

One Health Research Project Abstract

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Title: Interactions between Water, Sanitation, and Hygiene (WASH) and mosquito dynamics in western Kenya: Implications for diarrheal and mosquito-borne diseases

Research Abstract:

Background: Despite the implementation of Water, Sanitation, and Hygiene (WASH) and malaria vector control programs diarrheal illness and malaria are the leading cause of morbidity and mortality in Kenya, with highest rates in western Kenya. The inter-related nature of diarrheal illness and malaria is poorly explored in the literature. However, both can influence the other through outdoor latrines. Besides, much focus is placed on only malaria in western Kenya due to malaria-endemic areas. Other human and zoonotic mosquito-borne pathogens including O'nyong-nyong, Rift Valley and West Nile fever have caused outbreak in east Africa,¹⁸ and Bancroftian filariasis was detected in Ghana.²⁰ *Anopheles* mosquitoes could transmit O'nyong'nyong fever and Bancroftian filariasis as well as malaria.^{15,16} Our preliminary work identified a high abundance of *Mansonia* and *Culex* mosquitoes in outdoor latrines, and these mosquitoes could contribute to Rift Valley fever, West Nile fever and Bancroftian filariasis.^{15,16}



Aims: Our goal is to evaluate the risk posed by the non-use and use of outdoor latrines for diarrheal illness, malaria, and other human and zoonotic mosquito-borne diseases in the malaria-endemic area of western Kenya. Specific aims of this study are to 1) identify factors associated with outdoor latrine use and handwashing during the day and at night, 2) identify the number, composition, blood meal sources, and pathogens of *Anopheles*, *Mansonia*, and *Culex* mosquitoes in outdoor latrines and inside houses, and explore factors influencing the number of female mosquitoes at these sites, and 3) examine how

use of outdoor latrines at night is associated with risks of diarrheal illness and malaria compared with non-use.

Approach: The proposed study area is in two lowland sub-locations (Kabar West and Kabar Central) of Miwani in the eastern part of Kisumu in Kenya, where the altitude is approximately 1,200 m above sea level. A cross-sectional population-based survey will be conducted for Aim 1 from November to December (a short rainy season) in 2023. Our targets are individuals at four years of age or older, who potentially use outdoor latrines.²¹ Since females' sanitation behaviors influence their children's behavior,²² female caregivers will be interviewed about latrine use of each family member during the day and at night on the most recent day. In addition, data collected will include demographics, latrine structures (presence of a shower room adjacent to outdoor latrines, materials used, and eaves status), frequency and material used for cleaning latrines, location of the sanitary station, presence of water and soap, latrine use and handwashing practice when urinating and defecating, water source, round-trip time to obtain water, water treatment prior to drinking and factors influencing the use of outdoor latrines (distance from a house to an outdoor latrine, level of cleanness and odor, level of agreement on safety from houses to latrines, level of importance on privacy protection, perception of insects in outdoor latrines).^{21,23} For Aim 2, host-seeking and resting mosquitoes will be monthly collected in outdoor latrines and inside houses using Centers for Disease Control (CDC) light traps and Prokopack aspirators, respectively, from November to December in 2023, and from March to May (a long rainy season) in 2024. Samples will be separated into *An. gambiae sensu lato (s.l.)*, *An. funestus group*, *Ma. Africana*, *Ma. uniformis*, *Culex* and others microscopically. Abdomen of each mosquito will be used for host blood source identification by multiplex.²⁴ O'nyong-nyong virus from *Anopheles* mosquitoes, and Rift Valley virus and West Nile virus from *Anopheles*, *Mansonia* or *Culex* will be detected using real-time reverse transcription PCR (rRT-PCR).^{18,17} For Aim 3, female caretakers will be interviewed about behaviors of outdoor latrine use and diarrhea episodes in the past two weeks of each family member, and malaria tests will be conducted for all participants. Aim 3 will be conducted from November to December in 2023, and from April to May in 2024. A generalized linear mixed model will be performed to analyze each Aim. **Impact:** The findings will provide valuable insights for human behavior change and outdoor vector control to prevent diarrheal illness and mosquito-borne infections from a holistic viewpoint.

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