhaemoglobin of only about 1. 4–2.0%, which is clinically insignificant.

Hence, I find it less than plausible that the very low ambient levels of CO in England could be the direct cause of so many deaths from respiratory disease.

I can present an alternative hypothesis to explain these pollutant–mortality correlations. I have argued[3] that the use of methyl ether (such as methyl tert-butyl ether (MTBE) or tert-amyl methyl ether (TAME)) in gasoline creates MN in the exhaust. As CO is primarily an engine exhaust product, increased CO would be expected to be strongly correlated with MN exhaust. Furthermore, MN can easily be confounded with NO_2, as I have argued previously.[4] One review[5] stated: "The overall results suggest that outdoor NO_2 was serving as a marker for more causal airborne agents rather than a direct effect of NO_2".

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Methodological issues in determining the relationship between street trees and asthma prevalence

A study published in the July issue of the *Journal of Epidemiology and Community Health*[1] documents the relationship between the density of street trees and the prevalence of childhood asthma in New York City. Findings suggest that street trees are associated with a lower prevalence, although no causality was inferred. I would like to point out a number of methodological issues which should benefit future studies on this subject.

The prevalence of asthma was determined for 4-year-old and 5-year-old children using data from school screenings in 1999. Street tree density was derived from the 1995 street tree census completed by the Parks and Recreation Department of the City of New York and expressed as the total number of trees on street segments divided by the land area. Data were aggregated at the level of United Hospital Fund (UHF) areas. Additional variables used in the analysis were population density, racial/ethnic composition and a measure of proximity to pollution sources. The initial correlation analysis suggested a negative association between street tree density and prevalence of asthma. However, one of the strongest positive associations was between street tree density and population density. This initially appears somewhat counterintuitive, until it is recognised exactly which types of trees are included in the analysis. The street tree census conducted by the Parks and Recreation Department of the City of New York considered only trees along city streets, and trees in parks and open space were not included. As a result, the street tree density derived by this study[1] is a substantial underestimate of the actual number of trees within a UHF area, in particular in areas with large areas of parks and open space. In fact, a recent study by the Forest Service[2] estimates that New York City has about 5.2 million trees, while the latest street tree census in 2005–2006 counted 592 130 trees.[3] Street trees, therefore, account for only around 11% of trees within the study area. The strong correlation between street tree density and population density is strongly driven by the fact that the total length of street segments per unit area increases with population density. Logic suggests that overall tree density and population density are probably negatively associated since many parks and open spaces occur in areas with lower (average) population density. The pattern in street tree density by UHF areas is therefore a poor representation of the overall tree density.

Figure 1 provides an example of a park in Brooklyn adjacent to a residential area. Although numerous trees are visible on the residential streets, the number of trees in the park far exceeds the number of

Figure 1 Digital orthophoto of a portion of Prospect Park in Booklyn, New York City, adjacent to a residential area. Source: United States Geological Survey 2006.

street trees. While fig 1 is not representative for the entire study area, it illustrates how not including trees in parks and open spaces presents a misleading picture of the potential effects of trees on local air quality in urban areas.

The argument could be made that street trees are more relevant than those in parks and open spaces since street trees are much closer to the residential homes. However, Lovasi *et al*[1] do not make this argument and instead aggregate all variables at the level of UHFs. This aggregation does not allow for a determination of street tree density in close proximity to the residential addresses of asthma cases. If street trees in close proximity are deemed of greater relevance than trees in parks and open spaces at greater distances, an individual- or street segment-level analysis is required.

A second methodological issue relates to the determination of the measure of proximity to pollution sources. Relying on the methodology presented by a recent study on sources of air pollution in New York City,[4] Lovasi *et al*[1] create uniform distance buffers around toxic release inventory sites, stationary point sources and major truck routes and then determine the percentage of each UHF falling within one or more of these buffers. While the specific distances and types of sources were derived from the original study,[4] the authors fail to highlight the many limitations of this approach, as detailed at length in the original study, including the use of single buffer distances, treating all pollution sources as being similar and ignoring cumulative effects from multiple sources. Perhaps more importantly, the original study[4] used the individual geocoded residential locations of asthma hospitalisation cases and determined whether they fell within a particular buffer or not. Lovasi *et al*[1] instead determined the prevalence of asthma as a rate based on the number of children within each UHF and compared this with the percentage of the area of the UHF falling within one of more of the buffers around the pollution sources, without considering the proximity of individual cases to pollution sources. The data aggregation to the level of UHFs represents a very substantial loss of information. No evidence is presented that aggregation at the level of UHF areas is justified given the nature of the research question since it remains unclear at what (spatial) scale the potential effects of street trees on air quality are expected to occur.

Future research efforts in this area should consider the following three refinements.

1. Developing a more robust measure of tree density which includes trees in parks and open spaces. This could be addressed by using land use or land cover maps supplemented with field sampling as employed by the Forest Service.[2]
2. Using individual-level analysis instead of aggregation to coarse units. This would involve geocoding individual address locations of asthma cases and creating individual-level measures of tree density and proximity to pollution sources, as well as creating a meaningful sample of non-asthma cases for comparison.
3. Employing more robust measures of proximity to pollution sources. One approach to accomplishing this is to use cumulative distribution functions.[5 6]

While each of these three elements requires considerable effort, they should contribute to a much improved understanding of the complex relationships between tree density and asthma prevalence.

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Gender differences in spousal household material status estimation

Gender differences in socioeconomic inequalities in mortality are well known.[1] However, gender differences in self-reported socioeconomic status in public health surveys has been much less frequently investigated. We aimed to compare the material status estimates provided by men and women in spousal pairs, obtained from the larger genetic epidemiology study in Croatia that was focusing on the families, thus enabling spousal pairs analysis. A total of 182 spousal pairs from the Adriatic island of Vis were included in this study. Household material status was estimated as the equally weighted sum of 16 questions on various items that were either present or absent from the household, as in our previous study.[2] Examinees were also asked to provide the information on their education level (years of schooling). Additionally, we asked examinees to provide information on three questions that were used as control questions: examinee's marital age, their spouse's marital age and a number of children they have. The data were analysed with the paired non-parametric Wilcoxon test. The results indicated no gender difference in any of the three control questions. As expected on the basis of the official population census,[3] men had significantly higher education level than women (10.5 ± 3.2 vs. 9.6 ± 3.3 years, respectively; $p<0.001$). Additionally, men provided significantly higher self-reported material status estimates than women (10.1 ± 2.2 vs. 9.8 ± 2.4, respectively; $p = 0.027$). This result indicates that either men were prone to overestimation, or women were prone to underestimation of the household material status. Theoretically, the only way to further explore these differences would be to compare the responses with the actual household, which was well beyond the scope of this study. The finding of unequal gender estimates in this population is even more interesting knowing that we had previously described a high level of socioeconomic homogeneity and virtual lack of health inequalities in the Vis Island population.[2] Admittedly, these results might be confined to the investigated island population and not very prevalent in other populations. Nevertheless, we propose that differences in self-reported socioeconomic estimates depending on the examinee's gender should be taken into account, especially in studies that use gender-dependent socioeconomic estimates in pooled analyses.

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