Air quality in early childhood: the impact on later life outcomes

From the end of the 1960s, government regulations on air pollution have become increasingly strict, leading to sharply improved air quality in many places. Research shows that better air quality improves neonatal health and reduces infant mortality (see Currie, 2009). But previous studies have not generally been able to assess the long-run effects of exposure to poor air quality in early life on the surviving infants and children.

Since relatively few children are on the life/death margin at birth, the total cost of air pollution could be much higher if other effects are taken into account. For example, many pollutants are 'neurotoxicants', which even at low levels of exposure can impair children's development. Psychological or behavioural problems not noticeable at birth or in early childhood may become apparent later on.

My study focuses on the causal impact of early childhood air lead exposure on later life outcomes (Nilsson, 2009). Merging unique data on local air lead levels in early childhood with comprehensive population micro data, it is possible to follow all the children in nine birth cohorts from birth through school and examine their experiences in the labour market as young adults.

The outcomes considered include scholastic performance, cognitive ability test scores, educational attainments and early labour market outcomes. These outcomes have previously been shown to be predictive of subsequent outcomes through the life cycle, and should therefore be particularly interesting from a public policy perspective.

Since the blood lead levels of Swedish children at their peak in the early 1970s were, on average, *lower* than the current limit suggested by the World Health Organisation, Sweden's experience is particularly interesting. It essentially provides a direct test of the relevance of the currently prescribed limit.

The local air lead pollution measure stems from a previously unexplored data source. Since the early 1970s, the Swedish environmental protection agency has conducted 'moss' surveys with a high spatial resolution across Sweden to examine regional differences and trends in heavy metal depositions. Moss lead levels are a good predictor of blood lead levels in children (Nilsson et al, 2009).

Although there is a consensus on the health impact of high levels of lead exposure on adult health, the association between lower levels of lead exposure in childhood and cognitive development is still under debate. The main reason is that lead exposure is not randomly distributed across locations.

Lead exposure early in life has significant effects on future educational attainments and labour market outcomes

Parents with high incomes or preferences for cleaner air are likely to sort into areas with better air quality and hence their children are less likely to be exposed to high levels of lead pollution. Failing to account for residential sorting of this kind can result in an overestimated effect of lead exposure on children's subsequent outcomes.

To mitigate this concern, my study focuses on children born between the early 1970s and the mid-1980s. The reason is that during the 1970s, along with many other developed countries, Sweden initiated a gradual phase-out of leaded gasoline to protect the environment and public health.

The main reduction in gasoline lead levels in Sweden occurred between 1973 and 1981, when the maximum lead level per litre of gasoline dropped by 79%. Since gasoline lead was the main source of lead exposure in the general population, children's blood lead levels decreased drastically from the 1970s until the mid-1990s when leaded gasoline was finally banned.

Due to substantial differences in initial lead levels, the phasing out of leaded gasoline meant that there was substantial variation across localities in the reduction of lead exposure. My analysis exploits the differential changes in early childhood lead

What are the long-run effects of exposure to poor air quality in early life? *Peter Nilsson* looks at the later life outcomes of people born in Sweden in the 1970s, a period in which regulations on leaded gasoline gradually reduced the lead content in the air and in children's blood.

exposure for the cohorts born between 1972 and 1984.

I compare changes in the outcomes of children born in municipalities that experienced large reductions in lead exposure with changes in the outcomes of children born in municipalities with only minor changes in air lead levels. By exploiting these differential changes in exposure across birth cohorts within the same municipalities, unobserved differences between the municipalities are taken into account.

My results suggest that low levels of lead exposure early in life have both statistically significant and economically important effects on future educational attainments and labour market outcomes. A key finding is a seemingly nonlinear relationship between local air lead levels in childhood and long-term outcomes at the relatively low levels of exposures considered.

Above an estimated municipality average early childhood blood lead level of 5 microgram/dL, reductions in lead exposure have a consistently positive and significant impact on long-term outcomes. Below this level, further reduction no longer seems to affect adult outcomes in a consistent or significant direction.

Children from poorer families have benefited relatively more from gasoline lead reductions

The estimated effects imply that by reducing average blood lead levels between ages 0-3 from 10 microgram to 5 microgram/dL, for example, high school graduation rates would increase by 2.3% and earnings at age 30 would increase by approx. 0.5-1% on average.

I also find that children from poorer families seem to have benefited relatively more from the gasoline lead reductions. Although data constraints prohibit a full differentiation of the mechanisms behind the differences in socio-economic status, a key finding is that residential segregation within municipalities (and thereby potentially differential neighbourhood lead exposure levels) *does not* seem to be able entirely to explain the different effects of lead.

Instead, different avoidance behaviour, differences in sensitivity to the same levels of exposure or differences in the ability to compensate for the effects of early lead exposure seem to be more plausible explanations for the relationship between socio-economic status and the impact of decreasing lead exposure.

Environmental policies may act as an instrument of redistribution by improving long-term outcomes disproportionally for disadvantaged children

Further analysis will potentially reveal which one of these pathways matters most. The current results indicate that environmental policies may be able to reduce the intergenerational correlation in economic outcomes. They could potentially function as a redistributive instrument since they seem to improve long-term outcomes disproportionally among children of lower socio-economic status.

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Further reading

Currie J (2009) 'Healthy, Wealthy, and Wise: Socioeconomic Status, Poor Health in Childhood, and Human Capital Development', *Journal of Economic Literature* 47(1): 87-122.

Nilsson, JP (2009) 'The Long-term Effects of Early Childhood Lead Exposure: Evidence from the Phase-out of Leaded Gasoline', mimeo, Uppsala University.

Nilsson, JP, S Skerfving, S Stroh and U Strömberg (2009) 'Pollution by Lead as Reflected in Moss and Children's Blood', mimeo, Uppsala University.