KENYA MEDICAL RESEARCH INSTITUTE

In Search of Better Health

Bernard Abong'o
(MS.c., PhD)
KEMRI – CGHR

VCWG 2024

Passive cooling options in combination with vector proofing for indoor heat reduction and mosquito control: a pilot study in rural western Kenya

Introduction

- Door, eaves and windows facilitate transfer of heat between indoor and outdoor environment.
- The openings are usually not oriented or are disproportionate in size to the indoor environment to achieve meaningful cooling.
- They also serve as the entry routes for disease carrying vector such as mosquitoes.
- Screening of these openings for vector proofing have the potential of modifying the indoor environment.
- Combination of housing modification for passive cooling and mosquito control have the potential of reducing indoor temperatures and mosquito numbers.

Housing modification for vector proofing and heat reduction- objectives

1. To assess the indoor cooling effect achieved in a house due to cross breeze ventilation, cool roof system and mat ceiling

2. To determine the impact of full house proofing on indoor mosquito densities as measured by CDC light trap.

3. To assess community knowledge, perception and attitude towards house modification for insect proofing and thermal comfort.

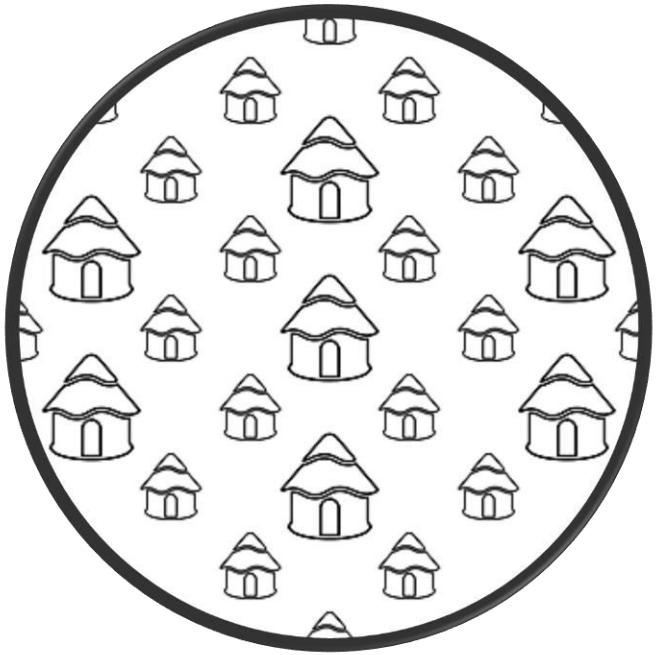
Methodology – Community engagement

- Community mobilization
  - Identification of study households
  - Community meetings
  - Consenting
  - Randomization

Methodology - Study design

Baseline – 40

- Mosquito numbers
- Community KAP



Randomization and modification

- 10 Control
- 10 Cross ventilation
- 10 Mat ceiling
- 10 Cool roof

Intervention phase

CDC light trap collection

Temperature and humidity monitoring

Interview with study participants

Housing modification – passive cooling options

A – A participant standing outside of their house with cool Roof

B – The addition of windows screened windows to achieve cross ventilation

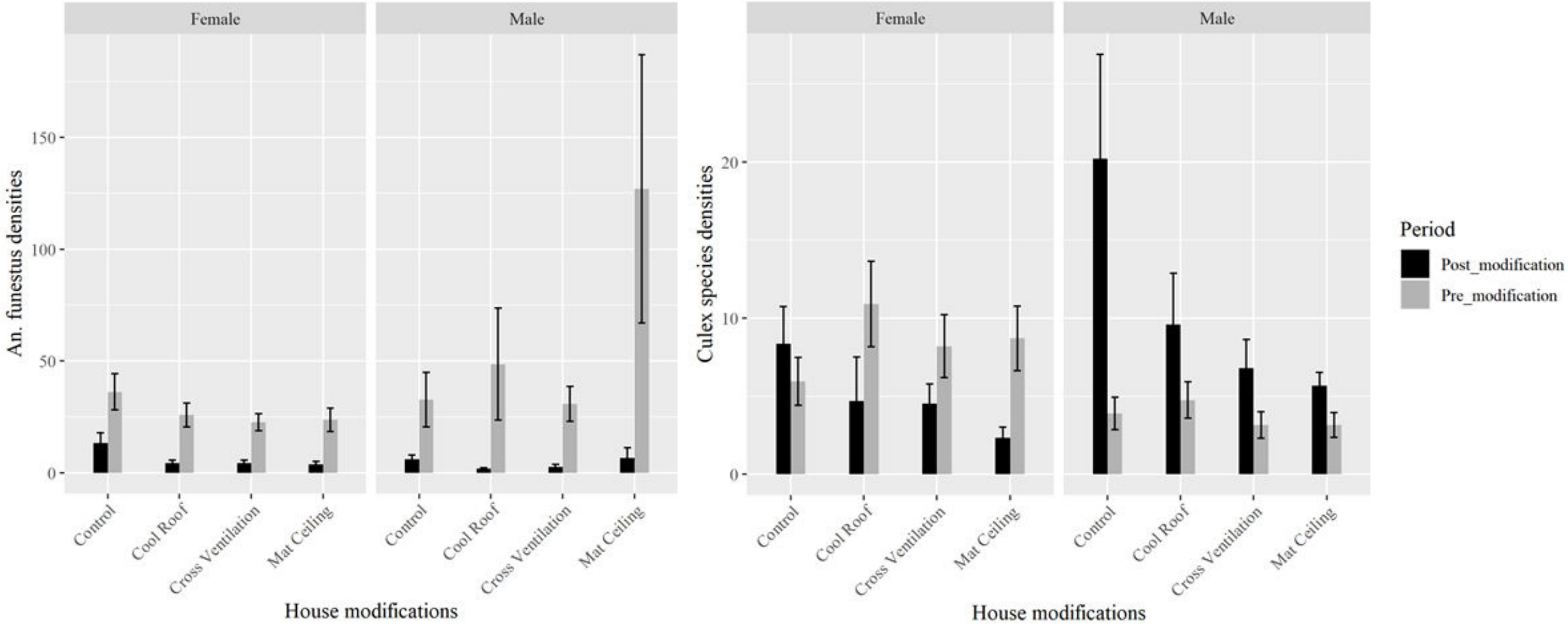
C – Mat ceiling to reduce indoor temperatures

Housing modification – window and door screening

A & C – Screened eaves

B – Screened door

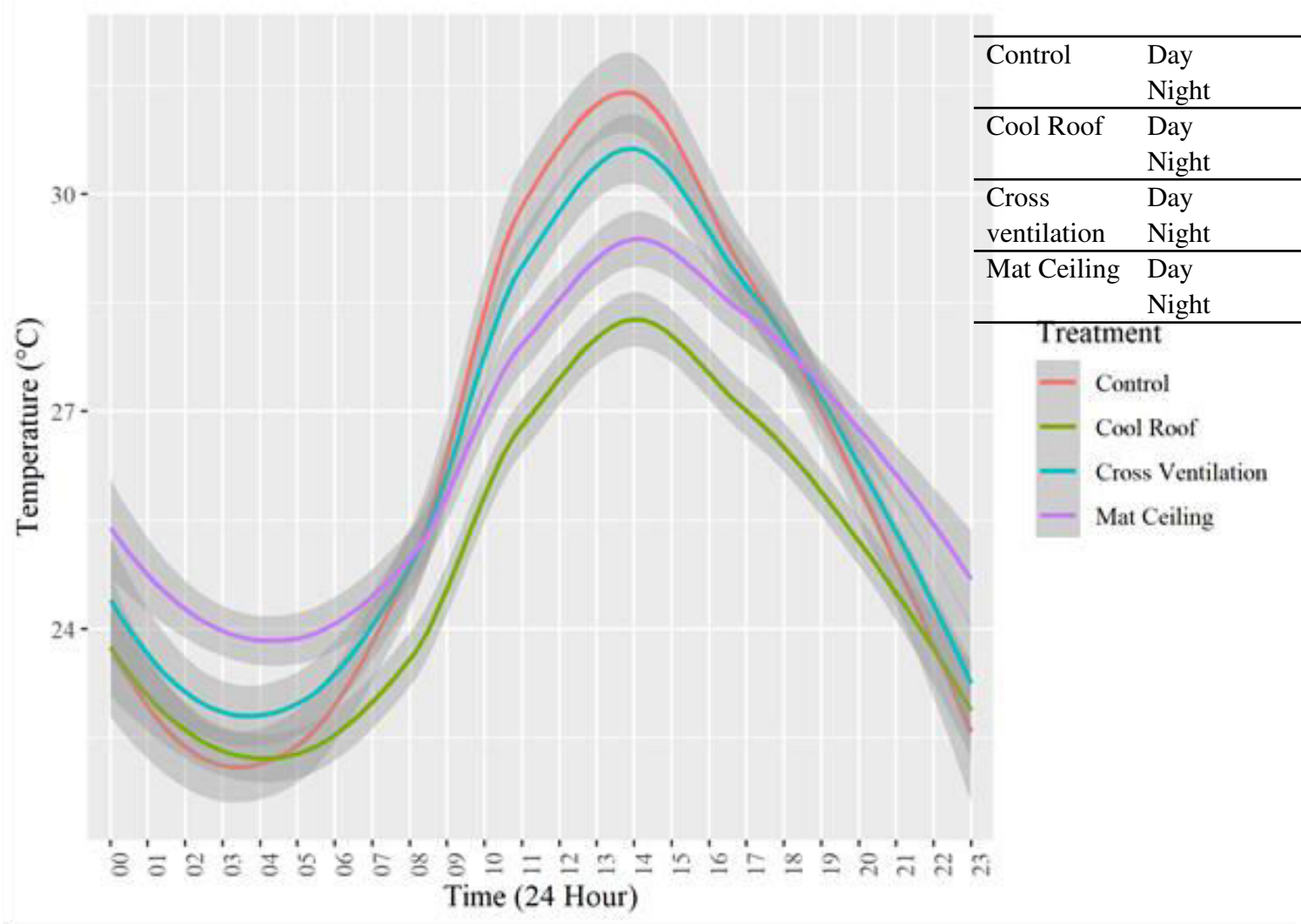
Results- Mean number of male and female mosquitoes collected indoors in control, cool roof, cross ventilation and mat ceiling houses before and after modification.



Results - Comparison of mean number of male and female *An. funestus* and *Culex* species between different study arms.

Anopheles specie	Parameters	Mean	RR	95%CI	p Values
	Screened	12.18	0.46	0.24-0.85	**0.014**
	Not screened	22.54	1		
	Pre-Screening	27.14	5.8	3.73-9.00	**<0.001**
An. funestus female	Post Screening	6.53	1		
	Screened	29.77	0.71	0.29-1.73	0.451
	Not screened	16.82	1		
	Pre-Screening	59.83	14.17	7.10-28.25	**<0.001**
An. funestus male	Post Screening	4.33	1		
	Screened	6.02	0.69	0.39-1.23	0.209
	Not screened	7.4	1		
	Pre-Screening	8.44	1.83	1.10-3.05	**0.020**
Culex female	Post Screening	4.98	1		
	Screened	5.89	0.5	0.32-0.78	**0.002**
	Not screened	13.68	1		
	Pre-Screening	3.74	0.42	0.29-0.61	**<0.001**
Culex male	Post Screening	10.57	1		

Results - Mean daily temperature in control, cool roof, cross ventilation and mat ceiling houses.

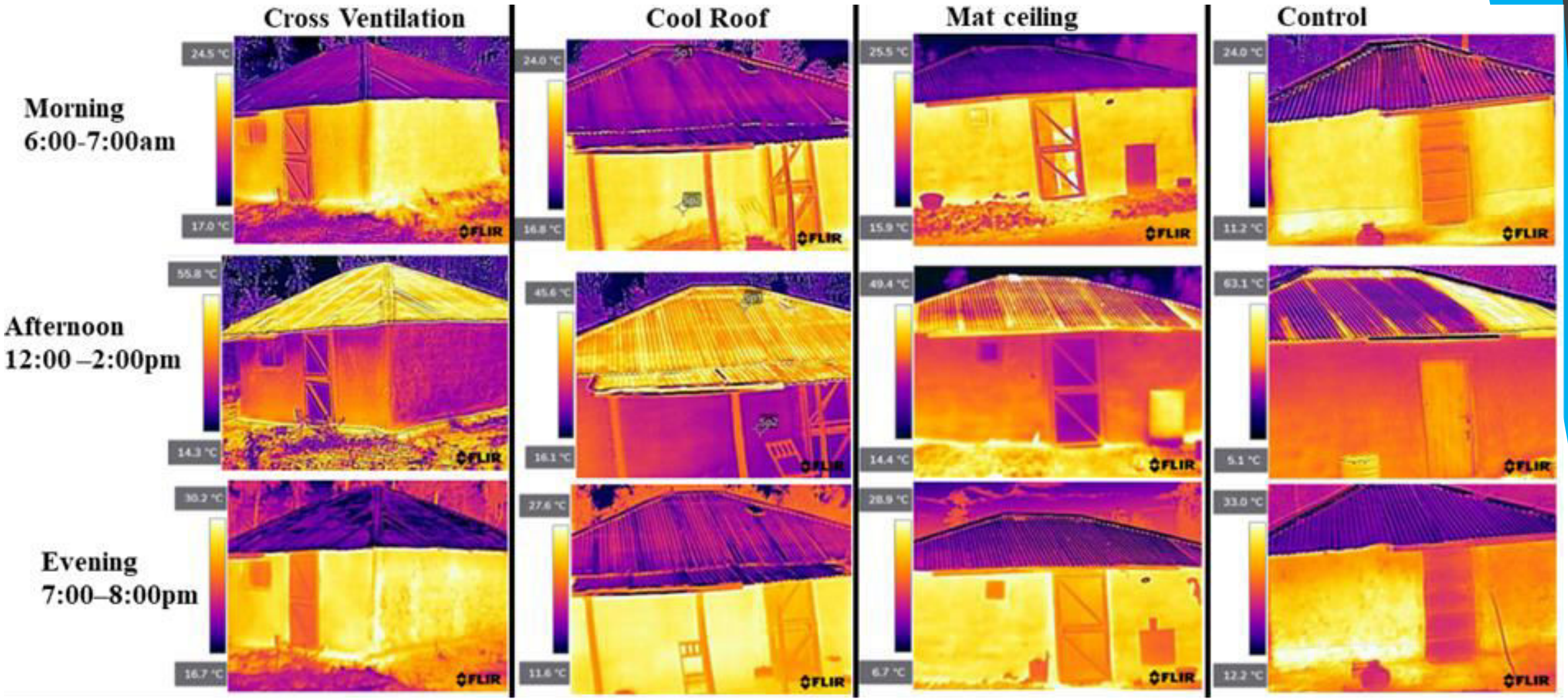


Category	Time of the Day	Minimum Temperature (°C)	Maximum Temperature (°C)	Mean (°C)
Control	Day	18.06	46.98	28.62
	Night	18.27	42.55	23.38
Cool Roof	Day	18.80	39.38	26.18
	Night	18.85	30.15	23.29
Cross ventilation	Day	19.60	40.03	28.31
	Night	19.10	30.28	24.09
Mat Ceiling	Day	19.60	37.80	27.56
	Night	19.00	35.99	25.18

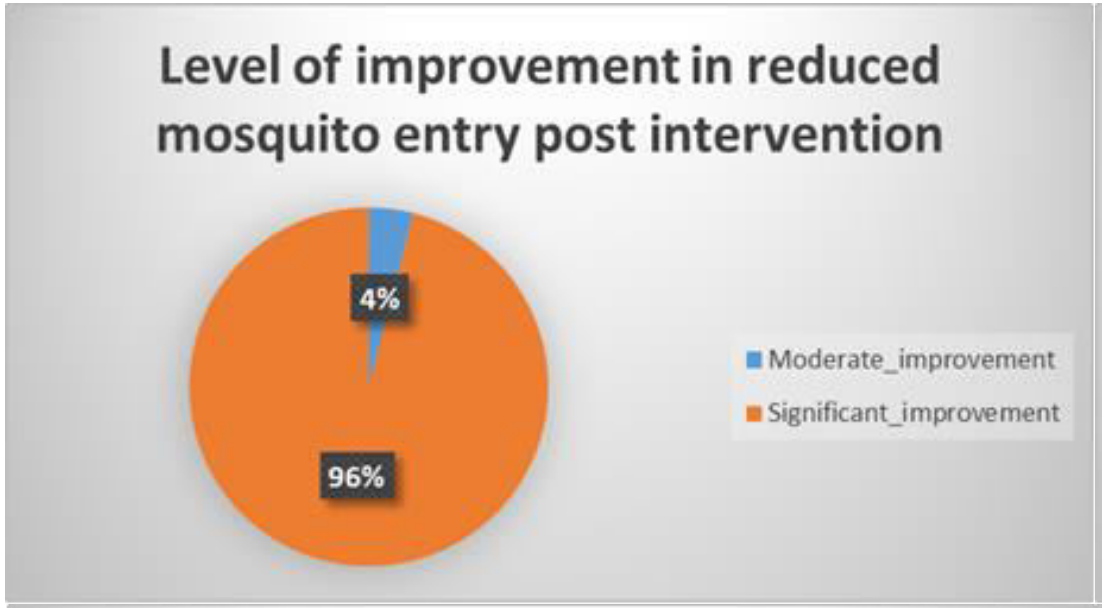
Results - Pairwise comparison of mean daily temperature between houses with different passive colling option and control.

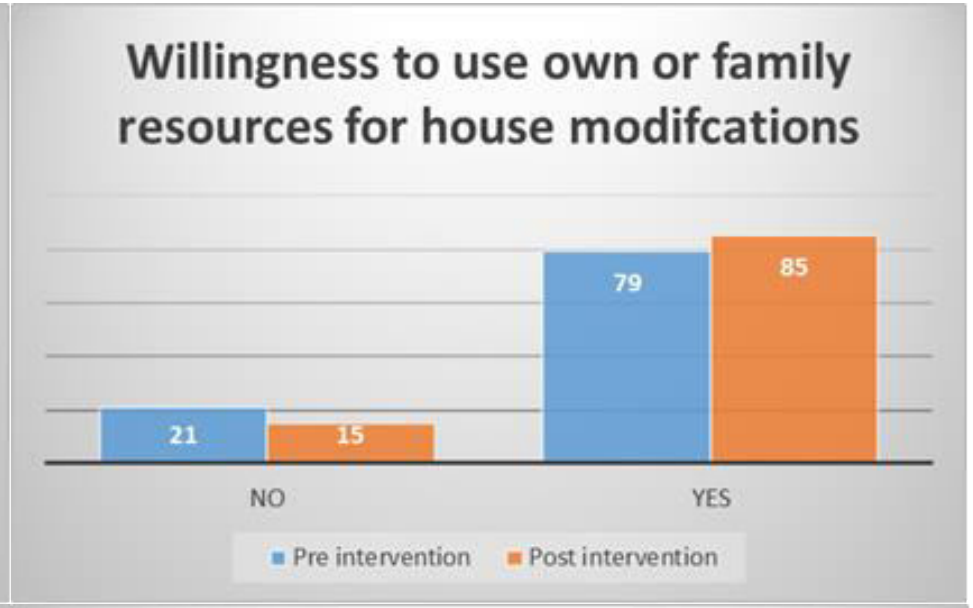
Category	Mean	Estimate	Std. Error	t -value	p-values
Cool roof and	24.73				
Control	26.00	-2.44	0.01	-163.13	<0.001
Cross Ventilation and	26.20				
Control	26.00	-0.31	0.01	-21.52	<0.001
Mat Ceiling and	26.37				
Control	26.00	-1.06	0.01	72.13	<0.001
Cross ventilation	26.20				
Cool roof	24.73	2.13	0.01	149.25	<0.001
Mat Ceiling	26.37				
Cool roof	24.73	1.38	0.01	93.66	<0.001
Mat Ceiling	26.37				
Cross Ventilation	26.20	-0.76	0.01	-53.7	<0.001

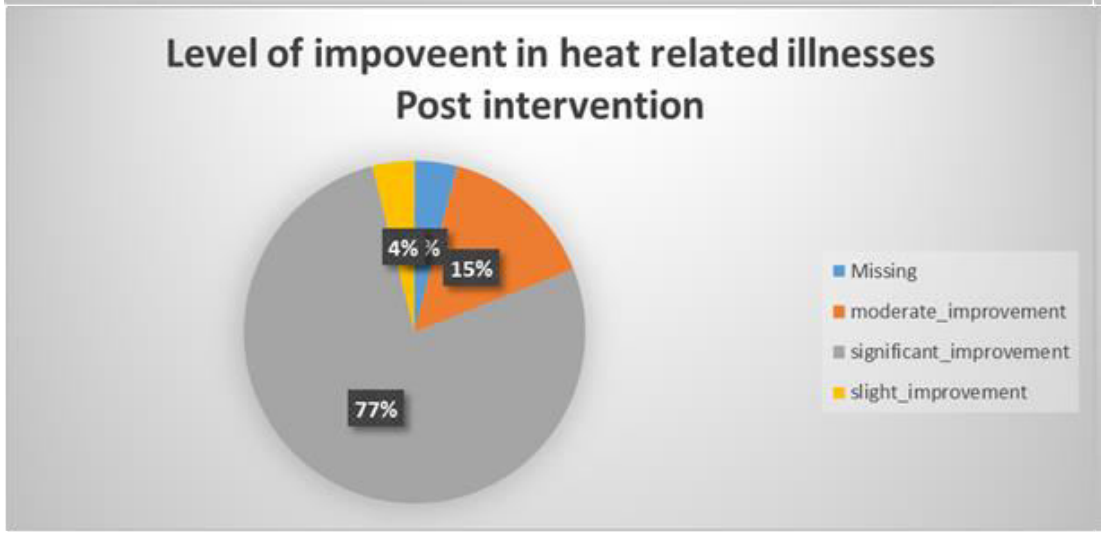
Results - Thermal images of houses with different modifications, taken at different times of the day, morning, afternoon, and evening.

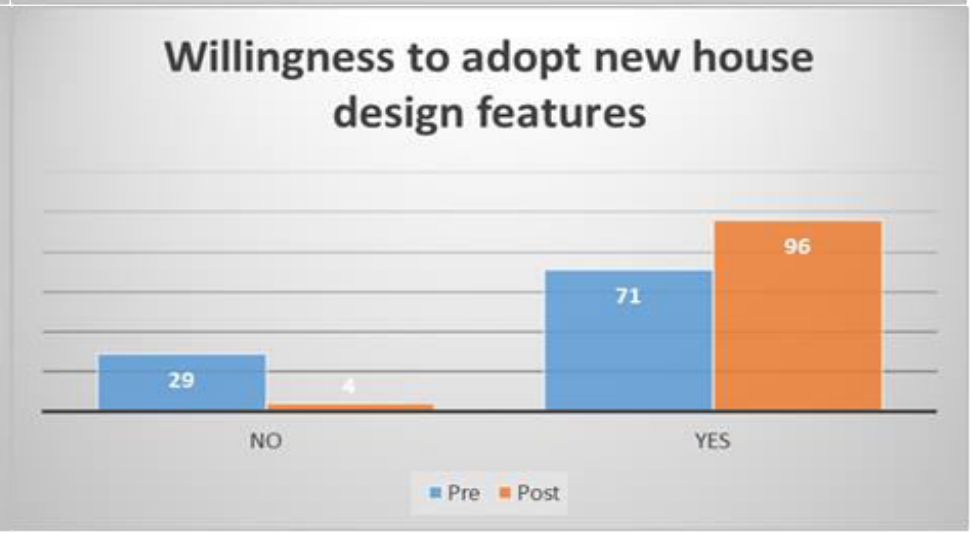


Results – community knowledge, perception and attitude









Conclusion and recommendation

- Vector proofing and passive cooling have great potential for controlling the persistent indoor malaria transmission while mitigating the impact of the constantly rising temperatures due to global warming in rural Africa communities.
- Cool roof, mat ceiling and cross ventilation all offer practical solutions for achieving indoor thermal comfort in the low-income communities of Africa.
- Assessment of these modifications on health outcomes including sleep quality, heart rate variability, heat stress and strain and malaria transmission is recommended.
- Mobilization and training of community and experts in the built environment is critical for uptake and scale up of housing modification for improved living standards

Acknowledgements

- Study community
- KEMRI staff
- Prof. Martina Anne Maggioni - Charitte University
- Mr Harry Sangree - Funder