

# The Lasting Impact of Parental Early Life Malnutrition on Their Offspring: Evidence from the China Great Leap Forward Famine

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**Summary.** — We investigate whether the effects of parents' *in utero* malnutrition extend to the second generation (their children). Specifically, we explore whether the second generation's level of schooling is negatively impacted by their parents' malnutrition *in utero*, using the China Famine as a natural experiment. We find that, the impact of mother's *in utero* malnutrition due to the Famine reduced second generation male and female entrance into junior secondary school by about 5–7 percentage points. We measure famine severity with provincial excess death rates instrumented by measures of adverse climate conditions, which corrects for possible biases induced by measurement errors and omitted variables. Our findings indicate the existence of an important second-generation multiplier of policies that support the nutrition of pregnant women and infants in any country where nutritional deficiencies remain today.  
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**Key words** — fetal origin, malnutrition, schooling, Barker hypothesis, China Famine

## 1. INTRODUCTION

While much has been learned about the long-term effects of malnutrition on adult outcomes of the first generation (Barker, 1997; and much subsequent research), much less is known about second-generation outcomes. There is substantial evidence that poor infant health, often associated with infant malnutrition, portends serious consequences for the development of human capital throughout an individual's life (Alderman, Behrman, Lavy, & Menon, 2001; Currie, Stabile, Manivong, & Roos, 2010; Handa & Peterman, 2007; Oreopoulos, Stabile, Walid, & Roos, 2008). It should not be surprising, then, that poor infant health may frequently be associated with a parent's early-life malnutrition experience.

There are two potential paths through which first-generation's early-life malnutrition shocks may impact the human capital accumulation of the second generation: First, the child of a famine-born parent (or of a parent who experienced famine in early infancy) may suffer due to famine-induced defects in the parental reproductive system (ova or sperm) (direct channel—see Figure 1). Epidemiological studies suggest that “adverse *in utero* experiences may permanently affect maternal growth and development, altering [the mother's] metabolism in such a way as to provide an adverse environment for her fetus (Drake & Walker, 2004).” Drake, Walker, and Seckl (2005) report second-generation impact of patrilineal nutritional shock in rats. Patrilineal transmission of *in utero*

shock to the second generation is reported by Franklin *et al.* (2010) in animal laboratory experiment, and Pembrey (2010) summarizes second-generation patrilineal impact of variation in food supply to the second generation of humans based on Swedish data.

Second, parents born around the time of famine tend to acquire lower social and economic status (SES) than those born outside the famine period and this in turn may lead to lower human capital development among their children than the children would otherwise acquire (indirect channel). Deficiencies in scheduled brain and body development in prenatal periods of life are likely to have cumulative effects on the productivity of future investments and, hence, the lifetime accumulation of human capital. Moreover, acquired schooling, earning capacity, income, available marriage partners, and other factors affecting child-rearing potential are likely to be negatively impacted by *in utero* exposure to famine (Victoria *et al.*, 2008). Using the 2000 China Census, Almond, Edlund, Li, and Zhang (2010) show that men and women born during the China Famine are more likely to be illiterate, not working, and to live in smaller houses. There is abundant evidence that socioeconomic characteristics of parents including their schooling and income are related to the schooling of their children. Evidence of such socioeconomic impacts on chil-

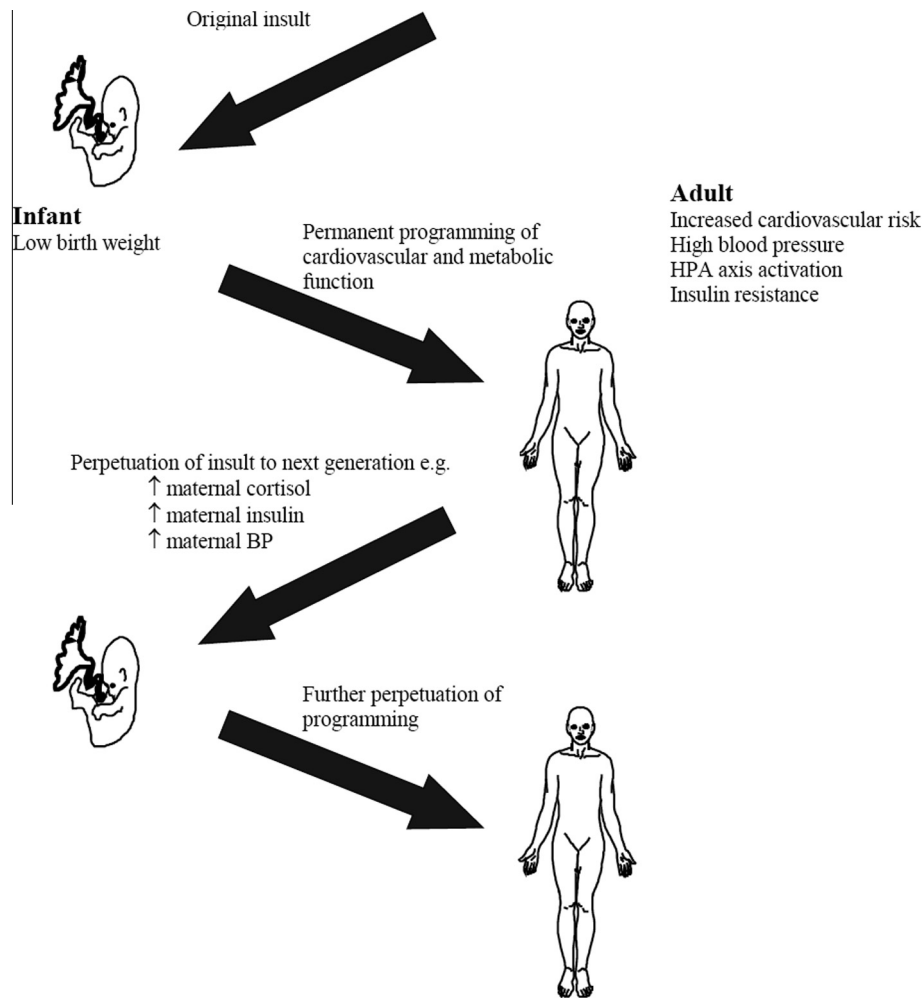


Figure 1. First- and second-generation direct effects of fetal programming. Note: Drake et al. (2005) report second-generation epigenetic effects of *in utero* exposure to nutritional shock through the male line as well. Source: Drake and Walker (2004).

dren's schooling in China and references to the broader literature can be found in Heckman and Li (2004), Hannum and Wang (2006), and Wang, Fleisher, Li, and Li (2011).

In this paper, we report evidence from the China Great Leap Forward famine (China Famine) that parental *in utero* malnutrition adversely impacts the human capital of their offspring (the second generation). The China Famine, generally recognized as the worst in world history as measured by mortality and length (Li & Yang, 2005), provides a natural experiment from which information on second-generation effects of malnutrition, depicted in Figure 1 as "perpetuation of first-generation insult" can be obtained.

Specifically, we find that both female and male offspring of parents who were born in the Famine years are less likely to enter junior secondary school, and this impact is quantitatively important. Approximately a 5–7 percentage point smaller proportion of the children of mothers from the most severely famine-impacted provinces enter junior secondary school than would otherwise have done so. Our findings of the existence of second-generation effects on human capital development imply extended benefits for policies that support the nutrition of pregnant women and infants in any country where nutritional deficiencies remain today.

In earlier work, we examined health outcomes using data from the China Health and Nutritional Survey. The qualitative results for health outcomes using the CHNS are

consistent with our findings on education outcomes (i.e., *in utero* exposure to famine negatively affects measures of health in the second generation.) However, usable sample sizes are small (fewer than 800 observations meeting criteria required for this research), and the estimated effects are imprecise. We do not have comparable health measures from the census data. Additional reasons for focusing on middle school enrollment are: (a) elementary school enrollment in China is mandatory, and (b) there are many children who leave their family when they enter high school, and thus they do not appear in our sample (some of them left their home to work in urban areas or some left their home to study at a more prestigious high school.).

Ideally, the severity of malnutrition would be better measured by caloric intake measured at an individual level. Unfortunately, we do not have such data, and thus we follow the literature with our key assumption that the provincial excess death rate (EDR) around the famine years is a reasonable proxy for the severity of malnutrition.

The rest of this paper is organized as follows. The next section presents a brief history of the China Famine. Section 3 reviews literature related to the impact of the famine on first-generation human capital and labor market outcomes; Section 4 discusses methodological issues and presents our analytical framework; Section 5 describes the data and sample selection; Section 6 reports the estimation results, and Section 7

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