The disease environment, schooling, and development outcomes: Evidence from Ethiopia
Online appendix

Mapping of villages

The demarcation of villages
Ethiopia is organized as a federation of 7 states and 2 major cities. Each state is then further subdivided into *zones*, regions or *woredas*, and finally at the smallest level, *kebeles,* or peasant associations. These kebeles may consist of more than one village, but the Ethiopian administration equates the kebele with the village, since generally the kebele is small in size and population. Administrative reorganizations, informal dealings between kebeles, lack of official demarcations created a situation where, by the time the WMS survey was done, even the government did not know how many kebeles or woredas there are in the country.
The Central Statistics Agency (CSA), responsible for carrying out the WMS and censuses, has dealt with the problem by creating "unofficial" subdivision maps for the 1997 population census. While the administrative subdivision has changed since then due to the informal dealings that I have mentioned, the CSA has been using these maps for various surveys including the 2004 WMS. Fortunately, the EDRI/IFPRI electronic maps have also been drawn using the 1997 census subdivisions, allowing me to match the kebeles from the WMS survey with the kebeles of the electronic maps. The 1997 CSA maps have 'approximate' kebele boundaries, since the location of the 'real' boundary is subject to dispute and debate.

The drawing of the EDRI/IFPRI village maps
Researchers at EDRI/IFPRI office in Addis Ababa transferred paper maps of all Ethiopian administrative units into digital form. These digital maps spatially divide the country into its administrative units, from largest (states) to smallest (villages). The process of drawing electronic maps of villages was done without actual GPS readings of the villages. Rather, this process was done by hand by superimposing the original CSA paper maps on 1:25000 topological maps, deriving coordinates of the boundaries, and then manually drawing the boundaries in the computer. Not all zones or regions were electronically mapped by the time I took the information with me in July 2006.

Matching of CSA and EDRI/IFPRI data
The CSA provided a roster of WMS villages for this paper. The roster indicated, for each village in the sample, the name of the village, *wareda*, zone and state, plus the census code for each administrative level. With census codes, I constructed a village-specific village ID number. On the EDRI/IFPRI side, the attribute table associated with the village maps included the name of the village and *wareda,* so it was possible to match the GIS data to WMS interviews. Working zone by zone, I manually matched the names of the villages in the WMS roster with the names of each polygon, and added the created village ID in the GIS attributes table.

It was not always possible to match villages using their names, for two reasons. First, some areas were unmapped. Second, there may be more than one way to write the name of a village, or they may have more than one name (a local name and an Amharic name for instance). Thus, 35% of the WMS villages were were not found and were dropped from my analysis. Appendix table W1 compares the average characteristics of mapped and unmapped rural villages. Unmapped villages have similar health profiles, but appear to be more agricultural (higher proportion of farmers and livestock).

Appendix Table W1. Differences between mapped and unmapped villages

	Unmapped villages		Mapped villages		Diff. mapped/ unmapped	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean Diff.	T-statistic
Recent reported health problems:						
Proportion sick	0.251	0.127	0.244	0.128	0.01	1.02
Proportion malaria	0.056	0.084	0.057	0.094	0.00	-0.17
Schooling outcomes						
Adult highest grade (years)	0.985	0.790	1.058	0.931	-0.07	-1.60
Children highest grade (years)	1.024	0.716	1.073	0.762	-0.05	-1.25
Other characteristics						
Proportion farmers	0.958	0.078	0.922	0.110	0.04	7.46
Number of livestock	5.762	5.049	4.676	4.097	1.09	4.22
Number of oxen	1.026	0.562	0.927	0.657	0.10	3.08
Distance to school (hrs)	0.670	0.527	0.710	0.599	-0.04	-1.34
Droughts in 5 yrs	0.353	0.734	0.417	0.798	-0.06	-1.55
Floods in 5 yrs	0.159	0.494	0.133	0.393	0.03	1.05

Notes: averages from 1,000 mapped and 516 unmapped villages.
Mapped villages include villages above 2,500 meters of elevation

Timing of malaria in Ethiopia

In Ethiopia, malaria transmission peaks in two periods—first, following the _Belg_ rains, May through August, and then, following the *Meher* rains, October and November. In general, malaria rates following *Meher* rains are higher; however, the first peak can also be quite high. In addition, given that the *Belg* and *Meher* rains follow one another relatively closely, it is often the case that the trough between the two peaks is also a period of positive malaria transmission. On the other hand, between the *Meher* and the *Belg* rains, malaria transmission may fall to very low levels. See figure 1 below for a time series of malaria incidence in one Ethiopia district, as reported by a district hospital (source: Abeku et al (2002); the second figure shows seasonality of both falciparum and vivax malaria across a larger sample of hospitals in Ethiopia (source: Abeku et al, 2003).

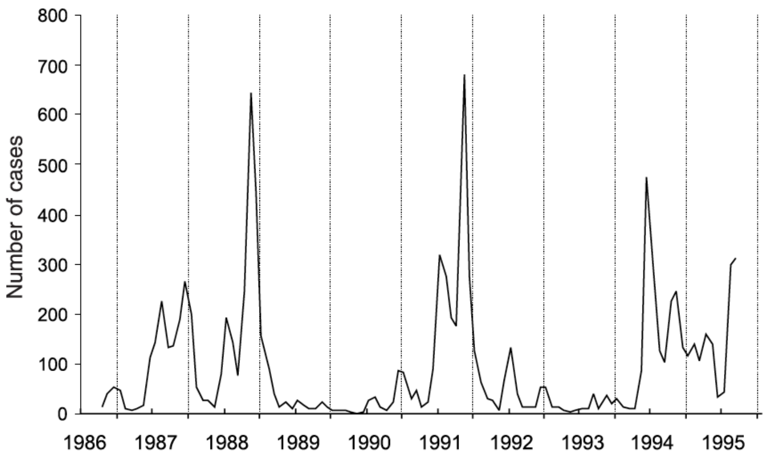


Figure 1 Incidence of *falciparum* malaria reported from Finote Selam Sector during the period September 1986–August 1995, showing seasonal and year-to-year variability of transmission.

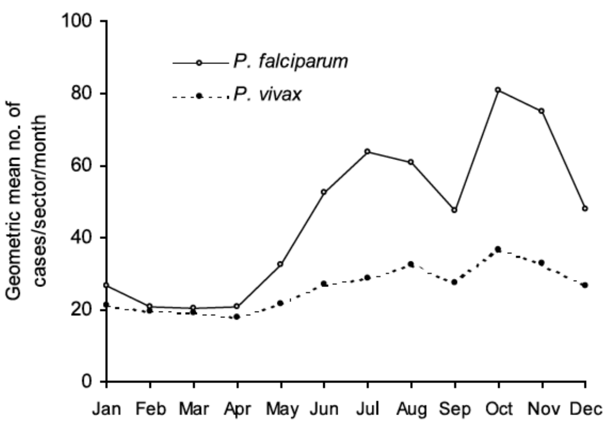


Fig. 1. Seasonal variations in incidence of *P. falciparum* and *P. vivax* malaria in Ethiopia (September 1986–August 1993).

MARA model

A detailed explanation of the MARA (Mapping Malaria Risk in Africa) model is provided in the Craig, Snow and le Sueur (1999). The MARA model uses measurements of average monthly rainfall and temperature to assign a "malaria suitability" reading to each location. In particular, for each local climate measurement *x* (rainfall, day temperature, minimum daily temperature for each month of the year), the model assigns a value of 1 if the climate measure is "suitable" for malaria transmission during that particular month; a value of 0 if the climate is "unsuitable"; and an intermediate value for areas located at the edge of suitability. In particular, the model assigns a suitability value y_x according to equation (4) in their paper,

$$y_x = \begin{cases} 1 & if\ x \geq S \\ \cos^2\left\{\frac{x-U}{S-U} \times \frac{\pi}{2}\right\} & if\ U < x < S \\ 0 & if\ x \leq U \end{cases}$$

where x is a climate reading (rainfall or daily temperature), S is a threshold value for suitable climate conditions, and U is a threshold value for unsuitable conditions. An algorithm (specified in their paper) described how each climate measurement is aggregated to the final measure.

The climatological data in my possession allowed me to create a suitability measure in the study villages that closely resembles the MARA measure, with some small difference. Like Craig, Snow and le Sueur, I have access to average daily temperature and mean minimum daily temperature for 12 months of the year, so my measurements of temperature y_x for each month of the year follows the exact MARA methodology. On the other hand, I do not have access to monthly rainfall data. Rather, I have total (yearly) rainfall. Thus, my measurement of a climate suitability model required some additional adjustments and assumptions.

- I assumed that the only periods relevant for malaria transmission are the two rainy seasons, *Berg* (February through April) and *Meher* (June through September). While in the original model all months are considered, the distribution of malaria in Ethiopia is bimodal and tracks (with a short lag) the rainy season.[1]
- As an upper bound of the rainfall estimate, I assume that the entire yearly rainfall fell evenly across the six months that encompass the two rainy seasons. As a lower bound on the estimate, I assumed that the rainfall fell across 8 months.

Because annual rainfall in the regions under consideration is generally plentiful (500 ml to 2,000 ml per year) the rainfall estimates never create a binding constraint. In other words, the variation in malaria suitability condition constructed relies entirely on the temperature variation.

Appendix table W2 shows the correlation coefficients between malaria (incidence and presence) and the alternative predictors (elevation, MARA model for the *Berg* period only, model for the *Meher* period only, and the maximum between the two). As expected, all predictors are highly correlated with one another, and have similar correlation levels with malaria incidence and malaria presence. In the text we use the MARA model with the

[1] In Craig, Snow and le Sueur (1999) suitability measurements from each month are aggregated in the following way: the measurement considered is the *highest* value spanning any 5 months. In Ethiopia, the highest value is likely to fall within the *Berg* or the *Meher* periods. The approach taken here is thus conservative, given the limitations in the data.

strongest predictive power (the one calculated over the *Berg* period). The figure below shows the relationship between elevation and the *Berg* measure.

Appendix Table W2. Correlation coefficients of different measures of malaria and malaria

Correlation Coefficients	Malaria intensity	Malaria presence	Elevation	Berg measure	Meher measure
Malaria intensity	1				
Malaria presence	0.4993	1			
Elevation	-0.3124	-0.3927	1		
Berg measure	0.3252	0.3993	-0.842	1	
Meher measure	0.2297	0.2416	-0.7136	0.7767	1
Max(Berg, Meher)	0.3029	0.3807	-0.8318	0.975	0.8344

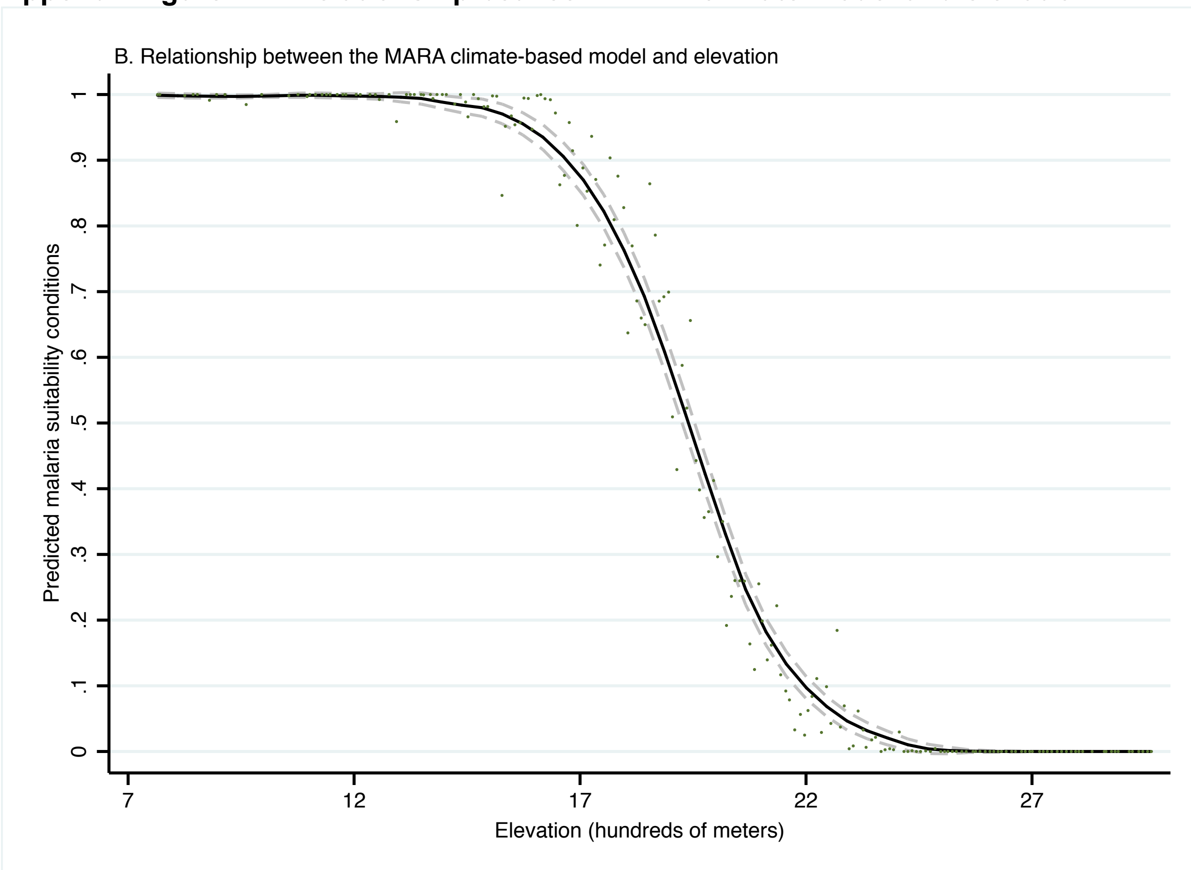
Bibliography

Abeku, T. A., de Vlas, S. J., Borsboom, G., Teklehaimanot, A. Kebede, A. Olana, E. van Oortmarssen, J. & Habbema, J.D.F. (2002). Forecasting Malaria Incidence from Historical Morbidity Patterns in Epidemic-Prone Areas of Ethiopia: A Simple Seasonal Adjustment Method Performs Best. *Tropical Medicine and International Health*, 70(10), 851-857.

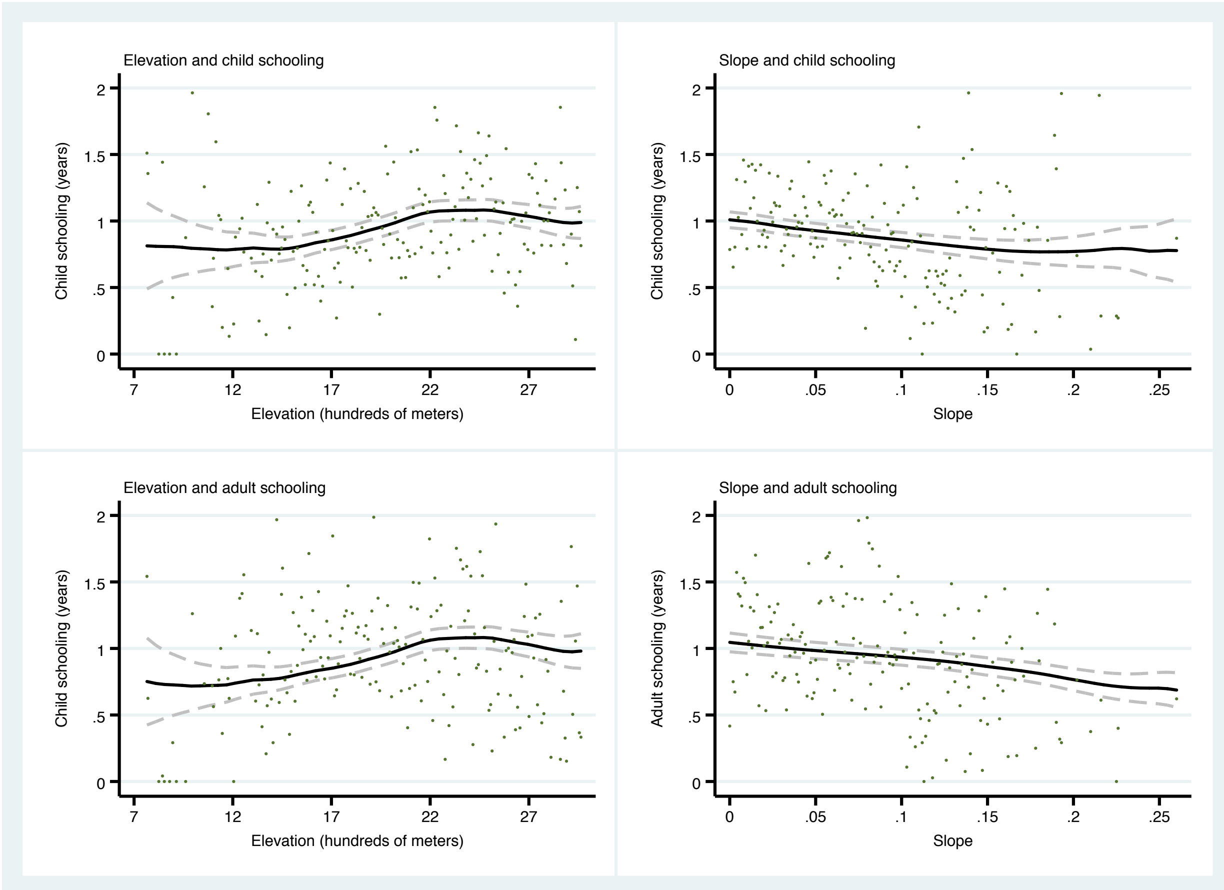
Abeku, T. A., van Oortmarssen, G.J., Borsboom, G., de Vlas, S. J. & Habbema, J.D.F. (2003). Spatial and Temporal Variations of Malaria Epidemic Risk in Ethiopia: Factors Involved and Implications. *Acta Tropica*, 87, 331-340.

Additional figures

Appendix figure W1: Relationship between MARA climate model and elevation



Appendix figure W2: Relationship between topography and schooling



Elevation and child schooling
Child schooling (years)
Elevation (hundreds of meters)
Slope and child schooling
Child schooling (years)
Slope
Elevation and adult schooling
Child schooling (years)
Elevation (hundreds of meters)
Slope and adult schooling
Adult schooling (years)
Slope

Additional tables and robustness tests

Appendix table 1: Village topography and schooling

	(1)	(2)	(3)	(4)	(5)	(6)
Dep var:	Villages <2,500 m		All villages		Villages < 2,500 m	
Average yrs. schooling	Children	Adults	Children	Adults	Children	Adults
Elevation	0.031**	0.045**	0.031***	0.036*	0.097***	0.075*
	(0.013)	(0.022)	(0.012)	(0.021)	(0.023)	(0.040)
Slope	-1.617**	-2.266**	-1.224*	-2.247**		
	(0.795)	(1.107)	(0.632)	(0.890)		
Elevation X:						
2,500 meters			-0.051**	-0.019		
			(0.024)	(0.027)		
Slope 2					-0.049**	0.003
					(0.021)	(0.033)
Slope 3					-0.067***	0.007
					(0.021)	(0.034)
Slope 4					-0.058**	-0.054
					(0.024)	(0.037)
Slope 5					-0.090***	-0.052
					(0.025)	(0.038)
Observations	844	844	1,000	1,000	844	844
R-squared	0.408	0.105	0.412	0.120	0.418	0.130
Number of provinces	276	276	295	295	276	276
P-Value of F-test:						
Elev. 2nd quintile=0					0.002	0.009
Elev. 3rd quintile=0					0.084	0.01
Elev. 4th quintile=0					0.02	0.388
Elev. 5th quintile=0					0.706	0.335

OLS regressions at the village level. Controls for regressions on children schooling include: average village rainfall, fraction agricultural households, fraction female headed household, average household size, number of livestock, oxen, wealth, land sizes, schooling of adult males and females, child age, and distance to schools and health clinics. Controls for regressions on adult schooling include rainfall, average adult age, land size, and distance to schools and health clinics. Errors clustered at the province level in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table A2:
Relationship between elevation, slope and reported health incidents

Panel A:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No controls	All sickness types		Malaria		Other health problem		Death	
Elevation ('00s meters)	-0.009***	-0.009***	-0.006***	-0.006***	-0.003	-0.002	-0.009	-0.008
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.011)	(0.010)
Elevation x Above		0.010**		0.010***		-0.000		0.030**
2,500 m		(0.005)		(0.002)		(0.005)		(0.012)
Slope	-0.211	-0.165	-0.312***	-0.269***	0.099	0.103	-0.481	-0.283
	(0.140)	(0.114)	(0.073)	(0.053)	(0.116)	(0.099)	(0.368)	(0.305)
Sample of villages	<2,500m	All	<2,500m	All	<2,500m	All	<2,500m	All
Observations	856	1,013	856	1,013	856	1,013	856	1,013
R-squared	0.041	0.040	0.102	0.116	0.005	0.006	0.003	0.005
Province f.e.	YES	YES	YES	YES	YES	YES	YES	YES
P-value of F-test: Elevation + Elevation X Above = 0		0.927		0.1996		0.495		0.2635

Replicates table 2, without any village controls other than rainfall.

Panel B:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Individual sample	All sickness types		Malaria		Other health problem		Death	
Elevation ('00s meters)	-0.009***	-0.009***	-0.006***	-0.006***	-0.003	-0.003	-0.006	-0.007
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.013)	(0.012)
Elevation x Above		0.009*		0.009***		-0.000		0.030*
2,500 m		(0.005)		(0.002)		(0.005)		(0.018)
Slope	-0.153	-0.118	-0.309***	-0.273***	0.155	0.153	-0.287	-0.227
	(0.143)	(0.114)	(0.077)	(0.057)	(0.112)	(0.095)	(0.422)	(0.354)
Sample of villages	<2,500m	All	<2,500m	All	<2,500m	All	<2,500m	All
Observations	17,178	20,457	17,178	20,457	17,178	20,457	17,178	20,457
R-squared	0.056	0.057	0.114	0.123	0.017	0.020	0.029	0.024
Province f.e.	YES	YES	YES	YES	YES	YES	YES	YES
P-value of F-test: Elevation + Elevation X Above = 0		0.950		0.169		0.579		0.081

Replicates table 2, with the sample of children. Children controls as in table 5.
*** p<0.01, ** p<0.05, * p<0.1

Appendix table A3:
Elevation, slope, and reported health incidents

Panel A: No controls		(1) All sickness types	(2) Malaria	(3) Other health	(4) Death
Elevation		-0.008	-0.011***	0.002	-0.020
		(0.005)	(0.004)	(0.004)	(0.014)
Elevation X quintile:					
	Slope 2	-0.000	0.002	-0.002	0.014
		(0.005)	(0.004)	(0.004)	(0.013)
	Slope 3	-0.003	0.002	-0.005	-0.002
		(0.005)	(0.004)	(0.004)	(0.012)
	Slope 4	0.000	0.005	-0.005	0.012
		(0.005)	(0.004)	(0.004)	(0.018)
	Slope 5	-0.001	0.008*	-0.008*	0.017
		(0.006)	(0.004)	(0.004)	(0.017)
Observations		856	856	856	856
R-squared		0.046	0.118	0.017	0.010
Province f.e.		YES	YES	YES	YES
P-values of F-test: Elevation+ Elevation X quintile=0:					
Elev. 2nd quintile		0.075	0.006	0.880	0.606
Elev. 3rd quintile		0.002	0.000	0.407	0.053
Elev. 4th quintile		0.028	0.020	0.338	0.646
Elev. 5th quintile		0.027	0.227	0.066	0.837

Replicates table 3, without any controls other than rainfall.

Panel B: Sample of children		(1) All sickness types	(2) Malaria	(3) Other health	(4) Death
Elevation		-0.007	-0.009***	0.002	-0.014
		(0.005)	(0.003)	(0.004)	(0.017)
Elevation X quintile:					
	Slope 2	-0.002	0.000	-0.002	0.011
		(0.005)	(0.003)	(0.004)	(0.015)
	Slope 3	-0.003	0.001	-0.004	-0.003
		(0.005)	(0.003)	(0.004)	(0.014)
	Slope 4	-0.000	0.003	-0.003	0.011
		(0.005)	(0.003)	(0.004)	(0.018)
	Slope 5	-0.003	0.006*	-0.010**	0.011
		(0.005)	(0.004)	(0.004)	(0.017)
Observations		17,178	17,178	17,178	17,178
R-squared		0.060	0.127	0.030	0.030
Province f.e.		YES	YES	YES	YES
P-values of F-test: Elevation+ Elevation X quintile=0:					
Elev. 2nd quintile		0.062	0.004	0.978	0.819
Elev. 3rd quintile		0.003	0.000	0.401	0.196
Elev. 4th quintile		0.068	0.027	0.632	0.887
Elev. 5th quintile		0.004	0.270	0.011	0.814

Replicates table 3, with sample of children. Controls same as table 5.
*** p<0.01, ** p<0.05, * p<0.1

Appendix table A4: Topography correlates with other factors

Panel A: No controls		(1) Floods	(2) Droughts	(3) Livestock losses	(4) Price shocks/ Other shocks	(5) School distance	(6) Health facility distance	(7) Land sizes
Elevation		-0.014	-0.079**	0.010	0.001	-0.033	-0.048	-0.029
		(0.013)	(0.034)	(0.030)	(0.013)	(0.021)	(0.350)	(0.041)
Elevation x:								
	Slope 2	-0.000	0.043	0.035	0.007	0.020	0.320	-0.047
		(0.012)	(0.028)	(0.026)	(0.017)	(0.021)	(0.331)	(0.041)
	Slope 3	0.004	0.045	0.011	-0.000	0.018	0.078	-0.033
		(0.015)	(0.030)	(0.030)	(0.012)	(0.018)	(0.372)	(0.034)
	Slope 4	0.014	0.049	0.021	0.006	-0.028	-0.026	-0.014
		(0.014)	(0.035)	(0.031)	(0.014)	(0.034)	(0.351)	(0.040)
	Slope 5	-0.003	0.051	-0.052	-0.011	-0.021	-0.044	-0.061
		(0.017)	(0.035)	(0.039)	(0.013)	(0.033)	(0.343)	(0.039)
Observations		856	856	856	856	856	856	844
R-squared		0.007	0.017	0.028	0.014	0.065	0.019	0.045
Province f.e.		YES	YES	YES	YES	YES	YES	YES
Mean dep. Var		0.132	0.414	0.386	0.048	0.712	4.83	2.88
P-value of F-test: Elevation + Elevation X Quintile = 0								
Elev., 2nd quintile=0		0.259	0.132	0.054	0.314	0.468	0.210	0.017
Elev., 3rd quintile=0		0.368	0.135	0.403	0.852	0.378	0.880	0.013
Elev., 4th quintile=0		0.986	0.285	0.142	0.366	0.060	0.691	0.126
Elev., 5th quintile=0		0.253	0.299	0.078	0.040	0.048	0.487	0.000

Resplicates table 4, without any village controls other than rainfall.
*** p<0.01, ** p<0.05, * p<0.1

Appendix table A4 (continued): Topography correlates with other factors

Panel B:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample of children	Floods	Droughts	Livestock losses	Price shocks/ Other shocks	School distance	Health facility distance	Land sizes
Elevation	0.005	-0.078**	0.033	0.008	-0.020	-0.089	0.001
	(0.016)	(0.037)	(0.036)	(0.017)	(0.020)	(0.350)	(0.043)
Elevation x:							
Slope 2	-0.005	0.058*	0.013	0.001	0.008	0.411	-0.065
	(0.014)	(0.030)	(0.031)	(0.019)	(0.025)	(0.351)	(0.043)
Slope 3	-0.005	0.041	0.006	-0.011	0.016	0.166	-0.031
	(0.017)	(0.030)	(0.035)	(0.015)	(0.019)	(0.379)	(0.038)
Slope 4	0.002	0.060	0.010	-0.005	-0.037	0.044	-0.028
	(0.016)	(0.039)	(0.038)	(0.016)	(0.041)	(0.355)	(0.041)
Slope 5	-0.012	0.066*	-0.095*	-0.021	-0.037	-0.023	-0.080*
	(0.021)	(0.039)	(0.049)	(0.018)	(0.034)	(0.348)	(0.041)
Observations	17,178	17,178	17,178	17,178	17,178	17,178	17,178
R-squared	0.076	0.016	0.056	0.033	0.039	0.028	0.108
Province f.e.	YES	YES	YES	YES	YES	YES	YES
Mean dep. Var	0.132	0.414	0.386	0.048	0.712	4.83	2.88
P-value of F-test: Elevation + Elevation X Quintile = 0							
Elev., 2nd quintile=0	0.984	0.457	0.095	0.282	0.546	0.154	0.065
Elev., 3rd quintile=0	0.990	0.109	0.206	0.709	0.832	0.688	0.283
Elev., 4th quintile=0	0.670	0.609	0.146	0.734	0.161	0.813	0.377
Elev., 5th quintile=0	0.694	0.707	0.042	0.106	0.049	0.467	0.002

Replicates table 4, with sample of children. Controls same as table 5.

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table A5:
Relationship between village topography and schooling (no controls)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep var:	Villages <2,500 m		All villages		Villages < 2,500 m	
Average yrs. schooling	Children	Adults	Children	Adults	Children	Adults
Elevation	0.079***	0.047*	0.071***	0.040*	0.127***	0.055
	(0.021)	(0.028)	(0.019)	(0.024)	(0.036)	(0.054)
Slope	-3.615***	-3.878***	-3.453***	-3.384***		
	(1.018)	(1.390)	(0.886)	(1.123)		
Elevation X:						
Above 2,500 meters			-0.065*	-0.029		
			(0.035)	(0.030)		
Slope 2					-0.035	0.015
					(0.029)	(0.043)
Slope 3					-0.052	0.022
					(0.032)	(0.044)
Slope 4					-0.042	-0.015
					(0.034)	(0.049)
Slope 5					-0.071*	-0.036
					(0.037)	(0.052)
Observations	18,005	21,108	21,377	24,965	18,005	21,108
R-squared	0.005	0.002	0.005	0.002	0.007	0.004
Province f.e.	YES	YES	YES	YES	YES	YES
P-Value of F-test: Elevation + Elevation X Quintile = 0						
Elev. 2nd quintile=0					0.001	0.056
Elev. 3rd quintile=0					0.019	0.079
Elev. 4th quintile=0					0.002	0.220
Elev. 5th quintile=0					0.005	0.467

Replicates table 5, without controls other than rainfall.
*** p<0.01, ** p<0.05, * p<0.1

Appendix table A6: Topography IV estimates of malaria intensity on schooling (no controls)

	(1)	(2)	(3)	(4)	(5)
	OLS	IV	IV	IV	IV-LIML
Instruments		Elevation	Elevation	Elevation X	
Dep Var:		only	X Slope	Slope quintiles	
Years of schooling			quintiles	X Above 2500m	
A. All children aged 7-19					
Village malaria	0.089	-11.912***	-6.139	-6.171**	-
	6.628**	(0.414)	(4.498)	(4.969)	(3.047)
	(3.330)				
Observations	18,005	18,005	18,005	21,377	21,377
B. Boys aged 7-19					
Village malaria	0.140	-12.610***	-6.902	-6.526*	-7.196*
	(0.533)	(4.836)	(5.730)	(3.411)	(3.849)
Observations	9,264	9,264	9,264	10,973	10,973
C. Girls aged 7-19					
Village malaria	0.106	-9.755**	-2.183	-4.816	-5.301
	(0.417)	(4.524)	(4.674)	(3.208)	(3.567)
Observations	8,741	8,741	8,741	10,404	10,404
D. All adults					
Village malaria	0.114	-7.436	-7.615	-3.636	-3.759
	(0.417)	(5.184)	(4.914)	(2.492)	(2.576)
Observations	21,108	21,108	21,108	24,965	24,965
E. Male adults					
Village malaria	-0.278	-8.415	-11.236*	-5.724*	-5.966*
	(0.567)	(6.510)	(6.483)	(3.163)	(3.313)
Observations	10,092	10,092	10,092	11,912	11,912
F. Female adults					
Village malaria	0.382	-7.175	-4.035	-2.069	-2.166
	(0.359)	(4.571)	(4.180)	(2.286)	(2.378)
Observations	10,991	10,991	10,991	13,028	13,028
Province f.e.	YES	YES	YES	YES	YES
Elevation controls	None	None	Linear	Linear	Linear
Sample	<2,500m	<2,500m	<2,500m	All	All
F-test of excluded instruments		11.75	1.272	3.562	3.562

Replicates table 6, without controls other than rainfall.

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table A7: Estimates of malaria on other outcomes (no controls)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Excluded instruments	None	Elevation X Slope quintiles	Elevation X Slope X Above 2,500m		None	Elevation X Slope quintiles	Elevation X Slope X Above 2,500m		None	Elevation X Slope quintiles	Elevation X Slope X Above 2,500m	
	OLS	IV	IV	IV-LIML	OLS	IV	IV	IV-LIML	OLS	IV	IV	IV-LIML
Column title is dependent variable	Child labor (children >10 y.o. only)				Food insecurity (All adults)				Asset index (All adults)			
Village malaria	0.321**	-0.160	1.524*	1.685*	1.967***	3.110	5.720	6.194	-0.213	-0.942	-1.374	-1.507
	(0.143)	(1.608)	(0.865)	(0.990)	(0.490)	(5.346)	(3.625)	(4.116)	(0.295)	(3.626)	(2.132)	(2.383)
Sample of villages	<2,500	<2,500	All	All	<2,500	<2,500	All	All	<2,500	<2,500	All	All
Observations	11,563	11,563	13,780	13,780	52,142	52,142	61,662	61,662	52,135	52,135	61,655	61,655
R-squared	0.005	0.142	0.113	0.108	0.255	0.253	0.207	0.201	0.256	0.255	0.224	0.223
Province f.e.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Replicates table 7, without controls other than rainfall.
*** p<0.01, ** p<0.05, * p<0.1

Appendix table A9: MARA model predictions (no controls)

Dep Var:	(8)	(9)	(8)	(9)
Years of schooling	IV	IV	IV	IV
Instrumented variable	Malaria intensity		Malaria presence	
A. All children aged 7-19				
Malaria intensity	-10.883**	-13.941	-1.024***	-1.115*
	(5.150)	(10.383)	(0.395)	(0.634)
Observations	21,377	21,377	21,377	21,377
B. All adults				
Malaria measure	-5.118	-5.348	-0.490	-0.446
	(5.349)	(7.429)	(0.453)	(0.577)
Observations	24,965	24,965	24,965	24,965
C. Child Labor				
Malaria measure	2.348**	3.502	0.226**	0.281
	(1.119)	(2.733)	(0.110)	(0.211)
Observations	13,780	13,780	13,780	13,780
Province f.e.	YES	YES	YES	YES
Elevation control	NO	YES	NO	YES
Sample	All	All	All	All
F-test of excluded instruments	10.94	3.044	39.84	12.44

Replicates table 9,
*** p<0.01, ** p<0.05, * p<0.1