

REFLECTIONS ON AIR POLLUTION AND EQUITY FROM A STUDY OF PUBLIC PERCEPTIONS

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ABSTRACT

It appears that air pollution, like many environmental risks, is not evenly distributed across the population. Many mapping studies have shown that minority racial groups and people of lower socio-economic status tend to be subjected to greater air pollution where they live.

This is extremely important by itself but a recent study of people's experiences of air pollution has added a further dimension. This particular study looked at four neighbourhoods in north London, in which calculated pollution levels and socio-economic status differed. The study considered perceived levels of pollution as well as perceived health and non-health impacts. It was found that residents of the different areas differed in their perception of air pollution levels but their perception of the impacts attributed to air pollution differed far less. It seems, therefore, that concentration at home may not be the most important factor in terms of perceived impacts, as people experience air pollution in many places in their daily lives. Nevertheless, the physical attributes of certain areas may affect how air quality is experienced. In addition, other aspects such as the individual's medical vulnerability may be important in the experience of impacts. This has implications for the conceptualisation of environmental equity or implementation of environmental justice, as it concerns air pollution.

INTRODUCTION

Concern over distributional equity in relation to environmental and health risks has been the basis of the concept of environmental equity. Cutter (1995:112) defines environmental equity as "a broad term that is used to describe the disproportionate effects of environmental degradation on people and places".

Environmental equity is conceptually allied to environmental justice, although the two may not be synonymous. The environmental justice movement is rooted in US civil rights movement starting in the 1970s, which was concerned with discrimination in environmental policy making, particularly in relation to the siting of toxic facilities. This discrimination, they noted, was resulting in racial minorities and the poor suffering a greater burden of environmental risks resulting from such siting policies (e.g. Bullard 1983; United Church of Christ Commission on racial justice 1987).

These concerns have broadened out to address a number of different environmental and health risks, showing that a similar pattern may be observable across the board. However there are methodological and conceptual issues to be addressed here, particularly relating to the dominance of a mapping approach to such studies. In this paper I briefly review the evidence with respect to air pollution, then go on to discuss the relevance of a study of public perceptions of air pollution conducted in London, which approaches the issue from an angle of perceived effects rather than mapped distribution.

THEORY

As outlined above, studies have shown that environmental risks are not evenly distributed and that their distribution may be concentrated in areas where the population has a greater

proportion of both ethnic minority residents and residents of lower socio-economic status. With respect to air pollution specifically, research in the US clearly suggests that minority communities suffer a greater amount of toxic air pollution (e.g. Lopez 2002; Pastor et al 2002; Perlin et al 2001). However, the pattern is less clear with respect to poverty; some studies found poorer people were more residentially exposed to air pollution (e.g. Glickman et al 1994; Jerrett et al 2001) but others found an unclear or even the reverse relationship (e.g. Perlin et al 1995; Daniels and Friedman 1999).

There have been fewer studies published in the UK but the results have again been somewhat variable, particularly with respect to poverty indicators. King and Stedman (2000) and Pye et al (2001) found a positive correlation between pollution and deprivation in most, but not all of the UK cities studied. Brainard et al (2002) found a trend to higher emissions with increasing deprivation in Birmingham; Mitchell and Dorling (2003) studying all wards in the UK found that the poorest wards tended to experience the most NO₂, but the least poor did not experience the best.

Overall, these studies seem to provide evidence that poorer people, as well as ethnic minorities, do on the whole suffer from worse air quality. However there are methodological issues with this body of work. The geographical scale of analysis and the choice of statistical method for example have been shown to affect results (Tiefenbacher and Hagelman 1999; Perlin et al 1995); different studies have also measured different pollutants and used different indicators of poverty or deprivation. Further than this however, there are assumptions inherent in the spatial mapping approach, the most important being that inequity in the burden suffered from a risk or pollutant can be assumed from inequity in spatial distribution of the risk or pollutant. This may not be true for several reasons, one being that ambient concentration may not correspond to dose, as other factors intervene. Furthermore, this approach tends to assume that residential exposure is an indication of actual exposure, while people clearly move through a number of environments in their daily lives. In addition, however small the area unit of analysis in these studies (and most are quite large, for example US counties), variation in pollution levels is actually very fine grained, on a scale of tens of metres, and this is not accounted for. Thus the 'ecological fallacy' may be in operation here – that relationships may be observable at an area level that do not hold at the individual level.

As a separate point, the concept of environmental equity also implies that an equal distribution (in this case of air pollutants) is the desirable situation, which does not take account of the fact that at any given level some people may feel the effects more than others. Cutters definition, given earlier, actually does emphasise unequal effects, but in practice work has concentrated on distribution. Some studies have touched on the concept of unequal effects by including children and older people in the analysis as particularly vulnerable groups (Brainard et al 2002; Mitchell and Dorling 2003), but these are few.

For these reasons it is interesting to approach the issue from the perspective of how and how much people feel the effects of pollution. This paper presents results from a study of public perceptions of air pollution and its effects in four different neighbourhoods in north London, and reflects on what these results contribute to understanding environmental (in)equity.

METHODOLOGY

The study took place in four different areas of the London borough of Barnet. The four study areas were chosen on the basis of pollution level and socio-economic characteristics. Pollution level was inferred from Barnet's maps of predicted exceedence of the European (and UK) NO₂ air quality standard, and from background and roadside NO₂ modelled data produced by

the South East Institute of Public Health (SEIPH). The two study areas chosen to be of higher pollution were alongside very busy major roads. Socio-economic characteristics were inferred from local knowledge, house prices and the income data of those interviewed (recent census data was not available at a small scale at the time of the study being carried out).

The four study areas selected were as follows:

1. **Totteridge** – high average socio-economic status (s.e.s.), low pollution (background NO₂ 18ppb)
2. **Hampstead Garden Suburb** – high average s.e.s, high pollution (roadside NO₂ 39-42ppb)
3. **Brent Cross** – low average s.e.s, high pollution (roadside NO₂ 37-41 ppb)
4. **Grahame Park** – low average s.e.s, low pollution (background NO₂ 23 ppb)

The fieldwork comprised a first, qualitative stage followed by a second, quantitative stage. In each study area, a series of in depth interviews took place with 8-10 people of mixed age and gender, and these were analysed thematically using Atlas Ti software. Following this and building on the themes to emerge from this analysis, a questionnaire was then designed which was sent to all adults in each area for self completion and return by post. This resulted in a sample size of 200. The survey was analysed quantitatively, using a range of bivariate and multivariate techniques, with SPSS.

RESULTS

The results presented here are a combination of those from the interviews and survey. Names of interviewees have been changed.

Perceived air quality

Responses to a question in the survey showed clearly that residents of the different study areas rated their local air quality differently, and the results were broadly in line with the modelled values above, at least in a relative sense. Given a 7 point scale on which to rate air quality where they live, the mean score in Totteridge was 4.8, in Hampstead Garden Suburb 3.22, in Brent Cross 3.06 and in Grahame park 3.86. Totteridge residents saw their air as significantly better than all others. Grahame Park was significantly higher rated than Hampstead and Brent Cross, which were not significantly different. This is an important backdrop to the following results as residents were clearly aware of local differences in air quality. The interview data also showed a strong awareness of different air quality in different places.

Self-reported health impacts

In the survey, respondents were asked if they suffered from any health problem or illness that they believe was caused by air pollution. They were offered 'yes', 'no' or 'don't know' as responses; these were later recoded into a binary variable of 'yes' against 'no/don't know'.

A multiple logistic regression was then performed to model this variable as the dependent variable, with gender, age, having asthma, chest problems, heart disease, rhinitis/hayfever, eczema, and area indicators all entered as covariates. The only variables to emerge as significant predictors in the model (at 95% confidence) were having asthma (OR = 5.358, $p = 0.000$); having other chest problems (OR = 3.832, $p = 0.038$); and having allergic rhinitis/hayfever (OR = 3.620, $p = 0.001$). Area of residence was not a significant predictor of

responses. This implies that residential pollution level was not significantly related to responses to this question.

Survey respondents were also similarly asked whether they suffered from any health problem or illness that they thought was made worse by air pollution. Performing a multiple binary logistic regression as above showed a similar result – the only significant predictors of responses were having asthma (OR = 8.263, $p = 0.000$); having other chest problems (OR = 4.437, $p = 0.021$); and having allergic rhinitis/hayfever (OR = 7.300, $p = 0.000$). Having eczema was less significant but perhaps worth note (OR = 2.452, $p = 0.082$). Again, area of residence was not significantly associated with responses.

Given that asthma, chest problems and allergies are among the conditions that would be expected to be those through which people would feel affected health-wise, it is perhaps not to be expected to find an area effect over and above that operating through these conditions. However, bivariate analyses, not controlling for the presence of these conditions, also showed no relationship with area of residence.

The qualitative data also sheds some light on these findings. From the interviews, it was apparent that people experience air quality and air pollution in many places in their day to day lives, including where they work, shop and socialise, and it was in these places as well as at home that they might feel affected by air pollution, for example:

Janet (Brent Cross): I mean Cricklewood Broadway, where I go to do most of my shopping, there's lots of local shops there you know.....I go down to Cricklewood, and the traffic down there is very bad as well, so you do notice the air quality down there, because its quite, its very, you know, blatant,

Interviewer: how can you tell?

Janet: I can, because I mean, it affects me, I'm actually affected quite,...I think I'm slightly, erm, slight allergy, hayfever type thing, yeah. And you can notice, the symptoms get worse when you're, you know.

Mrs C (Totteridge): 'Cause I used to do some postgrad research at the Institute and I used to walk through from Euston, but I could hardly walk, I worked in Somerstown doing the [...] work, and I used to feel quite poorly most of the time, and I thought it was pollution.

Behavioural changes because of pollution

In the survey, respondents were given a list of 8 possible actions that might be taken because of air pollution, and asked how often they would undertake that action, due to air pollution. The list was compiled from actions that had been talked about by participants in the interviews. Survey respondents were asked to rate frequency of each action on a scale from 1 = never to 5 = always.

There were few differences between the study areas. Those in Hampstead Garden Suburb (high s.e.s., high pollution) kept their windows closed significantly more than those in Totteridge (high s.e.s., low pollution) – means 2.71 vs. 1.96, $p = 0.003$.

The greatest modifications in behaviour were again by people with medical conditions, with those with asthma making the greatest adjustments. The following table shows the mean frequency rating for those with and without asthma for those actions for which there was a significant difference, with t test and p values. The smaller degrees of freedom for some indicate that Tamhane's test was used (rather than Tukey's) due to unequal variances in the two sets.

Action	Mean Asthma	Mean No asthma	t	d.f.	p
avoid going out	1.67	1.29	2.220	37.95	0.032
keep windows closed	2.70	2.24	2.153	191	0.033
take medication	3.57	1.71	8.297	190	0.000
drive rather than walk	2.43	1.73	2.581	42.7	0.013

Those with rhinitis type allergies also kept windows closed more frequently (mean = 2.67 cf. 2.17, $p = 0.005$) and took medication more often (mean 2.84 cf. 1.72, $p = 0.000$). It should be noted that some people would have had both asthma and rhinitis/hayfever and so these effects may not be independent.

Impacts in geographical context

The quantitative data, as the above examples show, showed few differences between the study areas in terms of the felt impacts of pollution. However, from the interview data, where the participants were not constrained by pre-defined impacts and set a choice of answers, and could explain themselves at length, some differences between the areas did emerge.

A comparison between Hampstead Garden Suburb and Brent Cross – the two areas of high pollution – brings out an interesting point, which is that other features of the surroundings can affect how much people suffer the nuisance of pollution. This may not affect how much they feel compromised in terms of definable health conditions but nevertheless relates to the overall impact pollution may have. Residents of Hampstead Garden Suburb who had large houses and gardens and lived in an otherwise green and pleasant neighbourhood felt to some extent protected from pollution:

Karen: I mean you've got the main road so I'd say, in terms of pollution and so on then that, [...] but you sort of mask that fact because you've got a nice garden and you forget that you've got juggernauts going down the road, because you've got a nice garden and park and so on.

Omar: this is the old A1 [major national transport route], as you know, I'm right on top of it, there's nothing I can do, but the saving grace is that I do have a garden which I enjoy at the back, and around, also around the place, so one can relax, and er in that sense I think that it is healthy.

This compared with residents of Brent Cross who talked much more about accepting pollution and getting used to it:

Nigel: I'm probably not getting the real natural fresh air because of all the traffic, but apart from that you know it's not too bad. It's just something you have to live with isn't it.

Thus it was apparent that features of the place where people lived – particularly open space and greenery – had a role in how much people felt the effects of living in a polluted area. Being able to retreat into a larger house with more personal space, screening and double glazing was also important in this respect.

DISCUSSION

These results have several implications for the conceptualisation of environmental (in)equity and how it may be played out. Firstly, there is an inference that residential concentration may not be the dominant factor in determining how much people feel the effects of pollution – because people encounter pollution in many places as they move through their daily lives. Even if people live in an unpolluted area, they may work or shop in a polluted place. The assumption in mapping-based studies, as discussed above, that residential exposure is an indication of actual exposure, is thus indeed shown to be problematic. It seems here that people housed in more polluted environments may not on average feel greater health impacts or make more behavioural changes. This is not to say that a situation of unequal distribution does not need attention, but that the effects of people's daily mobility, and where they encounter pollution, needs more examination.

Running somewhat counter to this, however, is the inference that the place where people live can affect how the impacts of pollution are felt. This becomes particularly apparent when the impacts of pollution are broadened to include nuisance and bother, rather than just defined medical conditions or concrete behavioural changes. People living in a pleasant area with gardens and open space around with plenty of trees felt buffered from the effects of pollution. Such areas are most likely to be inhabited by people of higher socio-economic status, and so this provides a mechanism by which inequity linked to social deprivation may be played out. However, it is important to note that this is because through this mechanism, *at the same given level of pollution*, people in a built-up, less spacious and green environment will feel a certain kind of impact more. Thus if poorer people do also suffer from greater residential pollution, these effects will compound, in terms of the amount of nuisance suffered when at home.

The point that effects may be different at the same level of pollution is important for the conceptualisation of environmental equity, as noted at the start of this paper. Equity in terms of distribution may not therefore produce equity in terms of burden. The third important point from the results presented here is that those who feel the greatest health effects and make the most behavioural modifications due to air pollution are those with asthma, chest problems and allergic rhinitis. These are arguably the people who are bearing the greatest burden in terms of the felt effects of air pollution. It should be added here that although some of the effect relating to rhinitis could be attributed to hayfever sufferers including pollen in their understanding of air pollution, it also became clear from the interviews that many people felt that air pollution from traffic could make their existing allergies, including hayfever, worse. Clinical evidence would also support this view (e.g. Diaz-Sanchez et al 2000; Knox et al 1997). It is however, interesting to note that people with heart disease did not appear to feel a

greater impact, although clinical evidence indicates that heart disease is one of the conditions that makes people most vulnerable to the effects of pollution. This is a point that would bear further investigation, as there were relatively few people with heart disease in this study sample, but it may need addressing in terms of a possible gap between clinical and lay knowledge.

CONCLUSIONS AND POLICY IMPLICATIONS

Studying the impacts of air pollution from an experiential viewpoint shows different process at work which create a more complex picture in terms of environmental equity.

In terms of who feels the effects of pollution the most, asthma, chest problems and allergy sufferers emerged as a clear group who experience the greater burden.

It is also the case that the burden of poor air quality may be either amplified or ameliorated by other attributes of the environment, and this operates to the effect that more deprived people are likely to feel the nuisance of air pollution in their local area more, whilst, although better-off people may sometimes suffer from high residential pollution, they can to some extent retreat from the nuisance.

However it also became clear that people experience air pollution in many places apart from where they live, and so the overall impacts of air pollution depend also on people's mobility, where they go and how they get there. This seems to be particularly true when accounting for medical conditions by which people feel the effects of pollution.

This type of study in particular highlights that some assumptions of a mapping based approach, i.e. that residential concentration is an indicator of dose, and that equal concentration/dose means equal effects, are indeed in need of more examination – although I acknowledge that mapping studies have been, and are, very important and valuable in environmental equity work. Studying the experiential dimension however and the use of different methodologies can expand the understanding of how inequity may operate and is experienced.

In terms of policy implications, these preliminary results would point to the value of an approach to pollution control which aims to reduce pollution in places where many people go, particularly for example shopping centres or areas where workplaces are concentrated. The results also indicate, interestingly, that even where pollution control is difficult, impacts, and indeed inequity, may be reduced by attention to other features of the environment, particularly the amount of trees and greenery present. Finally, the particular protection of individuals with asthma, chest problems and allergies is difficult to achieve, but these conditions do tend to be more prevalent in children and the elderly, so attention could be paid to reducing pollution as much as possible around for example schools, day centres and areas where the elderly are housed, in order to promote environmental equity.

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