Temperature shapes human malaria transmission through effects on mosquito survival and Plasmodium development.

For malaria transmission to occur, a mosquito must survive long enough for *Plasmodium falciparum* to complete its extrinsic incubation period (EIP). Temperature strongly influences both mosquito survival and parasite development, yet how these two processes interact remains poorly understood. This gap limits our ability to predict transmission under changing climatic conditions.

Here, we studied how temperature shapes malaria transmission through its combined effects on mosquito survival and parasite EIP in two major African vectors: *Anopheles gambiae* and *An. coluzzii*. We infected mosquitoes with *P. falciparum*, and kept them at either 21°C or 27°C under constant (±0°C) or fluctuating (±6 °C) temperature regimes. We analysed a total of 7883 mosquitoes across 10 experimental replicates. Mosquito survival was monitored daily for 30 days, and EIP was determined via daily dissections. We estimated the proportion of infectious mosquitoes in the population under each condition by estimating survival to EIP (i.e. proportion of mosquitoes that become infectious) and beyond that point (i.e. for how long they remain alive thereafter).

We found that exposure to *Plasmodium falciparum* affected mosquito survival, and that this effect depended on the environmental temperature and mosquito species. At 21°C, exposure increased late-life mortality in *An. coluzzii*, while its effects on *An. gambiae* were earlier and more complex. At 27°C, exposure increased mid-life mortality in *An. coluzzii*, while no effect was observed on *An. gambiae*. Temperature affected parasite development: EIP was longer at 21°C, although fluctuating conditions mildly relaxed this effect ($p_{mean} = 0.001$, $p_{range} = 0.060$, $p_{mean \times range} = 0.029$). Mosquito species did not affect EIP ($p_{species} = 0.186$). Altogether, the proportion of mosquitoes old enough to be infectious was similar for both species at 27°C ($p_{species|27\pm0°C} = 0.054$, $p_{species|27\pm6°C} = 0.051$), but not at 21°C, where more *An. gambiae* mosquitoes became old enough to transmit malaria than *An. coluzzii* ($p_{species|21\pm0°C} < 0.001$, $p_{species|21\pm6°C} < 0.001$).

Our results show that temperature affects malaria transmission via effects on mosquito survival and parasite EIP in a species-specific manner. By disentangling these mechanisms, our work provides refined parameters for transmission models and improves predictions of malaria risk under environmental change.