

Effects of malaria interventions during pregnancy on low birth weight in Malawi

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Appendix 1 Summary of results for sensitivity analysis

Table s1 Detailed variable definition

Variable	Description	References
Adequate intermittent preventive treatment for malaria during pregnancy (IPTp) and insecticide treated nets (ITN) use	Those that took recommended IPTp dose and reported to have slept under an ITN the night before the survey	
Wealth	Wealth was calculated by the demographic and health (DHS) survey team by scoring household items using principle component analysis method. The scores were then grouped into quintiles from the lowest 20% to the highest 20% with poorest, Poor, Middle, Rich, and richest categories. In this analysis, lower 40% were grouped as being poor, middle 20% as being middle, and upper 40% as rich.	National Statistical Office - NSO/Malawi and ICF. 2017. Malawi Demographic and Health Survey 2015-16. Zomba, Malawi: NSO and ICF. https://dhsprogram.com/pubs/pdf/FR319/FR319.pdf .
Body mass index (BMI)	BMI measured as weight in kilograms by height in meters squared (kg/m^2) based on WHO conventional classification and was categorized into four groups (underweight < 18.5 , normal $18.5-24.9$, overweight $\geq 25.0 \text{ kg}/\text{m}^2$)	WHO. Obesity: Preventing and Managing the Global Epidemic. [Internet]. 2000. Available from: https://whqlibdoc.who.int/trs/WHO_TRS_894.pdf .
Antenatal care (ANC) visit	Those with < 4 visits defined as inadequate while those with ≥ 4 visits categorized as having adequate visits	WHO. Recommendations on antenatal care for a positive pregnancy experience. Geneva: World Health Organization; 2016. http://apps.who.int/iris/bitstream/10665/250796/1/9789241549912-eng.pdf .
Cooking fuels used	Those that reported to use wood, dung, crop residues, shrubs, coal, charcoal categorized as high polluting fuels or otherwise, were regarded as using low polluting fuels	Milanzi EB, Namacha NM. Maternal biomass smoke exposure and birth weight in Malawi: Analysis of data from the 2010 Malawi Demographic and Health Survey. Malawi medical journal. 2017;29(2):160-5.
Water source	Improved water source included piped water, boreholes or tube-wells, protected dug wells, protected springs, rainwater, and packaged or	WHO (2017). Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines, WHO.

Sanitation access	delivered water...otherwise categorized as unimproved improved included flush toilets, piped sewer system, septic tank, flush/pour flush to pit latrine, ventilated improved pit latrine, pit latrine with slab, and composting toilet...otherwise categorized as unimproved	https://www.unicef.org/publications/index_96611.html WHO (2017). Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines, WHO. https://www.unicef.org/publications/index_96611.html
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Table s2a Association between IPTp uptake and low birth weight stratified using ITN usage – IPTp cut-off at 2 doses across surveys

ITN usage	IPTp uptake APR ^a (95% CI)				Total	
	Inadequate	Adequate				
No	1.00	0.86	(0.75–0.98*)	1.00		
Yes	0.84	(0.72–0.99*)	0.80	(0.69 – 0.93**)	0.89	(0.80–0.99*)
Total	1.00	0.90	(0.80–0.99*)			

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child.

Table s2b Association between IPTp uptake and low birth weight stratified using ITN usage – IPTp cut-off at 3 doses across surveys

ITN usage	IPTp uptake APR ^a (95% CI)				Total	
	Inadequate	Adequate				
No	1.00	0.94	(0.80–1.11)	1.00		
Yes	0.84	(0.79–1.02)	0.81	(0.68–0.97*)	0.89	(0.80–0.99*)
Total	1.00	0.93	(0.82–1.05)			

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child.

Table s2c Association between IPTp uptake and low birth weight stratified using ITN usage – IPTp cut-off at 4 doses across surveys

ITN usage	IPTp uptake APR ^a (95% CI)				Total
	Inadequate		Adequate		
No	1.00		1.03	(0.78–1.36)	1.00
Yes	0.89	(0.79–0.99*)	0.87	(0.63–0.95*)	0.89 (0.79–0.99*)
Total	1.00		0.95	(0.83–1.25)	

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child.

Table s3 Association between IPTp uptake and low birth weight stratified using ITN usage – Infants only (n = 6,747)

ITN usage	IPTp uptake ^b APR ^a (95% CI)				Total
	Inadequate		Adequate		
No	1.00		0.85	(0.67–1.09)	1.00
Yes	0.81	(0.65–1.01)	0.65	(0.50 – 0.84**)	0.79 (0.65–0.95*)
Total	1.00		0.83	(0.69–0.99*)	

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child. ^b

Adequate IPTp, ≥ 3 or more doses for samples from 2015–16 and ≥ 2 or more doses for samples from 2004 and 2010, Inadequate IPTp, < 3 doses for samples from 2015–16 and < 2 doses for samples from 2004 and 2010.

Table s4 Association between IPTp uptake and low birth weight stratified using ITN usage based on pooled data from MDHS 2010, 2015–16 (n = 15, 406) – controlling for health behavior variable

ITN usage	IPTp uptake ^b APR ^a (95% CI)		Total
	Inadequate	Adequate	
No	1.00	0.94 (0.80–1.09)	1.00
Yes	0.90 (0.78–1.04)	0.84 (0.71 – 0.98*)	0.90 (0.80–1.01)
Total	1.00	0.94 (0.83–1.05)	

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child and health behavior. ^b Adequate IPTp, ≥ 3 or more doses for samples from 2015–16 and ≥ 2 or more doses for samples from 2004 and 2010, Inadequate IPTp, < 3 doses for samples from 2015–16 and < 2 doses for samples from 2004 and 2010.

Table s5a Association between IPTp uptake and low birth weight stratified using ITN usage—written records on birth weight (n = 6,691)

ITN usage	IPTp uptake ^b APR ^a (95% CI)		Total
	Inadequate	Adequate	
No	1.00	0.89 (0.69–1.14)	1.00
Yes	0.83 (0.67–1.02)	0.87 (0.68 – 1.11)	0.88 (0.75–1.05)
Total	1.00	0.95 (0.79–1.15)	

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child. ^b Adequate IPTp, ≥ 3 or more doses for samples from 2015–16 and ≥ 2 or more doses for samples from 2004 and 2010, Inadequate IPTp, < 3 doses for samples from 2015–16 and < 2 doses for samples from 2004 and 2010.

Table s4b Association between IPTp uptake and low birth weight stratified using ITN usage–mother’s recall records on birth weight (n = 11,594)

ITN usage	IPTp uptake ^b APR ^a (95% CI)		Total
	Inadequate	Adequate	
No	1.00	0.83 (0.71–0.96*)	1.00
Yes	0.87 (0.75–1.01)	0.76 (0.63 – 0.90**)	0.89 (0.79–0.99*)
Total	1.00	0.84 (0.75–0.95**)	

APR, adjusted prevalence ratio; IPTp, intermittent preventive treatment for malaria during pregnancy; ITN, insecticide-treated nets; MDHS, Malawi Demographic Health Survey.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^a Adjusted for wealth, educational level, residence, region, survey year, preceding birth interval, ANC visits, iron tablet consumption, BMI, water source, age at birth, parity, sex of the child. ^b Adequate IPTp, ≥ 3 or more doses for samples from 2015–16 and ≥ 2 or more doses for samples from 2004 and 2010, Inadequate IPTp, < 3 doses for samples from 2015–16 and < 2 doses for samples from 2004 and 2010.

Appendix 1 Summary of results for sensitivity analysis

As shown in Tables s2a, s2b, and s2c, the sensitivity analyses used different cut-off points for intermittent preventive treatment for malaria during pregnancy (IPTp) dose to categorize as adequate or inadequate with results shown similar to those from the main analyses (i.e., low birth weight (LBW) was lower among children whose mothers used adequate IPTp dose regardless of the cut-off point across survey years). This indicates that using different cut-off points with respect to the World Health Organization (WHO) recommendation on the optimal doses at the time of the survey did not influence the findings.

Table s3 displays sensitivity results restricting the analysis to infants so that recall in a shorter period in behavior of insecticide treated net (ITN) usage and IPTp uptake and LBW was obtained. There were no differences with the main findings in terms of the influence of using both IPTp and ITN, indicated that recall bias on the main variables was minimal.

Similarly, we created health behavior variable (i.e., a composite health behavior variable (good, moderate, and poor) from water treatment behaviors in households (yes/no) and the presence of handwashing facilities (yes/no)) to consider in the models. The variables were present in the 2010 and 2015-16 survey. As such, analysis was restricted to those surveyed in 2010 and 2015-16. The main effects were still significant (similar to the main findings reported) even after additionally controlling for the behavioral variables (Table s4).

Table s5a and s5b are sensitivity analyses comparing results of the effects of IPTp on LBW based on written or mothers' recall birth weight records. Risks of LBW based on maternal recall were lower among children whose mothers had adequate IPTp uptake and used ITN (adjusted prevalence ratio (APR) = 0.76, 95% confidence interval (CI) = 0.63–0.90) compared with those whose mothers had no adequate IPTp and ITN use. Similar directions in the findings when the sample was restricted to written birth weights records were observed albeit insignificant. This suggest the potential recall bias threat to the study findings hence results should be cautiously interpreted.