

The following are supplemental materials and will be published online only

Supplemental Information

Yimgang DP, Buchwald AG, Coalson JE, Walldorf JA, Bauleni A, Kapito-Tembo A, Mathanga DP, Taylor TE, Laufer MK, Cohee. Population attributable fraction of anemia associated with *P. falciparum* infection in children in Southern Malawi.

Contents:

- I. Analysis using only surveys in which both age groups had data on anemia (surveys in 2014-2016)

Table S1: Characteristics of study participants by age group

Table S2: Prevalence of anemia among children with *P. falciparum* infection compared to children without *P. falciparum* infection

Figure S1: Adjusted population attributable fraction of anemia associated with *P. falciparum* infection by age group and season

- II. PAF anemia due to malaria among younger children in the 2014 Malawi Malaria Indicator Survey

Table S3: Anemia and *P. falciparum* infection by microscopy among children 0-5 years old in the 2014 Malawi Malaria Indicator Survey

- III. Association of hemoglobin and parasite density

Figure S2: Association of hemoglobin and parasite density by microscopy among children 6-59 months (A) and 5-15 years old (B).

Table S1. Characteristics of study participants by age group (only surveys 2014-2016)

	Children under 5 years (N=1,713)	School-age children (N=3,759)
Child factors		
Age in years, median (IQR)	2.4 (1.2)	9.4 (5.0)
Female, n (col %)	863 (50.4)	1937 (51.5)
Hemoglobin level, mean (SD)	11.1 (1.3)	12.1 (1.4)
<i>P. falciparum</i> infection, n (col %)	255 (15.9)	895 (23.8)
Smear positive, n (col %)	159 (9.3)	578 (15.4)
Geometric mean (SD)	7.4 (2.0)	6.8 (1.7)
Fever, n (% col)	537 (31.4)	653 (17.4)
Anti-malarial drugs, n (% col)	189 (11.0)	239 (6.4)
Anemia [§] , n (col %) Any	734 (42.8)	1309 (34.8)
Mild	449 (26.2)	625 (16.6)
Moderate	272 (15.9)	666 (17.7)
Severe	13 (0.8)	18 (0.5)
Using bed nets, n (col %) [†]	1173 (68.5)	1852 (49.3)
Household factors		
Number of people in household, median (IQR)	5.0 (2.0)	5.3 (2.0)
Wealth index, mean (SD) [‡]	0.01 (2.4)	0.10 (2.6)
Highest education level of household head or spouse, n (col %)		
No schooling	165 (9.6)	582 (15.5)
Primary education	1020 (59.5)	2192 (58.3)
Secondary and college	528 (30.62)	985 (26.2)
Study factors		
Season, n (col %)		
Rainy	937 (54.7)	2046 (54.4)
Dry	776 (45.3)	1713 (45.6)
District, n (col %)		
Blantyre (urban, peri-urban highland)	360 (21.0)	786 (20.9)
Chikhwawa (rural, lowland)	898 (52.4)	1938 (51.6)
Thyolo (rural, highland)	455 (26.6)	1035 (27.5)

School-age defined as children 5-15 years old

[§]Mild anemia (age<5y:10.0-10.9g/dL; age 5-11y:11.0-11.4g/dL; females age 12-15y and males age 12-14y:11.0-11.9g/dL; males age 15y:11.0-12.9g/dL), moderate anemia (age<5y:7.0-9.9g/dL; age 5-15y:8.0-10.9g/dL), and severe anemia (age<5y:<7.0g/dL; age 5-15y:<8.0g/dL).

[†] Individual bed net use was assessed by asking whether the individual slept under a bed net the previous night

[‡] Wealth index based on household assets was created using principal component analysis and the Filmer and Pritchett method.²⁰ Asset indicators were assessed using questions on ownership of house, phone radio, television, bike, and/or car, availability of electricity in the house, food security, source of income, and highest level of education of head of household or spouse.

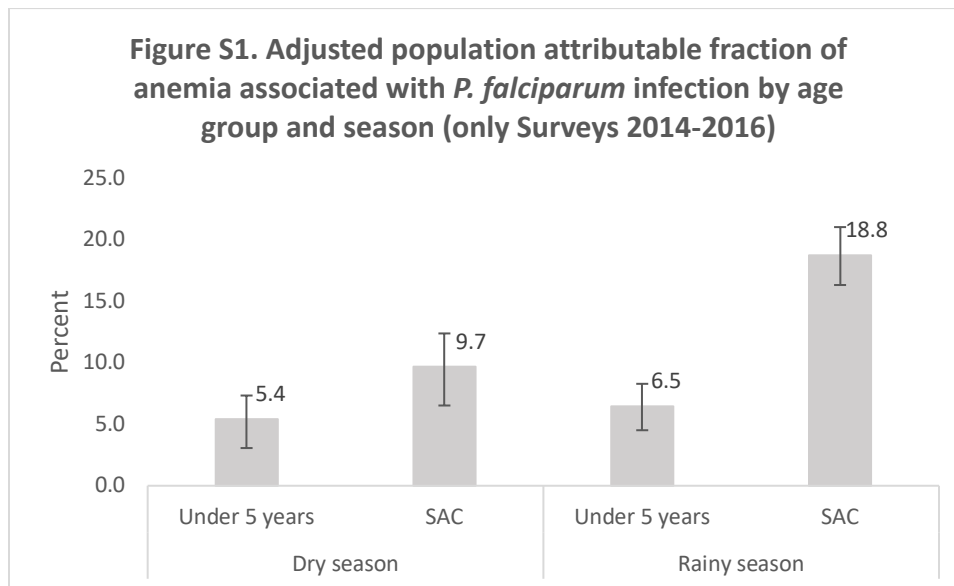
Table S2. Prevalence of anemia among children with *P. falciparum* infection compared to children without *P. falciparum* infection (only surveys 2014-2016)

	Age groups	Exposure groups	Total n (col %)	Anemia n (row %)	Unadjusted PR of anemia (95% CI)	Adjusted† PR of anemia (95% CI)
Dry season	Under 5 years	<i>P. falciparum</i> infection	92 (11.9)	53 (57.6)	1.45 (1.20, 1.78)**	1.49 (1.23, 1.81)**
		No infection	684 (88.1)	270 (39.5)		
	School-age	<i>P. falciparum</i> infection	371 (21.7)	166 (44.7)	1.54 (1.34, 1.77)**	1.48 (1.28, 1.71)**
		No infection	1342 (78.3)	390 (29.1)		
Rainy season	Under 5 years	<i>P. falciparum</i> infection	163 (17.4)	166 (44.7)	1.33 (1.13, 1.56)**	1.42 (1.26, 1.61)**
		No infection	774 (82.6)	390 (29.1)		
	School-age	<i>P. falciparum</i> infection	524 (25.6)	304 (58.0)	1.97 (1.77, 2.19)**	1.88 (1.68, 2.09)**
		No infection	1522 (74.4)	449 (29.5)		

** p-value <0.001

† Log-binomial models controlling for district, education, net use, wealth, and survey cluster

PR: Prevalence ratio; School-age defined as children 5-15 years old



Three-way interaction malaria, age category, and season significant: $p=0.0365$

Interaction between malaria and season among children below 5 years: $p=0.57$

Interaction between malaria and season among children aged 5-15 years: $p=0.0003$

Pooled aPR : 1.37; 95% CI : 1.21-1.55

Pooled PAF: 5.26; 95% CI: 3.38-6.91

Table S3: Anemia and P. falciparum infection by microscopy among children 0-5 years old in the 2014 Malawi Malaria Indicator Survey

	Anemic	Not anemic
Microscopy positive	347	163
Microscopy negative	641	763

P. falciparum prevalence = 26.6%

PAF anemia due to malaria = 11.6%

Figure S2: Association of hemoglobin and parasite density by microscopy among children 6-59 months (A) and 5-15 years old (B). Slope is interpreted as the change in hemoglobin for each log increase in parasite density. P-value for both models was <0.0001.

