Supplementary Text:

Modern Housing variable construction:

We constructed a composite "modern housing" variable using data from the roof, wall, and floor material variables reported in the DHS. The definition of modern housing was based off those used by Tusting et al[1]. Modern roofing materials included: metal, zinc/cement, tiles/slate, or cement. Modern wall material included: cement, stone, bricks, or covered adobe. Modern floor materials included: vinyl, asphalt, ceramic tiles, cement, or carpet. Only houses with a modern roof, walls, and floor materials were considered "modern housing".

PrevMap analysis:

We estimated cluster-level drug resistance allele frequencies using the *PrevMap* package in R[2]. We fit a model in order to generate cluster-level SNP prevalence estimates at all sampled DHS clusters from the 1,065 children with available data. Each resistance mutation was analyzed individually. We first determined raw cluster-level SNP frequencies and then transformed the proportions using a logit transformation. We fit linear a geospatial model of the following form:

$$yi = S(xi) + Zi$$

In this model, yi is equal to the transformed allele frequency for each cluster and $S(xi)$ represents an isotropic Gaussian Process with a variance of $\boldsymbol{\sigma}^2$ and a Matern correlation function[2]. Zi represents a Gaussian error term[2]. Model parameters were estimated using maximum likelihood and models were run using 10,000 simulations to generate spatially smooth frequency estimates. After fitting the model, we extracted the frequency estimate for each DHS cluster included in the analysis. To minimize bias, we averaged the estimated values for all geopoints within 15km square of the DHS cluster geopoint.

We used the same model framework to generate spatially smoothed *P. falciparum* prevalence estimates (**Figure 3**). Using this model, we also determined the estimate error for all points (**Supplementary Figure 1**).

Bed-net use sensitivity analysis:

We evaluated four different methods for determining bed-net usage based on the questions asked in the DHS questionnaire. The first (M1) asked if the individual slept under an "ever treated" net the previous night. The second (M2) asked if the individual slept under a "long lasting insecticide treated net". For the third method (M3), we constructed a "new net" variable based on whether the individual had obtained the net, or re-treated it with insecticide, within the previous 3 years[1]. Lastly (M4), the DHS asks, "the type of mosquito bed-net person slept under", with options of no net, an untreated net, or a treated net. We compared the estimated prevalence ratio of those who used nets versus those who did not based on each method's definition of net use. The results (**Figure S2**) demonstrate no substantial differences in the effect of net use between the four methods. The variable used in M1 was used for the primary analysis.

Supplementary Tables/Figures:

Figure S1: Standard error map for smoothed *P. falciparum* PCR prevalence estimates generated using *PrevMap*[2]

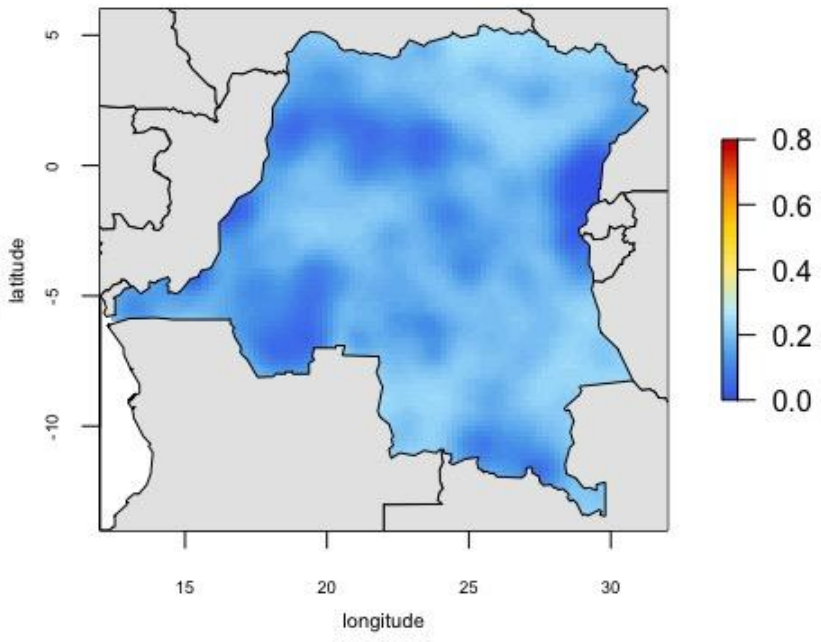

Figure S2: Results of sensitivity analysis evaluating different methods for measuring and coding bed-net usage. Each model compared the prevalence of PCR detectable *P. falciparum* amongst individuals who reported using a net versus those who did not.

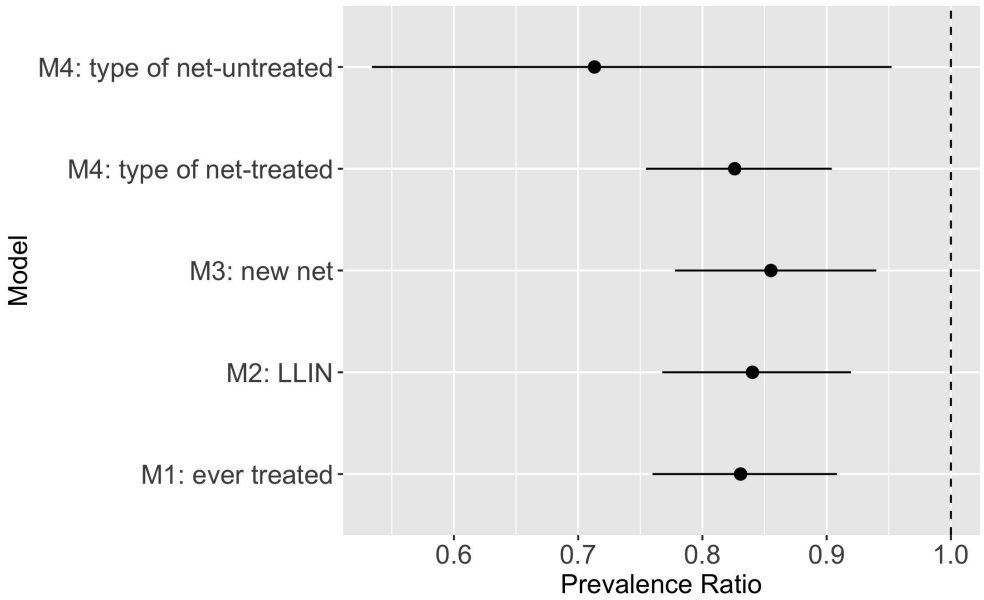

Table S1: Province level *P.falciparum* prevalence estimates measured by PCR.

Province name	Prevalence % (SE)
Kinshasa	18.6 (2.3)
Kwango	21.4 (3.7)
Kwilu	25.8 (5.0)
Mai-Ndombe	43.9 (4.7)
Kongo Central	40.5 (3.8)
Equateur	22.4 (2.7)
Mongala	26.3 (2.9)
Nord-Ubangi	48.9 (5.0)
Sud-Ubangi	31.3 (5.3)
Tshuapa	33.7 (4.4)
Kasai	44.5 (7.3)
Kasai-Central	43.5 (4.0)
Kasai-Oriental	35.9 (4.3)
Lomami	52.5 (3.1)
Sankuru	27.2 (3.3)
Haut-Katanga	22.5 (3.4)
Haut-Lomami	41.0 (5.2)
Lualaba	38.6 (9.6)
Tanganyka	54.3 (5.1)
Maniema	45.5 (5.7)
Nord-Kivu	6.7 (1.6)
Bas-Uele	58.3 (6.4)
Haut-Uele	42.7 (3.6)
Ituri	33.9 (4.1)
Tshopo	29.6 (4.9)
Sud-Kivu	16.4 (3.2)

Table S2: Descriptive statistics of individuals with missing GPS data. Only cluster-level variables that did not require GPS location to derive are described. All values are unweighted as no sampling weights are assigned to individuals missing location data.

	PCR positive	**PCR negative**
Total (unweighted)	607	795
Individual-level		
Age	27 (20 - 36)	30 (22 - 39)
Female (%)	313 (51.6%)	412 (51.8)
HIV positive (%)	8 (1.3)	9 (1.1)
Education		
No School	78 (12.9)	131 (16.5)
Primary	262 (43.2)	319 (40.1)
Secondary	259 (42.7)	337 (42.4)
Higher than secondary	8 (1.3)	8 (1.0)
Owns a bed-net	443 (73.0)	603 (75.6)
Slept under a bed-net	325 (53.4)	459 (57.7)
Wealth (%)		
Poorest	197 (32.5)	270 (34.0)
Poor	164 (27.0)	200 (25.2)
Middle	159 (26.2)	199 (25.0)
Rich	79 (13.0)	112 (14.1)
Richest	8 (1.3)	14 (1.8)
Household-level		
Average number of bed-nets per person (SE)	0.27 (0.01)	0.27 (0.01)
Modern Housing (%)	8 (1.3)	11 (1.4)
Metal Roofing (%)	41 (6.8)	82 (10.3)
Cluster-level		
Median Age (IQR)	29 (27- 30.5)	28 (26 – 30.5)

Median Wealth (IQR)	2 (2-3)	2 (2-3)
Median Education (IQR)	2 (2-3)	2 (2-3)

Table S3: Associations between identified risk factors and *P. falciparum* prevalence, stratified by urbanicity

Variable	Urban Category	Prevalence Ratio	95% Confidence Interval	P-value	F-test
Individual level:					
Bed-net use (all brands)	Rural	0.79	0.71 – 0.89	<0.001	0.442
	Urban	0.86	0.73– 1.01	0.066	
Deltamethrin or alphacypermethrin bed-net use	Rural	0.75	0.66- 0.85	<0.001	0.077
	Urban	0.94	0.77- 1.14	0.523	
Female Sex	Rural	0.83	0.77 – 0.90	<0.001	0.909
	Urban	0.84	0.75– 0.94	0.002	
Age (scaled)	Rural	0.86	0.83 – 0.90	<0.001	0.537
	Urban	0.84	0.78– 0.90	<0.001	
Modern Housing	Rural	0.98	0.71 – 1.34	0.876	0.035
	Urban	0.60	0.46 – 0.79	<0.001	
Metal Roofing	Rural	0.85	0.69– 1.03	0.099	0.002
	Urban	0.53	0.43- 0.66	<0.001	
Wealth	Rural	0.95	0.90– 1.01	0.106	<0.001
	Urban	0.72	0.65– 0.80	<0.001	
Education	Rural	1.03	0.96 – 1.11	0.435	<0.001
	Urban	0.80	0.71– 0.89	<0.001	
Net Ratio >0.5	Rural	0.82	0.72 - 0.93	0.002	0.521
	Urban	0.90	0.72- 1.12	0.351	

Cluster level:

Deltamethrin or alphacypermethrin net use*	Rural	0.93	0.89 – 0.97	0.002	0.040
	Urban	1.07	0.94– 1.21	0.299	
SP[†] use	Rural	0.96	0.94- 0.97	<0.001	0.458
	Urban	1.00	0.87 - 1.15	0.953	
A437G*	Rural	0.90	0.85 – 0.95	<0.001	0.599
	Urban	0.92	0.85 – 0.99	0.032	
K540E*	Rural	0.96	0.92 – 0.99	0.009	0.180
	Urban	0.92	0.87 – 0.97	0.002	
A581G*	Rural	0.85	0.78 – 0.92	0.001	0.507
	Urban	0.80	0.67– 0.94	0.008	
CRT K76T*	Rural	0.95	0.92 - 0.98	<0.001	0.649
	Urban	0.93	0.87 - 0.99	0.029	

[†] Sulfadoxine/pyrimethamine
*logit transformed

Table S4: Comparison of the association between individual LLIN use vs no LLIN[†] use and malaria prevalence between adults and children in the 2013-2014 Demographic and Health Survey. Data from children has been previously published[3,4].

Population	Prevalence Ratio	95% Confidence Interval
Children	0.82	0.72 – 0.91
Adults	0.83	0.76 – 0.91

[†]Long-lasting insecticide treated net

REFERENCES

1. Tusting LS, Bottomley C, Gibson H, et al. Housing Improvements and Malaria Risk in Sub-Saharan Africa: A Multi-Country Analysis of Survey Data. *PLoS Med*. 2017;14(2):e1002234.

2. Giorgi E, Diggle P. PrevMap : An R Package for Prevalence Mapping. *J Stat Softw*. 2017;78(7). doi:10.18637/jss.v078.i08

3. Doctor S, Liu Y, Whitesell A, et al. Malaria Surveillance in the Democratic Republic of the Congo: Comparison of Microscopy, PCR, and Rapid Diagnostic Test. *Diagn Microbiol Infect Dis*. 2017;85(1):16-18.

4. Levitz L, Janko M, Mwandagalirwa K, et al. Effect of individual and community-level bed net usage on malaria prevalence among under-fives in the Democratic Republic of Congo. *Malar J*. 2018;17(1).