Permethrin-treated baby wraps for the prevention of malaria



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Declarations

- **Grant Support**
  - Doris Duke Foundation*
  - National Institutes of Health
  - Centers for Disease Control and Prevention
- **Conflicts of Interest**
  - No relevant





Agenda

- Background
- Trial Design
- Results
- Future Directions



The Concept

Baby Wraps

- Widespread across Africa
- Used from ~2 months of age
- Used until ~ 2 years of age
- Also serves as blanket or swaddle



Hypothesis

Treatment of wraps used to carry children with permethrin will provide an additional layer of protection against malaria, especially when the child is outside the home (i.e., not under a net)

Advantages

- Protects against outdoor biting
- Aligns with cultural practices
- Existing market demand
- Targets key age group (6-24 mo)
- Reduced skin absorption
- Complements existing interventions (i.e., nets)



Trial Design

- **Randomized**
  - Randomized 1:1 using REDCap
  - Stratified by age category at enrollment (6-11 vs. 12-18 months) and site
  - Block design

- **Placebo-controlled**
  - All wraps purchased from local vendors
  - No differences in materials or patterns by arm
  - Treatment and re-treatment by soaking in water

- **Blinded**
  - Clinicians and laboratory technicians were not aware of randomization

Boyce et al., *PLOS One,* 2023

Eligibility

- Adult (age ≥18) with *singleton* child between 6-18 months of age
- Current resident of Bugoye, Maliba, or Mubuku sub-counties
- Known HIV or sickle-cell disease
  - Malaria prophylaxis recommended in these population
- Known allergies to pyrethroids

Boyce et al., *PLOS One,* 2023



Intervention

- 2 x 1 m cotton cloth (2)
- Initial treatment prior to randomization
- Re-treatment or sham treatment every 4 weeks
- New net (pyrethroid only)

Outcome Measures

- **Primary Outcome**
  - Clinical malaria defined as:
    - Temperature ≥38° Celsius or history of fever in past 24 hours
      AND
    - Positive malaria rapid diagnostic test (RDT)

  - Clinical malaria cases censored from analysis for 28-days

- **Secondary Outcomes**
  - Malaria-related hospitalizations
  - Change in hemoglobin levels
  - Prevalence of asymptomatic parasitemia
  - Clinical malaria in mother
  - Change maternal hemoglobin level

- **Safety Measures**
  - Adverse event
  - Change growth measures

Boyce et al., *PLOS One,* 2023

Results

Participation

- 400 of 419 mother-infant pairs
  - 4 sets of twins
  - 2 with known sickle cell
  - 13 HIV positive
- Attended 5,194 of 5,200 visits
- No loss to follow up
- LLIN use reported 99% of nights



Primary Outcome

	Sham-treated wrap (n=200)	Permethrin-treated wrap (n=200)	IRD[a] (95% CI)	IRR[a] (95% CI)
Clinical malaria episodes	94 (73.4%)	34 (26.6%)	-	-
Time at risk (person-weeks)	4,395	4,641	-	-

Boyce et al., *NEJM,* 2025

Primary Outcome

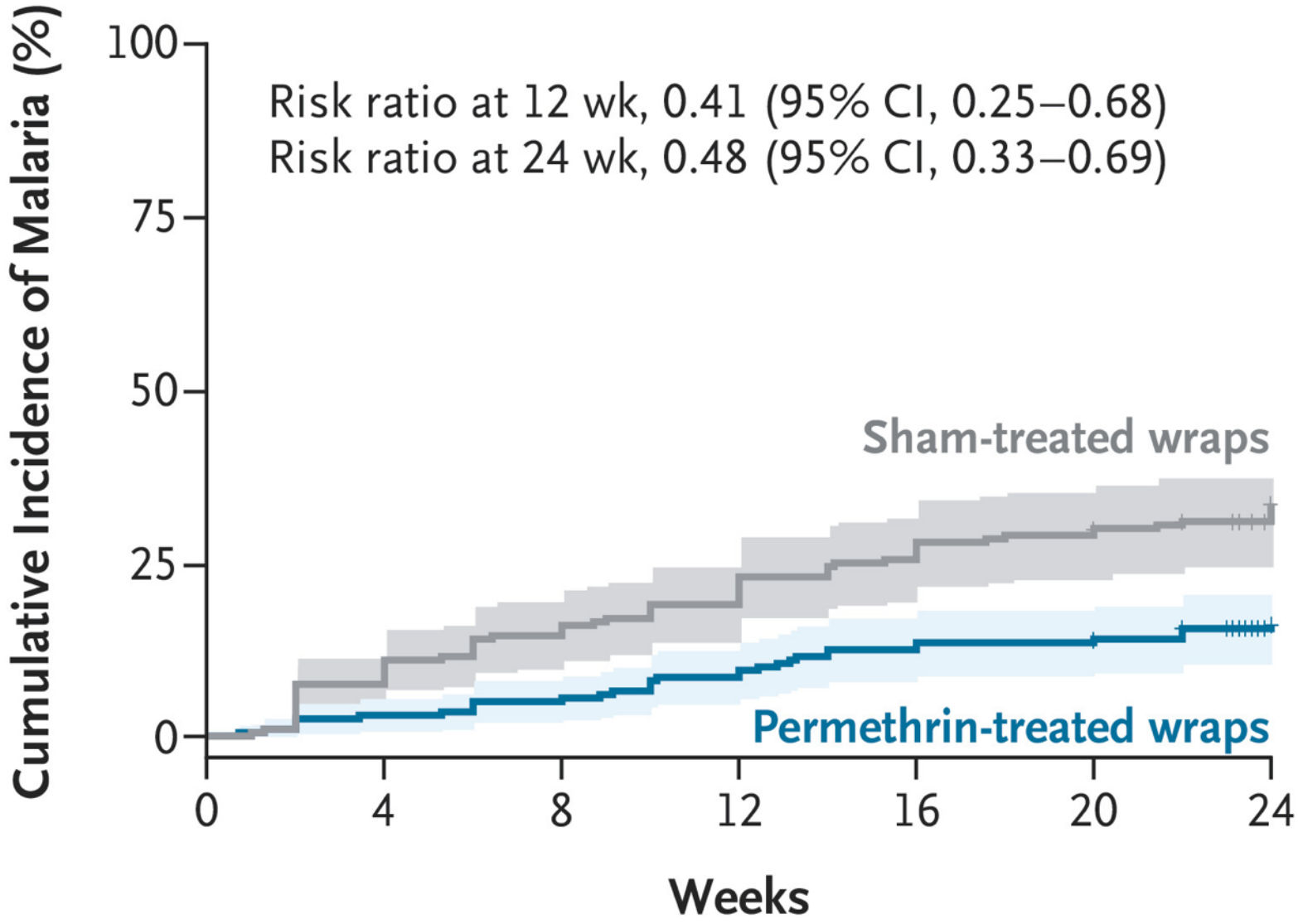
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Clinical malaria incidence (per 100 person-weeks)	2.14 (1.73, 2.62)	0.73 (0.51, 1.02)	-1.41 (-2.03, -0.83)	0.34 (0.23, 0.51)[b]

Boyce et al., *NEJM,* 2025

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Age 6-11 months	2.07 (1.52, 2.76)	0.66 (0.37, 1.09)	-1.42 (-2.22, -0.70)	0.32 (0.18, 0.57)
Age 12-18 months	2.21 (1.62, 2.94)	0.80 (0.48, 1.26)	-1.41 (-2.39, -0.51)	0.36 (0.21, 0.62)

Boyce et al., *NEJM,* 2025



No. at Risk (no. of events)

Sham-treated wraps	200 (0)	185 (22)	171 (32)	162 (46)	149 (56)	142 (60)	132 (67)
Permethrin-treated wraps	200 (0)	194 (6)	190 (11)	183 (19)	175 (27)	173 (28)	153 (32)

Secondary Outcomes

- **Fewer malaria-related hospitalizations**
  - 17 (8.5%) vs 7 (3.5%), PD 5.0% (95% CI -10.3 to -0.2)

- No differences in:
  - Change in hemoglobin levels
  - Change in growth measures (MUAC, Z-scores for weight-for-age, etc.)

- AEs were infrequent, mild, and balanced between trial arms

Boyce et al., *NEJM,* 2025

Key Findings

- **Permethrin-treated wraps effectively reduced the incidence of clinical malaria among young children in western Uganda**

- Effects were observed even with provision of new LLIN and high (reported) use
  - *Suggests dawn/dusk and outdoor biting plays substantial role in transmission*

- Effects were observed in a region with >90% prevalence of pyrethroid resistance
  - *Suggests permethrin maintain repellency effect even when no longer insecticidal*

- Permethrin-treated wraps were safe for at least for 6 months of use



Important Questions

- What is the mechanism?
- Are wraps safe for the anticipated period of use?
- Do treated wraps complement new interventions?
- Different permethrin application strategies?

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Questions?

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