The scourge of Asian flu: effects of *in utero* exposure

In the late 1950s, Britain was struck by the Asian influenza pandemic. *Elaine Kelly* examines the consequences for children who were *in utero* at that time. Her findings are revealing about the channels by which health conditions experienced in the womb influence later life outcomes.

The foundations for lifelong health and acquisition of education and skills are laid in the womb. Economists have typically tried to understand the influence of 'the intrauterine environment' on later life outcomes by analysing circumstances in which there have been sharp and random shocks to foetal health conditions.

For example, work on the devastating Spanish flu of 1918-19 has established that exposure to pandemic influenza is one such potential shock. Almond (2006) finds that people exposed during the first or second trimester of their mothers' pregnancy were less likely to complete high school, had consistently lower earnings, received higher welfare payments and had higher rates of incarceration than would be expected.

My research examines the impact of intrauterine exposure to the Asian influenza pandemic of 1957-58 on outcomes at birth and in childhood (Kelly, 2009). Asian flu began in China and although it was far milder than Spanish flu, between one and two million perished worldwide.

When the pandemic struck Britain in the autumn of 1957, the children in the National Child Development Study (NCDS) were at between 15 and 25 weeks in gestation. The NCDS follows a panel of over 17,000 individuals born in Britain in one week in March 1958. My study uses data from the first three waves of data gathering on these individuals, conducted in 1958, 1965 and 1969.

Outcomes at birth are measured by birthweight and gestation. Birthweight is used for two purposes: first, as an indicator of whether the effects of the epidemic can be detected at birth; and second, to assess whether outcomes measured at birth capture the effects of foetal health shocks on subsequent development. At ages 7 and 11, the outcomes used are cognitive test scores and height in metres.

The epidemic is measured using a surrogate influenza infection rate in the cohort members' local authority of birth, namely, official pneumonia notifications per 100,000 population (see maps). The impact of Asian flu on outcomes is identified using variation in the intensity of the epidemic measure across the 172 local authorities. All estimations include controls for children's background and for the health and socio-economic characteristics of the local authorities.

The study adds to the research on Spanish flu by providing results for outcomes at birth and in early childhood. But the more substantive contributions stem from the panel structure of the NCDS.

Exposure to Asian flu had a significant and negative effect on birth outcomes for some children

Two issues are addressed in detail: first, the extent to which the effects of the epidemic on childhood outcomes are captured by birthweight; and second, the role of maternal health in moderating the effects of influenza. The principal aim is to gain some information on the mechanisms that might link foetal health shocks to subsequent outcomes, and the findings are as follows.

Birth outcomes

Asian influenza had a significant and negative effect on birth outcomes, but only for the offspring of mothers with certain health characteristics. There was no effect of the epidemic on average birthweight, gestation or intrauterine growth (birthweight corrected for gestation).

But analysis of interactions between the epidemic and two indicators of maternal health – pre-pregnancy smoking and adult height – shows that negative effects on birth outcomes were confined to particular groups of women: those that smoked before pregnancy; and those who were 61 inches (155 cm) or shorter.

Smoking weakens the respiratory system, increasing the risk of infection and the severity of symptoms. Height is an indicator of

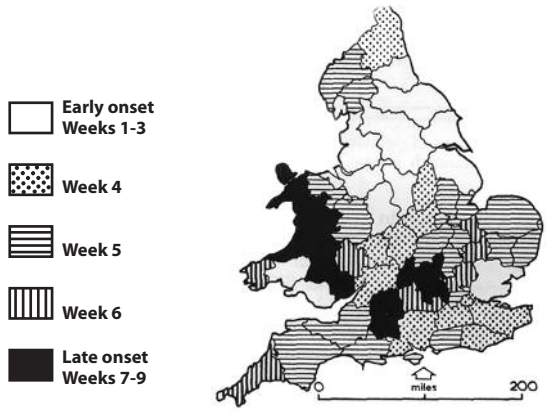

Figure A: Spatial timing of the epidemic

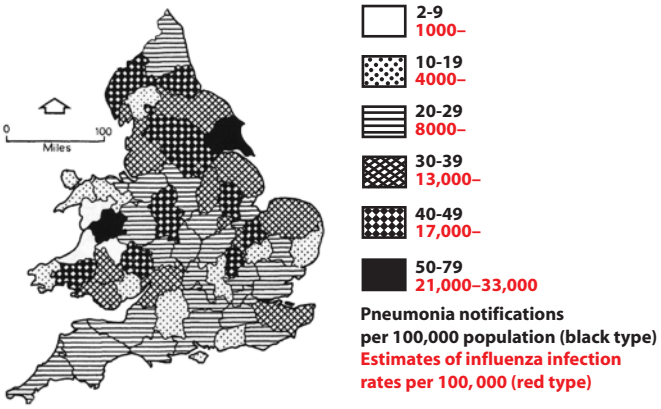

Figure B: Total incidence of the epidemic

the long-run nutritional status of the mother, and therefore the store of nutrients from which the baby can draw.

Outcomes at ages 7 and 11

The epidemic had significant effects on average test scores at age 7 and 11: a one standard deviation increase in epidemic intensity reduces test scores by 0.06 standard deviations at 7 and 0.05 at 11. By way of comparison, Rockoff (2004) finds that a one standard deviation increase in teacher quality increases reading and maths test scores by 0.1 standard deviations.

These effects are general, and do not vary with cohort member characteristics, including maternal health, socio-economic background and measures of parental investment.

The epidemic also had negative effects on children's height at 7 and 11 but only for the children of smokers.

Does birthweight mediate the impact of the epidemic on test scores?

The effects of the epidemic on childhood height and test scores do not operate through, and are not captured by, birthweight. The association between birthweight and later physical and cognitive outcomes is well documented by medical and social science research, but it remains poorly understood. My results suggest that birthweight should not be viewed as a catchall measure of influences on development prior to birth.

Transmission mechanisms

The effects of Asian flu appear to have operated through two distinct channels. Physical development growth is impeded where mothers are unable to compensate for interruptions in nutrition (indicated by maternal height) or when symptoms are plausibly more severe (through maternal smoking). The effects on cognitive development are more general, and may be related to the inflammation that typically accompanies a flu infection.

The implications of these results are threefold:

First, the effects of foetal health shocks are not necessarily observable at birth. In particular, there may be no effect on an individual's birthweight or gestation. It may therefore take years or decades before the full ramifications of a particular health shock become clear.

Second, the effects of a foetal health shock might vary considerably across those who are exposed.

Third, maternal smoking plays the most consistent role in moderating the effect of the epidemic on physical growth. The negative interaction between smoking and influenza emerges at birth, and continues into adulthood. Whether these results are attributable to smoking during pregnancy or to the damage caused by previous smoking behaviour, it is not possible to determine using these data. Women are already advised not to smoke during pregnancy. My results perhaps provide one more reason to give up.

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Further reading

Almond, D (2006) 'Is the 1918 Influenza Pandemic Over? Long-term Effects of in utero Influenza Exposure in the Post-1940 US Population', *Journal of Political Economy* 114(4).

Kelly, E (2009) 'The Scourge of Asian Flu: in utero Exposure to Pandemic Influenza and the Development of a Cohort of British Children', IFS Working Paper No. 09/17.

Rockoff, JH (2004) 'The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data', *American Economic Review* 94(2): 247-52.