

Early-life Malaria Exposure and Adult Outcomes: Evidence from Malaria Eradication in India

Web Appendix

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A.1. The National Malaria Control Program

APPENDIX TABLE 1
Expansion of the National Malaria Control Program

	# Units established	# Units established (cumulative)	Population protected (cumulative, in millions)	% of population protected
1953-54	84.00	84.00	49.50	13.2
1954-55	26.75	110.75	79.90	20.9
1955-56	23.00	133.75	112.00	28.7
1956-57	35.50	169.25	144.50	36.3
1957-58	23.25	192.50	165.57	40.8

Source: NMEP (1986). A “unit” is defined as “a contiguous area comprising of one million population for undertaking anti-malaria activities” (NMEP, 1986). Since units are defined by population covered, they are not always in integers. The population statistics used to calculate the percentage of the population protected are from the United Nations Demographic Yearbook Historical Supplement. We use the 1953 midyear population figure for 1953-54, etc.

A.2. Declines in Malaria Prevalence During the Eradication Era

APPENDIX TABLE 2
National Malaria Prevalence over Time

	Population (in millions)	Malaria cases (in millions)	% of population with malaria	# Deaths
1947	344	75	21.8	800,000
1965	483	0.1	0.02	0
1976	616	6.5	1.1	59
1984	735	2.2	0.3	247
1994	900	2.5	0.3	1122

Source: NMEP (1986), NMEP (1996). The population statistics used to calculate the percentage of the population with malaria are from the United Nations Demographic Yearbook Historical Supplement.

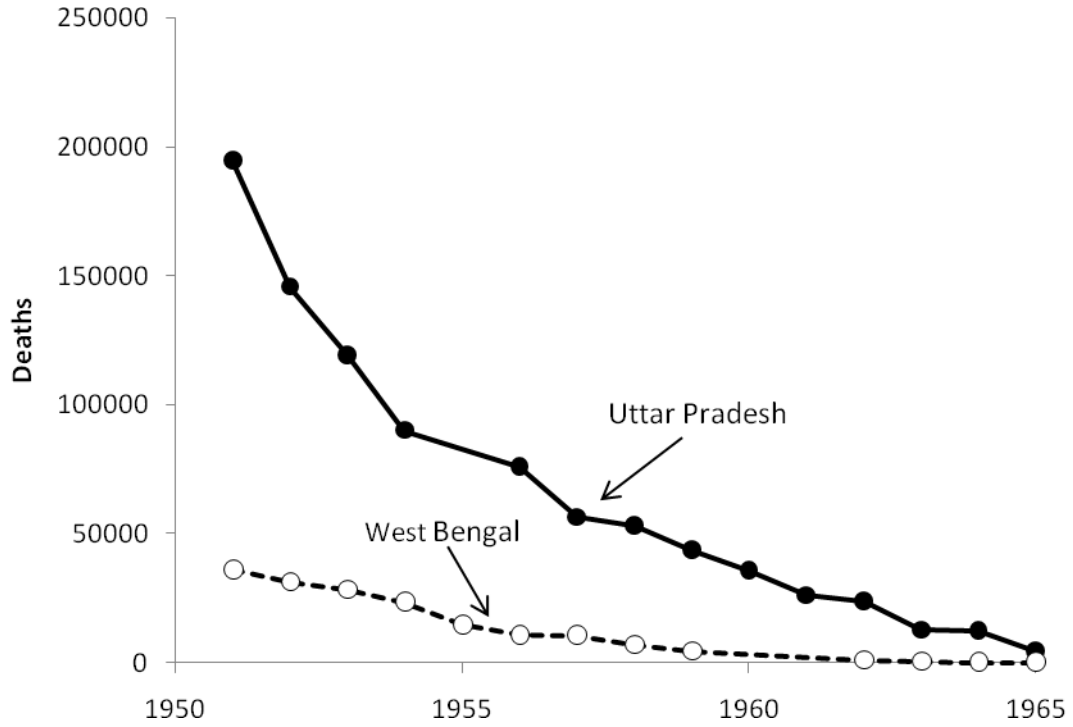
APPENDIX TABLE 3

Child Spleen Rates in 15 Indian States and Territories

	1953-54	1954-55	1955-56	1956-57	1959-60
<i>States</i>					
Andhra Pradesh	18.2	14.2	12.8	13.0	2.1
Bihar	22.5	23.2	18.2	11.8	1.2
Bombay	5.6	4.5	4.1	3.6	0.6
Kerala	19.2	5.3	4.6	4.6	0.2
Madhya Pradesh	41.1	22.7	12.6	12.3	3.5
Mysore	4.6	3.0	2.7	1.9	0.4
Orissa	37.0	29.0	19.0	—	8.0
Punjab	5.3	5.2	2.5	2.0	0.5
Rajasthan	4.9	4.4	21.2	18.0	2.8
Uttar Pradesh	14.8	19.6	13.5	13.9	1.3
West Bengal	20.6	16.5	6.9	4.0	0.4
<i>Union Territories</i>					
Delhi	1.1	0.5	0.3	0.5	0.1
Himachal Pradesh	18.2	14.1	2.7	1.2	0.2
Manipur	23.3	17.8	12.0	13.2	1.7
Tripura	55.9	61.2	18.1	3.9	2.5

Source: NMEP (1986). Sample includes all states and territories with child spleen rate data for 1953-54. These rates are based on tables that report the results of NMCP spleen surveys. For the entire eradication era, the tables use consistent administrative boundaries as defined by the States Reorganization Act of 1956. The tables for 1953-54 to 1956-57 divide areas within states and territories into those sprayed with DDT and those still unsprayed. We calculate the total number of enlarged spleens detected in each state/territory and divide by total number of examinations performed in the state/territory.

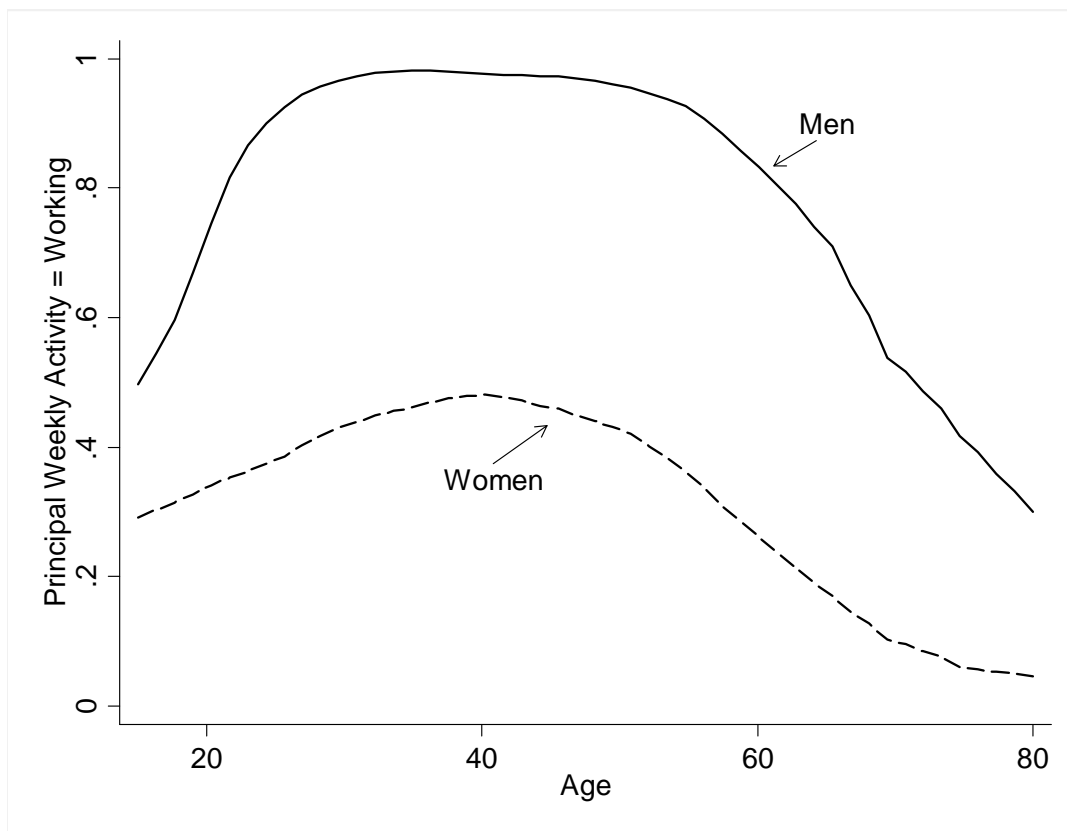
APPENDIX FIGURE 1
Declines in Malaria Deaths



Source: *Health Statistics of India, 1951-1965*. We show West Bengal and Uttar Pradesh due to these states' relatively complete time series, as well as the stability of their borders through the States Reorganization Act of 1956. The figures above imply a ratio of malaria deaths to population of 0.3% in Uttar Pradesh and 0.1% in West Bengal in 1952. These rates are similar to the nationwide rate in 1947 (0.2%) implied by the NMEP figures in *Appendix Table 1*.

A.3. Labor Force Participation in the National Sample Survey

APPENDIX FIGURE 2
Age Profiles of Labor Force Participation



Note: Profiles are based on the entire rural sample of the NSS. The curves are from local linear regressions estimates with a bandwidth of 2 years. We define the following categories as working: worked in household enterprise (self-employed), worked as helper in household enterprise, worked as regular salaried wage employee, worked as casual wage labor in public works, worked as casual wage labor in other types of work.

A.4. Ecological Determinants of Malaria Endemicity

APPENDIX TABLE 4
Ecological Determinants of Pre-Eradication Malaria Endemicity

	Summary Statistics, Ecology Measures	Malaria Index	
	(1)	(2)	(3)
Avg. temperature (°C)	24.05	-0.086	1.22
	[4.85]	(0.034)**	(0.302)***
(Avg. temperature) ² /100			-0.027
			(0.006)***
Avg. precipitation (mm/month)	106.68	0.002	0.011
	[64.16]	(0.001)	(0.003)***
(Avg. monthly precipitation) ² /100			-0.002
			(0.001)**
Avg. humidity (%)	62.44	0.02	0.519
	[9.37]	(0.007)***	(0.060)***
(Avg. humidity) ²			-0.004
			(0.0004)***
Avg. elevation (km)	0.50	-1.144	-1.425
	[0.74]	(0.209)***	(0.245)***
(Avg. elevation) ²			0.862
			(0.196)***
<i>R</i> ²		0.25	0.43
F-statistic (<i>p</i> -value)		23.16 (<0.0001)	41.12 (<0.0001)
Number of Districts		415	415

Note: The ecology data are drawn from the International Water Management Institute *World Water and Climate Atlas* (<http://www.iwmi.org>) and the Climatic Research Unit (<http://www.cru.uea.ac.uk>). The dataset consists of a 10° latitude/longitude mean monthly climatology of surface climate over global land areas, and is interpolated from station means for the period 1961 to 1990. New et al. (2002) provide a detailed description of the dataset. We use GIS to overlay the ecology data with district boundaries. Column (1) lists means of the independent variables, with standard deviations in brackets. Columns (2) and (3) report coefficients from regressions of the average malaria category in a district (the malaria index) on the variables listed in the table, with robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Consistent with the accumulated knowledge on malaria ecology (e.g., Sharma 2002), the malaria index is positively associated with precipitation and humidity and negatively associated with elevation. The coefficient on temperature is negative (and the coefficients of the quadratic in column 3 imply a negative relationship over relevant temperatures), but the unconditional correlation between the malaria index and temperature is strongly positive (unreported).¹

¹ Ordered probits of the modal malaria category on the same ecological variables yield similar conclusions.

References

New, Mark, David Lister, Mike Hulme, and Ian Makin. 2002. "A High-Resolution Data Set of Surface Climate over Global Land Areas." *Climate Research*, 21: 1-25.

Sharma, V. P. 2002. "Determinants of Malaria in South Asia." In *The Contextual Determinants of Malaria*, ed. E.A. Casman and H. Dowlatabadi, 110–32. Washington, D.C.: Resources for the Future.