



BEDNETS TO PREVENT MALARIA: META-ANALYSIS OF INDIAN TRIALS CONFIRMING RESULTS OF A COCHRANE SYSTEMATIC REVIEW

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INTRODUCTION & OBJECTIVES

New malaria cases in India are estimated at 24 million per year by the World Health Organization, resulting in a high socio-economic burden¹. A Cochrane systematic review, based on randomized controlled trials in non-Indian countries, showed that insecticide treated bednets are highly effective in reducing morbidity from malaria². As part of the development of evidence-

based Indian first aid and prevention guidelines, a cooperation between Belgian Red Cross-Flanders and the Indian Red Cross Society, we aimed to investigate the effectiveness of both insecticide-treated and untreated bednets on malaria in Indian families.

METHODS

- A systematic literature review was performed in Medline, Embase and Central.
- An Indian search filter was developed (including all Indian States) to search for Indian studies.
- Inclusion and exclusion criteria:
 - Population: studies done in India with lay people, community health workers.
 - Intervention: studies on the effectiveness of (un)treated bednets. The minimum target impregnation dose of the treated bed nets was 200 mg/m² permethrin or etofenprox, 30 mg/m² cyfluthrin, 20 mg/m² alphacypermethrin or 10 mg/m² deltamethrin/lambdacyhalothrin.
 - Comparison: no bednets.
 - Malaria outcomes: parasite prevalence (=number of malaria cases (positive blood slide for any parasite) divided by the population under surveillance) was assessed after a door-to-door fortnightly surveillance was car-

ried out and blood smears of all fever cases were collected (finger prick method, Figure 1).

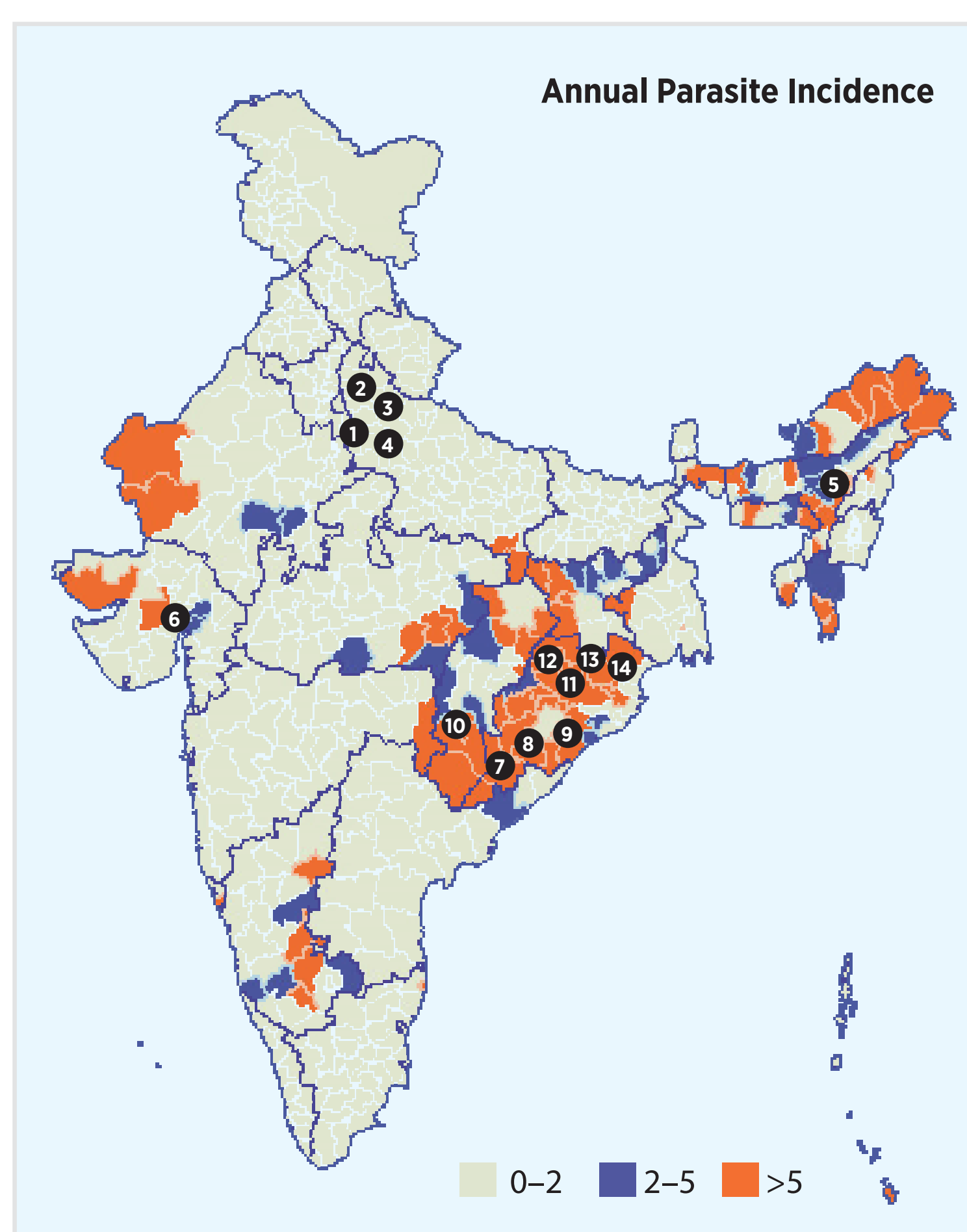
- Design: observational or experimental studies.
- Language/time window: no restriction.
- The overall effect of using (un)treated bed nets compared to no bednets on malaria (parasite prevalence) was investigated by grouping all studies in a meta-analysis (random-effects model) and calculating the pooled risk ratios (RR).



Figure 1. Active malaria detection via the finger prick method.

RESULTS

- Box 1 represents the study selection flowchart. Fourteen from the 16 included trials were selected for the meta-analysis (due to availability of data on malaria cases)
- Studies were divided into subgroups according to the Annual Parasite Incidence (API); low endemic area (API<2) versus high endemic area (API≥2) (Figure 2).
- Meta-analysis showed that untreated bednets reduced the risk of malaria by 58% in low endemic areas (pooled RR 0.42 [95% CI; 0.30,0.60]) and by 39% in high endemic areas (pooled RR 0.61 [95% CI; 0.57,0.65]). When using treated bednets, the risk of malaria was further reduced; by 82% (pooled RR 0.18 [95% CI; 0.08,0.42]) and by 65% (pooled R 0.35 [95% CI; 0.26,0.47] in low and high endemic areas, respectively (Box 2).
- The Cochrane Systematic Review (randomized non-Indian trials, 2004) showed that treated bednets had a protective impact on malaria (average RR 0.87 for stable malaria areas compared to no bednet use).



Low endemic area (API<2)

1. Ansari 2002³
2. Sreehari 2007⁴
3. Mittal 2012⁵
4. Ansari 2003⁶

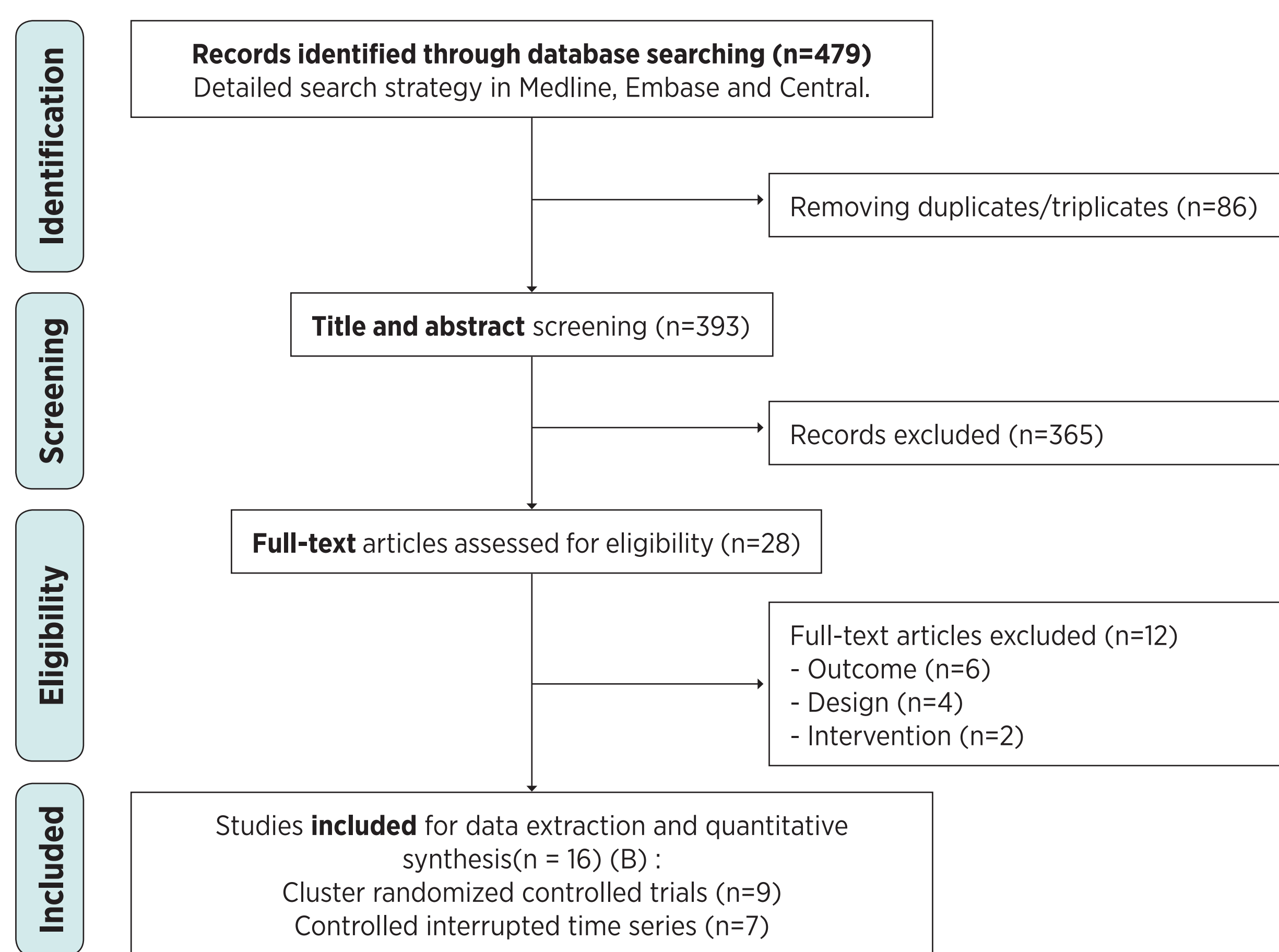
High endemic area (API≥2)

5. Dev 2011⁷
6. Bhatia 2004⁸
7. Das 1993⁹
8. Sahu 2003¹⁰
9. Sahu 2008¹¹
10. Bhatt 2012¹²
11. Sharma 2006¹³
12. Sharma 2009¹⁴
13. Yadav 1998¹⁵
14. Yadav 2001¹⁶

Figure 2. Classification of the included studies into low endemic versus high endemic area, based on the Annual Parasite Incidence.

Box 1: Study selection flowchart for preventive bednet intervention for malaria, identified in Indian studies

(B: level of evidence moderate according to GRADE)



Box 2: Meta-analysis with calculation of the pooled effect of treated bed nets on parasite prevalence

Study or Subgroup	Treated bed nets		No bed nets		Weight	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI	
	Events	Total	Events	Total				
2.2.1 low endemic area								
Ansari 2003	2	802	9	510	2.6%	0.14 [0.03, 0.65]		
Ansari 2002	3	1350	11	1410	3.3%	0.28 [0.08, 1.02]		
Sreehari 2007	3	2000	67	2000	3.8%	0.04 [0.01, 0.14]		
Mittal 2012	6	1381	18	1337	4.9%	0.32 [0.13, 0.81]		
Subtotal (95% CI)		5533		5257	14.6%	0.16 [0.06, 0.44]		
Total events	14		105					
Heterogeneity: Tau ² = 0.69, Chi ² = 8.67, df = 3 (P = 0.03), I ² = 65%								
Test for overall effect: Z = 3.55 (P = 0.0004)								
2.2.2 high endemic area								
Dev 2011	4	2100	76	2078	4.5%	0.05 [0.02, 0.14]		
Sharma 2009	16	1953	50	1853	7.3%	0.31 [0.17, 0.53]		
Sharma 2006	36	506	49	367	8.4%	0.53 [0.35, 0.80]		
Sahu 2003	29	489	82	501	8.4%	0.36 [0.24, 0.54]		
Sahu 2008	27	497	156	590	8.5%	0.21 [0.14, 0.30]		
Das 1993	36	368	166	797	8.9%	0.47 [0.33, 0.66]		
Bhatt 2012	87	5316	171	3865	9.4%	0.37 [0.29, 0.48]		
Yadav 1998	191	1134	438	626	9.9%	0.24 [0.21, 0.28]		
Yadav 2001	339	1062	337	786	10.0%	0.74 [0.66, 0.84]		
Bhatia 2004	1226	30634	2556	30647	10.1%	0.48 [0.45, 0.51]		
Subtotal (95% CI)		44059		42120	85.4%	0.35 [0.26, 0.47]		
Total events	1991		4081					
Heterogeneity: Tau ² = 0.19, Chi ² = 189.41, df = 9 (P < 0.00001), I ² = 95%								
Test for overall effect: Z = 6.90 (P < 0.00001)								
Total (95% CI)								
		49592		47377	100.0%	0.31 [0.24, 0.42]		
Total events	2005		4186					
Heterogeneity: Tau ² = 0.20, Chi ² = 209.19, df = 13 (P < 0.00001), I ² = 94%								
Test for overall effect: Z = 8.05 (P < 0.00001)								
Test for subgroup differences: Chi ² = 2.17, df = 1 (P = 0.14), I ² = 53.8%								

CONCLUSIONS

- There is evidence from 16 experimental Indian studies that using (insecticide treated) bednets is an effective intervention to prevent malaria, which is in line with the findings of the Cochrane systematic review, performed outside India.

- The present findings support the current bednet use in the National Vector Borne Disease Control Programme in India¹⁷ and will be included in the Indian first aid and preventive guidelines.

References: ¹ World Malaria Report 2012 by the World Health Organisation; ² Lengeler C. Cochrane Database of Systematic Reviews 2004; ³ Ansari et al. Indian J Malariol 2002; ⁴ Sreehari et al. J Vector Borne Dis 2007; ⁵ Mittal et al. J Vector Borne Dis 2012; ⁶ Ansari et al. J Vector Borne Dis 2003; ⁷ Dev et al. Acta Trop 2011; ⁸ Bhatia et al. Soc Sci Med 2004; ⁹ Das et al. Southeast Asian J Trop Med Public Health 1993; ¹⁰ Sahu et al. Acta Trop 2003; ¹¹ Sahu et al. Indian J Med Res 2008; ¹² Bhatt et al. Malar J 2012; ¹³ Sharma et al. J Am Mosq Control Assoc 2006; ¹⁴ Sharma et al. Acta Trop 2009; ¹⁵ Yadav et al. J Am Mosq Control Assoc 1998; ¹⁶ Yadav et al. J Med Entomol 2001; ¹⁷ <http://www.nhp.gov.in>.

Budget and funding: The development of evidence-based Indian first aid and prevention guidelines was financed by Belgian Red Cross-Flanders with co-funding from the Belgian Directorate-General for Development Cooperation (DGD).