Additional File 5. Association between house construction and entomological outcomes

a. Intervention studies

Study reference	Design	Intervention (type of screening)	Comparison	Outcome	Measurement of outcome	Mean density or rate				Measure of effect	
						Pre–intervention		Post–intervention			
						Control	Treatment	Control	Treatment		
Massebo 2013	RCS (pilot)	Full	Screening vs no screening	HBR	Mean number *An. arabiensis* per CDC light trap per night	20.1 (10.9–29.3)	20.3 (12.8– 27.8)	7.9 (6.5–10.1)	4.8 (3.9–6.2)	Abundance ratio	0.61 (0.44-0.83)
Mng'ong'o 2011	RCS (pilot)	Full	Lantana plant vs no Lantana plant	HBR	Mean number adult anophelines per CDC light trap per night	n/a	n/a	–	–	Crude IRR	0.54 (0.40–0.73)
Mng'ong'o 2011	RCS (pilot)	Full	Lantana plant vs no Lantana plant	HBR	Mean number adult anophelines per CDC light trap per night	n/a	n/a	–	–	IRR adjusted for smoke stains	0.503 (0.380–0.667)
Ogoma 2010	Non–randomized cross–over study (pilot study)	Eaves	Screened eaves vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	80.0 (4–630)	59.0 (9–415)	Relative Rate	0.91 (0.84–0.98)
Ogoma 2010	Non–randomized cross–over study (pilot)	Windows	Screened windows vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	80.0 (4–630)	80.0 (15–370)	Relative Rate	0.98 (0.94–1.02)
Ogoma 2010	Non–randomized cross–over study (pilot)	Door	Screened doors vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	80.0 (4–630)	96.0 (17–700)	Relative Rate	1.03 (0.97–1.09)
Kirby 2009	RCS	Ceiling	Ceiling vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	37.5 (31.6–43.3)	19.1 (16.1–22.1)	Ratio of means for total *An. gambiae* s.l. over all trapping visits, adjusted for location, year, SES, wall material, horses, people in house	0.60 (0.46–0.80)
Kirby 2009	RCS	Full	Full vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	37.5 (31.6–43.3)	15.2 (12.9–17.4)	Ratio of means for total *An. gambiae* s.l. over all trapping visits, adjusted for location, year, SES, wall material, horses, people in house	0.46 (0.34–0.63)
Kirby 2009 (2006 data)	RCS	Ceiling	Ceiling vs no screening	EIR	Measured using CDC light traps	n/a	n/a	2.27 (1.38–3.16)	1.14 (0.85–1.42)	Abundance ratio	0.50 (0.32-0.79)
Kirby 2009 (2006 data)	RCS	Full	Full vs no screening	EIR	Measured using CDC light traps	n/a	n/a	2.27 (1.38–3.16)	0.77 (0.57–0.96)	Abundance ratio	0.34 (0.21-0.54)
Kirby 2009 (2007 data)	RCS	Ceiling	Ceiling vs no screening	EIR	Measured using CDC light traps	n/a	n/a	1.35 (0.74–1.97)	0.90 (0.22–1.57)	Abundance ratio	0.67 (0.28-1.58)
Kirby 2009 (2007 data)	RCS	Full	Full vs no screening	EIR	Measured using CDC light traps	n/a	n/a	1.35 (0.74–1.97)	0.42 (0.24–0.63)	Abundance ratio	0.31 (0.16-0.59)
Kampango 2013	RCS (pilot)	Eaves	Gables screened with local cloth vs no screening	HBR	Mean number *An. funestus* per CDC light trap per night	n/a	n/a	43.4 (38.0–49.6)	13.0 (10.7–15.7)	Crude IRR	0.3 (0.25–0.37)
Kampango 2013	RCS (pilot)	Full	Gables screened with local cloth vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	6.88 (4.98–9.51)	2.13 (1.48–3.08)	Crude IRR	0.31 (0.19–0.50)
Njie 2009	Randomised cross–over study (pilot)	Eaves	Screened eaves vs no screening	HBR	Mean number *An. gambiae* s.l. per CDC light trap per night	n/a	n/a	6.1 (3.5–10.0)	2.1 (1.3–3.1)	Percent reduction	0.34 (0.18-0.67)
Njie 2009	Randomised cross–over study (pilot)	Screened eaves	Screened eaves vs no screening	Adult density	Odds of finding *An.gambiae* in house (CDC light trap)	n/a	n/a	–	–	OR adjusted for trapping week, crossover group, numbers of horses and cows in compounds	0.34 (0.20–0.56)

b. Observational studies

Reference	House feature	Specific comparison	Outcome	Mean density or rate		Measure of effect	Crude results	Adjusted results	Factors adjusted for
				Exposed	Unexposed				
Barber 1935	House type	New (tiled roof, ceiling, non–leaky) vs old (thatched roof, reed or no ceiling, in poor condition)	Density of adult anophelines (mean number *An. elutus* and *An. maculipennis* per resting catch)	6.8	9.4	None reported	–	–	n/a
Bosman 1992	House type	Modern vs traditional	Density of adult Anophelines (August monthly mean number adult Anopheles per pyrethrum spray catch)	–	–	None reported	–	–	n/a
Gamage–Mendis 1991	House type	Poor vs good	Indoor resting density (geometric mean number of *Anopheles* per trap per night)	3.42	1.95	None reported	–	–	n/a
Hiscox 2013	Village type	Modern vs traditional homes	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	0.72 (0.45–1.14)		n/a
Konradsen 2000	House type	Poor vs good	Presence (vs absence) of *An. culicifacies* in each collection (pyrethrum spray catch)	–	–	OR	1.6 (1.1–2.1)	–	n/a
Konradsen 2000	House type	Poor vs good	Presence (vs absence) of *An. subpictus* in each collection (pyrethrum spray catch)	–	–	OR	1.4 (1.1–1.7)	–	n/a
Liu 2014	House type	Highest quintile of housing index compared to lowest quintile (based on roof, wall and floor material, ceiling, eaves, screening)	Density of adult anophelines (mean number of *Anopheles* collected per household)	–	–	IRR	0.334 (0.228–0.489)	0.571 (0.373–0.874)	Cattle near house, water source, electricity, urban or rural
Mutuku 2011	House type	Poor vs good	Density of adult Anophelines (pyrethrum spray catch)	–	–	IRR	1.07 (0.72–1.44)	–	n/a
Wanzirah 2015	House type	Modern vs traditional	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	–	0.48 (0.37–0.64)	Study site, household wealth
Coogle 1927	Screening	Screened vs unscreened	Density of adult anophelines (mean number *An. quadrimaculatus* per home	2.2	–	None reported	–	–	n/a
Geissbuhler 2007	Screening	No ceiling and unscreened windows vs ceiling and screned windows	Human biting rate (mean number of bites received by those sleeping indoors (HLC))	4.4	2.3	None reported	–	–	–
Zhou 2007	Screening	No screening vs screening	Density of adult anophelines (mean number o*f An. gambiae* s.s. per house (pyrethrum spray catch))	4.15 (3.95–5.35)	2.92 (2.08–3.76)	OR (proportion houses with *An. gambiae* s.s.)	1.04 (1.01–1.07)	–	n/a
Zhou 2007	Screening	No screening vs screening	Density of adult anophelines (mean number o*f An. funestus* per house (pyrethrum spray catch))	0.52 (0.37–0.67)	0.44 (0.29–0.59)	OR (proportion houses with *An. funestus*)	1.14 (1.09–1.20)	–	n/a

b. Observational studies (continued)

Reference	House feature	Specific comparison	Outcome	Mean density or rate		Measure of effect	Crude results	Adjusted results	Factors adjusted for
				Exposed	Unexposed				
Adiamah 1993	Main wall material	Mud vs brick/concrete	Density of adult Anophelines (geometric mean number adult *Anopheles* per light trap catch)	24.6	15.5	None reported	–	–	n/a
Hiscox 2013	Main wall material	Other vs wood	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	1.83 (1.14–2.93)	2.35 (1.30–4.23)	Village, location of kitchen, veranda style, presence of animals
Kirby 2008	Main wall material	Mud vs cement	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	5.36 (3.92–7.31)	1.44 (1.10–1.87)	Distance to nearest pit latrine, horses, eave type, crowding, churai in room
Zhou 2007	Main wall material	Mud vs brick	Density of adult anophelines (mean number of *An. gambiae* s.s. per house (pyrethrum spray catch))	4.16 (3.24–5.08)	0.86 (0.53–1.19)	OR (proportion houses with An. gambiae s.s.)	1.34 (1.29–1.40)	–	n/a
Zhou 2007	Main wall material	Mud vs brick	Density of adult anophelines (mean number of *An. funestus* per house (pyrethrum spray catch))	0.53 (0.37–0.65)	0.22 (0.06–0.38)	OR (proportion houses with *An. funestus*)	1.87 (1.70–2.04)	–	n/a
Wanzirah 2015	Main wall material	Cement, wood or metal vs mud	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	–	0.63 (0.48–0.84)	Study site, household wealth
Hiscox 2013	Main roof material	Other vs iron	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	0.49 (0.16–1.44)	–	n/a
Kirby 2008	Main roof type	Thatch vs metal	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	1.15 (0.94–1.41)	–	n/a
Wanzirah 2015	Main roof material	Tiles or metal vs thatch	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	–	0.72 (0.52–1.00)	Study site, household wealth
Zhou 2007	Main roof material	Grass thatch vs iron sheet	Density of adult anophelines (mean number of *An. gambiae* s.s. per house (pyrethrum spray catch))	4.26 (3.15–5.37)	2.00 (1.33–2.67)	OR (proportion houses with *An. gambiae* s.s.)	1.15 (1.12–1.19)	–	n/a
Zhou 2007	Main roof material	Grass thatch vs iron sheet	Density of adult anophelines (mean number of *An. funestus* per house (pyrethrum spray catch))	0.39 (0.27–0.51)	0.61 (0.39–0.83)	OR (proportion houses with *An. funestus*)	0.75 (0.71–0.79)	–	n/a
Wanzirah 2015	Main floor material	Woods, bricks or cement vs earth, sand, dung or stones	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	–	0.42 (0.32–0.55)	Study site, household wealth
Adiamah 1993	Eaves	Presence vs absence of eaves	Density of adult Anophelines (geometric mean number adult *Anopheles* per light trap catch)	29.3	14.6	None reported	–	–	n/a
Animut 2013	Eaves	Open vs closed eaves	Density of *An. arabiensis* (mean number *An. arabiensis* per CDC light trap per house)	0.97 (0.60–1.34)	0.66 (0.43–0.88)	Abundance Ratio	1.5 (0.9-2.4)	–	n/a

b. Observational studies (continued)

Reference	House feature	Specific comparison	Outcome	Mean density or rate		Measure of effect	Crude results	Adjusted results	Factors adjusted for
				Exposed	Unexposed				
Animut 2013	Eaves	Open vs closed eaves	Density of *An. arabiensis* (mean number *An. arabiensis* per pyrethrum spray catch)	5.67 (4.22–7.12)	0.77 (–0.15–1.69)	None reported	7.4 (2.2-24.4)	–	n/a
Kirby 2008	Eaves	Closed vs open	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	0.38 (0.32–0.46)	–	n/a
Kirby 2008	Eaves	Continuous variable (eave gap size)	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	1.06 (1.04–1.08)	0.71 (0.60–0.85)	Distance to nearest pit latrine, horses, main wall material, crowding, churai in room
Lindsay 1988	Eaves	Open vs closed	Density of adult Anophelines (mean number of *Anopheles* per night)	–	–	Percent reduction	43.2	–	n/a
Lindsay 1995 (wet season)	Eaves	Open vs closed	Density of of adult anophelines (mean number *An. gambiae* s.l. caught under bednets)	–	–	Percent increase	–	10 (0–21)	Store room, bednets tucked, fire, ceiling
Russell 2013	Eaves	Closed vs open	Density of aduly *An. gambiae* s.l. (CDC light trap))	31.25% households in low anopheline density cluster (Z scores <1.96) had closed eaves vs 0% houses in high anopheline density cluster (Z scores >1.96)					
Wanzirah 2015	Eaves	Closed vs open	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	–	0.58 (0.45–0.74)	Study site, household wealth
Adiamah 1993	Ceiling	No ceiling vs ceiling	Density of adult Anophelines (geometric mean number adult *Anopheles* per light trap catch)	20.5	10.7	None reported		–	n/a
Lindsay 1995 (wet season)	Ceiling	Ceiling present vs absent	Density of of adult anophelines (mean number *An. gambiae* s.l. caught under bednets)	–	–	Percent decrease	–	13 (1–25)	Store room, bednets tucked, fire, open eaves
Burkot 1989	Elevation	Houses built on stilts vs at ground level	Human biting rate (mean number of Anopheles per human landing catch)	50.8 (SD 46.9)	166 (SD 125)	None reported	–	–	–
Charlwood 2003	Elevation	Ground level homes vs homes built on stilts	Human biting rate (mean number of Anopheles per man hour of collection (HLC))	3.58 (2.9–4.4)	2.38 (1.7–3.3)	Abundance Ratio	1.5 (1.0-2.2)	–	n/a
Charlwood 2003	Elevation	Ground level homes vs homes built on stilts	Human biting rate (mean number o*f An. gambiae* per light trap per night)			None reported	–	–	n/a
Hiscox 2013	Elevation	Continuous variable (height on stilts)	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	1.00 (0.99–1.00)	–	n/a
Animut 2013	Windows	Present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per CDC light trap per house)	0.27 (–0.04–0.60)	1.02 (0.78–1.27)	Abundance Ratio	0.3 (0.1-0.9)	–	n/a

b. Observational studies (continued)

Reference	House feature	Specific comparison	Outcome	Mean density or rate		Measure of effect	Crude results	Adjusted results	Factors adjusted for
				Exposed	Unexposed				
Animut 2013	Windows	Present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per pyrethrum spray catch)	1.95 (0.72–3.18)	2.35 (1.30–3.39)	Abundance Ratio	0.8 (0.4-1.8)	–	n/a
Hiscox 2013	Doors and windows	Other covering vs resettlement style shutters	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	1.23 (0.75–2.01)		n/a
Hiscox 2013	Doors and windows	Open vs resettlement style covers	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	0.87 (0.25–3.12)		n/a
Animut 2013	Roof condition	Hole present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per pyrethrum spray catch)	4.81 (3.31–6.31)	1.17 (0.24–2.10)	Abundance Ratio	4.1 (1.8-9.5)	–	n/a
Animut 2013	Roof condition	Hole present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per CDC light trap per house)	1.12 (0.75–1.50)	0.61 (0.38–0.83)	Abundance Ratio	1.8 (1.1-3.0)	–	n/a
Animut 2013	Wall condition	Hole present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per CDC light trap per house)	0.77 (0.54–1.01)	0.67 (0.32–1.02)	Abundance Ratio	1.1 (0.6-2.1)	–	n/a
Animut 2013	Wall condition	Hole present vs absent	Density of *An. arabiensis* (mean number *An. arabiensis* per pyrethrum spray catch)	3.27 (2.22–4.32)	0.73 (–0.48–1.94)	Abundance Ratio	4.5 (0.9-23.4)	–	n/a
Hiscox 2013	Veranda style	Closed vs open	Human biting rate (mean number of *Anopheles* per CDC light trap per night)	–	–	IRR	0.32 (0.18–0.58)	0.51 (0.23–1.11)	Village, location of kitchen, wall material, presence of animals

CDC: Centers for Disease Control and Prevention; OR: Odds Ratio; IRR: Incidence Rate Ratio; SES: socioeconomic status