
Housing & malaria – new opportunities for control and elimination

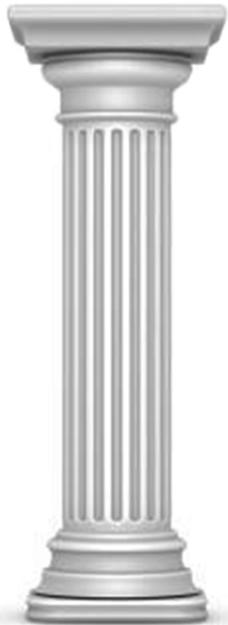
Prof Steve Lindsay



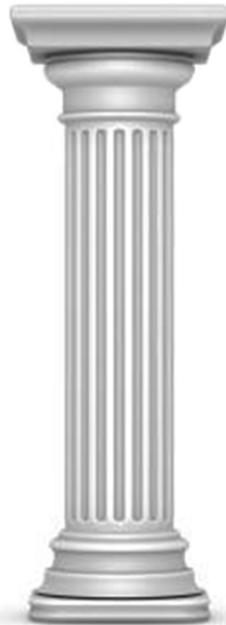
What I'm going to cover

- Making the case for housing as a malaria control intervention
- Estimating the effect size of 'good' quality housing
- Doing the experiment to measure the protective efficacy of housing against clinical malaria

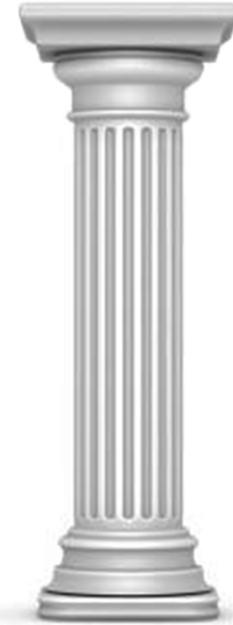
Principal Pillars of Public Health



Clean water



Sanitation



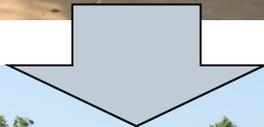
Housing

80% malaria transmission in sub-Saharan Africa occurs indoors



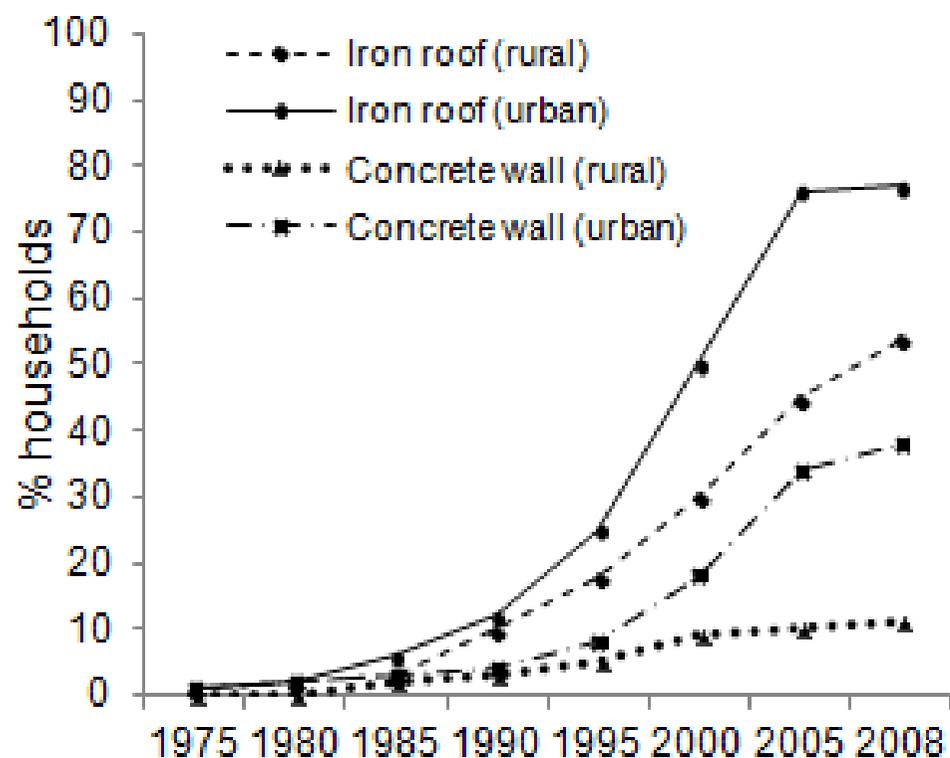
Huho et al. *Int J Epidemiol* 2013; 43: 235-47.

Future opportunities

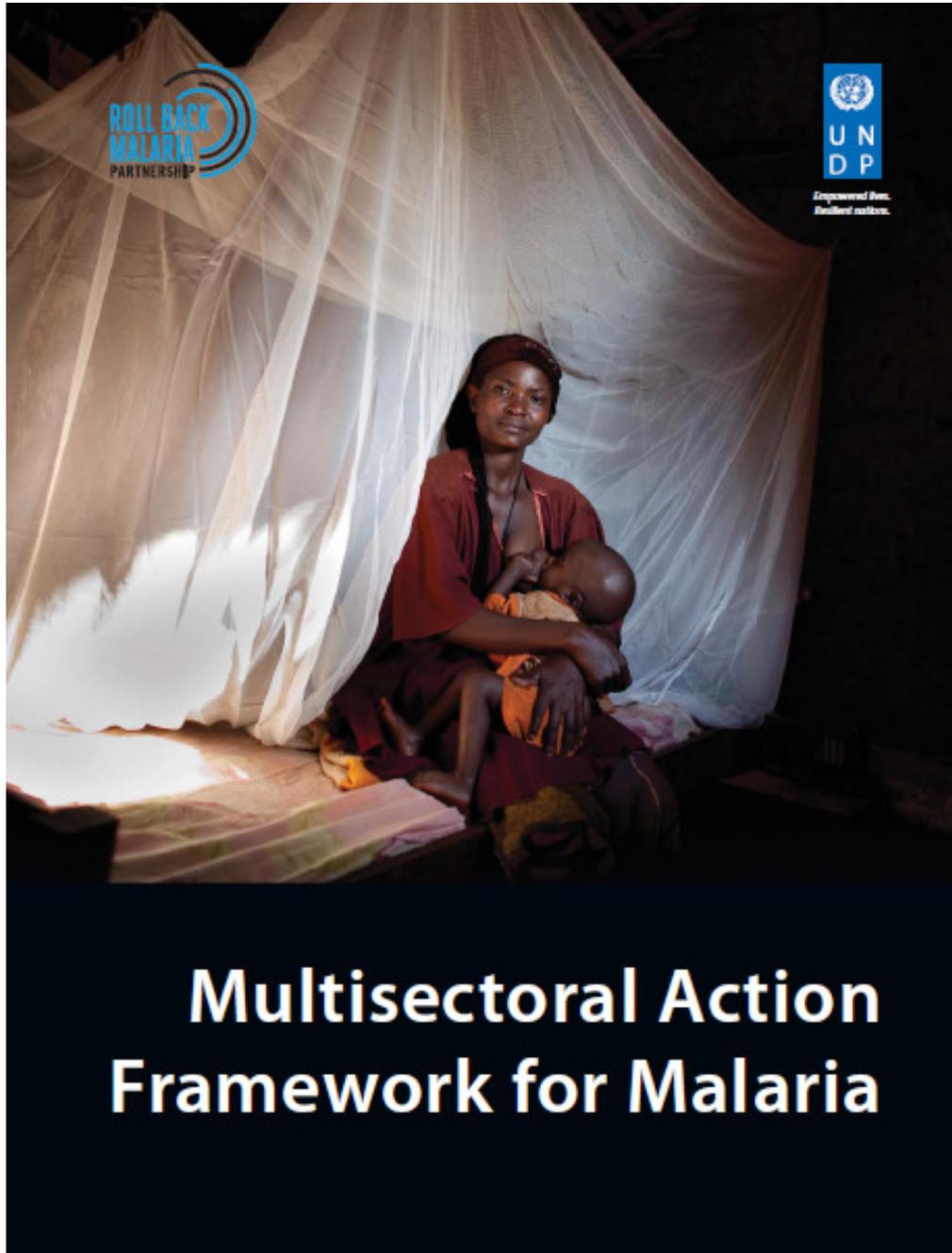


- Quiet revolution: housing in Africa is changing from thatch to metal roofed houses
- 115 M rural houses to be built in Africa by 2050
- Insecticide-resistance strategy
- Help move to elimination

House improvements in Korogwe, Tanzania, 1975–2008

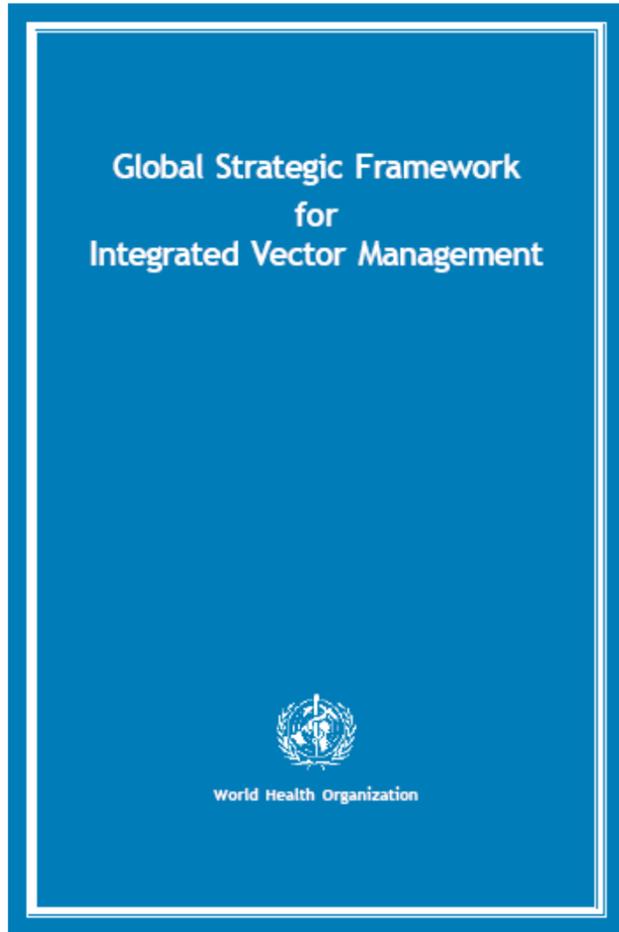


Liu et al. *PLoS ONE* 2014; 9: e87358.



**New RBM/UNDP
calls for action
outside the
health sector to
control malaria
– including
housing**

Integrated Vector Management



- IVM is a World Health Organisation recommended management approach for the control of VBDs globally.
- Advocates interventions both within and outside the health sector

The evidence for improving housing to reduce malaria: a systematic review & meta-analysis

Tusting LS, Ippolito M, Willey B, Kleinschmidt I, Dorsey G, Gosling R, Lindsay SW



Rationale

- Despite historical precedent for housing in malaria control, few rigorously conducted studies – only one intervention study with epidemiological outcomes (Kirby 2009 Lancet)
- *Multisectoral Action Framework for Malaria* emphasises need for good housing - yet a paucity of supporting evidence
- We undertook the first systematic review and meta-analysis of housing and malaria, to:
 1. Characterise all published and unpublished data
 2. Assess strength and quality of the evidence

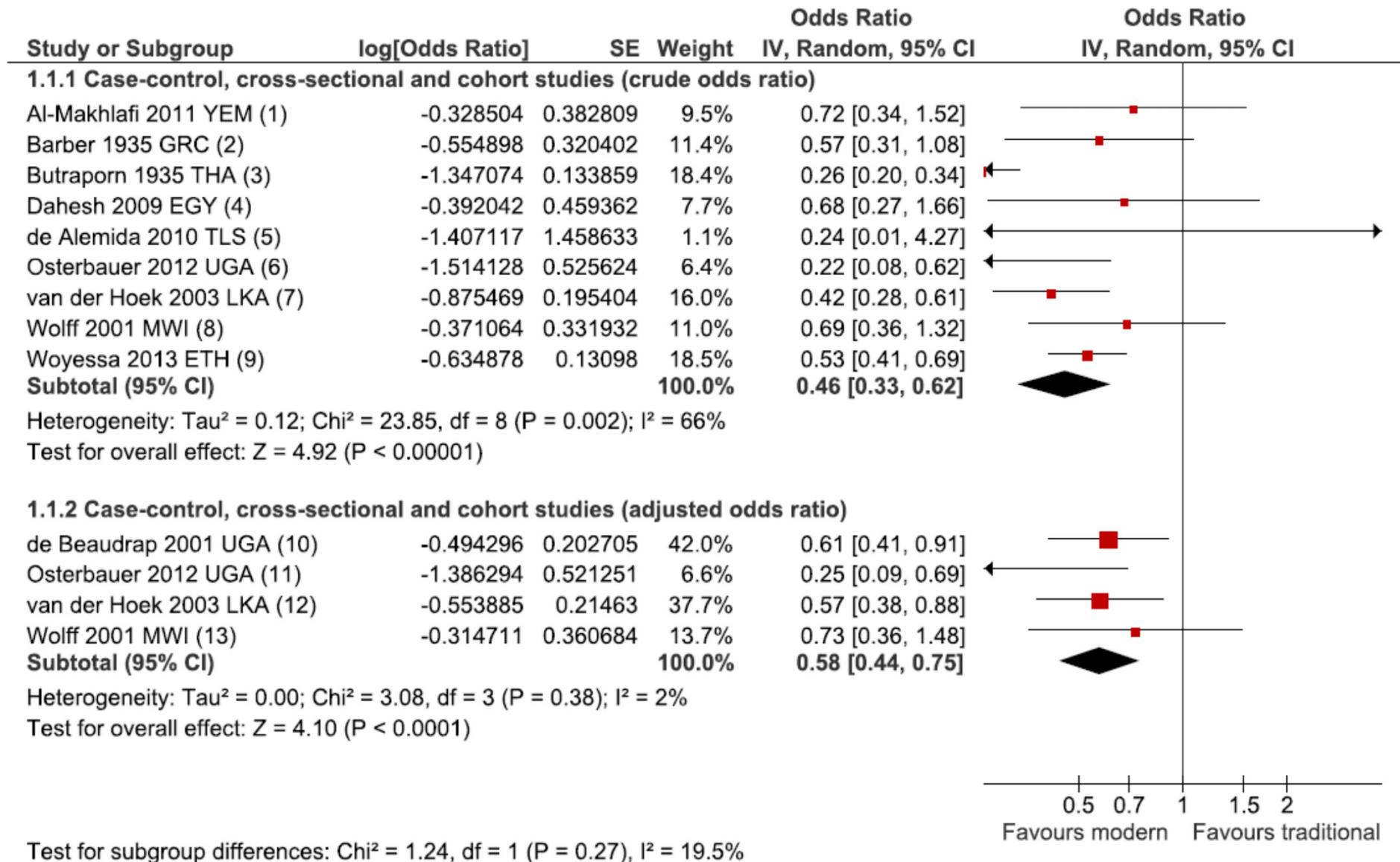
Methods

- **Aim:** To assess whether modern housing is associated with a lower risk of malaria than traditional housing, across all age groups and malaria-endemic settings
- **Search strategy:** six electronic databases and grey literature; intervention and observational studies published from 1st Jan 1900 to 13th Dec 2013
- **Analysis:** Crude and adjusted effects combined in meta-analyses, with subgroup analyses for:
 - Overall house type (traditional versus modern housing)
 - Main roof, wall and floor materials
 - Eave type
 - House screening

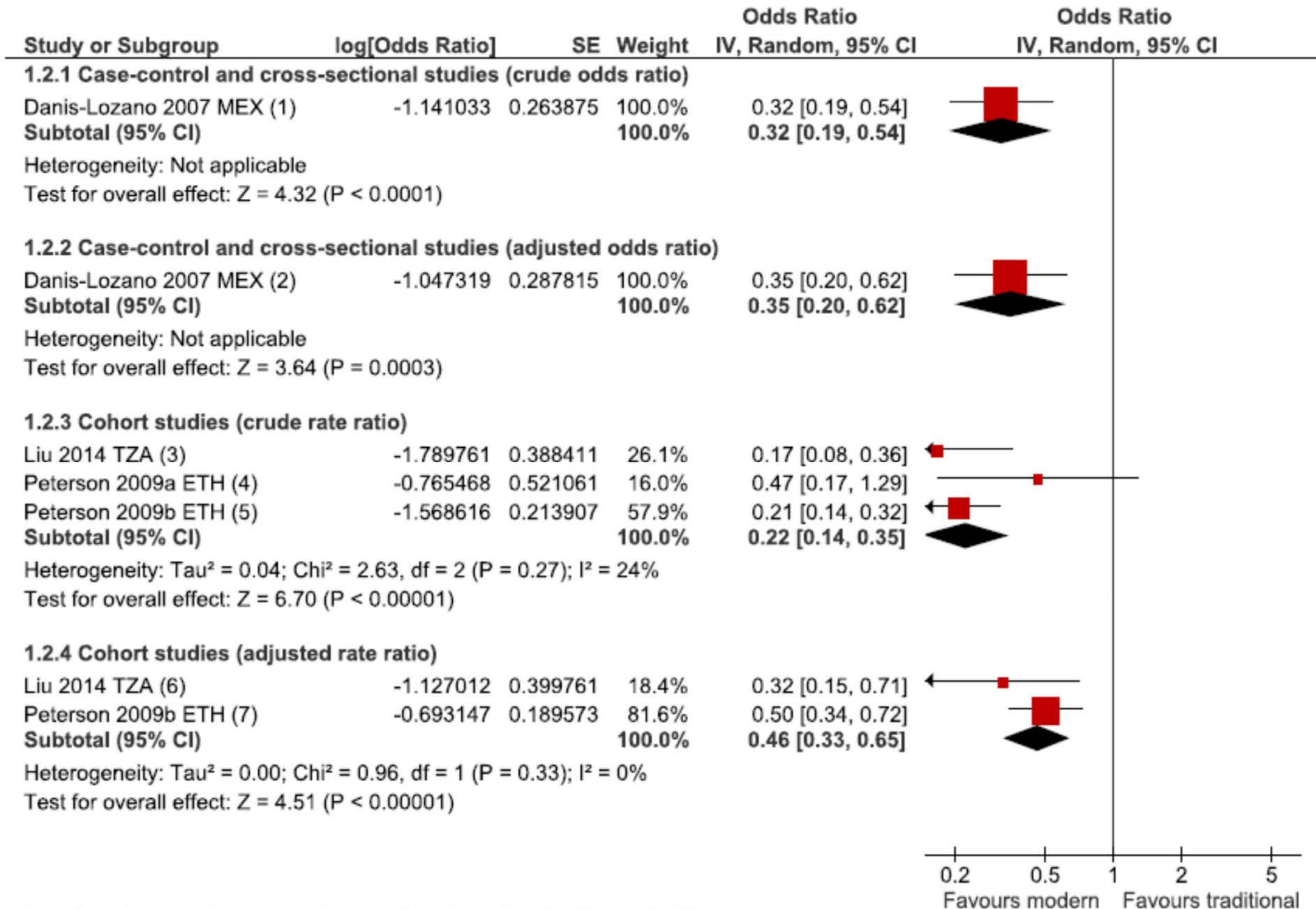
Results

- 15526 studies screened → 90 included in a qualitative synthesis and 52 included in meta-analysis
- Compared to traditional homes, residents of modern homes had:
 - 42% lower odds of malaria infection
 - Adjusted OR 0·58, 95% CI 0·44–0·75, $p < 0·001$
 - 54–65% lower odds of clinical malaria
 - Case-control studies: adj OR 0·35, 95%CI 0·20–0·62, $p < 0·001$
 - Cohort studies: adj RR 0·46, 95%CI 0·33–0·65, $p < 0·001$

Association between modern housing and malaria infection



Association between modern housing and clinical malaria

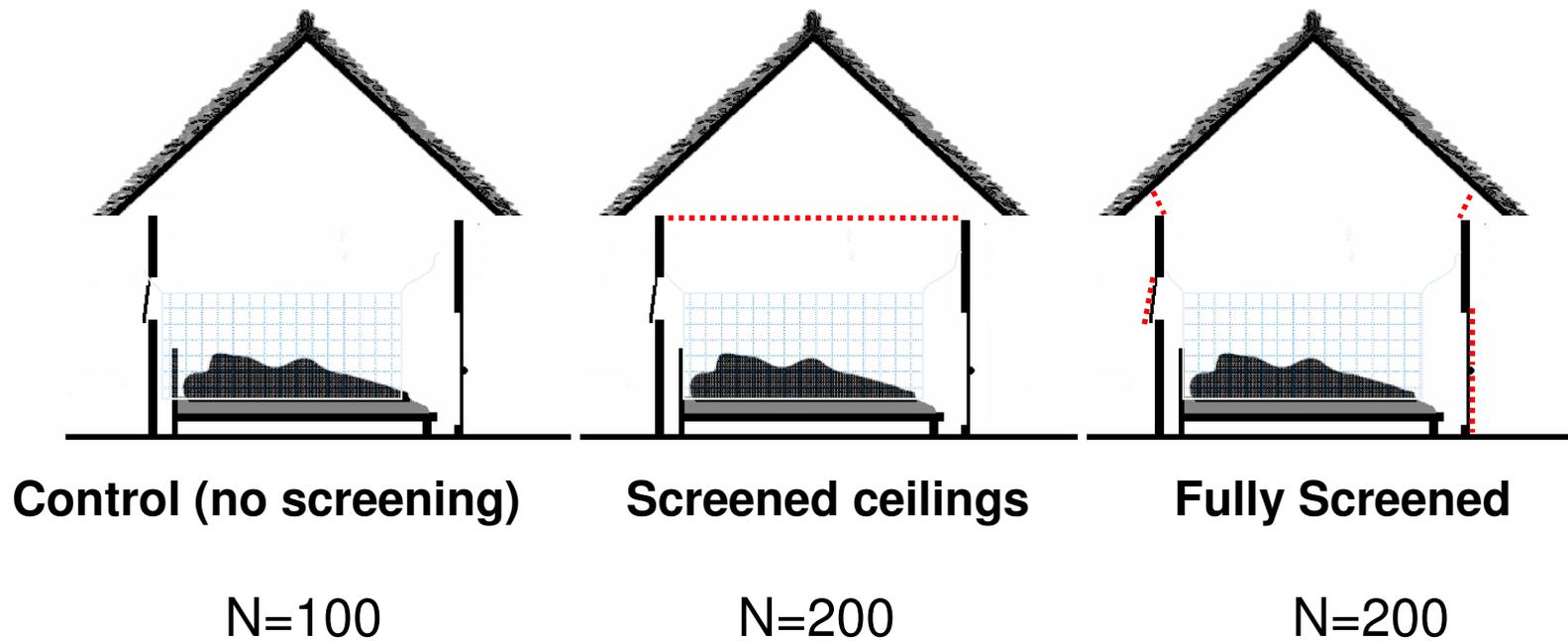


Test for subgroup differences: Chi² = 6.74, df = 3 (P = 0.08), I² = 55.5%

Conclusion

- 'Good' quality housing associated with substantial reduction in clinical malaria and infection;
- We found a high risk of bias within and across studies
- Cannot be entirely confident that there is no residual confounding associated with socio-economic status
- Increase in modern house may contribute to some of the decline in malaria over the past 12 years
- Need to do randomised-controlled trials

Randomised-controlled study in The Gambia



Screening interventions



Ceiling screens



Closed eaves, screened doors & windows

Trial Outcomes

	No screening (n=96)	Screened ceiling (n=178)	% reduction	Full screening (n=188)	% reduction
<i>An. gambiae s.l.</i>	12.4 (9.9-15.3)	6.0 (5.1-7.0)	↓52*	4.6 (3.9-5.4)	↓63*

	OR (95% CI)	p
Anaemia (<8g/dL)		
Control	1.0	
Screened ceiling	0.48 (0.26-0.91)	0.02
Full screening	0.51 (0.28-0.95)	0.03

Kirby et al., 2009 *Lancet*



Can improved housing provide additional protection against clinical malaria over current best practice? A household-randomised controlled study.

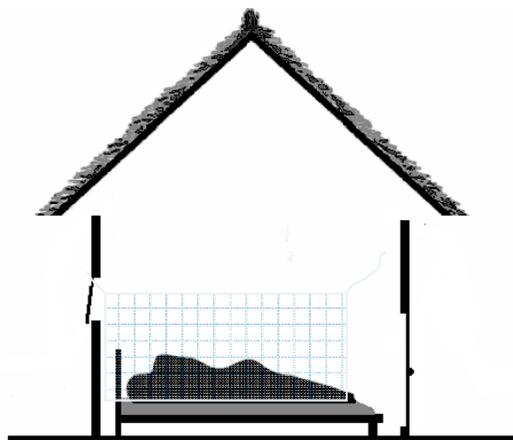
Lindsay SW, Conteh, L, D'Alessandro, U, Kandeh, B, Knudsen, U, Jones, C, Pinder, M, Sicuri, E.

Financed by MRC-DfID-Wellcome Trust Global Health Trials

Study plan

- Randomised controlled trial
- Study on how to scale-up these interventions

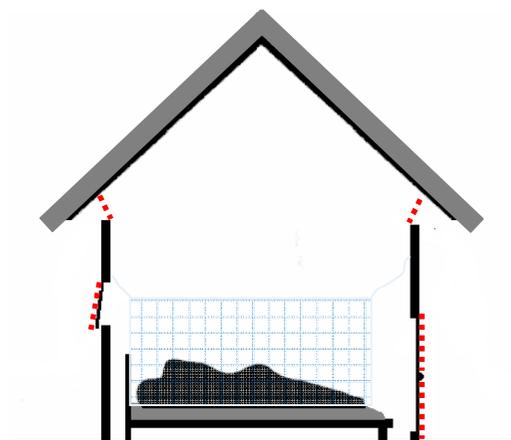
Study interventions



Traditional

Control houses

1. mud walls
2. **thatch roof**
3. **open eaves**
4. At least one child
5. LLIN provided



Modern

Intervention houses

1. mud walls
2. **metal roof**
3. **closed eaves**
4. **untreated screening**
5. at least one child
2. LLIN provided

What the interventions look like:



Square-based houses



Circular-based houses

Study plan

- Comparison between traditional vs modern housing
- Both arms will have LLINs
- Maximum of 5 houses from each arm selected in each village (i.e. 5 traditional & 5 modern houses/village)
- 400 traditional houses vs 400 modern houses
- Followed for two years (2 transmission seasons)
- Main outcomes
 1. incidence of clinical malaria measured using active case detection
 2. number of *Anopheles gambiae* collected indoors using light traps

Additional questions to be addressed

- Are these interventions acceptable and durable?
- Are these interventions cost-effective?
- Can we develop a strategy for potential scale-up of housing interventions?

Summary

- Evidence that housing protects against malaria across the world
- Potentially important measure for malaria control, insecticide-resistance management strategy & for elimination
- Strategic intervention to be a supplementary method of control
- RCT in progress to measure the efficacy of 'good' housing against malaria
- More RCTs needed in other parts of sub-Saharan Africa
- New interventions & pathways to impact need to be developed