Examining the Quality-Quantity trade off: Evidence from a public health intervention in India

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Abstract

We examine the fertility response to a massive public health intervention in India during the 1950's that led to a sharp drop in malaria. Using cohort level variation in women of reproductive age to exposure to the malaria eradication program during 1950's we test whether the districts that were most burdened by malaria in the pre-eradication era experienced the largest changes in fertility, testing it both at the intensive and the extensive margin. Our main estimating strategy employs a difference in difference approach using the differences in pre eradication malaria endemicity controlling for district and time trends. Our results on the intensive margin find evidence of decline in fertility outcomes for women who have at least one child.

1 Introduction

This paper investigates the fertility response to a massive public health intervention in India during the 1950's that led to a sharp drop in malaria. We examine whether there were any significant impact on the fertility outcomes(quantity) looking both at the intensive and extensive margins. On the intensive margin we essentially test the hypothesis that with potential reduction of risk of mortality and morbidity outcomes led by the eradication initiative whether individuals reduce their fertility outcomes. Theoretical models predict that it is likely that

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individuals will reduce their precautionary demand to have more kids in the presence of risk thus reducing the total number of children they have in their reproductive life-cycle. The argument on the extensive margin is that reduced cost of bearing children in the form of reduced infant and maternal mortality can lead to a positive impact on fertility outcome for women without kids(going from 0 to 1). Our paper contributes to the growing literature that looks at the quality-quantity trade-off by examining this hypothesis in a developing country framework using rich micro level household and administrative level data across the country.

Using cohort level variation in women of reproductive age to exposure to the malaria eradication program during 1950's we test whether the districts that were most burdened by malaria in the pre-eradication era experienced the largest changes in fertility, testing it both at the intensive and the extensive margin. Our main estimating equation uses a difference in difference approach using the differences in treatment intensities. We include district and year level trends and a set of pre-intervention controls. Our results on the intensive margin find evidence of decline in fertility outcomes for women who have at least one child. The differences in differences estimates show significant negative impact on the intensive margin and no such impact on the extensive margin.

2 Conceptual Framework

Fertility is often higher in poorer families in a society with poor public health. A statistical relationship that has been of long interest to the demographers has been to study the relationship between decline in infant mortality, improved health outcomes and the rate of growth of population. (Schultz (1997); Eswaran (1998)) considers several mechanisms that impacts the paths of demographic transition in developing countries. Several models of family behaviour (Becker and Lewis (1974)) consider that parental decision on the quantity of children is associated with the quality of human capital they invest for each children.

As the literature notice the experience of developed countries with demographic transition from the phase of high fertility, high mortality to low fertility, low mortality facilitates economic growth. It is important to understand the causal mechanism of the positive relationship and empirically test if there exists any trade off between health environment and fertility.

The underlying mechanism that links health outcomes and fertility is that families in poor societies with high risk disease environment and low infant mortality and life expectancy are likely to increase the number of children they have to account for precautionary demand for old age security. If there is an improvement in the external disease environment coupled with the possibility of higher economic returns due to improved trajectory of lifetime health outcomes it is likely to reduce fertility.

Theoretical model that looks at this debate emphasize the link between child mortality in impacting fertility in mainly two ways. Increases in life expectancy can encourage more investments and can potentially reduce the precautionary demand for children due to reduction in survival uncertainty thereby lowering fertility. On the other hand an improvement in the prevalent disease environment with reduced infant and maternal mortality can potentially reduce the cost of child bearing and thus lead to increased fertility, specifically if the precautionary demand is low.

Bhalotra, Hollywood, and Venkataramani (2014) uses the change in fertility behaviour on both extensive and intensive margins exploiting the introduction of antibiotics in America that lowered both infant and maternal mortality. They find that the fall in infant mortality and improvements in child health reduced fertility in the white population.

Bleakley (2010) finds that early exposure to malaria lowers labour productivity and income using information on malaria eradication campaigns in US, Brazil, Colombia and Mexico. Cutler et al. (2010) examine the effects of early exposure to malaria on educational attainment and economic status in adulthood by exploiting geographic variation in malaria prevalence in India prior to a nationwide eradication program in the 1950. They use the digitized version of 1948 government map of India that classifies areas under six different categories of malaria endemicity to compare gains for cohorts before and after the program in areas with varying pre-eradication prevalence. They find modest increases in economic status for men. While they do not find any significant impact on human capital outcomes in education this could be driven by selection at survival. It could be possible that if the malaria eradication intervention resulted in bringing down infant mortality rates it is possible that weaker babies are able to survive and thus have a negative impact on the average human capital outcomes.

In this regard an eradication drive plausibly gives a source of external variation to disease environment and health outcomes that impacts fertility decision. The improvements in the public health space due to reduction in malaria could potentially improve returns to human capital investment through lifetime. Now, the investment decisions are often guided by the rate of return on such investments such as the child's productivity as an adult that can be impacted by the average mortality, morbidity outcomes in the society. There could be various potential channels acting behind this: prevention of early childhood and maternal infection during pregnancy can result in improved lifetime human capital outcomes for the children, reduction in school absences could improve learning outcomes, improved investments at the household level, increase work productivity and expenditure as adults.

Using the set up as used in Cutler et al. (2010) to identify exogenous improvements in disease environment we examine the causal question how does it impact the fertility behaviour of households. As pointed in Bhalotra, Hollywood, and Venkataramani (2014) it is important to look at change in fertility behaviour in both intensive and extensive margins that we are able to address that question in the current set-up. It would be very important to bring out whether the change in the disease environment has differential impacts on household fertility by their socio-economic vulnerability and preference for sex selection that we plan to examine additionally.

3 Data

The micro-data used in this survey are derived from the second round of the National Family Health Survey of India (NFHS-I) conducted in 1992-1993. This data-set contains complete fertility histories for ever-married women aged 13-49 years in 1992-93, including the retrospective time and incidence of child deaths. The data has information on the district of residence of the household. We have used this data-set to construct individual-level indicators of fertility at the extensive and intensive margin. The estimation sample contains children born to more than 66,000 mothers born over the period 1954-1993. The estimation sample contains children born to more than 66,000 mothers born over the period 1954-1993. Data on malaria endemicity comes from replication dataset of Cutler et al. (2010). The pre-eradication malaria map classifies areas into six endemicity categories and we classify the districts according to their maximum value of malaria prevalence. Table 1 shows the summary statistics. explain the summary statistics

4 Estimation Strategy

In order to find the effect of the fall in morbidity on fertility we exploit the malarial eradication program which took place in India during the 1950's. Cutler et al. (2010) argued that the most prevalent form of malaria in India is P.vivax which rarely leads to mortality. Urban areas were relatively unaffected by this eradication program (Cutler et al. (2010)). Thus we mainly focus on our rural sample and use urban areas for falsification tests.

Following Cutler et al. (2010) we use the national malaria eradication program in India during 1950's and exploit the geographic variation of the disease prevalence prior to the program. We use a difference in differences strategy to exploit the geographic variation in malaria prevalence prior to the program. We use malaria prevalence during the reproductive life of the woman on her fertility outcomes and examine whether the fertility behaviour was affected most at the high malaria endemic areas which supposedly benefitted most out of the eradication process. The underlying hypothesis being that prevalent disease environment impacts the desired number of children at the household level.

We use the maximum endemicity category for a district for classifying the overall endemicity. Additionally, we construct average malaria by taking the average and the minimum of the values for subcategories under a district. The results that we present currently is using the maximum value for a district to categorise its endemicity.

To start with we to do a simple DID analysis. The malarial eradication program stated in 1953 and by 1961 the entire country was brought under its coverage. First we estimate the effect of this program on fertility at the intensive margin. Given that fertility decisions are likely to respond to interventions with a lag, we compare mothers who gave birth before 1960 with mothers who gave birth after 1965.

The following equation is estimated for mothers who gave birth to more than one child.

$$Y_{idt} = \delta_d + \tau_t + \beta post_t \times base\ malaria_d + {X_{idt}}'\gamma + u_{idst} \tag{1}$$

where Y_{idst} is the dummy variable indicating whether a woman i in district d gave birth in the year t. post_c is again a dummy variable indicating whether the period t corresponds to the post eradication period, $base\ malaria_d$ denotes the pre-eradication endemicity in woman i's district d. *describe what malaria_max variable actually is.* X_{idst} includes a set of controls like a the scheduled caste, scheduled tribe and religion dummies. δ and τ are district and time fixed effects respectively. The main coefficient of interest is β.

To find the effect of this program on the extensive margin, we consider only mothers who gave birth to 0 or one child in their entire reproductive period. In order to ensure full coverage, we consider women who are older than 40 years in 1992-93 assuming that chances of births after 40 years is relatively low. We estimate the following equation:

$$Y_{id} = \delta_d + \beta exposure_{id} \times base\ malaria_d + \tau exposure_{id} + {X_{idt}}'\gamma + u_{idst} \tag{2}$$

where Y_{idst} is the dummy variable indicating whether a woman i in district d gave birth to one child and 0 if she did not give birth. exposure_{id} denotes the years of her reproductive life which the woman spent in the post eradication period (i.e. post 1965). $base\ malaria_d$ denotes the pre-eradication endemicity in woman i's district d. X_{idst} includes a set of controls like a the scheduled caste, scheduled tribe and religion dummies. δ denotes district fixed effect. The main coefficient of interest is again β.

The other channels that can impact fertility over time considering both the demand and supply side factors are through improved women's income earning opportunities, improved access to birth control measures, access to better financial instruments for old age saving. However if we believe that these trends are not systematically different for our high malaria prone districts we are able to address the concern by the inclusion of year and district fixed effects. Additionally, we are able to examine whether communities with potential bias for male children have any special dynamics of infant mortality post intervention period.

5 Results

Table 1 shows the summary statistics. To find the effect at the extensive margin we compare women with zero birth with women with just one child. Again in order to allow full exposure, we restrict our attention to women above 40 during the time of the survey. Thus the sample size gets substantially reduced in this case.

Table 2 presents our preliminary results. Columns 1 and 2 show the results for the intensive margin while columns 3 and 4 are for the extensive margin. Our preliminary difference in difference estimation results on the intensive margin (column 1) finds a significant negative impact on the probability of giving birth for women with at least one kid in post eradication period for high malaria endemic districts. The result holds true in our most demanding specification when we control for district and time fixed effects. The signs on the control variables are as per expectation. We find a negative and significant impact of household education level on the birth outcome. We find positive and significant relationship on birth for the scheduled tribe, scheduled caste and the muslim population arguably the vulnerable subgroups of population. As a falsification test we do not find any significant impact on the birth variable for our urban sample in column 2.

On the extensive margin (columns 3 and 4 of Table 2) we do not find any significant impact on changing the fertility outcome from 0 to 1 in post eradication period. It is plausible that the result on the extensive margin is not pronounced in a developing country context as we have very few proportion of married women without children to begin with.

The preliminary results are robust to district and time trends and a rich set of pre-intervention district and household level controls. We are currently investigating further specifications for examining whether this intervention impacted infant mortality as well as looking at whether the dynamics are systematically different for special vulnerable sections of population subgroups.

6 Conclusion

Economics literature provides limited evidence on the effect of child health improvements on fertility decisions of households in developing countries. In this paper, we attempt to find this effect by separately analysing the effect both at the internal margin as well as the external margin. Our preliminary evidence suggests that although there is no statistically significant effect at the external margin, health improvements significantly reduces fertility at the internal margin.

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Table 1: Summary Statistics

Variable	**Mean**	**(Std. Dev.)**	**N**
Fertility: Intensive Margin	0.102	(0.303)	1517828
Fertility: Extensive Margin	0.575	(0.495)	387
Maximum Malaria Exposure	5.012	(1.114)	1517828
Age of Woman	31.406	(8.568)	1517828
Woman's Years of Schooling	1.925	(3.386)	1517828
Husband's Years of Schooling	4.692	(5.149)	1517828
Muslim	0.102	(0.303)	1517828
Scheduled Caste	0.138	(0.345)	1517828
Scheduled Tribe	0.105	(0.306)	1517828

Notes: Standard deviations are in parentheses.

Table 2: Fertility and Disease Exposure

	(1)	(2)	(3)	(4)
	Intensive Margin		Extensive Margin	
	Rural	Urban	Rural	Urban
malaria_max_post1	-0.00326**	-0.00215		
	(0.00129)	(0.00147)		
malaria_max_exposure1			-0.000333	0.00315
			(0.0153)	(0.0120)
yrs_exposure1			0.0774	0.0754
			(0.237)	(0.193)
Observations	1517930	592382	387	242
r2	0.0585	0.0464	0.509	0.493

Notes: Standard errors in parentheses. Each column represents a separate regression. Fertility defined at the intensive margin is the dependent variable in columns 1 and 2. Fertility defined at the extensive margin is the main dependent variable in equations 3 and 4. Errors are clustered at district level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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