Examination of travel histories as risk factors for malaria in Adami Tulu woreda, Ethiopia

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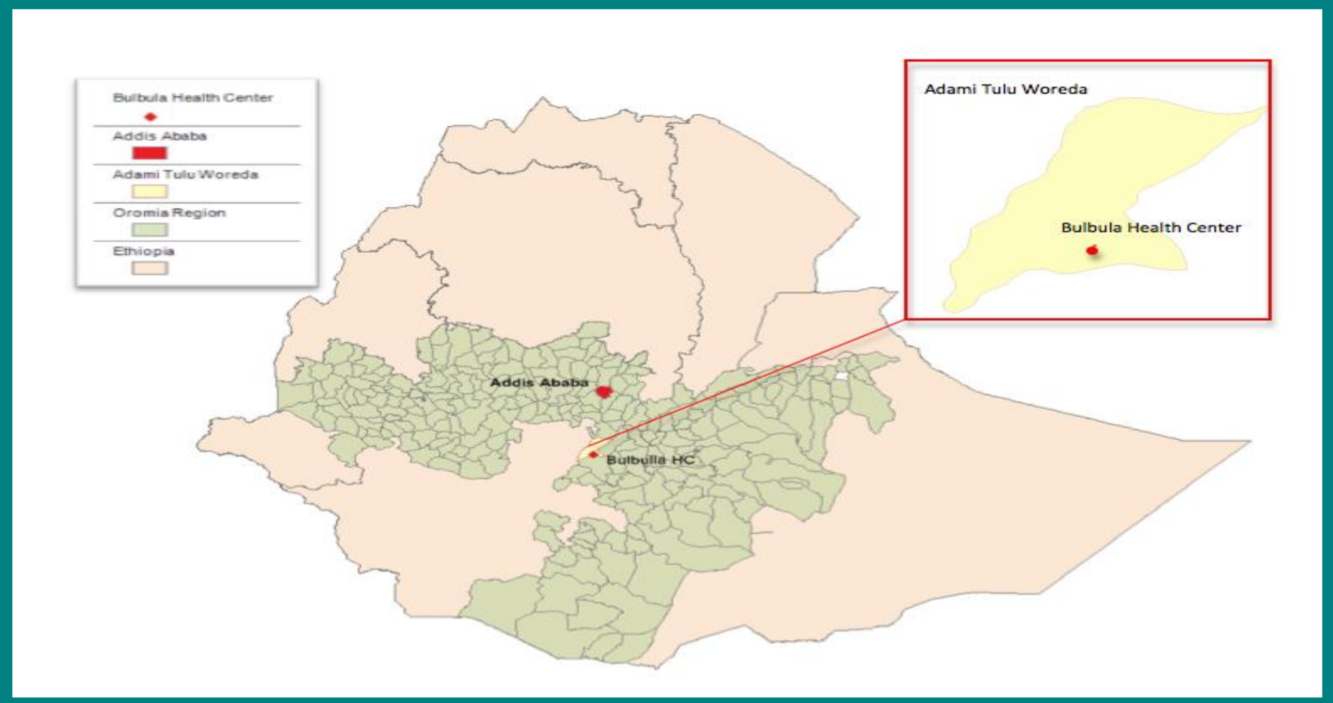
Background

- Malaria transmission in much of Ethiopia is unstable and seasonal with most of the country having low prevalence and incidence.
- In low transmission or malaria free areas with limited vectorial capacity, it is likely that imported cases of malaria may lead to reintroduction of malaria or contribute largely to the overall clinical burden.
- Additionally as malaria is highly heterogeneously distributed, there maybe specific areas within an overall geographic area with significantly higher transmission than others.
- Currently, there is little known about the small scale clustering of malaria cases or local travel patterns within Ethiopia as well as the significance of travel as risk factors for malaria within the country.
- In order to inform the planning of interventions and understand the role of travel in malaria transmission a pilot case control study was conducted based form the Bulbulla Health Center in the Oromia Region of Ethiopia.

Methods

- A facility-based unmatched case-control study was conducted between June 22, 2011-October 14, 2011 at Bulbula Health Center in Adami Tulu Woreda (Figure 1).
- Cases were defined as any person who is a resident of Adami Tulu woreda, over the age of 18, with a positive thick blood smear or RDT (regardless of parasite species), diagnosed between June 22 and October 14, 2011
- Controls included patients who are residents of Adami Tulu woreda, over the age of 18, whose thick blood smear tests results were negative for malaria.
- A questionnaire including place of residence, employment, household assets, use of protective measures, and the places traveled outside of their village (including any overnight stay) within the preceding one month before disease onset was administered to consenting patients while they awaited results of their malaria tests.
- The names and locations of the villages where the patient slept outside of their village of residence were recorded.
- Analysis of data was conducted in STATA v11.2 (StataCorp, College Station, TX) and used χ^2 tests for categorical predictors in bi-variate analysis. Multi-variate logistic regression was used to adjusted for potential confounding.

Figure 1



Results

- In total, 141 cases and 419 controls (560 total) were recruited (Table 1).

Table 1

Cases and Controls	Frequency	Percent
Positive Malaria	**141**	**25.1**
• *P.f.*	*84*	*59.6*
• *P.v*	*56*	*39.7*
• *Mixed*	*1*	*0.7*
Negative Malaria	**419**	**74.7**
Total	**560**	**100**

* Percent P.f. and P.v and mixed cases calculated out of total cases

Sample Description (Table 2)

- Patients were predominately female (54.7%). The age of patients ranged from 18-80 with 49% of patients in the study between the ages of 18-25.
- The most frequent occupation among study participants was agricultural work (80%), followed by students (9%) and housewives (5%) .
- Eighty seven percent of study participants own animals nearly all of these participants (82%) owned cows, oxen, or bulls.
- Reported housing characteristics were primarily composed of thatch/leaf roofing (51%) or corrugated iron (47%). The most common wall material included covered adobe (45%) as well as bamboo/wood (33%).
- A wealth index was created based on radio ownership, electricity, and roofing type.

Travel

- Approximately one-third of all patients reported spending a night away from their home village in the past month.
- The mean travel period for all patients who travelled was 5.2 days; though, longer travel periods (11-15 days) were more common among *P.v.* cases (28.6%) than *P.f.* cases (2.8%) (*p*=0.003).
- Men in the study population were 1.7 times (CI 95%=1.19-2.43, *p*=0.003) more likely to travel than women and were 1.9 times more likely to have a positive malaria diagnosis than women (CI 95%=1.33-2.9, p=0.001).

Bed Net Usage

- Of the total study population only 20% reported sleeping under a bed net the previous night.
- Of people that reported traveling and spending the night outside of their village, only 5% reported using a bed net during their travel.

Table 2

	P.f.	P.v.	Cases	Controls	Total
	n=85 (%)	n= 57 (%)	n=141 (%)	n= 419 (%)	n=560 (%)
Male	46 (54.1)*	35 (61.4)**	81 (57.5)**	169 (40.6)**	250 (44.6)**
Age					
• 18-20	26 (31.7)	24 (42.8)**	50 (36.5)*	116 (28.3)*	166 (30.4)*
• 21-25	17 (20.7)	12 (21.4)	29 (21.2)	80 (19.6)	109 (20.0)
• 26-32	16 (19.5)	11 (19.6)	27 (19.7)*	113 (27.6)*	140 (25.6)*
• 32+	23 (28.1)	9 (16.1)	31 (22.6)	100 (24.5)	131 (23.9)
Traveled overnight	36 (42.4)	21 (36.8)	57 (40.4)*	136 (32.5)*	193 (34.4)*
Slept-under bed net previous night	15 (17.7)	12 (21.1)	27 (19.2)	84 (20.1)	111 (19.8)
Electricity	15 (17.8)	17 (29.8)	32 (22.8)	95 (22.8)	127 (22.8)
Corrugated Iron Roof	31 (36.5)	30 (52.6)	61 (43.2)	205 (48.5)	266 (47.5)
Radio Ownership	29 (34.5)*	21 (37.5)	50 (35.9)**	190 (45.8)**	240 (43.3)**

*Indicates significance p<0.10 ** Indicates significance p<0.05 (Tests are Chi-2 tests between cases and controls for each category (*P.f.*, *P.v.* or all malaria cases)

Table 3

	P.f. infection		*P.v.* infection		All malaria infections	
	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
traveled overnight in the past 30 days	1.6 (0.96-2.57)	0.07	1.10 (0.61-2.00)	0.74	1.47 (0.97-2.22)	0.07
Wealth (Quartile)						
Most Poor (1)	--	--	--	--	--	--
2	0.71 (0.40-1.26)	0.25	0.94 (0.47-1.87)	0.85	0.78 (0.48-1.26)	0.31
3	0.58 (0.27-1.25)	0.17	0.63 (0.24-1.69)	0.363	0.57 (0.29-1.08)	0.09
Least Poor (4)	0.48 (0.21-1.06)	0.07	0.99 (0.43-2.28)	0.98	0.63 (0.33-1.17)	0.14
Age 18-20	--	--	--	--	--	--
Age 21-25	0.98 (0.50-1.94)	0.97	0.65 (0.30-1.42)	0.28	0.79 (0.44-1.37)	0.40
Age 26-32	0.69 (0.35-1.38)	0.30	0.46 (0.21-1.01)	0.05	0.53 (0.30-0.92)	0.02
Age 32+	1.03 (0.54-1.94)	0.92	0.41 (0.18-0.93)	0.03	0.64 (0.37-1.09)	0.10
Sex – Female	--	--	--	--	--	--
Male	1.46 (0.89-2.38)	0.13	2.07 (1.15-3.76)	0.02	1.88 (1.23-2.83)	0.002
Slept under a bed net the previous night	0.99 (0.53-1.84)	0.98	1.32 (0.66-2.67)	0.43	1.16 (0.70-1.92)	0.558

Multivariate Analysis (Table 3)

•Logistic regression models were fit with *P.f.*, *P.v*. and all malaria cases as outcome variables to adjust for potential confounding in the analysis of travel as a risk factor for malaria infection in the Oromia region.

•Known potential confounders included sex, age, socioeconomic status, household characteristics, and use of preventative measures.

•As household wealth increased individuals were less likely to have a P.f. diagnosis than controls.

•After adjustment, individuals with a *P.f.* diagnoses were more likely to have traveled in the past 30 days than controls (OR 1.6 *p*=0.07).

•Travel was not a significant risk factor for *P.v.* infection

•Use of a bednet was extremely low and did not appear protective.

Conclusions

- Travel overnight was not strongly associated with malaria infection our study population. However, the directionality of association and the marginal significance suggests that it may play a role in malaria transmission and may be important in other areas of Ethiopia.
- Men were significantly more likely to travel than women. Being male was also a significant risk factor for malaria infection. Indicating that the relationship between travel and infection may be confounded by gender.

Limitations and next steps

- Travel timing may be important to understanding the relationship between travel and infection as very recent travel (less than 10 days is unlikely to have led to the current symptomatic infection).
- Geographic clustering may also confound the association of malaria with travel as travel to non-endemic areas will not lead to an increase in risk.
- Gender may be a potential confounder of malaria risk and travel history.
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