

# #1525: Contributions of Women with Children and Youth Workers to Spatial Malaria Transmission: A Survey of Movement Patterns in four Sub-Saharan African Countries

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## BACKGROUND & SURVEY PROTOCOL

As malaria prevalence declines in many parts of the world due to wide-scale control efforts, a quantitative understanding of human movement is becoming increasingly relevant to progressing towards elimination. However, despite its importance, significant gaps remain in our understanding of human movement, particularly in sub-Saharan Africa.

We conducted a survey of human movement patterns in four sub-Saharan African countries – Mali, Burkina Faso, Zambia and Tanzania (Figure 1). Questions were asked about demographic and trip details, malaria risk behaviours, children accompanying travellers, and mobile phone usage to enable cell phone signal data to be better-correlated with movement.

A total of 4,352 individuals were interviewed and 6,411 trips recorded.

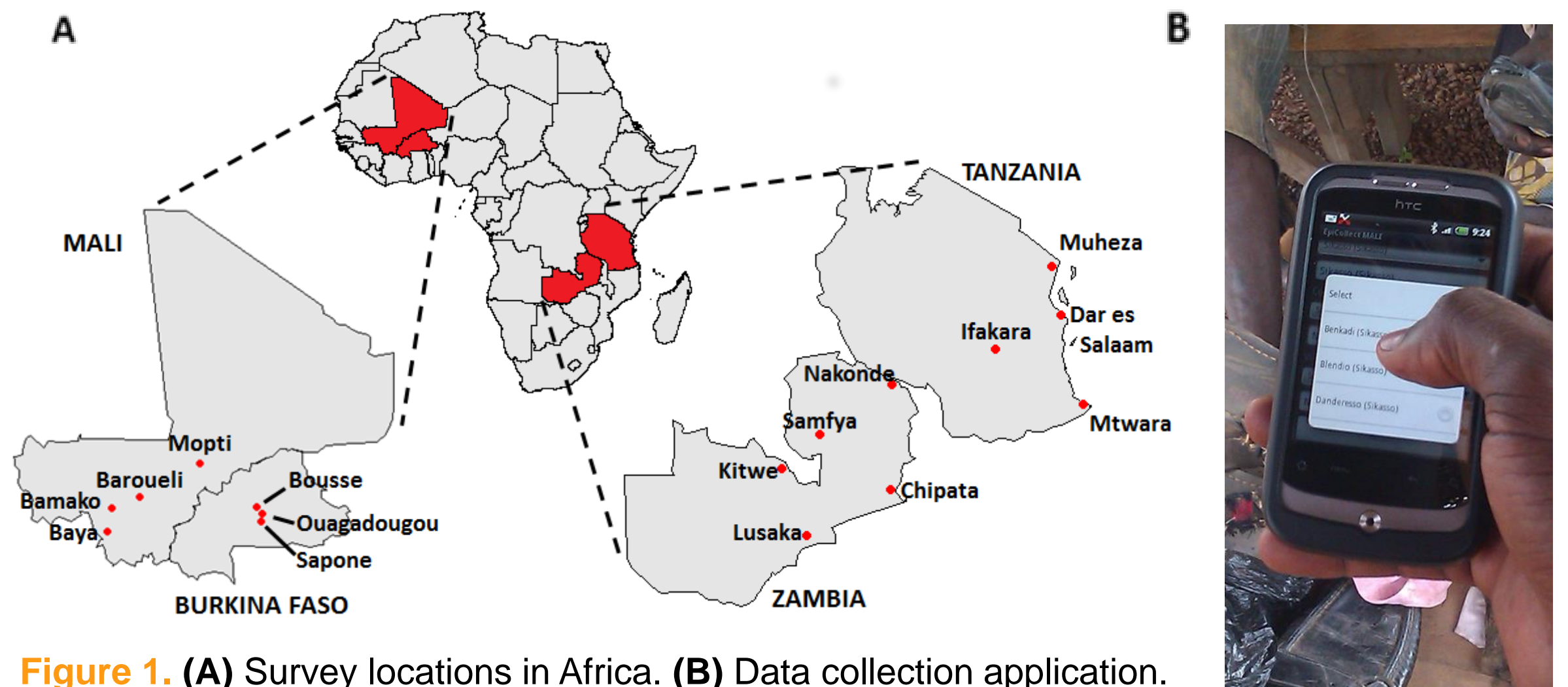


Figure 1. (A) Survey locations in Africa. (B) Data collection application.

## CLUSTER ANALYSIS & TRAVELER GROUPS

A cluster analysis was performed using demographic and trip properties as input variables. This highlighted two distinct traveler groups of relevance to malaria transmission – women traveling with children (in all four countries) and youth workers (in Mali) (Figure 2).

### Women traveling with children:

- Women, 16-45 years old who traveled with children, usually for family-related reasons.
- More likely to travel to areas of relatively high malaria prevalence in Mali (OR=4.46, 95% CI=3.42-5.83), Burkina Faso (OR=1.58, 95% CI=1.23-1.58), Zambia (OR=1.50, 95% CI=1.20-1.89) and Tanzania (OR=2.28, 95% CI=1.71-3.05) compared to other travelers.
- More likely to own bed nets in Burkina Faso (OR=1.77, 95% CI=1.25-2.53) and Zambia (OR=1.74, 95% CI=1.34-2.27).
- Less likely to own a cell phone in Mali (OR=0.50, 95% CI=0.39-0.65), Burkina Faso (OR=0.39, 95% CI=0.30-0.52) and Zambia (OR=0.60, 95% CI=0.47-0.76).

### Youth workers:

- Malian youths, 16-29 years who travel mostly for work.
- More likely to travel to areas of relatively high malaria prevalence (OR=23, 95% CI=17-31).
- Travel for longer durations (mean of 70 days c.f. 21 days for other travelers,  $p < 0.001$ ).

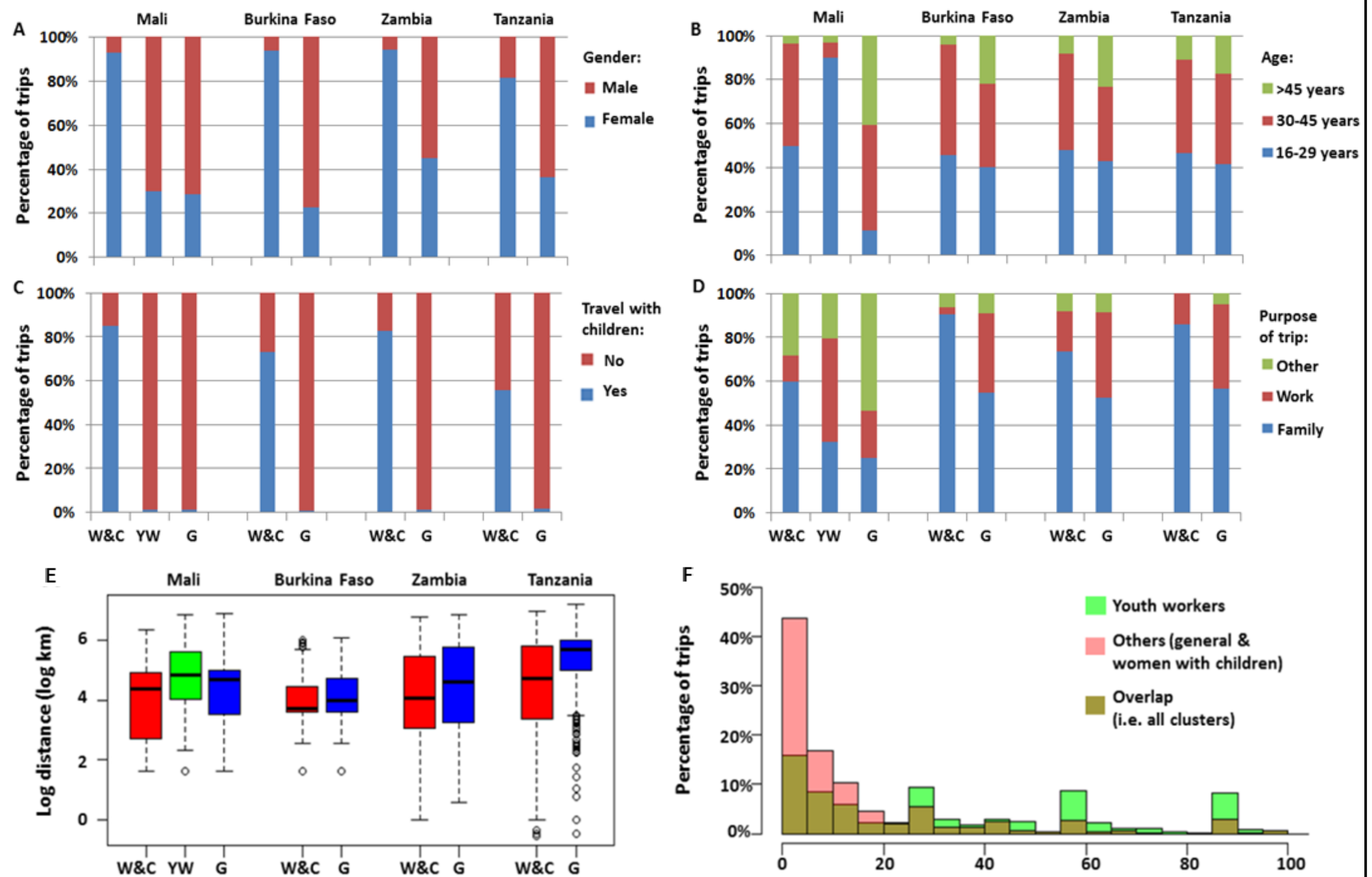


Figure 2. Characteristics of traveler groups. (A-D) Bar plots representing percentages of demographic and trip variables (gender, age, purpose, etc.) by country and traveler group (W&C = women traveling with children, YW = youth workers, G = general cluster). (E) Box plot of log trip distances by country and traveler group. (F) Histogram of trip durations for youth workers and others (general and women traveling with children) for Mali.

## HUMAN MOVEMENT PATTERNS

To generalize the movement patterns to a national level, we fitted gravity and radiation models (Figure 3) to the set of origin-destination pairs for each country and traveler group. In all cases, gravity models provided the best fit to the data.

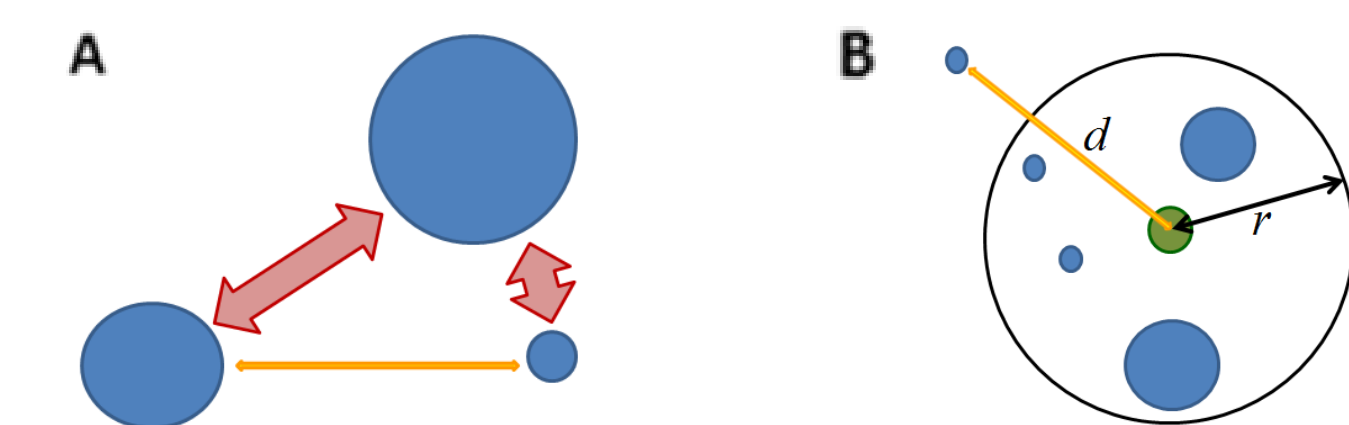


Figure 3. (A) In a gravity model, travel frequency increases with population size and decreases with distance. (B) In a radiation model, travel frequency beyond a distance  $r$  is inversely proportional to population size within radius  $r$ .

## SPATIAL MALARIA TRANSMISSION

To estimate rates of spatial malaria transmission, we combined the fitted movement models with a simple model of malaria transmission and estimates of parasite prevalence at the ward or commune level.

Figure 4 shows the estimated malaria exportation for each country. In Mali, exportation is strongest in the south of the country where malaria prevalence is highest. In Burkina Faso, exportation is widespread; however peaks are seen around the population centres of Ouagadougou and Bobo-Dioulasso. In Zambia, exportation is strongest in the north and east, and in Tanzania, in the south-east and west, where parasite prevalence is highest.

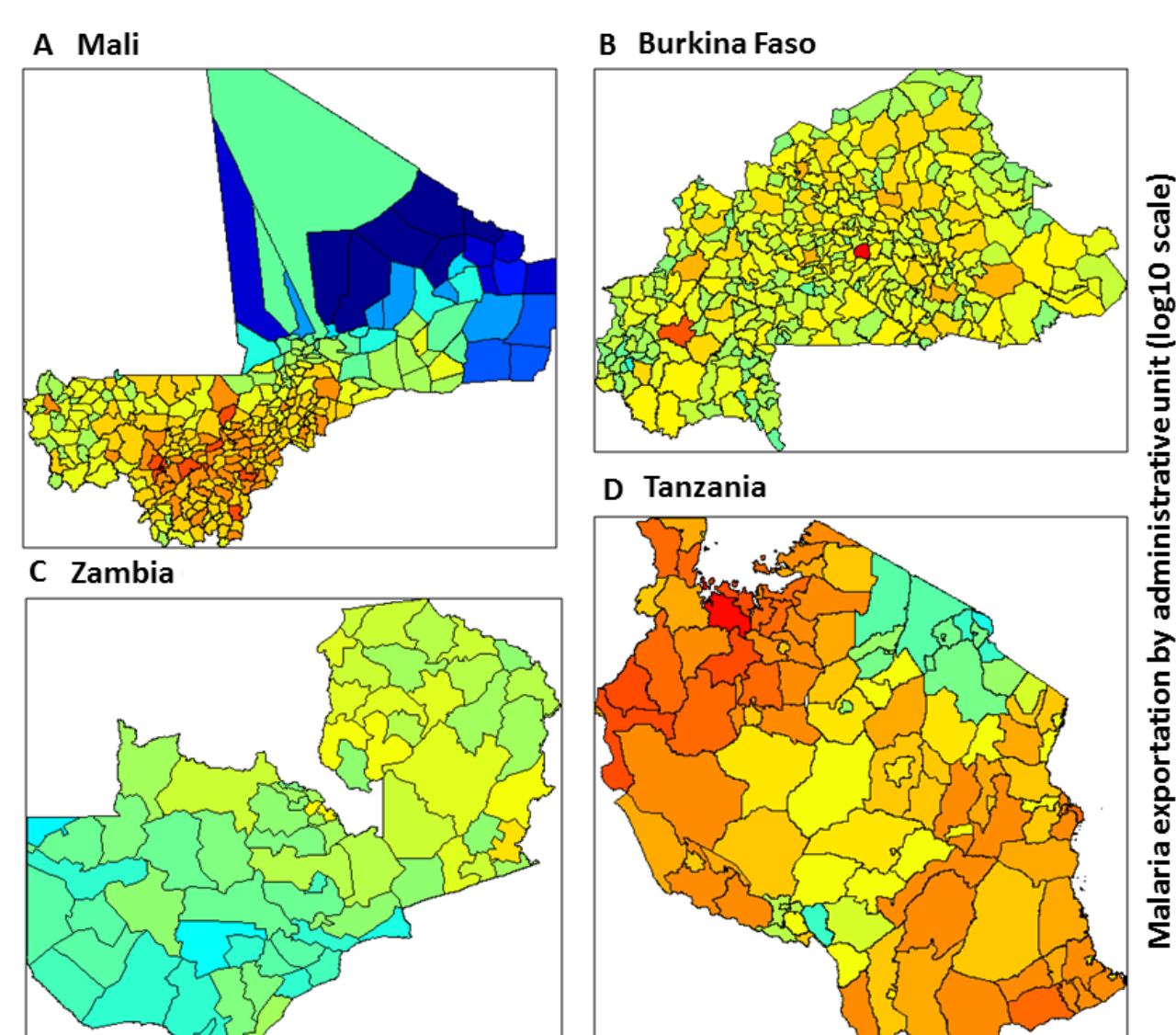


Figure 4. Estimated malaria exportation rates for administrative units within each survey country.

## TRAVELER GROUPS & SPATIAL MALARIA TRANSMISSION

The total contribution of each traveler group to spatial malaria transmission was estimated by summing the flow of infection over all origins and destinations for each cluster. Women with children were estimated to make the largest contribution to spatial malaria transmission in Mali, Burkina Faso and Zambia, closely followed by youth workers in Mali (Figure 5).

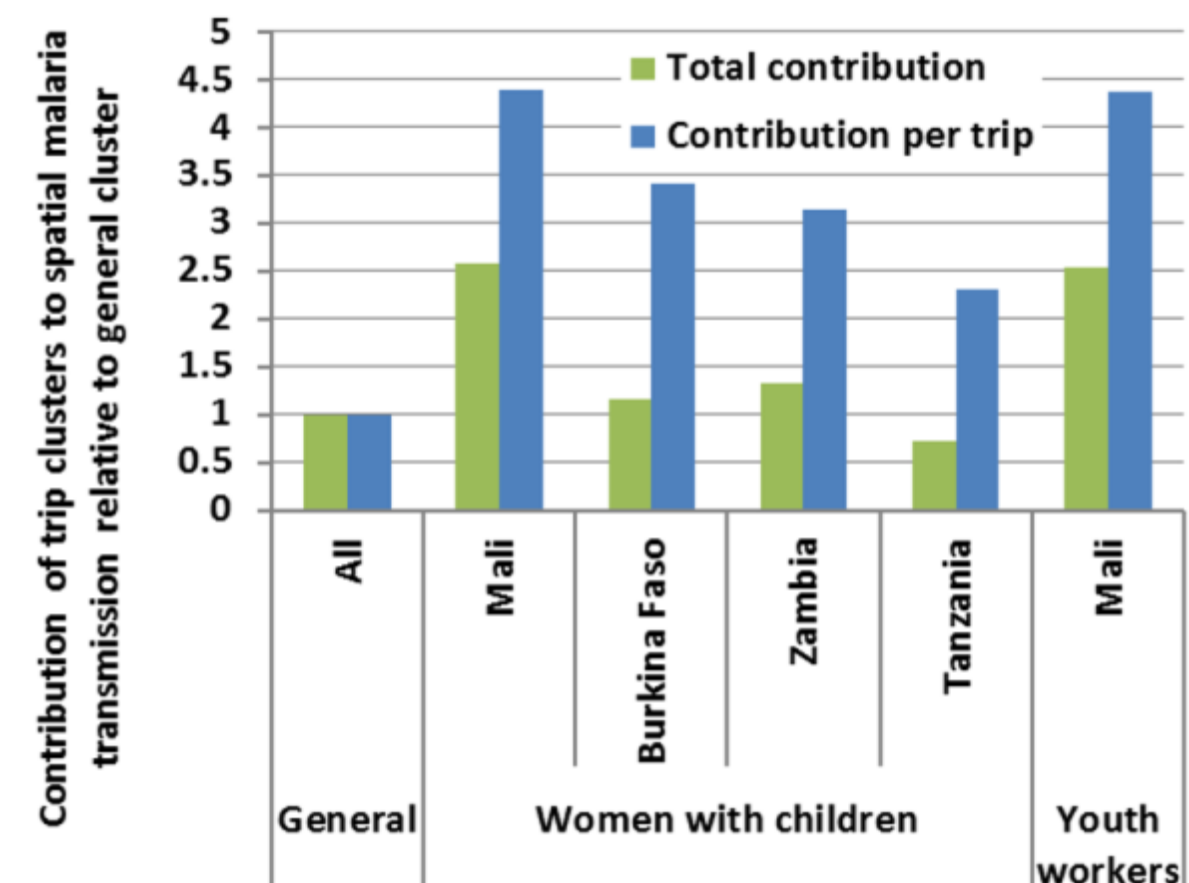


Figure 5. Contribution of traveler groups – women with children, and youth workers – to spatial malaria transmission relative to the general cluster in each survey country.

## REFERENCE

Marshall JM *et al.* (under review) Contributions of women with children and youth workers to spatial malaria transmission.