Fetal Origins of Covid-19 Mortality. Evidence from Peru

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Abstract

In this study, we exploit the Cholera Epidemic in Peru in the early 1990s as a quasi-natural experiment to explore whether prenatal circumstances increase the risk of Covid-19 mortality. We find that a one-standard deviation increase in the exposure to Cholera during the first trimester in-utero increases the likelihood of working-age women to die of Covid-19 by 21 percent. As potential mediators we find a significant effect on BMI, obesity rates and high blood pressure, as well as on self-employment. In-utero infection with Cholera can result in nutritional deprivation, moreover, the epidemic represented an income and stress shock for many mothers, hence some, or a combination, of these factors could have prompted the results.

Introduction

Covid-19 has generated more than 1 million deaths worldwide. While there is an important and fast-growing literature about the consequences of the pandemic, the literature addressing the determinants of Covid-19 mortality is surprisingly small. In this study, we aim to contribute to this literature by investigating whether early-life, in particular prenatal, circumstances play a role in Covid-19 mortality and other long-term outcomes. We exploit the Cholera Epidemic afflicting Peru in the early 1990s as a quasi-natural experiment for variation in such circumstances.

From Prenatal Exposure to a Cholera Epidemic to Adult Covid-19 Mortality. Potential Mechanisms

Prenatal exposure to a Cholera Epidemic can have long-term effects, for several reasons. First, Cholera resembles acute starvation in effects, since it reduces dietary intake and intestinal absorption of nutrients (Brown, 2003). Intrauterine starvation can lead to long-term obesity and cardiovascular diseases (Barker, 1990). In turn, obesity and cardiovascular diseases are risk factors for Covid-19. Second, there is evidence that prenatal and early-life nutrition also have long-term detrimental effects on education and labor market outcomes (Almond and Currie, 2011). In turn, less educated individuals and the self-employed are less likely to comply with lock-downs and social distance measures, making them more vulnerable to Covid-19 (Bel, 2020, Wiemers et al., 2020). Finally, as with most epidemics, the Cholera Epidemic in Peru represented an income and stress shock for many families (Cueto, 2017), and there is also evidence of the detrimental long-term effects of those type of shocks (Almond and Currie, 2011). Moreover, an epidemic can overwhelm the healthcare system, reducing its ability to attend to patients, including pregnant women (Ritter and Sanchez, 2020).

Data and Empirical Strategy

Sources of data used in this paper are: Cholera cases from the Report General Directorate of Epidemiology 2011 of the Ministry of Health of Peru, Covid data from the Sistema Informatico Nacional de Defunciones, and the Peruvian Demographic and Family Health Survey from 2009 to 2018.

We apply a Difference-in-Difference approach exploiting the variation in Cholera incidence across cohorts (month-year) and regions before and during the first year of the epidemic (1991). The spread of the disease throughout different regions of the country over time, in particular in the first year of the epidemic, was largely determined by their geographic proximity to the first cases. The locations of the first cases were close to random: they appeared in a couple of coastal cities, apparently because the bacteria originated from the Pacific Ocean.

We estimate the following specification:

$$Y_{r,m,t} = \beta_o + \beta_1 Ch^{1tr}_{r,m,t} + \beta_2 X_{r,m,y} + \alpha_r + \rho_{my} + \phi_r t + \epsilon_{r,t} \quad (1)$$

where $Y_{r,m,t}$ stands for the outcome of women born in month m, and year t, who currently live in region r. $Ch^{1}_{r,m,t}$ stands for the cholera incidence corresponding to the first trimester in-utero of the child. Our main model estimates the effect of exposure to cholera during the first trimester following the results in the epidemic literature. α_r stands for region fixed effects, $\rho_{m,t}$ stands for month-year of birth fixed effects, $\phi_r t$ stands for region-specific trends, and $X_{r,m,t}$ stands for the age of the woman and the temperature of by month-year and region. Standard errors are clustered at the regional level. P-values are obtained from Wild Bootstrap inferences, to correct for the small number of regions.

Results

Working-age adults (directly or indirectly) exposed to Cholera during the first trimester in-utero are more likely to die from Covid-19; a 1 standard deviation increase in the incidence of Cholera during the first trimester in-utero increases Covid-19 mortality by 0.06 over 1000 or 11 percent of working-age adults and 21 percent of women. Results are not statistically significant for men. Effects on infection rate are positive but not statistically significant. Later trimesters and after-birth exposure had no significant effects.

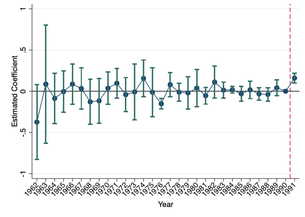

Figure 1: Event Study - Effect on Covid-19 Mortality - Working-age Women

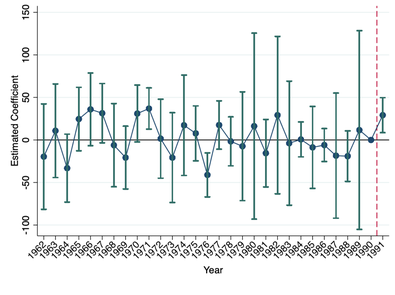

Figure 2: Event Study - Effect on Covid-19 Infection Rate - Working-age Women

As potential channels, we find that a 1 standard deviation increase in the incidence of Cholera during the first trimester in-utero among women increases:

– BMI by 0.3 kg/m2,
– obesity by 2 pp (8
– high-blood pressure by 0.2 pp (3
– self-employment in the service sector by 4.7 pp (6

We do not find significant effects on height and educational attainment. We do not have data for men.

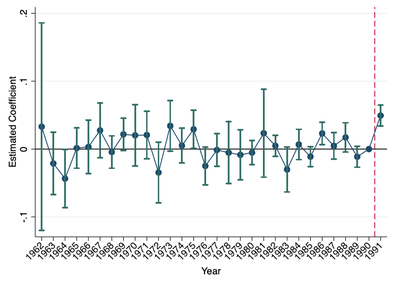

Figure 3: Event Study - Effect on Obesity Rate - Working-age Women

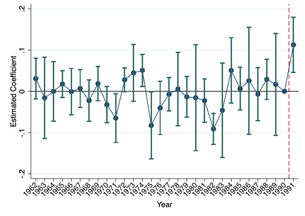

Figure 4: Event Study - Effect on Self-employment, Service and Retail - Working-age Women

Conclusions

With this study we aim to contribute in several ways. First, we aim to contribute to the understanding of the determinants of Covid-19 mortality. This study provides evidence that early-life circumstances can have a powerful impact on Covid-19 mortality. Covid-19, and similar epidemics, will be most likely part of the future (World Bank, 2017), and we still know very little about their main determinants. In this study, we cannot identify the exact mechanism(s). Future studies should provide more evidence about the effect of early life shocks on Covid-19 mortality and about the potential role of prenatal nutrition, parental investments and other behaviors as potential mediators.

Second, this study aims to contribute to the literature about the long-term consequences of epidemics, and, more precisely, Cholera epidemics. Cholera epidemics are far from over. In fact, Cholera epidemics have been the second most common type of epidemic in the world in the last two decades (Smith, 2014) and affect the poorest countries. The long-term consequences of obesity, self-employment and Covid-19 should inform policy makers about the additional very large costs of this type of epidemics and the urgent need to prevent them.

Finally, this study adds more generally to the literature concerned with the long-term effects of early-life shocks. Although the literature presenting evidence of long-term effects on human capital variables is quite large, there is little evidence of long-term effects on mortality, especially on the mortality of working-age individuals. This is especially important in less developed countries, where life insurance, labor benefits and institutional protection to widows is so meager that the death of a working-age member can throw a family into a poverty trap.

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