Returns to Controlling a Neglected Tropical Disease Schistosomiasis Control Program and Education Outcomes in Nigeria

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This paper investigates the impact of the schistosomiasis control program on school-aged children education outcomes. The contribution of the paper is to carefully document the one dimension—education outcomes—of controlling endemic diseases in low income settings. Using the rollout of the schistosomiasis control program in Nigeria as a quasi-experiment, we estimate that children who benefited from the disease control program were 16 percentage points more likely to be enrolled in school and have completed 0.642 more years of education compared to children who have not benefited of the program.

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I. Introduction

Wide spread mass drug administration to school-aged children in Nigeria has made it possible to reduce the prevalence of schistosomiasis a neglected tropical disease that results in anemia, stunted growth, cognitive impairment and premature death. A substantial body of the medical literature has examined the effectiveness of the schistosomiasis mass treatment. Studies that have investigated student performance response to the treatment have so far relied on cross sectional techniques comparing the outcome between a control and a test group (Ekanem et al., 1994; Meremikwu et al., 2000; Ayoya et al., 2012). This paper contributes to and extends the literature by reporting empirical results of the schistosomiasis control program impact on child's education outcomes. Our estimation strategy uses difference-in-difference to show that effort intensity in fighting disease in developing region has positive effects on child education outcomes. By taking advantage of the expansion of the Schistosomiasis control program in four regions of Nigeria from 1999 to 2013, we are able to show that the reduction in the water-borne disease has contributed in improving the level of education of younger cohorts who were exposed to the program. Our main result suggests that children in treated regions have on average 0.6 additional year of education that is attributable to the program.

A. Schistosomiasis

Schistosomiasis is a water-borne disease that mostly affects children in tropical regions especially in developing countries of Africa, Asia and South America. The schistosome parasite, which is a worm, is acquired by contact with unprotected stagnant water. The classical sign of schistosomiasis infection is blood in urine. Once in the blood vessels, the parasite attacks mainly bladder and kidneys and causes fever, pain in the stomach and during urination. The most vulnerable group to the disease are school-aged children. They are more likely to come in contact with the vector and the disease exposes them to serious deficiency manifested through anemia, inhibited growth, debility and high morbidity. Nigeria is one the country that has the highest prevalence rate of schistosomiasis in the world. Schistosomiasis is a concern for the developing world because it tends to be endemic in infested rural places and densely populated urban areas as well. As with other neglected tropical diseases, schistosomiasis can hinder development prospects if it is not adequately addressed.

Although schistosomiasis is endemic in many regions, there are effective treatment regimen. The most common course of treatment consists of periodic intake of the drug praziquantel. The drug is highly effective as it can reverse up to 90 percent of the damage at relatively low cost between, i.e. \$0.15 to \$0.20 per treatment (Hopkins, Richards Jr, Ruiz-Tiben, Emerson, & Withers Jr, 2008). The World Health Organization (WHO) is active in raising awareness about schistosomiasis and recommends health education on access to safe water, improved sanitation and hygiene.

Gutman et al. (2008) advocate for presumptive mass treatment of all school-aged children as the cheapest approach to control schistosomiasis. Infected children have their body weakened by the disease affecting their ability to work. They end up showing signs of poor growth and learning difficulty at school. Agi & Okafor (2005) study the epidemiology of schistosomiasis and find a significant negative correlation between age and intensity of infection. Their results suggest that there is a progressive rise in prevalence for children aged 5-9 but the infection rate often peaks for children aged 10-14 and grows weaker as the individual gets older. Similarly, Ezeadila et al. (2015) find the difference in prevalence between children aged 6-9 and 10-13 to be not significant at the 5 percent level.

The paper is connected to a strand of literature that relate the impact of a neglected tropical disease to children education outcomes. Early studies, such as Ekanem et al. (1994), in a cross sectional analysis assess the effect of schistosoma infection children aged 5-15 in south eastern Nigeria to find no significant impact on their physical growth and school performance. Meremikwu et al. (2000) also find no improvement in school attendance following repeated treatment of praziquantel to children aged 8-9 in Adim, Nigeria. Like Ekanem et al. (1994), the paper employs a simple difference comparing cohort pupils characteristics pre-treatment and post-treatment period without controlling for observed or unobserved factors within child, school or village that could influence the outcome. Ayoya et al. (2012) offer a stronger analysis studying primary school children aged 7-12 in poor urban area in Bamako, Mali. Using a linear regression model they conclude to significant increase in children attendance and school achievement, measured as by the pupil’s passing rate. They notice that they do not control for unobserved factors that could bias their estimates. By using difference-in-difference (DID), we are able to account to account for unobserved heterogeneity across time and space in estimating the effects of schistosomiasis control on children educational outcomes.

B. Program Design

As part of the effort to control the disease, the Carter Center (CC) has provided schistosomiasis health education and drug distribution in Nigeria since 1999 to children aged 5-14. Children aged 5-14 are the most involved in water related household chores of all age groups. More specifically, the CC has provided annual oral mass treatment of praziquantel to at-risk populations in the states of Plateau, Edo, Delta and Nasarawa. In 2008, the CC received a donation of 1.1 million doses of praziquantel followed by another donation of 1.5 million drugs in 2009 from WHO and Merck. The contributions made in 2008 and 2009 to the program surpassed the cumulative number of treatment from 1996 to 2007 to illustrate a significant expansion of the schistosomiasis control program. The intervention as of today is believed to have considerably reduced schistosomiasis infection in the treated states as documented in many studies that report a reduction in blood in urine in targeted villages from 47 percent to 8 percent in 2002 (Hopkins, et al., 2002; Agi & Okafor, 2005; Hopkins, et al., 2008).

II. Empirical Model and Identification

To identify the effect of the schistosomiasis treatment we use the states in which the Carter Center in collaboration with the Ministry of Health provided the treatment. The intervention concerned 4 states out of the 37 states in Nigeria, including the federal capital territory of Abuja. The intervention started in Plateau and Nasarawa states and then extended to Delta and Edo states. The treatment states received the treatment on and after 1999. The remaining 33 states did not receive the mass treatment of praziquantel. Since the target group is school-aged children, our identification strategy is based on the assumption that it is only because of the intervention that eligible children in the treatment states are able to receive the drug praziquantel. The main assumption is that the trend in education outcomes in both control and treatment states would have been the same in the absence of the treatment.

We have access to 3 rounds of household surveys fielded in 1990, 2008 and 2013. However, Bertrand, Duflo and Mullainathan (2004) showed that estimates and inference of DID are sensitive to serial correlation when the data extended to several periods, and they recommend aggregating the the data in two periods of pre- and post-intervention in this case. Thus, we use the 1990 survey as the pre-intervention round (baseline), and the 2008 and 2013 surveys as post-intervention round.

We first examine the effect of the treatment on the group cohort dummy using the following equation

(1) $$E_{ijt} = \alpha_0 + \alpha_1 T_i + \alpha_2 Post_j + \alpha_3 (T_i \times Post_j) + \varepsilon_{ijt}$$

where E_{ijt} represents individual's education in single years, T_i is an indicator for whether the individual i is eligible for the treatment, $Post_j$ is a dummy to indicate whether the program intervention occurred in state j, and the interaction term $(T_i \times Post_j)$ is added to capture the treatment effect on the eligible group.

The baseline DID might be imprecisely estimated. It could be possible that the increase in education is changing systematically across regions or that the estimates simply reflect a mean reversion.

We next elaborate on a cohort analysis to provide more evidence the treatment impact. To perform a cohort analysis, we use the 2013 survey to identify individuals born between 1985 and 1992. This consists of individuals between 7 and 14 years of age in 1999. These individuals would have been eligible for the treatment, conditional on residing in a state where treatment was offered. We also identify cohorts of individuals who were never eligible to receive the treatment, that is, individuals who were too old to receive treatment by the time the program started. Using the 2013 survey, we define them to be the old cohort, more precisely, as individuals born between 1976 and 1983. In 1999, these individuals were between 16 and 23 years old, which disqualify them and make them ineligible for the treatment. We use these two groups to investigate key differences in education outcomes between treatment and comparison states.

The identification exploits the variation of cohort exposure to treatment across time and space. The old cohorts were never exposed to the program, regardless of state of residence. The young cohorts were exposed to the program if they lived in a treatment state. To account for variations in the control group over time we define groups of the even older individuals (born before 1976), cohort that was never exposed to the treatment. Equality in the pre-treatment period for these control groups should provide confidence in the estimation of the program impact. We estimate the following regression:

$$E_{ijk} = \beta_0 + \beta_1 T_i + \beta_2 S_j + \beta_3 X_{ijk} + \beta_4 (T_i \times S_j) + \delta_j + \tau_k + \mu_{ijk}, \quad (2)$$

where E_{ijk} is the education outcome, T_i is the cohort dummy for children aged 7-14 in 1999, S_j is an indicator for the treatment state, X_{ijk} is a vector of control variables, δ_j is the state fixed effects, τ_k is the group age fixed effects, and μ_{ijk} is the error term. Additional control variables, listed in table 1, are added to hopefully account for observed dynamic factors that could affect the individual education outcome over time. We include age dummies to partial out any heterogeneity related to group age. We also add the state fixed effects and survey month dummies to remove time invariant unobservables.

III. Data

To examine the effect of the program we assembled round surveys on Nigeria that are available from the Demographic Health Survey (DHS) covering the years 1990, 2008 and 2013. The surveys initiated by the National Population Commission and partly funded through the USAID were developed to provide accurate information on maternal and child health but also family planning. Their main goal is to provide policymakers better assessments on designing programmes and strategies for improving health and family planning service in the country.

A total sample of 37,385 observations and variables to contain information on child, woman and household characteristics. The DHS is constructed to be nationally representative of the entire population. The primary sampling unit or cluster, which is defined based on the list of enumerative areas, contains a fixed sample of 45 randomly selected households. The sample includes all the 37 states, including Plateau, Edo, Delta, and Nasarawa where most of the efforts against schistosomiasis by the Carter center have been concentrated. In the best of our knowledge, there were no other similar programs at the time of the program.

IV. Estimation Results

We first show a description of the data collected. The mean values of characteristics at the individual and household level are summarized in Table 1. The first column reports the mean value for the entire sample. In column 2, we present the characteristics for treatment states. In column 3, we show the same characteristics for control states. We then test for any statistical difference in the displayed average values. Only for the total number of adults we find no significant difference between the two groups, but for the rest we test significant differences. Table IB shows the description of the sample by gender and location. Boys aged 7-14 received more education than girls of the same age in terms of years of education (9.358 against 7.386) and school enrollment (0.799 against 0.653). Individuals in urban areas had on average higher years of education (10.79 against 6.56) and school enrollment than those in rural areas (0.894 against 0.600).

Table IIA reports the results of the baseline DID using equation 1. The dependent variable indicates whether a child has ever been enrolled in school. The DID estimate is the coefficient associated with the variable (post-treatment×Age 7-14). The results reported in column 1 indicates that relative to the non-treated group, children who receive the schistosomiasis treatment are on average 16.0 percentage points more likely to enroll in school. With respect to gender, columns 2 and 3 show that boys enrollment in school increased by 24.3 percentages point higher while girls enrollment rate increased only by 9.52 percentage points. Relative to location, columns 4 and 5 indicate that the effect of the schistosomiasis treatment is stronger in urban areas (37.5 percentage points) compared to rural areas (15.4 percentage points). Columns 6 and 7 show boys and girls in rural areas and indicate that boys' enrollment increased by 21.7 percentage points and girls' enrollment increased by 10.8 percentage points.

In table IIIA presents the results for the group cohort for the treatment using equation 2, which is for reasons explained above our preferred specification. The first column reports the point estimate for the entire sample. The coefficient on the DID interaction term is positive and significant at the 5 percent level indicating that relative to control states, school-aged children have on average 0.642 additional year in their education. The estimated effect correspond to approximately 7.90 percentage point increase starting from the average year of education in the control group (8.13 years). The point estimate in column 2 and 3 show the treatment impact for boys and girls, respectively. The coefficient for treatment interaction with young boys is 0.267, the estimate of the treatment is positive but not significantly different from zero at the conventional level. Comparatively, the coefficient on the interaction term for young girls in column 3 is larger, 0.945, and significant at the 5 percent level.

The results displayed in columns 4 and 5 separate the program impact into urban and rural areas. The schistosomiasis treatment essentially targeted rural villages in treatment states. It is then not surprising that the point estimate in urban areas is small, 0.143, and not significantly different from zero; meaning that the treatment has no significant effect in urban locations. In contrast, the effect of the program seems larger in rural areas, 1.024, and significant at the 1 percent level, as it should be expected. In other words, children who benefitted from the treatment in rural villages gain years of education relative to those in control villages who did not received the treatment. In columns 6 and 7, the results presented report the estimates for young boys and girls in rural areas. The estimated coefficient in column 6 indicates that boys' years of education increased by 0.700, significantly at the 5 percent level, and that girls gained an additional 1.293 year in their education, significant at the 1 percent level. All the results are robust to the inclusion on control variables, age dummies, state fixed effects and survey month dummies.

Results in table IIIB show the estimates for individuals not eligible for the treatment. The majority of schistosomiasis infections occur among children aged 5-14 and the program intervention has focused on this group. Therefore, the program should not have a significant effect on the schooling outcome for older individuals, say aged 16-23. In columns 1-7, the coefficient on the interaction term shows the treatment impact for these older individual using the same specifications as in table IIIA. The point estimates for are not significantly different from zero, at the exception of the education for boys aged 7-14 (-0.617) and for girls in rural areas (0.732), which are significant at the margin.

V. Robustness checks

In Nigeria, the efforts against schistosomiasis coincided with other treatment initiatives like the *malaria-lymphatic filaris* control program. The malaria policy intervention to eliminate lymphatic filaris started with a pilot project in 2004 and operated mass drug administration of single dose treatment as well as the distribution of insecticide treated bed nets to households in rural villages in Plateau and Nasarawa states (Blackburn, et al., 2006). It could be possible that the program have impacted child health and education and therefore introduce a bias in the estimates reported in Table IIIA and IIIB. Our data identified households that received treated bed nets. We thus estimate the effect of malaria treatment program on young children education. The results are reported in Table IVA. The estimates on the triple interaction term across all specifications are positive but not significantly different from zero at the conventional level. There is no evidence of any additional effect of the malaria campaigns on the schistosomiasis control program. In panel B, we investigate the effect of the intervention on older individuals. From columns 1 to 7, the point estimates are not statistically significant at the 10 percent level. The presented evidence support our main conclusion, other health initiatives are not driving our results.

VI. Conclusion

The findings of this paper make the case for substantial improvement in education returns following mass drug administration of schistosomiasis treatment. We show that the control program increases school-aged children years of education by 7.9 percentage points. Our results corroborate previous studies (Ayoya et al., 2012) that find significant effect of the treatment on children attendance at school. We further show that girls were more likely to benefit from the treatment than boys, highlighting that investment in girls' human capital is more elastic than for boys (Kazianga & Makamu, 2015).

VII. Bibliography

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VIII. Tables

TABLE IA—SUMMARY STATISTICS BY TREATMENT AND COMPARISON GROUP

	(1) All sample	(2) Treatment	(3) Control	(4) Difference in means	(5) p-value
Education completed in single years	8.301	9.663	8.130	1.532	0.000
	(9.435)	(6.259)	(9.748)	[0.155]	
High school completion	0.441	0.524	0.431	0.092	0.000
	(0.497)	(0.499)	(0.495)	[0.008]	
School enrollment	0.721	0.887	0.700	0.186	0.000
	(0.448)	(0.317)	(0.458)	[0.007]	
Total adults measured (women only)	1.370	1.385	1.368	0.017	0.298
	(0.998)	(1.070)	(0.989)	[0.016]	
Source of drinking water	31.799	33.068	31.639	1.428	0.000
	(15.897)	(15.159)	(15.981)	[0.261]	
Sex of head of household	1.129	1.153	1.126	0.027	0.000
	(0.336)	(0.360)	(0.332)	[0.006]	
Age of head of household	41.133	43.056	40.892	2.163	0.000
	(14.359)	(15.691)	(14.164)	[0.235]	
Owns livestock, herds or farm animals	0.534	0.407	0.550	-0.142	0.000
	(0.557)	(0.509)	(0.561)	[0.009]	
Sex of household member	1.536	1.512	1.539	-0.027	0.001
	(0.499)	(0.500)	(0.498)	[0.008]	
Average years of education - wife or wives	0.593	0.686	0.581	0.104	0.000
	(0.826)	(0.808)	(0.828)	[0.014]	
Years of education head - male	2.942	3.481	2.874	0.606	0.000
	(3.048)	(3.588)	(2.966)	[0.050]	
Age of household members	28.538	28.354	28.562	-0.207	0.007
	(4.722)	(4.789)	(4.713)	[0.078]	
Observations	37385	4177	33208		

Notes: Standard deviations are in parentheses. Standard errors are in brackets.

TABLE IB: SUMMARY STATISTICS BY SUBCATEGORIES

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys 7-14 rural	(7) Girls 7-14 rural
Education completed	8.301	9.358	7.386	10.790	6.560	7.773	5.537
in single years	(9.435)	(8.640)	(9.982)	(7.687)	(10.128)	(9.349)	(10.634)
High school	0.441	0.535	0.361	0.653	0.294	0.392	0.211
completion	(0.497)	(0.499)	(0.480)	(0.476)	(0.455)	(0.488)	(0.408)
School enrollment	0.721	0.799	0.653	0.894	0.600	0.701	0.515
	(0.448)	(0.401)	(0.476)	(0.308)	(0.490)	(0.458)	(0.500)
Total adults measured	1.370	1.054	1.643	1.333	1.396	1.091	1.654
(women only)	(0.998)	(0.956)	(0.952)	(1.082)	(0.934)	(0.877)	(0.902)
Source of drinking	31.799	32.200	31.451	31.810	31.791	31.936	31.668
water	(15.897)	(16.350)	(15.487)	(20.276)	(11.913)	(12.130)	(11.726)
Sex of head of	1.129	1.087	1.166	1.170	1.101	1.069	1.128
household	(0.336)	(0.282)	(0.372)	(0.375)	(0.302)	(0.254)	(0.334)
Age of head of	41.133	39.504	42.544	42.102	40.456	38.306	42.269
household	(14.359)	(15.512)	(13.119)	(14.828)	(13.982)	(15.108)	(12.677)
Owns livestock, herds	0.534	0.501	0.562	0.336	0.672	0.636	0.703
or farm animals	(0.557)	(0.566)	(0.548)	(0.546)	(0.522)	(0.537)	(0.507)
Sex of household	1.536	1.000	2.000	1.527	1.542	1.000	2.000
member	(0.499)	(0.000)	(0.000)	(0.499)	(0.498)	(0.000)	(0.000)
Years of education -	0.593	0.481	0.690	0.783	0.460	0.395	0.515
mother	(0.826)	(0.704)	(0.908)	(0.897)	(0.745)	(0.659)	(0.806)
Years of education -	2.942	3.171	2.744	3.428	2.602	2.800	2.435
father	(3.048)	(3.006)	(3.069)	(2.672)	(3.242)	(3.290)	(3.192)
Age of household	28.538	28.721	28.380	28.509	28.559	28.776	28.375
members	(4.722)	(4.767)	(4.678)	(4.760)	(4.695)	(4.739)	(4.651)
Observations	37385	17345	20040	15388	21997	10064	11933

Notes: Standard deviations are in parentheses.

TABLE IIA: BASIC DIFFERENCE-IN-DIFFERENCE, SCHISTOSOMIASIS CONTROL PROGRAM IMPACT ON CHILDREN ON SCHOOL ENROLLMENT

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys in rural areas	(7) Girls in rural areas
Post-treatment ×	0.160^{**}	0.243^{***}	0.0952^{*}	0.375^{***}	0.154^{**}	0.217^{***}	0.108^{*}
Age 7-14	(0.0295)	(0.0270)	(0.0380)	(0.0219)	(0.0300)	(0.0297)	(0.0358)
Post-treatment	0.336^{***}	0.246^{***}	0.416^{***}	0.458^{***}	0.309^{***}	0.240^{***}	0.370^{***}
	(0.0245)	(0.0162)	(0.0355)	(0.0291)	(0.0265)	(0.0244)	(0.0333)
Age 7-14	-0.337^{***}	-0.500^{***}	-0.193^{**}	-0.665^{***}	-0.278^{***}	-0.443^{***}	-0.138^{*}
	(0.0498)	(0.0651)	(0.0519)	(0.0563)	(0.0369)	(0.0619)	(0.0477)
Constant	0.235^{**}	0.461^{**}	-0.0396	0.261^{**}	0.194^{*}	0.425^{**}	-0.0917
	(0.0561)	(0.0854)	(0.0568)	(0.0563)	(0.0612)	(0.0962)	(0.0604)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month survey dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23685	11854	11829	7405	16280	8179	8099
R^2	0.259	0.249	0.323	0.240	0.257	0.250	0.331

Standard errors in parentheses are clustered at the state level.

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

Note: The control variables included are total adults in household, source of drinking water, head gender and age, livestock ownership, sex of household member, mother and father education. We also run the regressions on older individuals, the point estimates on the DD coefficient are not different from zero, at the exception of column 4 (urbans areas) which is significant at the 1 percent level. All specifications include age dummies, state fixed effects and survey month dummies.

TABLE IIIA—COHORT ANALYSIS, IMPACT OF SCHISTOSOMIASIS CONTROL PROGRAM ON CHILDREN YEARS OF EDUCATION, BY GENDER, URBAN/RURAL, AND INTERACTIONS

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys 7-14 rural areas	(7) Girls 7-14 rural areas
Treated states×	0.642**	0.267	0.945**	0.143	1.024***	0.700**	1.293***
Age 7-14	(0.240)	(0.208)	(0.366)	(0.355)	(0.259)	(0.269)	(0.475)
Treated states	2.006***	1.292***	2.696***	0.892**	2.604***	1.870***	3.327***
	(0.305)	(0.316)	(0.351)	(0.333)	(0.364)	(0.434)	(0.430)
Age 7-14 in 1999	0.743**	0.561	1.044**	0.063	1.269**	1.151**	1.479*
	(0.307)	(0.363)	(0.476)	(0.393)	(0.477)	(0.478)	(0.754)
Constant	5.592***	2.005	1.598	8.943***	4.761***	0.644	0.971
	(0.850)	(1.383)	(0.988)	(0.870)	(1.318)	(1.764)	(1.775)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37385	17345	20040	15388	21997	10064	11933
R-squared	0.138	0.144	0.135	0.076	0.127	0.157	0.111
lincom (Treated	1.386	0.828	1.989	0.207	2.294	1.851	2.772
states + Age 7-14)	(0.327)	(0.355)	(0.517)	(0.473)	(0.428)	(0.498)	(0.723)

Notes: Robust standard errors in parentheses are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The control variables included are total adults in household, source of drinking water, head gender and age, livestock ownership, sex of household member, mother and father education. All specifications include age dummies, state fixed effects and survey month dummies.

TABLE IIIB—COHORT ANALYSIS, IMPACT OF SCHISTOSOMIASIS CONTROL PROGRAM ON CHILDREN YEARS OF EDUCATION, BY GENDER, URBAN/RURAL, AND INTERACTIONS (OLDER CHILDREN)

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys 7-14 rural areas	(7) Girls 7-14 rural areas
Treated states×	-0.067	-0.617*	0.463	-0.238	-0.007	-0.783*	0.732*
Age 16-23	(0.239)	(0.320)	(0.334)	(0.277)	(0.312)	(0.415)	(0.426)
Treated states	1.823***	1.730***	2.178***	1.581***	1.971***	2.078***	2.521***
	(0.338)	(0.381)	(0.401)	(0.399)	(0.464)	(0.464)	(0.536)
Age 16-23 in	0.544	0.545	0.689	0.879	0.581	1.342***	0.003
1999	(0.368)	(0.456)	(0.717)	(0.576)	(0.483)	(0.477)	(1.019)
Constant	4.135***	-0.131	1.280	6.780***	3.195*	-1.301	1.270
	(1.243)	(1.442)	(1.387)	(1.255)	(1.671)	(1.547)	(2.186)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29274	14534	14740	11786	17488	8651	8837
R-squared	0.136	0.149	0.120	0.103	0.118	0.152	0.093
lincom (Treated	0.477	-0.071	1.153	0.642	0.573	0.560	0.735
states + age16-23)	(0.385)	(0.492)	(0.674)	(0.518)	(0.501)	(0.591)	(0.951)

Notes: Robust standard errors in parentheses are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The control variables included are total adults in household, source of drinking water, head gender and age, livestock ownership, sex of household member, mother and father education. All specifications include age dummies, state fixed effects and survey month dummies.

TABLE VI.A—ROBUSTNESS CHECK, MALARIA CAMPAIGNS FOR INSECTICIDAL NET INTERACTED WITH SCHISTOSOMIASIS TREATMENT PROGRAM

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys 7-14 rural areas	(7) Girls 7-14 rural areas
Treated states× Malaria treatment ×Age 7-14	0.791	0.412	0.800	0.583	0.761	0.756	0.705
	(1.130)	(0.672)	(1.326)	(0.927)	(1.181)	(0.729)	(1.358)
Malaria treatment ×Age 7-14	0.191	-0.349	0.513	0.0682	0.328	-0.359	0.728
	(0.246)	(0.248)	(0.335)	(0.228)	(0.320)	(0.322)	(0.492)
Treated states× Age 7-14	0.561*	0.227	0.844	0.0917	0.940***	0.625**	1.195*
	(0.308)	(0.201)	(0.518)	(0.368)	(0.330)	(0.270)	(0.625)
Constant	6.319***	2.609**	2.542***	8.998***	5.994***	1.851	2.319
	(0.777)	(1.261)	(0.894)	(0.805)	(1.213)	(1.687)	(1.508)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37385	17345	20040	15388	21997	10064	11933
R^2	0.138	0.144	0.135	0.076	0.128	0.157	0.111

Standard errors in parentheses are clustered at the state level.

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

Note: The control variables included are total adults in household, source of drinking water, head gender and age, livestock ownership, sex of household member, mother and father education. All specifications include age dummies, state fixed effects and survey month dummies

TABLE VI.B— ROBUSTNESS CHECK, MALARIA CAMPAIGNS FOR INSECTICIDAL NET INTERACTED WITH SCHISTOSOMIASIS TREATMENT PROGRAM FOR NON-TREATED (OLDER) CHILDREN

	(1) All sample	(2) Boys 7-14	(3) Girls 7-14	(4) Urban areas	(5) Rural areas	(6) Boys 7-14 rural areas	(7) Girls 7-14 rural areas
Treated states× Malaria treatment ×Age 16-23	-0.0818	0.373	-0.257	0.0472	-0.152	0.469	-0.448
	(0.362)	(0.417)	(0.442)	(0.394)	(0.536)	(0.557)	(0.750)
Malaria treatment ×Age 16-23	0.264	0.319	0.215	0.355	0.244	0.185	0.340
	(0.278)	(0.290)	(0.319)	(0.317)	(0.479)	(0.340)	(0.570)
Treated states× Age 16-23	-0.0541	-0.667**	0.510	-0.239	0.0174	-0.856**	0.817
	(0.239)	(0.312)	(0.363)	(0.278)	(0.351)	(0.414)	(0.524)
Constant	4.649***	0.363	1.927*	7.576***	3.757**	0.0181	1.217
	(1.086)	(1.227)	(1.111)	(1.053)	(1.387)	(1.322)	(1.837)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29274	14534	14740	11786	17488	8651	8837
R^2	0.136	0.149	0.120	0.103	0.118	0.152	0.093

Standard errors in parentheses are clustered at the state level.

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

Note: The control variables included are total adults in household, source of drinking water, head gender and age, livestock ownership, sex of household member, mother and father education. All specifications include age dummies, state fixed effects and survey month dummies