METHOD AND ASSUMPTIONS FOR ESTIMATION OF MORTALITY FROM AIR POLLUTION IN SOUTHAMPTON

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It is very challenging to estimate the number of premature deaths that are caused annually by poor air quality. I have estimated – perhaps controversially - that approximately 200 mortalities in Southampton should be attributed to air pollution per year. For the purposes of clarity, and also to stimulate debate, I have outlined the rationale behind this estimate below.

METHOD AND ASSUMPTIONS

I've estimated local mortality burdens associated with particulate air pollution (using a Public Health England method) for Southampton. The background data comes from authoritative sources such as the Office of National Statistics. The number of attributable deaths relating to particulate matter (PM) for Southampton range from approx. 110 to 102 between 2010 and 2013 (the most recent year for which I can get decent data). These data are routinely reported but what most people do not realise is that in these calculations, only deaths linked to fine particles[1], less than 2.5 μm in diameter ($PM_{2.5}$), have been estimated.

Hence the annual death toll from ALL air pollution is likely to be substantially higher because the effects of nitrogen dioxide and other pollutants emitted during fossil fuel burning are not being accounted for. At present, there is no method for taking into account attributable deaths for all pollutants. And frankly, real exposure to air pollution isn't taken into account at all, especially acute exposures to elevated concentrations.

It has been estimated (by reputable authorities) that the relative risks of $PM_{2.5}$ and NO_2 are similar. In the UK, scientists work on a 6% rise in mortality for a 10 μg m^{-3} increase in the atmospheric $PM_{2.5}$ concentration. The World Health Organisation's (WHO) Health Risks of Air Pollution in Europe report put the equivalent mortality increase for NO_2 at 5.5%. But annual average concentrations of NO_2 are higher than

[1] Particulate matter, or PM, is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particles less than 2.5 micrometers (μm) in diameter ($PM_{2.5}$) are believed to pose the greatest health risks. Because of their small size (approximately 1/30th the average width of a human hair), fine particles can lodge deeply into the lungs.

those for $PM_{2.5}$. Hence, you might expect to get a bigger number for NO_2 than for $PM_{2.5}$. Of course, it is not as straightforward as that - more polluted places usually have higher concentrations of both pollutants and both affect mortality and it can be difficult to separate the effects. The WHO has suggested that the overlap could be as much as 33% and also recommend only calculating the impact of NO_2 when concentrations exceed 20 μg m^{-3}.

And it gets more complex. Research suggests that the impacts of air pollution go beyond respiratory and cardiovascular disease. For example, the European Study of Cohorts for Air Pollution Effects project showed that living near polluting major roads increased the chances of lung cancer. The WHO's International Agency for Research in Cancer formally classified outdoor air pollution as a carcinogen, causing both bladder and lung cancers. And so on.

So bearing all this in mind, let's do a rough 'n' ready back of the envelope calculation - for argument's sake.

For Southampton in 2010, ~110 people died early because of $PM_{2.5}$. The relative risk for NO_2 is similar so it seems reasonable to assume that approx. 110 people died from long-term exposure to NO_2. But about 1/3 is overlap. This gives us about 150 deaths attributable to $PM_{2.5}$ and NO_2. BUT this ignores all the other pollutants AND the fact that air pollution also causes other diseases that tend to be ascribed to other causes. If 1% of the remaining deaths are down to other air pollution, this gives another 16 deaths. If 3% of the remaining deaths are down to other air pollution, this gives 48 deaths. I think it is perfectly reasonable – and in fact quite conservative - to assume that if an attributable fraction (AF) of 5.5-6% applies to $PM_{2.5}$ and NO_2, then we can apply an AF of 3% to all other air pollutants. This gives me the overall annual value of approx. 200 deaths.

CONCLUSION

I accept that my estimate is based to some extent on assumptions and sticking my finger in the air. I accept that is isn't the most scientifically robust method of estimating mortality. But I'm very confident that the real number of annual deaths attributable to air pollution in Southampton is much closer to 200 than 110. I'm willing to risk my academic reputation by stating this publicly. I'm also willing to be held accountable if I'm subsequently shown to be wrong. Watch this space!