Supplemental Appendix: Intergenerational Child Mortality Impacts of Deworming: Experimental Evidence from Two Decades of the Kenya Life Panel Survey

Michael Walker, Suleiman Asman, Sarah Baird, Lia Fernald, Joan Hamory, Alice Huang, Satoshi Koiso, Michael Kremer, Matthew N Krupoff, Michelle Layvant, Eric Ochieng, Pooja Suri and Edward Miguel*

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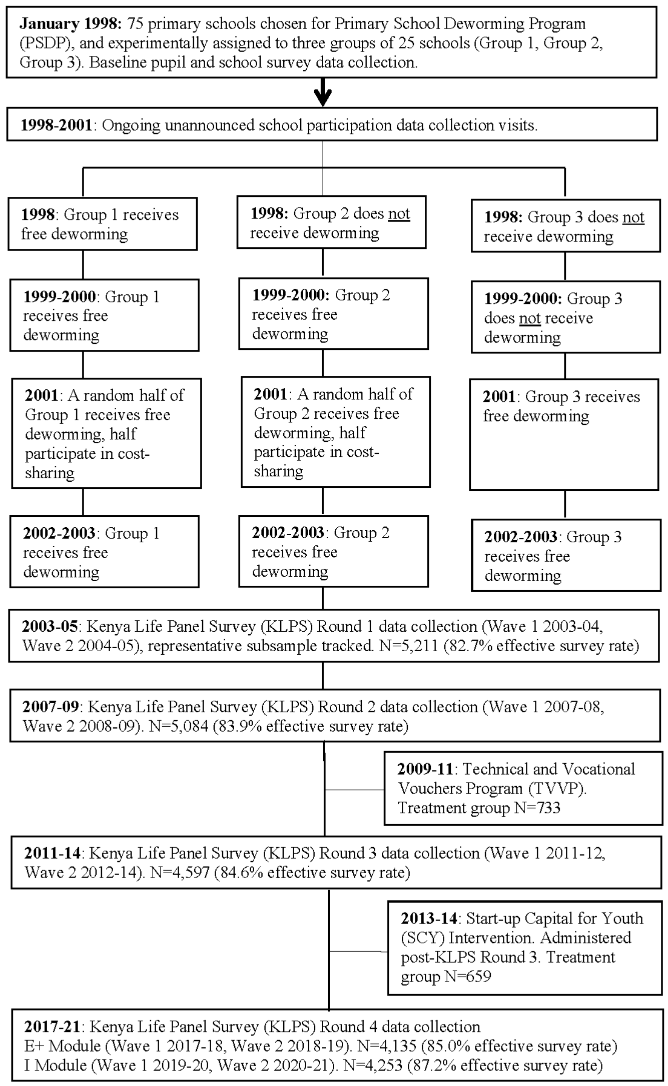
*Walker: University of California, Berkeley (mwwalker@berkeley.edu); Asman: Innovations for Poverty Action, Kenya (sasman@poverty-action.org); Baird: George Washington University (sbaird@gwu.edu); Fernald: University of California, Berkeley (fernald@berkeley.edu); Hamory: University of Oklahoma (jhamory@ou.edu); Huang: University of California, Berkeley (alice_huang@berkeley.edu); Koiso: University of California, Berkeley (satoshi.koiso@berkeley.edu); Kremer: University of Chicago (kremermr@uchicago.edu); Krupoff: University of California, Berkeley (mkrupoff@berkeley.edu); Layvant: University of California, Berkeley (mlayvant@berkeley.edu); Ochieng: Innovations for Poverty Action, Kenya (eochieng@poverty-action.org); Suri: University of California, Berkeley (pooja_suri@berkeley.edu); Miguel, University of California, Berkeley (emiguel@berkeley.edu).

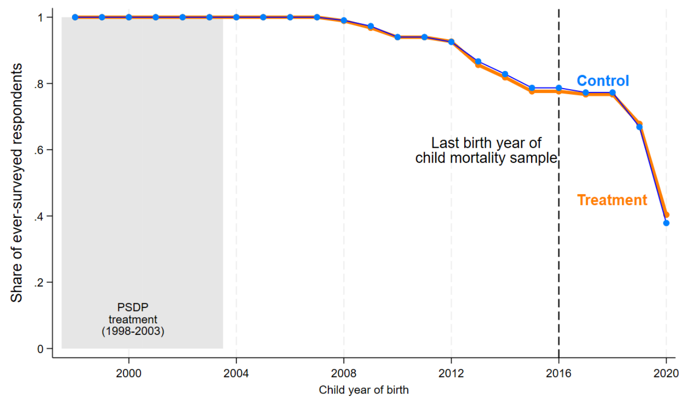
A Additional exhibits (for online publication)

Figure A.1: Primary School Deworming Project (PSDP) and Kenya Life Panel Survey (KLPS) Timeline

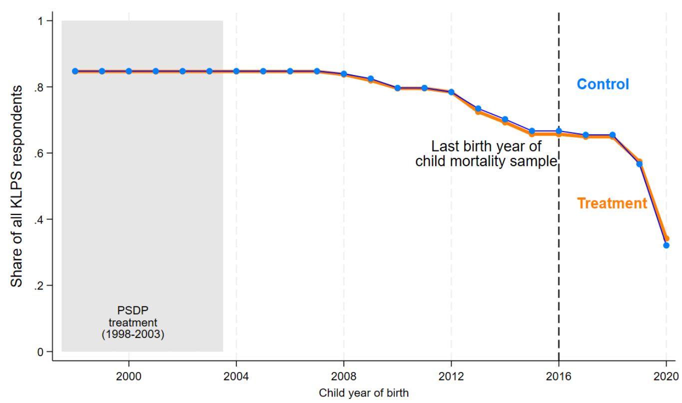


Notes: This figure presents the timeline of the PSDP and KLPS. The PSDP was conducted in 1998-2003, while the KLPS launched in 2003. Two additional interventions on vocational training and cash grants took place in 2009-11 and 2013-14; individuals assigned to the treatment group of these interventions are excluded from the analysis. For more details, see Appendix B.

Figure A.2: "Coverage" of fertility history by year



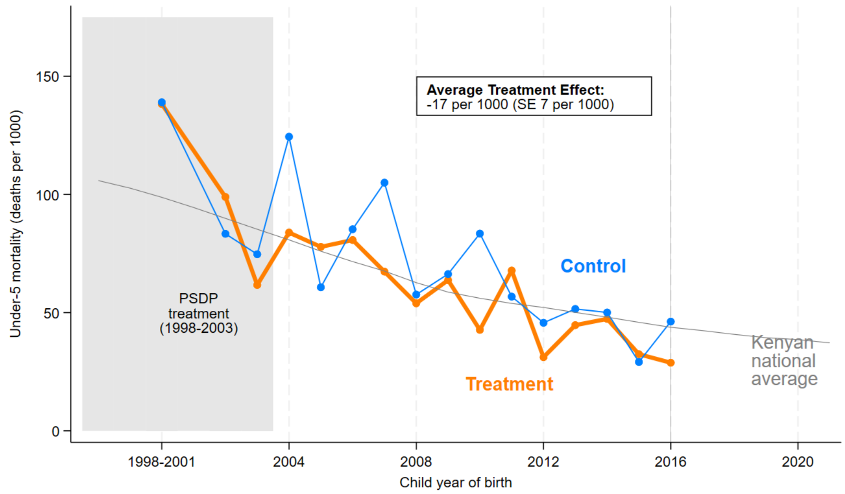
(a) Panel A: Among ever-surveyed households



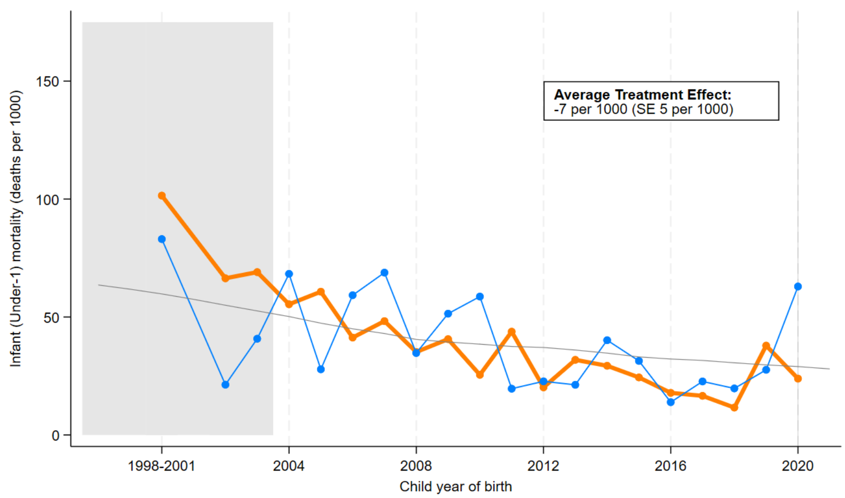
(b) Panel B: Among all KLPS respondents

Notes: This figure presents information on rates of "coverage" (i.e., whether the fertility modules collected from respondents covered a given year) for fertility history. For example, consider a respondent surveyed only in 2008 (say, as part of KLPS-2 Wave 1): as the fertility module would capture their fertility history up to this point in time, the years 1998-2008 would be considered "covered". For a respondent surveyed in every round, and last surveyed in 2019 (KLPS-4 Wave 1), the years from 1998 to 2019 would be "covered". Note that given this survey timing, not all KLPS respondents were targeted for surveying in the later years. The vertical line at 2016 represents the cutoff for data used in the main under-5 mortality estimates. Panel A shows patterns among ever-surveyed households within the child mortality sample, and Panel B shows patterns among all KLPS respondents within the child mortality sample (e.g., excluding the vocational training and cash grant control groups), regardless of survey status.

Figure A.3: Intergenerational Deworming Impacts on Child Mortality, for Parent Deworming Treatment group vs Control group, by year



(a) Panel A: Under-5 mortality over time (1998-2016)



(b) Panel B: Infant (under-1) mortality over time (1998-2020)

Notes: Figure 1 shows child (under-5, Panel A) and infant (under-1, Panel B) mortality rates by year. The orange line shows the mortality rates for respondents from treatment schools, and the blue line shows the mortality rates for respondents from control schools. The grey line shows the Kenyan national average by year. Panel A shows under-5 mortality which for a given year is calculated as the share of children born in that year who die before the age of 5, scaled to be deaths per 1000 births. Panel B shows the under-1 mortality rate, which is calculated as the share of children born in that year who die before the age of 1, scaled to be deaths per 1000 births. The data are restricted to include only children with complete mortality histories, i.e., that we have survey data at least five (one) years since birth. As a reminder, PSDP project years are from 1998-2003. The weights used are an average of round-specific PSDP sample weights; each of the round-specific weights are designed to maintain the representativeness of the original PSDP sample and reflect the two-stage tracking approach. For more details on the PSDP analysis sample and weights, see Appendix B and C.7.

Table A.1: Balance by baseline characteristics for the Main Analysis Sample

	Treatment − Control (s.e.)			Control group mean (s.d.)		
	All	Male	Female	All	Male	Female
Panel A: Ever Surveyed						
Age (1998)	0.02	-0.07	0.14	11.95	12.19	11.67
	(0.13)	(0.17)	(0.14)	(2.60)	(2.68)	(2.48)
Grade (1998)	0.04	0.04	0.04	4.23	4.20	4.27
	(0.06)	(0.08)	(0.06)	(1.65)	(1.65)	(1.66)
Female indicator	0.002			0.480		
	(0.017)					
School average test score (1996)	-0.016	-0.056	0.027	0.044	0.064	0.023
	(0.114)	(0.123)	(0.108)	(0.418)	(0.439)	(0.392)
Primary school located in Budalangi division indicator	0.002	-0.002	0.007	0.365	0.354	0.376
	(0.134)	(0.135)	(0.136)			
Population of primary school	65	60	71	432	435	428
	(53)	(50)	(57)	(141)	(139)	(143)
Primary school students within 6km in treatment schools (Group 1,2)	-6	14	-29	4681	4651	4713
	(391)	(405)	(379)	(1560)	(1585)	(1532)
Saturation P: Proportion of treated students within 6km	-0.044	-0.046	-0.043	0.543	0.544	0.542
	(0.018)	(0.019)	(0.017)	(0.060)	(0.062)	(0.058)
Years of assigned deworming treatment, 1998-2003	2.36	2.38	2.34	1.70	1.72	1.67
	(0.09)	(0.10)	(0.09)	(1.22)	(1.22)	(1.22)
Panel B: Surveyed in KLPS-4						
Age (1998)	-0.00	-0.09	0.09	11.93	12.19	11.63
	(0.15)	(0.21)	(0.21)	(2.60)	(2.65)	(2.51)
Grade (1998)	0.06	0.07	0.05	4.18	4.17	4.19
	(0.08)	(0.12)	(0.11)	(1.66)	(1.67)	(1.65)
Female indicator	-0.015			0.498		
	(0.025)					
School average test score (1996)	-0.040	-0.087	0.009	0.050	0.072	0.028
	(0.109)	(0.121)	(0.101)	(0.406)	(0.433)	(0.377)
Primary school located in Budalangi division indicator	-0.004	0.012	-0.019	0.363	0.330	0.396
	(0.135)	(0.131)	(0.141)			
Population of primary school	65	61	70	430	426	434
	(56)	(52)	(62)	(142)	(139)	(146)
Primary school students within 6km in treatment schools (Group 1,2)	60	10	110	4655	4694	4616
	(397)	(416)	(388)	(1588)	(1622)	(1553)
Saturation P: Proportion of treated students within 6km	-0.047	-0.049	-0.045	0.542	0.542	0.542
	(0.018)	(0.019)	(0.017)	(0.061)	(0.062)	(0.060)
Years of assigned deworming treatment, 1998-2003	2.36	2.36	2.36	1.73	1.73	1.72
	(0.10)	(0.11)	(0.12)	(1.22)	(1.23)	(1.21)

Notes: This table checks for balance among the PSDP analysis sample used in this paper. Namely, it drops individuals that were randomly assigned to treatment as part of cross-cutting vocational training and cash grant programs conducted in 2009-14. Panel A reports balance for this sample among respondents that were ever surveyed (N= 5,512, with 2,715 males and 2,797 females, except for age as captured at baseline in 1998, where N=4,084). Panel B reports balance among respondents surveyed as part of the KLPS-4 I Module, the most recent instrument to collect information on birth histories and child mortality (N=4,253, with 2,055 males and 2,198 females, except for age as captured at baseline in 1998, where N=3,084). In both panels, observations are weighted to maintain initial population proportions. Specifically, Panel A observations are weighted by KLPS population weights, with individuals assigned to the control group of the vocational training and cash grant programs upweighted to maintain representativeness of the original PSDP population. Panel B observations are weighted by KLPS-4 specific weights that take into account the round-specific tracking strategy, so that "intensive" sample respondents receive more weight. The "Treatment – Control" differences are derived from a linear regression on a constant and the treatment indicator. Standard errors are clustered by PSDP school.

Table A.2: Kenya Life Panel Survey (KLPS) Respondent Survey Tracking and Attrition Rates

	Control Mean			**Treatment − Control (se)**		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Female	Male	All	Female	Male
Panel A: Overall (2007-2021)						
Found	0.885	0.885	0.884	0.007	-0.011	0.025
				(0.018)	(0.018)	(0.021)
Deceased	0.046	0.040	0.052	0.006	0.009	0.004
				(0.007)	(0.009)	(0.010)
Surveyed, including deceased	0.848	0.852	0.844	-0.001	-0.022	0.020
				(0.018)	(0.019)	(0.020)
Number Surveyed	5512	2796	2716			
Panel B: KLPS-4 I Module (2019-2021)						
Found	0.924	0.928	0.920	0.008	-0.010	0.026
				(0.021)	(0.026)	(0.027)
Deceased	0.051	0.048	0.053	0.004	0.004	0.005
				(0.009)	(0.013)	(0.011)
Surveyed, among non-deceased	0.853	0.878	0.830	-0.004	-0.053	0.044
				(0.027)	(0.031)	(0.034)
Number Surveyed	4253	2198	2055			
Panel C: KLPS-3 I Module (2011-14)						
Found	0.859	0.847	0.869	-0.005	-0.019	0.010
				(0.022)	(0.028)	(0.023)
Deceased	0.024	0.023	0.024	0.004	-0.001	0.009
				(0.005)	(0.006)	(0.007)
Surveyed, among non-deceased	0.843	0.828	0.857	-0.012	-0.023	0.000
				(0.023)	(0.029)	(0.024)
Number Surveyed	4286	2111	2175			
Panel D: KLPS-2 (2007-09)						
Found	0.867	0.854	0.878	-0.007	-0.021	0.007
				(0.017)	(0.025)	(0.022)
Deceased	0.014	0.012	0.016	0.004	0.006	0.003
				(0.004)	(0.005)	(0.005)
Surveyed, among non-deceased	0.839	0.830	0.847	0.001	-0.018	0.019
				(0.017)	(0.025)	(0.023)
Number Surveyed	5084	2489	2595			

Notes: The effective survey tracking rate is calculated using a two-phase tracking design as in Orr et al. (2003). Columns (1) to (3) present control means for indicator variables for respondent found, deceased, or surveyed, respectively. Column (4) presents regression results of these indicator variables regressed on an indicator for PSDP treatment. Columns (5) and (6) present regression results for female and male subsamples, respectively. Panel A shows the overall tracking rate across all KLPS rounds. As such, the surveyed indicator is equal to 1 if the respondent was surveyed in any of the KLPS rounds. For Panels B, C, and D the sample includes all PSDP individuals found in initial tracking or placed under intensive tracking, and only includes individuals in the PSDP sample. These tracking rates are weighted to account for the two-stage tracking approach. Those treated in a separate vocational training intervention (VocEd) which occurred prior to KLPS-3 are dropped from the KLPS-3 and KLPS-4 attrition samples. Those treated in a separate small grant intervention (SCY) which occurred during KLPS-3 are dropped from the KLPS-4 attrition sample. Observations are weighted to be representative of the original KLPS population, and include KLPS population weights, SCY and VocEd control group weights, and KLPS intensive tracking weights. Standard errors are clustered at the 1998 school level.

Table A.3: Robustness checks on Intergenerational Deworming Impacts on Child and Infant Mortality: Logit, Probit and Alternative Weights

	Logit		**Probit**		**Child (Under-5) Mortality - Alternate Weighting**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Child (Under-5) Mortality	Infant (Under-1) Mortality	Child (Under-5) Mortality	Infant (Under-1) Mortality	Average PSDP Weights Across KLPS Rounds	KLPS Round Specific Weights	Population Weights Not Reweighted for Intensive	Unweighted
main								
Panel A: Full Sample								
Treatment	-0.312	-0.212	-0.149	-0.100	-0.017	-0.015	-0.015	-0.016
	(0.129)	(0.151)	(0.059)	(0.064)	(0.007)	(0.008)	(0.007)	(0.007)
Control Mean	0.074	0.040	0.074	0.040	0.074	0.072	0.073	0.072
Probability Reduction (%)	25.43	18.52	25.46	19.96				
Treatment Effect (%)					-23.26	-20.68	-20.61	-21.58
Number Observations	10067	13572	10067	13572	10077	9592	10077	10077
main								
Panel B: Female Parents								
Treatment	-0.273	-0.240	-0.129	-0.109	-0.015	-0.007	-0.013	-0.016
	(0.148)	(0.184)	(0.068)	(0.078)	(0.009)	(0.009)	(0.008)	(0.008)
Control Mean	0.073	0.042	0.073	0.042	0.073	0.067	0.072	0.076
Probability Reduction (%)	22.62	20.76	22.58	21.52				
Treatment Effect (%)					-20.52	-11.07	-18.27	-20.53
Number Observations	5833	7480	5833	7480	5842	5514	5842	5842
main								
Panel C: Male Parents								
Treatment	-0.371	-0.172	-0.179	-0.089	-0.020	-0.025	-0.017	-0.015
	(0.264)	(0.228)	(0.123)	(0.097)	(0.015)	(0.016)	(0.014)	(0.011)
Control Mean	0.075	0.038	0.075	0.038	0.075	0.078	0.074	0.066
Probability Reduction (%)	29.42	15.30	29.73	17.99				
Treatment Effect (%)								
Number of Observations	4234	6092	4234	6092	4235	4078	4235	4235

Notes: Columns (1) and (2) show the PSDP treatment effect on child and infant mortality using logit regressions, and columns (3) and (4) show the PSDP treatment effect on child and infant mortality using probit models, using the same variable construction, sample and weights as in Table 1. Panel A shows results using the full sample of children, whereas Panel B (Panel C) shows the results from children of female parents (male parents). Standard errors are clustered at the 1998 school level. Probability reduction (%) is calculated as the predicted probability of child mortality for the PSDP treatment group minus the predicted probability of child mortality for the PSDP control group divided by predicted probability in child mortality for the PSDP control group, evaluated at the regression covariate means. Columns (5) through (8) use OLS regressions to assess whether the main results are robust to alternative weighting schemes described in Appendix C.7. These regressions use the same variable construction, sample and standard errors as in Table 1, varying only the weights used.

Table A.4: Intergenerational Deworming Impacts on Child and Infant Mortality, Presenting Externality Terms

	Child (Under-5) Mortality		**Infant (Under-1) Mortality**	
	(1)	(2)	(3)	(4)
	Preferred (Prespecified)	No controls, unweighted	Preferred (Prespecified)	No controls, unweighted
Panel A: Full Sample				
Treatment	-0.017	-0.018	-0.007	-0.012
	(0.007)	(0.009)	(0.005)	(0.006)
Cost Sharing	0.015	0.010	0.009	0.008
	(0.007)	(0.007)	(0.004)	(0.004)
Saturation (demeaned)	0.007	-0.008	-0.023	-0.005
	(0.040)	(0.034)	(0.025)	(0.021)
Control Mean	0.074	0.074	0.040	0.040
Treatment Effect (%)	-23.26	-23.88	-18.55	-28.92
Joint F-test	0.07	0.24	0.17	0.10
Number Observations	10077	10117	13638	13678
Panel B: Female Parents				
Treatment	-0.015	-0.016	-0.009	-0.012
	(0.009)	(0.010)	(0.006)	(0.006)
Cost Sharing	0.023	0.015	0.016	0.012
	(0.011)	(0.011)	(0.006)	(0.006)
Saturation (demeaned)	0.063	0.006	-0.005	0.006
	(0.067)	(0.055)	(0.034)	(0.030)
Control Mean	0.073	0.073	0.042	0.042
Treatment Effect (%)	-20.52	-22.37	-20.44	-27.82
Joint F-test	0.050	.308	0.095	.134
Number Observations	5842	5848	7515	7521
Panel C: Male Parents				
Treatment	-0.020	-0.019	-0.006	-0.011
	(0.015)	(0.014)	(0.007)	(0.008)
Cost Sharing	0.004	0.003	0.003	0.005
	(0.010)	(0.009)	(0.006)	(0.005)
Saturation (demeaned)	-0.065	-0.021	-0.043	-0.015
	(0.067)	(0.054)	(0.037)	(0.034)
Control Mean	0.075	0.075	0.038	0.038
Treatment Effect (%)	-26.53	-25.49	-15.46	-29.65
Joint F-test	0.553	0.553	0.682	0.571
Number Observations	4235	4269	6123	6157

Notes: This table reproduces Table 1 to show the additional treatment-related terms from Baird et al. (2016). Note that this is the same regression as in Table 1, but in Table 1 these terms are omitted for brevity. The "Joint F-test" row presents the p-value on an F-test for the joint significance of the treatment, cost-sharing and deworming saturation variables. Standard errors are clustered at the 1998 school level. See Table 1 for more details.

Table A.5: Main Effects: Robustness to Alternative Control Variables

	Child (Under-5) Mortality				**Infant (Under-1) Mortality**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Preferred (Pre-specified)	No YOB Fixed Effects	Interview Controls only	Other treatment controls only	Preferred (Pre-specified)	No YOB Fixed Effects	Interview Controls only	Other treatment controls only
Panel A: Full Sample								
Treatment	-0.017	-0.020	-0.021	-0.021	-0.007	-0.009	-0.009	-0.009
	(0.007)	(0.008)	(0.009)	(0.009)	(0.005)	(0.005)	(0.006)	(0.006)
Control Mean	0.074	0.074	0.074	0.074	0.040	0.040	0.040	0.040
Treatment Effect (%)	-23.26	-27.52	-28.41	-28.63	-18.55	-22.69	-22.50	-21.49
Number Observations	10077	10116	10116	10117	13638	13677	13677	13678
Panel B: Female Parents								
Treatment	-0.015	-0.017	-0.017	-0.016	-0.009	-0.009	-0.009	-0.009
	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)	(0.007)	(0.007)
Control Mean	0.073	0.073	0.073	0.073	0.042	0.042	0.042	0.042
Treatment Effect (%)	-20.52	-22.69	-23.47	-21.88	-20.44	-22.11	-21.94	-21.00
Number Observations	5842	5848	10116	10117	7515	7521	13677	13678
Panel C: Male Parents								
Treatment	-0.020	-0.025	-0.026	-0.028	-0.006	-0.009	-0.008	-0.008
	(0.015)	(0.015)	(0.017)	(0.017)	(0.007)	(0.008)	(0.009)	(0.009)
Control Mean	0.075	0.075	0.075	0.075	0.038	0.038	0.038	0.038
Treatment Effect (%)	-26.53	-33.45	-34.13	-36.69	-15.46	-22.86	-22.51	-21.47
Number of Observations	4235	4268	4268	4269	6123	6156	6156	6157

Notes: This table assesses the robustness of the main effects on child and infant mortality to the inclusion/exclusion of various control variables. Panel A shows results using the full sample of children, whereas Panel B (Panel C) shows the results from children of female parents (male parents). Standard errors are clustered at the 1998 school level. These regressions use the same weights as in Table 1, varying only the control variables used across regressions. Columns (1) and (5) reproduce the preferred specification from Table 1. Columns (2) and (6) remove year-of-birth fixed effects. Columns (3) and (7) keep only interview-timing (indicators for survey wave, year of survey, and calendar month of survey), treatment-related controls (namely indicators for cost sharing, saturation, and being in the vocational training control group) and a gender indicator. Columns (4) and (8) keep only the treatment-related controls and the gender indicator.

Table A.6: Intergenerational Deworming Impacts on Child and Infant Mortality, Including Individuals in the Vocational Training and Cash Grant Treatment Groups

	Child (Under-5) Mortality		**Infant (Under-1) Mortality**	
	(1)	(2)	(3)	(4)
	Preferred (Prespecified)	No controls, unweighted	Preferred (Prespecified)	No controls, unweighted
Panel A: Full Sample				
Treatment	-0.015	-0.014	-0.007	-0.008
	(0.007)	(0.009)	(0.004)	(0.005)
Indicator for vocational education treatment (Voced)	-0.010	-0.003	0.007	0.012
	(0.007)	(0.010)	(0.007)	(0.008)
Indicator for Cash grant treatment	0.002	0.000	0.010	0.004
	(0.012)	(0.011)	(0.009)	(0.009)
Voced x Cash grant	0.010	0.013	-0.012	-0.003
	(0.021)	(0.020)	(0.014)	(0.015)
Control Mean	0.073	0.073	0.042	0.042
Treatment Effect (%)	-20.23	-18.55	-16.11	-18.58
Number Observations	12429	12498	16667	16736
Panel B: Female Parents				
Treatment	-0.013	-0.015	-0.007	-0.010
	(0.008)	(0.008)	(0.005)	(0.005)
Indicator for vocational education treatment (Voced)	-0.026	-0.016	-0.001	0.008
	(0.014)	(0.010)	(0.013)	(0.009)
Indicator for Cash grant treatment	-0.020	-0.010	0.008	0.001
	(0.018)	(0.014)	(0.016)	(0.011)
Voced x Cash grant	0.045	0.046	-0.009	0.009
	(0.025)	(0.022)	(0.022)	(0.020)
Control Mean	0.073	0.073	0.045	0.045
Treatment Effect (%)	-17.53	-20.65	-15.73	-23.43
Number Observations	7069	7079	9019	9029
Panel C: Male Parents				
Treatment	-0.017	-0.011	-0.007	-0.004
	(0.014)	(0.013)	(0.007)	(0.008)
Indicator for vocational education treatment (Voced)	-0.004	0.013	0.008	0.017
	(0.012)	(0.017)	(0.009)	(0.013)
Indicator for Cash grant treatment	0.012	0.013	0.006	0.008
	(0.017)	(0.016)	(0.011)	(0.011)
Voced x Cash grant	-0.014	-0.024	-0.009	-0.016
	(0.031)	(0.032)	(0.022)	(0.023)
Control Mean	0.074	0.074	0.040	0.040
Treatment Effect (%)	-22.91	-14.29	-16.97	-10.76
Number of Observations	5360	5419	7648	7707

Notes: This table reproduces Table 1 but includes births by individuals from the treatment groups of the cross-randomized vocational education and cash grant interventions (which are dropped in the main analysis). The regression includes indicators for vocational training treatment, cash grant treatment, and the interaction between the two, in addition to the covariates in Table 1. Weights are adjusted so as to not upweight the vocational training and cash grant control groups (see Appendix C.7), but otherwise follow the same procedures as Table 1. Standard errors are clustered at the 1998 school level. See Table 1 for more details.

Table A.7: Intergenerational Deworming Impacts on Child and Infant Mortality, by Other Sources of Heterogeneity

	(1) Child (Under-5) mortality	(2) Infant (Under-1) mortality
Panel A: Full Sample		
Treatment	-0.017	-0.008
	(0.007)	(0.005)
Control Mean	0.074	0.040
Treatment Effect (%)	-23.56	-18.79
Number Observations	10077	13638
Panel B: Parent Older at PSDP Baseline		
Treatment	-0.023	-0.011
	(0.009)	(0.007)
Control Mean	0.076	0.041
Treatment Effect (%)	-29.82	-27.35
Number Observations	6355	8135
Panel C: Parent Younger at PSDP Baseline		
Treatment	-0.010	-0.003
	(0.013)	(0.009)
Control Mean	0.071	0.038
Treatment Effect (%)	-14.26	-7.74
Number of Observations	3720	5501
Panel D: Female Child		
Treatment	-0.012	0.001
	(0.010)	(0.007)
Control Mean	0.070	0.034
Treatment Effect (%)	-16.99	1.82
Number Observations	4979	6739
Panel E: Male Child		
Treatment	-0.016	-0.011
	(0.011)	(0.006)
Control Mean	0.069	0.039
Treatment Effect (%)	-23.50	-28.96
Number of Observations	5063	6860

Notes: Column (1) shows the PSDP treatment effect on child mortality, and column (2) shows the PSDP treatment effect on infant mortality. See Table 1 for details on the variables, sample and weights. Panel A shows results using the full sample of children, whereas Panel B (Panel C) shows the results from children of parents who were older (younger) at baseline. Panel D (Panel E) shows the results for female (male) children of KLPS respondents. Standard errors are clustered at the 1998 school level.

Table A.8: Intergenerational Deworming Impacts on Child and Infant Mortality, by Birth Order and Birth Spacing

	Child (Under-5) Mortality		**Infant (Under-1) Mortality**	
	(1)	(2)	(3)	(4)
	Preferred (Prespecified)	No controls, unweighted	Preferred (Prespecified)	No controls, unweighted
Panel A: Full Sample				
Treatment	-0.017	-0.018	-0.008	-0.012
	(0.007)	(0.009)	(0.005)	(0.006)
Control Mean	0.074	0.074	0.040	0.040
Treatment Effect (%)	-23.56	-23.88	-18.79	-28.92
Number Observations	10077	10117	13638	13678
Panel B: First Birth				
Treatment	-0.025	-0.018	-0.015	-0.014
	(0.010)	(0.011)	(0.007)	(0.007)
Control Mean	0.078	0.078	0.045	0.045
Treatment Effect (%)	-31.79	-22.90	-32.02	-30.95
Number Observations	3883	3886	4569	4572
Panel C: Second (or later) Birth				
Treatment	-0.012	-0.018	-0.004	-0.010
	(0.008)	(0.011)	(0.006)	(0.007)
Control Mean	0.072	0.072	0.037	0.037
Treatment Effect (%)	-17.18	-24.47	-9.87	-27.75
Number of Observations	6194	6231	9069	9106
Panel D: Short birth spacing (< 3 years)				
Treatment	-0.006	-0.018	-0.001	-0.012
	(0.014)	(0.009)	(0.011)	(0.006)
Control Mean	0.078	0.078	0.045	0.045
Treatment Effect (%)	-7.57	-22.52	-3.08	-25.89
Number Observations	3354	3354	4308	4308
Panel E: Long birth spacing (≥ 3 years)				
Treatm	-0.015	-0.018	-0.002	-0.012
	(0.009)	(0.009)	(0.006)	(0.006)
Control Mean	0.051	0.051	0.026	0.026
Treatment Effect (%)	-30.18	-34.67	-9.59	-44.30
Number of Observations	2840	2840	4761	4761

Notes: This table presents heterogeneity in under-5 (columns (1)-(2)) and under-1 (columns (3)-(4)) mortality by parity and birth spacing. Panel A reproduces the main results from Table 1. Panels B and C present results by parity, splitting by whether these were first births (Panel B) or second or later births (Panel C). Panels D and E examine effects by birth spacing, in particular whether in cases of multiple births, the preceding birth took place less than 3 years prior (Panel D) or 3 years or more prior (Panel E). Three years represents the median time between births in the sample. First births are dropped in the birth spacing analysis panels. See Table 1 for details on the variables, sample and weights. Standard errors are clustered at the 1998 school level.

Table A.9: Deworming Impacts on Potential Mechanisms for Intergenerational Effects

	Fertility Patterns		**Parental Health**		**Education Outcomes**		**Living Standards and Residential Choice**			**Access to Healthcare**	
	(1) Num. of Children	(2) Age at First Birth	(3) Miscarriage	(4) Self-Reported Health Good	(5) Attended Sec. Ed.	(6) School Attainment	(7) Annual Per-Cap. Consumption	(8) Annual Ind. Earnings	(9) Lives in Urban Area	(10) Received ANC	(11) Inst. Delivery
Correlation with Under-5 Mortality (ρ)	0.162	-0.074	0.054	-0.011	-0.077	-0.079	-0.023	-0.033	-0.056	0.000	-0.048
Panel A: Full Sample											
Treatment	-0.11	0.40	-0.148	0.01	0.034	0.24	305.1	79.5	0.042	0.012	0.020
	(0.11)	(0.23)	(0.080)	(0.01)	(0.032)	(0.21)	(158.6)	(75.7)	(0.019)	(0.004)	(0.018)
Control Mean	2.62	22.66	.058	.811	.485	9.45	2156.5	1218.2	.455	.956	.738
Treatment Effect (%)	-4.16	1.78	-27.06	1.61	6.95	2.49	14.15	6.53	9.33	1.29	2.71
Number Observations	5450	4601	8325	12610	5512	5512	4794	13624	13793	11888	11828
Panel B: Female Parents											
Treatment	-0.10	0.32	-0.148	0.03	0.080	0.45	89.4	40.6	0.023	0.016	0.039
	(0.12)	(0.29)	(0.080)	(0.01)	(0.041)	(0.28)	(133.6)	(62.0)	(0.020)	(0.007)	(0.023)
Control Mean	2.85	21.14	.058	.785	.389	8.81	1715.2	673.6	.431	.95	.675
Treatment Effect (%)	-3.68	1.52	-27.06	3.20	20.48	5.15	5.21	6.02	5.23	1.64	5.75
Number Observations	2764	2443	8325	6315	2788	2788	2473	6826	6853	6703	6666
Panel C: Male Parents											
Treatment	-0.11	0.49		0.00	-0.013	0.01	512.6	118.2	0.062	0.008	-0.005
	(0.13)	(0.26)		(0.01)	(0.037)	(0.24)	(303.9)	(132.7)	(0.028)	(0.004)	(0.026)
Control Mean	2.4	24.29		.835	.576	10.05	2593.7	1727.8	.476	.964	.818
Treatment Effect (%)	-4.66	2.00		0.16	-2.28	0.14	19.76	6.84	12.97	0.84	-0.58
Number Observations	2686	2158		6295	2724	2724	2321	6798	6940	5185	5162

Notes: The table presents regression results of five main groups of outcomes on the PSDP treatment variable and their correlation with under-5 mortality. See Appendix C for details on the variable construction. Columns (1) and (2) are outcomes on fertility patterns and includes respondents from the last survey round in which they were observed across KLPS-2, KLPS-3, and KLPS-4. Columns (3) and (4) are outcomes on parental health, including an indicator for self-reported health good or very good, and an indicator for miscarriage (at the pregnancy-level). Column (3) is estimated in probit regression. Columns (5) and (6) are outcomes on education outcomes and include respondents from the last survey round in which they were observed across KLPS-2, KLPS-3, and KLPS-4. Columns (7) to (9) are outcomes on living standards and residential choice. Columns (10) and (11) are outcomes on healthcare access for all live births in the KLPS sample from the last survey round in which the parents were observed. Panel A shows the full sample of the respective outcomes, Panel B (Panel C) includes female (male) respondents. All regression specifications are weighted according to their inclusion in the KLPS sample, and re-weighted for intensive tracking. The sample includes individuals in the PSDP sample and excludes individuals who were treated in the separate vocational training and cash grant interventions (as in the rest of the analysis). Sample weights are adjusted for intensive tracking and inclusion in the vocational training and/or cash grant control group. Standard errors are clustered at the 1998 school level. The correlation with Under-5 Mortality (ρ, in the top row) is calculated as the pairwise correlation between under-5 mortality and the stated outcome. For outcomes measured in multiple rounds in columns (1) - (9), correlations with under-5 mortality are calculated as the average of the outcome at the PSDP respondent level. Columns (10) and (11) show correlations calculated at the child-level.

Table A.10: Correlations between Under-5 Mortality and Potential Mechanisms

	Dependent Variable: U5MR												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Number of Children	0.0160											0.0280	0.0187
	(0.0016)											(0.0031)	(0.0020)
Age at First Birth		-0.0032										0.0050	0.0013
		(0.0007)										(0.0014)	(0.0009)
Miscarriage			0.0864									0.0751	
			(0.0347)									(0.0411)	
Self-Reported Health Good				-0.0064								0.0010	-0.0002
				(0.0090)								(0.0135)	(0.0100)
Attended Secondary Education					-0.0243							-0.0017	-0.0059
					(0.0051)							(0.0146)	(0.0103)
School Attainment						-0.0042						-0.0036	-0.0003
						(0.0009)						(0.0027)	(0.0018)
Per-Capita Consumption ('000s)							-0.0018					0.0030	0.0022
							(0.0014)					(0.0027)	(0.0016)
Individual Earnings ('000s)								-0.0025				0.0067	-0.0012
								(0.0012)				(0.0034)	(0.0015)
Lives in Urban Area									-0.0218			-0.0028	-0.0027
									(0.0064)			(0.0104)	(0.0075)
Received ANC										0.0004		-0.0588	-0.0503
										(0.0183)		(0.0401)	(0.0267)
Institutional Delivery											-0.0214	0.0011	-0.0139
											(0.0041)	(0.0117)	(0.0086)
R^2	0.0263	0.0055	0.0029	0.0001	0.0059	0.0063	0.0005	0.0011	0.0031	0.0000	0.0023	0.0616	0.0409
Number Observations	3853	3852	2163	3883	3883	3883	3179	3736	3739	11901	11841	1711	3012
Deworming Treatment	-0.1064	0.4012	-0.1479	0.0131	0.0336	0.2343	298.5100	77.3000	0.0421	0.0123	0.0203		
Implied Effect on U5MR	-0.0017	-0.0013	-0.0128	-0.0001	-0.0008	-0.0010	-0.0005	-0.0002	-0.0009	0.0000	-0.0004	-0.0124	-0.0022
Percent of Total U5MR Effect	9.99	7.56	74.81	0.49	4.78	5.80	3.19	1.12	5.37	-0.03	2.55	72.34	13.08

Notes: This table presents regression results of potential mechanisms on under-5 mortality. Columns (1)-(9) regress the average value of that outcome across survey rounds on the average under-5 mortality rate by respondent, whereas, Columns (10) and (11) regress the outcome on under-5 mortality at the child-level. Columns (12) and (13) regress all outcomes on the average under-5 mortality rate by respondent. Pregnancy-level and child-level outcomes (miscarriage, ANC, and institutional delivery) are converted to respondent-level averages in columns (12) and (13). Deworming Treatment is the effect of deworming on the dependent variable as calculated in Table A.9. Implied Effect on U5MR is calculated as Deworming Treatment multiplied by the regression coefficient of that outcome on under-5 mortality. The Implied Effect on U5MR for Per-Capita Consumption and Individual Earnings is presented as the effect of an additional unit of consumption or earnings (as opposed to '000s). Percent of Total U5MR Effect is calculated as the Implied Effect on U5MR divided by the total deworming treatment effect on under-5 mortality as presented in Panel A of Table 1. See Table 1 and Appendix C for details on the variable construction.

Table A.11: Test of Sharp Null of Full Mediation (Kwon and Roth, 2024)

Mediators	p-value
Fertility, Above Median PCA (Age at first child, number of children) Parental Health (Indicator for self-reported health good) Education (Indicator for some secondary education) Living Standards, Above Median PCA (Indicator for ever lived in urban area, total consumption, total earnings) Access to Healthcare, Above Median PCA (Indicator for any antenatal care, indicator for any institutional delivery)	0.966
Parental Health (Indicator for self-reported health good) Education (Indicator for some secondary education) Living Standards, Above Median PCA (Indicator for ever lived in urban area, total consumption, total earnings) Access to Healthcare, Above Median PCA (Indicator for any antenatal care, indicator for any institutional delivery)	1

This table presents results from the test of the sharp null of full mediation proposed in Kwon and Roth (2024). The test is implemented using the TestMechs package available from Jon Roth's GitHub. The testing method is the conditional chi-squared test proposed by Cox and Shi (2023). $\alpha = 0.05$. The share of defiers (i.e., those for whom the deworming intervention affects the mediator variable in the opposite direction than for other individuals in the sample) is bounded above at 0.01. In order to minimize the number of covariates (for sample size reasons) while still including variables across all groups of potential mechanisms, for groups with more than one variable, we conduct principal component analysis (PCA) across variables within a group, and then discretize these measures into indicators for being above the median value. We omit miscarriage as we only use this measure for female respondents, and we only include an indicator for some secondary education as this splits the sample at roughly the median. In the first row, we include all five groups investigated in Table A.9, while in the second row, we drop the fertility index, as assumptions around monotonocity may be less straightforward to interpret.

Table A.12: Valuing the Benefits of Intergenerational Deworming Impacts on Child Mortality: Benefits, Costs, and Rate of Return

		Methods for Valuing Child Health Gains	
	(1) Required Benefits	(2) Revealed Preference	(3) Stated Preference
Panel A: Required Intergenerational Mortality Benefits (Calculated) for Internal Rates of Return (IRR)			
Social IRR of 5%	\$0.09	-	-
Social IRR of 10%	\$0.13	-	-
Panel B: Net Present Value (NPV) from Observed Intergenerational Mortality Benefits			
Social NPV for assumed discount rate of 5%	-	\$85.80	\$4713.41
Social NPV for assumed discount rate of 10%	-	\$37.24	\$2086.44
Panel C: Internal Rate of Return (IRR) from Observed Intergenerational Mortality Benefits			
Social IRR	-	41.6%	124.1%

Notes: This table presents the calculations of the costs and benefits of deworming following equation (1) in Appendix D.1 in 2017 USD PPP terms. The social net present value (NPV) and internal rate of return (IRR) consider only the drug treatment costs in Column (1) and the intergenerational child mortality benefits in Column 2 (revealed preference) and Column 3 (stated preference). Panel A calculates the minimum average benefits required to achieve an IRR of either 5% or 10% to compensate for the drug treatment costs. Panel B calculates the social NPV from two observed intergenerational mortality benefits under varying assumptions on the discount rates. Panel C calculates the social IRR using revealed preference and stated preference approaches to compute the intergenerational mortality benefit in monetary terms. Deworming costs include the direct cost of deworming medicine under school-based mass treatment. Revealed preference for child health gains uses the willingness to pay to avert a DALY of \$66.82. Stated preference for child health gains uses the willingness to pay to avert a DALY of \$3611.20. See Figure 6, and D for additional details on the assumptions.

B Additional study background details

In 1998, a nongovernmental organization (NGO) launched the PSDP in two geographic divisions of Busia District (since renamed Busia County), in 75 schools enrolling over 32,000 pupils. Baseline parasitological surveys indicated that helminth infection rates were over 90%, and over a third had a moderate–heavy infection according to a modified WHO infection criteria Miguel and Kremer (2004). The 75 schools were experimentally divided into three groups (groups 1, 2, and 3) of 25 schools each. The schools were first stratified by administrative subunit (zone), zones were listed alphabetically within each geographic division, and schools were then listed in order of pupil enrollment within each zone, with every third school assigned to a given program group. The three treatment groups were well balanced along baseline characteristics.

Due to the NGO's administrative and financial constraints, the schools were phased into deworming treatment during 1998–2001: group 1 schools began receiving free deworming and health education in 1998, group 2 schools in 1999, and group 3 in 2001. Children in group 1 and 2 schools were thus, on average, assigned 2.41 more years of deworming than group 3 children; these two early beneficiary groups are denoted the treatment group here, following Hamory et al. (2021). Drug take-up rates were high, at approximately 75% in the treatment group, and under 5% in the control group.

The KLPS was launched in 2003 to track a representative sample of approximately 7,500 respondents enrolled in grades 2 to 7 in the PSDP schools at baseline, where the KLPS subsample was selected using a computer random number generator. Figure A.1 provides a timeline of KLPS survey rounds. From the start, KLPS enumerators have traveled throughout Kenya and beyond to interview respondents, in order to maintain high tracking rates.

Three other cross-cutting experiments are relevant for the analysis. First, in 2001, the NGO required cost-sharing contributions from parents in a randomly selected half of the group 1 and group 2 schools, reducing deworming drug take-up from 75% to 18%; group 3 schools received free deworming treatment in 2001. In 2002–2003, the NGO again provided free deworming in all 75 schools. We account for the effect of this temporary reduction in deworming on later outcomes in the analysis. Second, in early 2009, approximately 1,500 individuals in the KLPS sample additionally took part in a vocational training voucher randomized control trial (RCT) prior to the start of the KLPS-3, and a subset of these also took part in a randomized cash grant program prior to KLPS-4; 1,070 of these individuals were randomly selected to receive a training voucher and/or cash grant. To focus the present analysis on deworming impacts, and avoid possible interactions with other programs, these individuals are dropped from the analysis for survey rounds after their assignment to the other treatments. The randomly assigned vocational training and cash control group (non-recipient) individuals are retained throughout, and given greater weight in the econometric analysis, to maintain the representativeness of the original PSDP sample.

With regards to external validity, the KLPS sample appears to be broadly typical of many other Sub-Saharan African (SSA) settings. Busia is close to the Kenyan national median along several leading socio-economic measures and is not an outlier on any. The 2009 Kenya Population and Housing Census indicates that Busia falls slightly below the national median in terms of the percentage of population with secondary education (10% in Busia vs. 11% in the median county). Given that Kenyan income levels are slightly higher than the SSA average, the fact that Busia is slightly poorer than the Kenyan average arguably makes the KLPS population more representative of other African settings as a whole.

C Variable construction

This section provides additional details on the construction of variables used in the analysis; summary statistics are presented in Table C.1.

C.1 Child mortality outcomes

The *Child Mortality* outcome is an indicator for whether a child died at an age under 5 years. Similarly, the *Infant Mortality* outcome is an indicator that takes a value of 1 if the child died at an age under 1 year. The main analysis restricts attention to observations for which we have "complete" infant or child mortality, i.e., that we have observed at least 1 or five years since birth.

The mortality indicators are constructed from survey modules based on the Demographic and Health Surveys (DHS) which were included in KLPS-4, SCYF2, KLPS-3, and KLPS-2. (The SCYF2 survey round was collected among participants in the vocational training and cash grant program, including the control group of those programs, who are included in the present analysis.) KLPS-4 has the parent's full roster of children, including each child's mortality status. If the parent was not observed in KLPS-4, then the children from the latest survey where they were observed is used. For KLPS-4, about 90% of all children were observed and their mortality status was captured. For those not observed in KLPS-4, about 8% were observed last in KLPS-3, 1% in SCYF2, and 2% in KLPS-2.

C.2 Adult Health Outcomes

The KLPS surveys collect information on self-reported health across rounds, as well as information on all pregnancies (for themselves for female respondents, and for their partners for male respondents), regardless of whether they ended in a live birth.

The *Self-Reported Health Good* outcome is an indicator variable equal to 1 if the respondent reported that their health was "good" or "very good", and equal to 0 if their health was reported as "fair", "poor", or "very poor".

The *Miscarriage* variable that we use in the pregnancy-level regression analysis is an indicator equal to 1 if the pregnancy ended in miscarriage, and equal to 0 if otherwise. The *Stillbirth* variable that we use in the pregnancy-level regression analysis is an indicator equal to 1 if the pregnancy ended in stillbirth, and equal to 0 if otherwise. Pregnancies that are ongoing at the time of the survey are excluded from the analysis. We focus on female respondents given that male respondents may be less well-informed about miscarriages by their partners.

C.3 Education Outcomes

The KLPS surveys each collect detailed education history for the respondents that allow us to measure, and update, the respondent's education attainment at the time of survey. We use the most recent survey round collected from each respondent, and add in a control for the survey round for this regression.

The *Attended Secondary Education* outcome is an indicator variable equal to 1 if the respondent attended Secondary School by the time of the latest survey, and 0 if they did not ever attend Secondary School by the time of the latest survey.

The *School Attainment* outcome is a continuous variable that is the highest year of schooling that the respondent has completed by the time of the latest survey. On average, the highest year of schooling is 9.5 years.

C.4 Living Standards and Residential Choice Outcomes

These measures were a focus of Hamory et al. (2021), which provides more detail on the variable construction. All KLPS-4 (20-year follow-up) respondents and a representative subset of one-sixth of KLPS-3 (15-year follow-up) respondents were administered a detailed consumption expenditure module featuring questions on over 150 distinct items. The *Annual Per-Capital Consumption* outcome is calculated as the sum of the monetary value of goods consumed by the household through purchase, gift, barter, or home production in the last 12 months, divided by the number of household members. Consumption is adjusted for urban-rural price differences for respondents living in Nairobi and Mombasa.

The *Annual Individual Earnings* outcome is calculated as the sum of wage employment across all jobs; nonagricultural self-employment profit across all businesses; and individual farming profit, defined as net profit generated from non-crop and crop farming activities for which the respondent provided all reported household labor hours and was the main decision maker within the last 12 months.

Lives in Urban Area is an indicator for whether the respondent lives in an urban area at the time of survey. This outcome was measured as part of a migration history module asked in each round. The outcome used in this analysis is simply if they live in an urban area irrespective of where they lived before.

C.5 Fertility Outcomes

From the child roster that is collected in each round, we are able to construct variables on individual fertility patterns. Here, *Age at First Birth* is measured as the age in which the respondent has their first live birth, across survey rounds.

The second fertility outcome we measure is the *Number of Children*, defined as the number of living children that the respondent has had by the time of the latest survey. This does not include children who are deceased, miscarriages, stillbirths or current pregnancies at the time of the survey. Again, this analysis uses the latest KLPS round in which the respondent was surveyed. Information is also collected in multiple KLPS rounds on *Desired Fertility*, defined as the ideal number of children that the respondent would like to have. For more information on how this variable is defined and constructed, refer to Müller et al. (2022).

C.6 Access to Healthcare Outcomes

The child roster in each round contains questions on healthcare access for each child. *Received ANC* is an indicator variable that takes a value of 1 if the respondent or the respondent's spouse sought antenatal care (ANC) for their child during pregnancy, and 0 if the respondent or the respondent's spouse did not seek ANC care. Although this was collected for all pregnancies, we only include live births throughout (i.e., we do not focus the anlaysis of how ANC impacts miscarriage or stillbirths), although this is possible with the data.

Institutional delivery is an indicator variable that takes a value of 1 if the child was delivered at a hospital or clinic, and 0 if the child was delivered at home. Similar to ANC, we focus on this for live births and exclude stillbirths and miscarriages, as well as current pregnancies.

Data on ANC and institutional delivery were collected for all children in KLPS-3 and KLPS-2. For KLPS-4, this data was only collected for children born between the previous round the respondent was surveyed and KLPS-4. We use the birth year of the child in the KLPS-4 roster to match these "older" children with previous rounds and merge in the healthcare access outcomes. The dataset used in the analysis is the same as the childhood health and mortality outcomes where we use the latest round the child's parents are observed.

C.7 Construction of Sample Weights

The sample weights used in the analysis are constructed according to the following steps. First, the individuals are assigned weights based on their probability of inclusion into the

KLPS sample, which we call *Population Weights*. Second, the population weights are adjusted for intensive tracking. For each round, a subset of individuals who cannot be found during the regular tracking are randomly selected into an intensive tracking sample. These individuals are up-weighted to be representative of the hard-to-reach individuals that were not found. This method is analogous to the approach in the Moving to Opportunities Study Orr et al. (2003). In each KLPS round, the sample is re-weighted to account for round-specific intensive tracking status. (There was no intensive tracking in the SCYF2 round so *Population Weights* are used for that round.) Finally, since we exclude the treatment groups of the vocational training and cash grant interventions, the weights are re-adjusted for the inclusion into the control group. These adjustments result in the final *PSDP Analytical Weights*.

The sample used in the child mortality analysis come from the latest survey in which the child is observed, with about 90% of the children coming from KLPS-4. However, unlike the analysis of contemporaneous outcomes, like household expenditure or consumption, child health and mortality status is collected retrospectively. There may thus be concerns about giving a child a KLPS-4 weight, even if the child was born years before. This is particularly of concern for children of parents who were in the intensive tracking phase in KLPS-4 as that means each of their children would be assigned a higher weight even if they were born before a previous KLPS round when a parent was found and surveyed during the regular tracking period. Therefore, in order to address this issue, we take the average of all round-specific PSDP Analytical Weights. This allows for higher weights for respondents who are harder-to-reach parents across rounds, and lower for respondents who are consistently found in the regular tracking phase.

An alternative weighting specification that we use as a robustness check is a round and child-age specific weight. That is, instead of using the PSDP Analytical Weights of the latest round the parent was observed, we use the weights of the first KLPS round that happens after the child turns (or would have turned) 5 years old for child mortality, and 1 year old for infant mortality. By using child-age to determine the round-specific weight to assign, we utilize weights that are most closely timed to the child's mortality status.

Table A.3 shows that the main results from Column 1 of Table 1 remain robust when using these alternative weighting specifications: Average Weights, Round and Age Specific, Population, and Unweighted.

Table C.1: Summary Statistics of Key Outcome Variables

	(1) Mean	(2) Standard Dev.	(3) Median	(4) Minimum	(5) Maximum	(6) Number of Obs. Total	Latest Survey (7) Number of Obs. KLPS-4	(8) Number of Obs. SCY-F2	(9) Number of Obs. KLPS-3	(10) Number of Obs. KLPS-2
Panel A: Mortality and Health Outcomes										
Child (Under-5) Mortality	0.064	0.245	0	0	1	10078	9378	80	552	68
Infant (Under-1) Mortality	0.037	0.188	0	0	1	13639	12237	118	1054	231
Panel B: Parental Health										
Self-reported health good	0.82	0.39	1	0	1	12613	4246	0	4286	4081
Miscarriage (females only)	0.05	0.22	0	0	1	8352	7438	57	674	183
Panel C: Education Outcomes										
Attended Sec. Ed.	0.50	0.50	0	0	1	5514	4250	N/A	924	340
Years of Schooling Attained	9.5	3.2	8	2	16	5514	4250	N/A	924	340
Panel D: Living Conditions and Residential Choice										
Annual Per-Cap. Consumption	2300.2	2566.7	1511	75	28691	4794	4076	N/A	718	0
Annual Ind. Earnings	1262.6	2470.5	195	0	25351	13613	4070	N/A	4516	5027
Lives in Urban Area	0.47	0.50	0	0	1	13793	4121	N/A	4595	5077
Panel E: Fertility Outcomes										
Age at First Birth	22.9	4.3	22	9	37	4602	3928	39	522	152
Number of Children	2.6	1.9	2	0	14	5451	4250	65	869	332
Panel F: Access to Healthcare										
Received Antenatal Care	0.96	0.20	1	0	1	13034	11302	202	1246	284
Institutional Delivery	0.74	0.44	1	0	1	12057	10355	298	1139	265

Notes: The table presents summary statistics for the key outcome variables for the child mortality and health analysis shown in Table 1, as well as the potential mechanisms shown in Table 3. Columns (1)-(5) presents the overall mean, standard deviation, median, minimum, and maximum, respectively, of the samples used in the regression analyses. Columns (6) is the total number of observations in that sample, where note that some are at the child-level (Panel A and Panel F), some at the pregnancy level (Panel B), and some at the parent respondent level (Panels C, D and E). Columns (7) through (10) show the number of observations in the latest KLPS round used in the respective sample. The samples used in Panels A, C, D, and E are based on the latest round the outcome variable was collected.

D Details of cost-benefit calculation

D.1 Rate of return and intergenerational deworming impacts on child mortality

The estimated impacts of deworming on intergenerational child mortality outcomes, combined with other data, allow us to estimate the social rate of return and social impacts of deworming subsidies. The social net present value (NPV) of providing deworming subsidies takes into account the costs of deworming medication (Baird et al., 2016) and the monetary value of intergenerational health benefits benefits of under-5 mortality reductions among children born to deworming recipients. For compatibility purposes, monetary values related to costs and benefits are reported in 2017 USD PPP terms as used in Hamory et al. (2021). We calculate the social NPV as follows:

$$\begin{aligned} NPV &= -\text{Discounted Deworming Costs} \\ &\quad + [\text{Discounted, Number of Additional Surviving Children} \\ &\quad \times \text{Number of Healthy Life Years per Child} \\ &\quad \times \text{Monetary Value of a Healthy Life Year}] \\ &= -\sum_{t=0}^{t=2} \left(\frac{1}{1+r}\right)^t SQ\left(S\right) + \sum_{t=0}^{t=25} \left(\frac{1}{1+r}\right)^t \gamma F_t H M_p \end{aligned} \tag{1}$$

where

$$\begin{aligned} H &= (5 - (\text{Avg Age of Death}|\text{Dying before Age 5})) \left(1 - \frac{\sum_{a=0}^{a<5} YLD_a}{\sum_{a=0}^{a<5} Pop_a}\right) \\ &+ (65-5)\left(1 - \frac{\sum_{a=5}^{a<65} YLL_a}{\sum_{a=5}^{a<65} Pop_a}\right)\left(1 - \frac{\sum_{a=5}^{a<65} YLD_a}{\sum_{a=5}^{a<65} Pop_a}\right) \\ &\text{for } a = \{0-4, 5-9, \cdots, 60-64\} \end{aligned} \tag{2}$$

The first term captures the upfront cost of providing a deworming subsidy at level $S > 0$ (relative to the case of no subsidies), calculated as the subsidy cost (S) times the take-up at that subsidy level, $Q(S)$. We focus on the free treatment case, and use PSDP project data to compute this take-up level (Kremer and Miguel, 2007; Miguel and Kremer, 2004), together with current estimates of per pupil mass deworming treatment costs (based on 2018 data provided by Deworm The World) of USD PPP 0.83 per year. Costs and benefits are discounted at rate r per year. Figure 6 displays components of this equation graphically, where the deworming drug costs are illustrated in the darkest gray in the first 2.4 years.

The second term captures benefits due to U5MR reductions among children of deworming recipients. γ estimates the average treatment effect identified in Table 1 (Panel A, Column 1: -0.017). F_t denotes children born per deworming respondent t years after deworming (see Appendix, Figure D.1). H denotes the number of healthy life years gained by survivors. M_p denotes the monetary value of health benefits per Disability Adjusted Life Year (DALY) averted. For F_t, we use the average childbirth data from 1998 to 2020. We assume fertility remains constant at the 22-year level from years 22 to 25 post-treatment, and then to be conservative, we assume zero mortality benefits starting at 25 years post-treatment. For M_p, we set the monetary value per DALY averted based on two approaches: revealed preference and stated preference. We estimate USD PPP 66.82 for the revealed preference value (Kremer et al., 2011) and USD PPP 3611.20 for the stated preference value (See Appendix, Table D.1), respectively.

We separate H into two terms: the first term captures the additional healthy life years for those who died before age 5 and the second term captures the additional healthy life years for those who survived past age 5 (up to age 65). For each term, in order to compute the number of additional healthy life years, we consider both the average per-capita years of life lost due to premature mortality (YLL) and the average per-capita years of life lived with disability (YLD), incurred by the population aged 0-64 in Kenya across 5-year age groups. Our average per-capita YLL (YLD) estimate is computed by summing across all causes of mortality (disability) occurring within the Kenyan population aged 0-64 as of 2019, then dividing by the Kenyan population aged 0-64 (Global Burden of Disease Collaborative Network, 2020*b*). We use data from the Global Burden of Disease (GBD) 2019 study (Global Burden of Disease Collaborative Network, 2020*b*) and the 2019 Kenyan Population and Housing Census (Kenya National Bureau of Statistics, 2019). To be conservative, we assume that children who survive to age 5 live up to 64.

For the first term in H, we compute the additional healthy life years as five minus the average age of death, conditional on dying before age five, multiplied by (one minus the YLD of the population aged 0-5). The latter term allows us to account for the additional years lived with disability, which we remove to get the number of additional healthy life years. We implement a similar procedure for the second term. For those surviving to age 5, we assume (in the absence of mortality or morbidity) that individuals can obtain a maximum of 60 additional healthy life years. However, in order to account for the mortality and morbidity conditions in Kenya for the population aged 5-64, we reduce the 60 maximum potential healthy life years by (one minus the YLL of the population aged 5-64) and (one minus the YLD of the population aged 5-64) to obtain the number of additional healthy life years for children surviving past age 5.

Through this calculation, the estimated intergenerational mortality benefits are, on average, USD PPP 7 per year for revealed preference and USD PPP 381 per year for stated preference. This calculation does not include the direct health benefits to the recipients that accrue during the deworming treatment period, the benefits pertaining to consumption gains and earnings gains of deworming recipients, or the teacher costs as estimated in Hamory et al. (2021). The calculations also exclude any reduced morbidity among children, as noted above. This analysis also makes other conservative assumptions by assuming that intergenerational child survival benefits occur at age five and ignoring benefits from cross-school externalities for both sample individuals and other community members (Ozier, 2018).

These assumptions allow us to compute the social internal rate of return (IRR), namely, the value of r that equates discounted costs and benefits such that social NPV = 0 (Appendix Table A.12, Panel C). The equation above also implies the magnitude of deworming treatment effects needed to attain a given rate of return. At current drug treatment costs, USD PPP 0.09 is needed as the monetary benefit of reduced U5MR due to deworming to attain an annualized internal rate of return of 5% (Appendix Table A.12, Panel

A). Five percent corresponds to the median real interest rate in Kenya during the 1998 to 2018 period (calculated based on Kenyan government bond and inflation rates), and thus larger benefits would indicate that deworming is likely to be cost-effective in Kenya; see https://www.centralbank.go.ke/statistics/interest-rates/ and World Bank Development Indicators for sources.

The cost-effectiveness results are presented in Table A.12. As shown in Table A.12, the estimated deworming intergenerational health benefits far larger than the benefits needed to attain the social IRR of 5 or 10% (USD PPP 0.09 and 0.13, respectively, Panel A). Thus, the social NPV estimates are positive for both revealed preference and stated preference approaches, and for annual discount rates of both 5 and 10% (Panel B). The implied social IRR estimates for revealed preference and stated preference are 41.5% and 124.6%, respectively (Panel C).

The results imply that even the intergenerational mortality reduction alone could justify subsidies for mass deworming treatment.

D.2 Survey setting and method of stated preference valuation

This section presents the survey setting conducted to measure the stated preference willingness to pay for child health in Appendix Table D.1, and the methods of calculating the monetary value per DALY averted used for the stated preference approach in Figure 6, Appendix Table A.12.

Health Valuation Survey Data Collection

The data was collected in Busia, Kenya, by a team of 13 field officers from November 23, 2016, to December 9, 2016. Data collection locations are differentiated by "Town" (Busia town) and "Rural" (rural villages in Busia county), where rural areas comprise the administrative locations of Busibwabo, Bukhayo West, and Lwanya. Data collection alternated between town and rural daily. The team used convenience sampling in both town and rural areas, with different methods adapted to the two settings.

Busia town consists of one main road running the length of the town, with many side streets extending perpendicularly. Nearly all structures along the main road are commercial, and most structures on the side streets are residential, with some small businesses interspersed. Pairs of field officers were dropped at the beginning of side streets and then worked their way down the side street, each field officer taking one side of the street. Field officers aimed to interview one in every three homes or businesses. Businesses were excluded on the first day of piloting, but included starting on the second day and thereafter. A home was defined as an apartment or house. A single compound could have multiple homes. Only businesses in structures (cement, tin, etc.) were included. In instances where the street forked or reached a T intersection, the field manager, who was familiar with the back streets, directed the officers. The field manager's directions were based on the method of taking first a left, then a right, then a left, while the field manager also ensured that different pairs of field officers did not end up on the same streets.

Rural areas comprise individual villages, each with roughly 100-200 compounds. Compounds usually have multiple structures and house a group of people who are usually related but can be part of one or more formally defined households (eating and sleeping together at least four nights per week). The team sampled businesses and compounds, as these can be identified more easily and quickly than households. At a village, the field team identified a central landmark, such as a school or health dispensary, with the help of a village guide. The village guide then helped the field manager identify the boundaries of the village. Pairs of field officers are dropped equidistantly along the outer edges of the village and then work their way inward toward the established landmark, surveying one person at every compound on their route. In some instances, a village runs parallel to a road and is shaped like a long rectangle, making the above sampling method difficult. In this case, landmarks are established equidistantly along one long side of the village. Pairs of field officers begin on opposite sides of the village and work across to their landmarks.

Within a sampling unit (business, apartment/house, or compound), field officers try to select respondents from different gender and age groups. We consider "older" respondents roughly over 35 years and "young" respondents approximately under 35 years, with a lower eligibility cutoff of 18 years. In the first two days of surveying, field officers were instructed to allow the first respondent to volunteer him/herself and then select a respondent with different demographic characteristics along both gender and age relative to the last survey conducted (with the assumption that some variation would be introduced by availability). However, due to the limited availability of male and older respondents, this approach was not sufficient to correct the imbalance. From the third day of surveying, field officers were instructed to try to survey a respondent of whichever demographic they have fewer of at that point in the day. This approach resulted in better demographic balance.

The survey collected information on the respondent's demographics: age, gender, occupation, parental status, household size. The summary statistics are in Appendix Table D.1 (Panel A). The survey instrument includes questions on household consumption in a typical month for food, fuel, health, and schooling, as shown in Panel B. The survey also asked the willingness to pay for the respondent's own health improvements and their child's health improvements. In particular, they were asked how much they were willing to pay to avoid adverse health states (e.g., diarrhea) for one month. The questions regarding these health states, the prices to be paid, and the ordering of own health versus child health questions, were all randomized across respondents (Panel C). Respondents without a child were asked to imagine if they had a child. The willingness to pay questions were asked in a single-bounded dichotomous choice format, where a respondent was asked whether or not s/he would pay a presented price for avoiding a specific health state. The asked price categories range from KES 50 to KES 8000 (specifically, 50, 100, 300, 500, 750, 1000, 2000, 5000, and 8000). (The exchange rate during the data collection period was roughly 100 KSH to 1 USD.) The 15 health states asked about comprised of conditions and severity levels are associated with intestinal helminths: Abdominopelvic problem, mild; Abdominopelvic problem, moderate; Abdominopelvic problem, severe; Anemia, mild; Anemia, moderate; Anemia, severe; Decompensated cirrhosis of the liver; Diarrhea, mild; Diarrhea, moderate; Diarrhea, severe; Infectious disease, acute episode, mild; Infectious disease, acute episode, moderate; Infectious disease, acute episode, severe; Infectious disease, post-acute consequences (fatigue, emotional lability, insomnia); Intestinal nematode (worm) infections, symptomatic. The health states and descriptions of the corresponding symptoms were cited from the Global Burden of Disease Study and asked in Swahili. We note that some health conditions are more familiar and translated more easily than others in the rural Kenyan context. Specifically, respondents understood anemia, diarrhea, and intestinal nematode infections very well. Cirrhosis of the liver was also familiar to a number of respondents. Respondents often had difficulty understanding the abdominopelvic problem, and were generally confused by infectious disease, seemingly due to its broad definition. The survey further asked for the willingness to pay for one more meal per week for the respondents and their child for one month, rental of a solar lantern for one month, and 10 jerrycans (20 liters each) of clean water delivered to their house every day for one month as economic status information.

Data Analysis

The data of 753 respondents are analyzed after eliminating irregular or missing values in willingness to pay questions. We add 1 to the answers on household size so that the data of household size includes the respondent. We trim the top 1% of observations of monthly consumption in Panel B to reduce the influence of outliers.

The mean and median values of willingness to pay in Panel C are calculated using the following method. We assume that the percentage of positive responses between adjacent categories is uniformly distributed, no respondent would have a positive response to a price higher than 8000 KES, and every respondent would have a positive response to price 0 KES. We calculate the percentage of positive responses at each price category and the relative frequency as the difference in the percentages of positive responses between the price category and one category lower. By multiplying the relative frequency and the midpoint between each price category and adding the results, we estimate the mean willingness to pay. We set the minimum price category where the percentage of the respondents who have positive answers exceeds 50 percent as the median willingness to pay. For Across All Health States in Panel C, we conduct the calculation regardless of the health states asked about. The monetary values are converted in 2017 USD PPP.

The results in Panel C show that there is a higher stated willingness to pay to avoid anemia and decompensated cirrhosis of the liver than for other conditions. The results also imply weak correlations between the willingness to pay and the disability weights because respondents might understand the health states conceptually but might have no immediate experience in some health states.

Calculation of the Monetary Value per DALY Averted

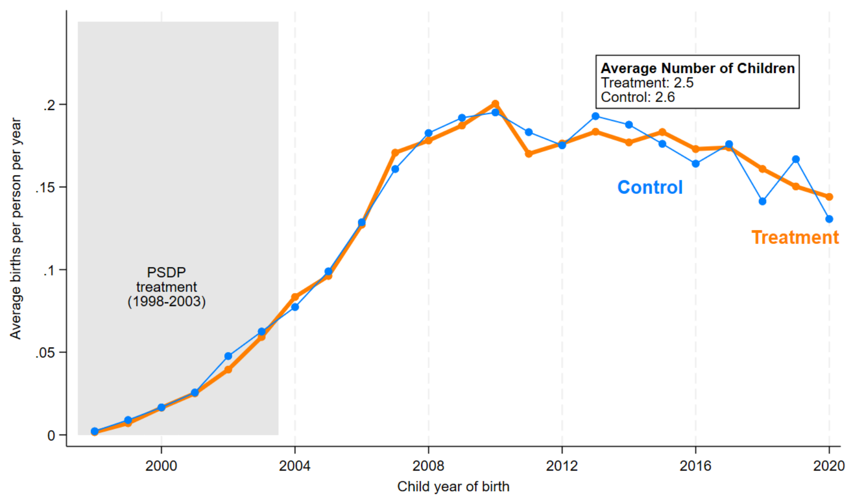
We next present the method of calculating the stated willingness to pay to avert a DALY based on the mean and median willingness to pay and the disability weights. We calculate the mean and median annual willingness to pay for averting 1 DALY by dividing the mean or median values of willingness to pay by the disability weights of each health state.

By definition, 1 DALY is equivalent to 1 year$\times$1.000 disability weight (disability weight is a measure of health loss where zero signifies a state of total health and 1 signifies a state of death, see Grosse et al., 2009; World Health Organization, 2001; Mont, 2007). Because the survey prompt asked the respondents about avoiding the health states for one month, we calculate the monetary values per DALY given the period and the disability weights. For simplicity, we do not consider discount rate or age-weighting for the DALY calculation (World Health Organization, Department of Data and Analytics, Division of Data, Analytics and Delivery for Impact, 2020).

Taking the average of the monetary value per DALY averted based on the mean willingness to pay (Column (1)) or taking the median of the values per DALY averted based on the median willingness to pay (Column (3)) for the health states, we estimate a mean willingness to pay to avert a DALY of USD PPP 38350.09 and a median willingness to pay of USD PPP

3611.20, respectively. To be conservative, in Figure 6 and Appendix Table A.12, we use USD PPP 3611.20 as the monetary value per DALY averted for stated preference.

Figure D.1: Average Number of Children Born Per Respondent Per Year



Note: This figure shows the average number of live births per respondent per year for those with available fertility data, separately by treatment and control, for those within the child mortality analysis sample. The grey shaded area denotes the PSDP project years from 1998-2003.

Table D.1: Stated Preference Valuations of Child Health in Kenya

	(1) Mean	(2) SD	(3) Median	(4) Min	(5) Max	(6) Disability Weights
Panel A: Respondents' Demographics						
Lives in Town (vs. Rural areas)	0.54	-	-	-	-	-
Age	36.99	15.76	32	18	95	-
Female	0.62	-	-	-	-	-
Has Any Children	0.83	-	-	-	-	-
Household Size	5.07	2.37	5	1	14	-
Panel B: Monthly Consumption (2017 USD PPP)						
Food	116	90	89	0	445	-
Fuel	21	22	13	0	115	-
Health	33	56	11	0	334	-
Schooling	64	105	27	0	645	-
Panel C: Monthly Willingness to Pay (2017 USD PPP)						
Across All Health States	78	-	22	1	178	-
Abdominopelvic problem						
mild	70	-	17	1	178	0.011
moderate	82	-	22	1	178	0.114
severe	85	-	45	1	178	0.324
Anemia						
mild	82	-	45	1	178	0.004
moderate	79	-	22	1	178	0.052
severe	96	-	45	1	178	0.149
Decompensated cirrhosis of the liver	98	-	111	1	178	0.178
Diarrhea						
mild	66	-	22	1	178	0.074
moderate	72	-	17	1	178	0.188
severe	82	-	22	1	178	0.247
Infectious disease						
acute episode, mild	66	-	22	1	178	0.006
acute episode, moderate	70	-	22	1	178	0.051
acute episode, severe	69	-	22	1	178	0.133
post-acute consequences	72	-	22	1	178	0.219
Intestinal nematode infections: symptomatic	72	-	22	1	178	0.027

Notes: Num. Observation = 753. This table presents the results of a survey conducted in Busia, Kenya, in 2016 to calculate the monetary value per DALY averted for stated preference in Figure 6 and Appendix, Table A.12. Panel A shows summary statistics on the respondents' demographics. Panel B shows monthly consumption in each item category in 2017 USD PPP terms. Panel C shows the monthly willingness to pay for respondents' child health to avoid the 15 different health states in 2017 USD PPP terms. Across All Health States in Panel C denotes the average willingness to pay across all the health states. Column (6) shows the disability weights, which are measures of the disabilities corresponding to the health states associated with intestinal helminths, cited from Global Burden of Disease Study 2019 (Global Burden of Disease Collaborative Network, 2020*a*). See D.2 for details on the survey setting and the calculation methods.

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