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2025

Original citation:

Logie, C. H., Leggett, R., Sivan, O., MacKenzie, F., Okumu, M., Loutet, M., Lukone, S. O., Kisubi, N., Gittings, L., Otika, L., Lukwago, M., Dorea, C., Hystad, P. & Kyambadde, P. (2025). Extreme weather events and refugee youths' experiences of physical health in a Ugandan humanitarian setting: qualitative insights. *International Journal of Qualitative Studies on Health and Well-Being*, *20*(1). https://doi.org/10.1080/17482631.2025.2549033

INTERNATIONAL JOURNAL OF QUALITATIVE STUDIES ON HEALTH AND WELL-BEING
2025, VOL. 20, NO. 1, 2549033
https://doi.org/10.1080/17482631.2025.2549033

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Extreme weather events and refugee youths' experiences of physical health in a Ugandan humanitarian setting: qualitative insights

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ABSTRACT

Purpose: Refugee settlements globally experience increased exposure to extreme weather events (EWE) compared with host national settings; however, refugee youth climate-related health experiences in humanitarian settings are understudied. We explored the lived experiences of climate change and EWE related to physical health among refugee youth aged 16–24 in a Ugandan refugee settlement.

Methods: We conducted a community-based, multi-method study. We purposively sampled refugee youth living in a Northern Ugandan refugee settlement reporting recent (past 14-day) EWE and/or resource insecurity. We conducted 32 refugee youth walk-along interviews to elicit a rich understanding of lived experiences in a target environment. During each interview, the youth brought the research assistant to places where they obtained resources (i.e. food, water, sanitation), took photos of their chosen places on a tablet, and described the photo and the place. We also conducted 12 in-depth interviews with key informants, comprising adults with experience working in this refugee settlement on refugee well-being, food security, water and sanitation hygiene (WASH), and/or climate change. We analysed the findings using template thematic analysis informed by the resource scarcity framework, which examines ecologic, social, and socioeconomic factors associated with resource insecurities.

Findings: Participants ($n = 44$) included refugee youth ($n = 32$; mean age: 20.0, standard deviation [SD]: 2.4; 50% men, 50% women) and key informants ($n = 12$; mean age: 37.0, SD: 5.8; 75% men, 25% women). Participant narratives identified how flooding, heavy rain, and drought contributed to youth experiencing resource insecurities (food, water, sanitation), in turn increasing malnutrition risks, water-borne diseases, and risks of bodily harm. Flooding and heavy rains also contributed to vector-borne diseases, and drought to dehydration and hygiene-related infections.

Conclusions: The findings highlight the need for better WASH infrastructure and increased food aid in Ugandan humanitarian settings, along with refugee youth-led initiatives to address the impacts of climate change on refugee well-being.

ARTICLE HISTORY
Received 14 April 2025
Accepted 12 August 2025

KEYWORDS
Uganda; youth; refugee; flooding; drought; physical health; water and sanitation hygiene; food insecurity

Background

There are a record 122.6 million forcibly displaced persons globally—the overwhelming majority live in low and middle-income countries (LMIC) (UNHCR, 2024). Refugee settlements across global humanitarian settings experience higher exposure to climate-related extreme weather events (EWE), such as extreme heat, heavy rains, and floods, than national averages (Fransen et al., 2024). Despite growing global attention to the nexus of climate change-migration-health, the experiences of forcibly displaced persons, such as refugees, who live in climate-affected LMIC regions are understudied (McMichael, 2020; McMichael et al.,

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2012; Schütte et al., 2018; Severoni et al., 2024). Climate change and related EWE have direct (e.g., flooding) and indirect (e.g., ecosystem disruption) effects on disease risk and negative health outcomes among children, yet review findings note evidence gaps regarding gender-specific experiences and socio-political influences and call for qualitative research to enhance the understanding of climate-related impacts on child health and well-being (Helldén et al., 2021). The climate-related health experiences of refugee youth are particularly important to explore in Uganda, Africa's largest refugee hosting nation with 1.79 million refugees in 2025 (UNHCR, 2025a). Similar to other global contexts, Uganda's refugee settlements experience greater exposure to higher temperatures and lower rainfall rates than the rest of Uganda (Fransen et al., 2024).

Climate change and related EWE have profound effects on physical health (Jung et al., 2023; Walika et al., 2023). For instance, flooding and storms can lead to the destruction of housing, resulting in large-scale population displacement and overcrowding, and damage to health and sanitation infrastructure (Ahmed et al., 2021; Suhr & Steinert, 2022). Additionally, floods may destroy toilet infrastructure and cause sewage overflow, which in turn can lead to the contamination of drinking water sources and subsequent exposure to water-borne diseases (Suhr & Steinert, 2022; Walika et al., 2023). As a result of both drought and flooding, water shortages lead to compromised water, sanitation, and hygiene (WASH) practices (Calderón-Villarreal et al., 2022; Semenza et al., 2023). In turn, droughts are associated with increased faecal pathogen transmission and infections, such as diarrhoea (Semenza et al., 2023; Walika et al., 2023), respiratory diseases (Ahmed et al., 2021), and skin infections (Enbiale & Ayalew, 2018). Increases in air and water temperatures create a more favourable environment for pathogens to survive and thrive, increasing exposure to typhoid and cholera (Semenza et al., 2023). Owing to social and structural inequities, people living in humanitarian settings may be disproportionately impacted by EWE.

Refugees in LMIC humanitarian settings experience social and structural inequities, such as economic precarity and food and water insecurity, which increase vulnerability to, and health impacts from, EWE (Sabates-Wheeler, 2019). For instance, refugee and displaced populations experience inadequate housing and WASH access (Calderón-Villarreal et al. ,2022), barriers to vaccinations (Ahmed et al., 2021), and loss of medical documentation (Schuster et al., 2024). These factors constitute barriers to maintaining good health and receiving health services, thus increase refugee and displaced populations' vulnerability to physical health-related harms of EWE (e.g., malaria, yellow fever).

This is important to understand in Uganda, which not only has Africa's largest number of refugees but is also affected by climate change-related EWE, such as increasing rainfall variability, droughts and floods, and temperature changes (Nsubuga & Rautenbach, 2018). Flooding in Uganda has led to infrastructure damage to sanitation, agriculture, roads, and shelter (Nuwagira & Yasin, 2022), whereas droughts have led to water scarcity and reduced agricultural production, in turn increasing economic and food insecurity (Nuwagira & Yasin, 2022; Sunday et al., 2023). Water scarcity increases the time required to fetch water, disproportionately affecting women because of gendered expectations for water collection (Amondo et al., 2022; Mukasa et al., 2020). Furthermore, drought among Ugandan nationals has been linked to various health issues, including fever, respiratory diseases, and diarrhoea arising through pathways related to malnutrition, fires, dust storms, and inadequate hygiene (Epstein et al., 2020). Findings from rural and urban Uganda found that socio-economic difficulties and insufficient clean water access resulted in worse WASH practices and a higher risk of water-borne diseases, such as diarrhoea (Maniragaba et al., 2023; Onohuean & Nwodo, 2023). A systematic review examining the lives of youth in relation to climate change in non-humanitarian Ugandan settings highlighted several impacts of climate change on youth physical health, including bodily harm, flood-related drowning, heat stress, and a general increase in diseases (Mugeere et al., 2021). Adolescents and youth are key to include in climate-related health research as they are at a critical developmental phase with changes in biological, cognitive, psychosocial, and emotional development (Committee on the Neurobiological and Socio-behavioral Science of Adolescent Development and Its Applications, 2019). Existing research suggests that while youth may be disproportionately impacted by the harms of climate change, they have limited power to influence responses to climate change and EWE (Mugeere et al., 2021). Within the minimal existing research evidence and policy focussed on the impact of climate change on youth, the majority focuses on children, leaving key gaps around adolescent and youth experiences (Mohamed et al., 2025; Zangerl et al., 2024).

There are critical knowledge gaps regarding the lived experiences of climate change, EWE, and physical health outcomes among refugee youth in Uganda. To address these urgent knowledge gaps, we conducted

a community-based study to explore the experiences and perceived impacts of climate change-related EWE and physical health among refugee youth aged 16–24 years old living in a refugee settlement in Northern Uganda.

Methods

We present qualitative findings from the Woli Na Kelan ("Planetary health") study conducted between September 2022 and August 2023. This was a community-based exploratory sequential mixed-methods study focused on understanding the connections between social, health, and environmental well-being among refugee youth in a Northern Ugandan refugee settlement.

Walk-along interviews were conducted with 32 refugee youth (50% men, 50% women) aged 16–24, and 12 individual in-depth interviews with key informants (KI) in the refugee settlement. Our present analyses focus on findings pertaining to refugee youths' physical health, including infectious diseases (e.g., vector-borne), respiratory diseases, and other health effects (e.g., skin) identified in a climate and child health review that called for further qualitative investigation in LMICs (Helldén et al., 2021).

Our study's research questions and analyses were informed by the resource scarcity framework (Wutich & Brewis, 2014) that details ecologic, socio-economic, and social factors that elevate risks for food and water insecurity and subsequent impacts on well-being. This framework was adapted to include other resource insecurities (e.g., firewood) with refugee youth in a Northern Ugandan refugee settlement (Bidi Bidi Refugee Settlement) (Logie et al., 2021).

Ethics approval was obtained from the University of Toronto Research Ethics Board (41103), the Mildmay Uganda Research Ethics Committee (MUREC-2021–85) (a local research board used by non-academic institutions including hospitals and the Ugandan Ministry of Health), and the Uganda National Council for Science and Technology (SS1315ES). All participants received information on the study's purpose and activities before enrolling and provided written informed consent. As the larger study explored sexual health, we obtained research ethics approval for youth aged 16–17 to provide their own informed consent rather than requiring parental consent that could pose participant barriers, aligned with youth sexual health research recommendations that youth aged 14 are capable of providing informed consent (Flicker & Guta, 2008; Santelli et al., 2025). All participants, including youth and key informants, provided written informed consent prior to participation; youth provided consent for publication of the photos and any identifying information was removed from the photos (e.g., any faces blurred out). Participants received an honorarium of 40,000 Ugandan shillings (~10 US dollars).

Reflexivity

The research team recognizes that positionality shapes all aspects of the research process. Acknowledging the collective positionality of this research team is therefore a necessary step towards greater transparency and critical reflexivity in the research process. This is aligned with the goal of this study and the research team to engage in reciprocal, ethical, and community-based research.

The co-authors of this research study are researchers and practitioners with experience living and working in Uganda, multiple Sub-Saharan African countries, Canada, and the United States, and include Ugandan co-authors living and working inside and outside of Uganda. The co-authors have varied training, from undergraduate, graduate, and doctoral students, early career academic faculty, senior academic faculty, and include medical practitioners, clinicians, and other community-based service providers. Among members of the research team exist a variety of positionalities, including members who identify as cisgender men and women, heterosexual and sexually diverse individuals, and white, Black, and racialized persons. Our team includes individuals with lived experiences relevant for this research: forcible displacement, (im)migration journeys, EWE, resource insecurity, violence, and multiple systems of oppression, including racism, sexism, and sexual stigma. The researchers share a commitment to share ownership of the study data and conclusions, intending to leverage findings beyond academic publications for use by community-based agencies and to contribute to larger goals of advancing health equity.

Setting and participants

This study was implemented in a refugee settlement in Uganda's Northern Region. Food insecurity is increasing in Northern Uganda, including in refugee settlements, because of the convergence of climate change (Ogenrwoth et al., 2023; Omona, 2022), poor harvests, insufficient land for agriculture, rising food prices, and cuts to the World Food Program's humanitarian food assistance (Adotu et al., 2024; Norwegian Refugee Council, 2023; Rédaction Africanews & Redden, 2024; World Food Programme, 2020).

Our study was a collaboration with a community-based refugee agency supporting refugee livelihoods in Ugandan refugee settlements from 2022–2023. KIs were purposively recruited from non-governmental organizations and local government officials in the refugee settlement, unnamed to ensure confidentiality, and neighbouring areas to offer diverse expert perspectives on refugee youth well-being, water, food and sanitation insecurity, and/or climate change. Youths were recruited using purposive sampling, including word-of-mouth, by refugee peer navigators (PN). PN were selected by local collaborator Uganda Refugee and Disaster Management Council (URDMC) through their youth programming; URDMC provided PN with support, training and supervision. PN were selected to reflect gender diversity in two refugee settlement zones that URDMC offers youth services in. PN were trained in research methods and ethics and have been engaged in several community-based collaborative health research projects by this study team (Logie et al., 2022, 2024). PN were residents of the refugee settlement, refugees between the age of 20–30, and fluent in English, Juba, Arabic, and/or Bari. The eligibility criteria for youth participants were: aged 16–24 years, refugees, residents of refugee settlement, able to speak English, Juba Arabic, and/or Bari, and had experienced either an extreme weather event (e.g., flooding) or resource insecurity (i.e., food) within 14 days prior to recruitment. All screened participants were included.

Data collection

The KI interviews and refugee youth walk-along interviews were conducted using semi-structured interview guides created collaboratively by a team of local community agencies, peer navigators, academics, the Ministry of Health, and the refugee community-based organization. After pilot testing the interview guides locally, feedback was provided to ensure contextual relevance and clarity. KI interviews were conducted by two senior refugee agency research staff, while youth walk-along interviews were conducted by two trained research assistants supported by the refugee agency. All interview facilitators received extensive qualitative training before conducting the interviews. Following the youth and KI interviews, a paper-based survey was conducted to collect demographic information. The KI interview guide contained questions about how changes in weather, EWE, and resource access (e.g., food and water) impacted refugee youth health and well-being, coping mechanisms, and recommendations for change.

We conducted walk-along interviews with refugee youth, a method designed to elicit a rich understanding of lived experiences in a target environment, including contextual and microscale environmental factors (Carpiano, 2009; Kusenbach, 2003). During each one-on-one interview, youth were invited to bring the research assistant to one to three places where they obtained resources (i.e., food, water, and sanitation). The participants were provided with tablets to take photos of their chosen locations. They described the photo and the place they had walked to in an interview conducted by a trained research assistant in a private, quiet space. The interview guide contained questions about the reasons for their choice of place, the impact of weather and seasonal changes on their experiences of each place, the corresponding impact on their health, and suggestions for improving each place. Each interview lasted between one and two hours, was digitally recorded and transcribed verbatim, and then translated into English by the refugee agency's multilingual staff. The interview transcription and translation were conducted by a separate trained research team member at URDMC in Yumbe, Uganda.

Data analysis

Four trained research assistants coded all transcribed interviews using Dedoose software. Data coding and analysis were conducted by members of the research team located in Canada; the researchers who developed the preliminary codebook include a researcher from West Africa with experience working in

humanitarian settings as well as a researcher with nine years of research experience with refugees in Uganda. Codes were shared with Ugandan team members and co-authors based in Uganda and the United States for feedback. The codebook was developed using both deductive codes adapted from the resource scarcity framework (Logie et al., 2021; Wutich & Brewis, 2014) and inductive codes identified within the data (e.g., extreme heat). We applied the template approach to codebook thematic analysis (Braun & Clarke, 2020, 2023; Brooks et al., 2015; Cassell et al., 2017; Ritchie, 2014), a flexible approach that uses both inductive and deductive analyses informed by prior theory (i.e., resource scarcity) (Wutich & Brewis, 2014) to explore the underlying patterns, meaning, and themes. This involved four researchers familiarizing themselves with a subset of the data (text and photos) to conduct preliminary coding, including noting patterns and codes, clustering codes into possible themes, and noting hierarchical relationships between themes (Brooks et al., 2015; Cassell et al., 2017). Once this was conducted with 5–6 transcripts and corroborated in team discussions, we developed an initial coding template reflecting these hierarchical relationships between themes (e.g., drought as a top-level theme, water insecurity as a mid-level theme, and insufficient water for hygiene as a lower-level theme). Following this, two researchers worked with the themes and sub-themes in Dedoose to modify and develop a template with the rest of the data, further identifying relevant text, refining and adding themes, and organizing themes and sub-themes into a final conceptual framework with illustrative quotations and photographs (Attride Stirling, 2001; Braun & Clarke, 2006; Brooks et al., 2015; Cassell et al., 2017). The first author managed any coding discrepancy. Quotations from transcribed interviews were identified to demonstrate the themes; quotes from refugee youth were identified with the participant's age, gender, and participant identification code [ID]; and KI quotes were identified based on gender, employment sector, and participant ID.

Results

The demographics collected from the paper-based surveys are summarized in Table 1. Participants ($N = 44$) included KI ($n = 12$; mean age: 37.0, SD: 5.8; 75% men, 25% women) and refugee youth ($n = 32$; mean age: 20.0, standard deviation [SD]: 2.4; 50% young men, 50% young women).

Participants identified two key top-level themes regarding extreme weather events: (1) ***flooding and heavy rains***, which contributed to multiple resource insecurities and infrastructure damage, in turn perceived as increasing malnourishment, water- and vector-borne diseases, and risk of bodily harm; and (2) ***drought***, which intensified multiple resource insecurities, that in turn increased malnourishment, dehydration, hygiene-related infection, water-borne disease, and risk of bodily harm. We have represented these themes in a conceptual framework that depicts pathways between flooding/heavy rains and drought, resource insecurities, and physical health outcomes (Figure 1).

Theme 1. Flooding and heavy rains

Participants described how flooding and heavy rains resulted in increases in mosquitoes, overgrowth of bushes, wet firewood, and destruction of both agriculture and infrastructure. These factors, in turn, contributed to food, water, and sanitation insecurities as well as other secondary outcomes, including infrastructure collapse and interrupted resource distribution. This leads to poorer physical health, including increased vector-borne diseases, bodily harm risks, malnourishment, and water-borne diseases.

Increases in mosquitoes during flooding and heavy rains heighten rates of vector-borne diseases

Participants highlighted that during periods of flooding and heavy rains, pooling water contributed to an increase in mosquitoes and associated vector-borne disease. One young man described, "When the rain is raining daily, it also increases the risks of getting diseases, because all these places will be filled with water. This is where mosquitoes stay" (young man, age 18, ID 040208). The overgrowth of thick vegetation during rainy periods was also identified as a contributing factor in the increase of mosquitos and malaria risk: "The grass grows so fast due to much rainfall. Even mosquitoes end up getting to their breeding places. When people come at night to fetch water, mosquitoes bite them, which contributes to malaria" (young man, age 18, ID 030206).

Table 1. Socio-demographic characteristics of key informant interview participants and refugee youth participants in a Northern Ugandan refugee settlement.

Refugee Youth Characteristics	Total N (%) or mean (S.D)
Total	32 (100)
Age, years	20 (2.4)
Gender	
Cisgender men	16 (50.0)
Cisgender women	16 (50.0)
In school currently	
Yes	23 (71.9)
No	9 (28.1)
Educational attainment (highest level completed)	
Primary school	11 (34.4)
Secondary	21 (65.6)
Employment status	
Not employed or in school, job searching	9 (28.1)
In school: work after school to support family	9 (28.1)
In school: job searching to work after school	12 (37.5)
In school: not job searching	2 (6.3)
Type of toilet used	
Private latrine only	23 (71.9)
Private latrine and public toilet (outdoors, public or community)	7 (21.9)
Outdoors only	1 (3.1)
Neighbour's private latrine	1 (3.1)
Distance to water access	
< 2 km	25 (78.1)
≥2 km	7 (21.9)
Food source	
Food Distribution Point (FDP) only	11 (34.4)
Garden/private farm and open market/street stalls	6 (18.8)
Garden/private farm and open market/street stalls, FDPs	6 (18.8)
Garden/private farm and FDPs	5 (15.6)
Garden/private farm only	3 (9.4)
Open market/street stalls only	1 (3.1)
Distance to food source	
< 2 km	17 (53.1)
≥2 km	15 (46.9)
Number of meals per day	
1	25 (78.1)
2	7 (21.9)
Key Informant Interview Characteristics ($n = 12$)	**Total N (%), or mean (SD)**
Total	12 (100)
Age, years	37 (5.8)
Gender	
Man	9 (75.0)
Woman	3 (25.0)
Education level	
Secondary	2 (16.7)
Post-secondary	10 (83.3)
Community role	
Social worker	3 (25.0)
Community leader	2 (16.7)
Healthcare provider	1 (8.3)
Climate education	1 (8.3)
Programme developer	1 (8.3)
Multiple roles*	4 (33.3)
Sector of employment	
Community development	3 (25.0)
Refugee services	5 (41.7)
Water insecurity	1 (8.3)
Food insecurity	3 (25.0)
Years worked with refugee youth	
1–5	8 (66.7)
6–10	3 (25.0)
> 10	1 (8.3)
Years worked in the refugee settlement	
1–5	9 (75.0)
> 5	3 (25.0)

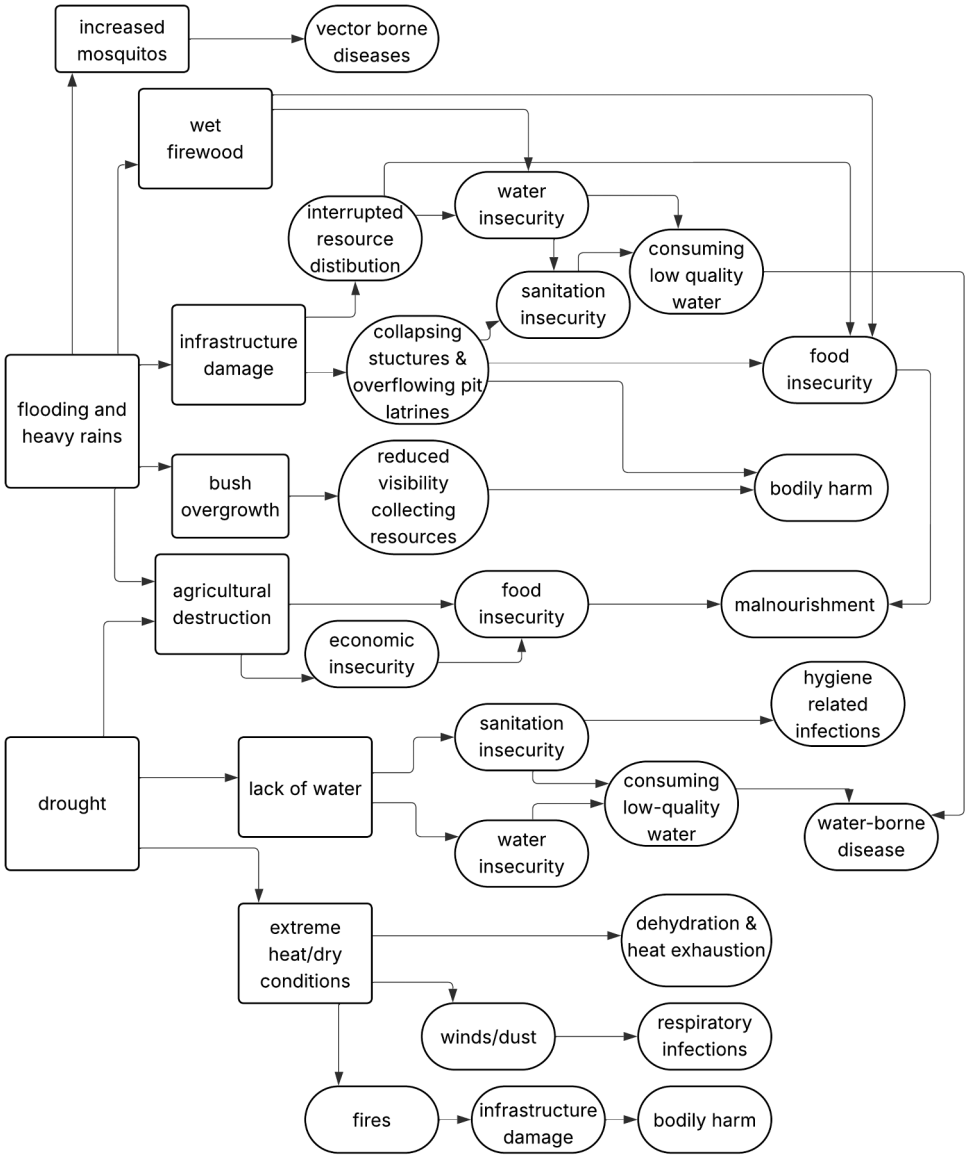

Figure 1. Pathways from flooding/heavy rains and drought to physical health outcomes among refugee youth in in a Northern Ugandan refugee settlement.

One KI highlighted how widespread the problem of malaria became during the rainy season, especially for young people:

> You find that most of the time people become sick—like last month—most of the youth or most of the children were sick [with] malaria … because mosquitoes now are many … Also, in small children, you find malaria, vomiting, and diarrhea. There was a time I went to the health center to assess [the situation]; you find most of the patients inside there are children from five years to ten. (women, KI-7, refugee sector)

Malaria was the most frequently referenced vector-borne disease among the participants. A KI also spoke of the increased risk of African trypanosomiasis (sleeping sickness) due to an increase in mosquitoes and tsetse flies during the rainy season.

> Rainy season comes with a lot of its own challenges, like most of the water that is logged will be a breeding place for mosquitoes. Then we have water that is logged that is breeding place for tsetse flies. So, you find malaria in the rainy season is very rampant then. (woman, KI-9, community development sector)

Bush overgrowth during the rainy season increases the risk of bodily harm during resource collection

With the increase in vegetation growth during periods of heavy rain, participants highlighted that resource collection became more dangerous owing to reduced visibility. One participant explained, "it is less bushy in the dry season than in the rainy season, therefore chances of people being attacked may be more in the rainy season" (man, KI-11, food insecurity sector). Many participants spoke of increased fear and perceptions of danger due to their busy environments.

Fear of animal/insect attacks was also cited in multiple interviews. During one walk-along interview, a young man showed the interviewer in a bushy area near a borehole (Figure 2). He described an instance in which another youth was bitten by a scorpion:

> Bushy area is a habitat for the wild animals, whereby they can hide . . . the sister of my colleague, she came here and she tried to fetch the water from here . . . she knew that there's a scorpion down there. From there, she was bitten by the scorpion. (young man, age 21, ID 030203)

A KI echoed this fear of animal/insect attacks due to vegetation overgrowth: "people fear going to these tall, tall areas with such grass people fear because of snakes, animals, the rest" (man, KI-6, community development sector).

Flooding and heavy rain-related food insecurity lead to malnourishment and hunger

Food insecurity during flooding and heavy rains occurs through two pathways: destruction of infrastructure needed for food distribution, and destruction of agriculture when flooded with rainwater. One KI explained the interrupted food distribution:

> Last month and this month, it has rained really, very heavily. Even you see now the roads are not all that good, you find that roads are now been affected. The other time, World Food Program was trying to give some support to the other side of the zone; vehicles were stuck, so it's just because of too much rain. (women, KI-7, refugee sector)

Figure 2. "Bushy area is a habitat for the wild animals, whereby they can hide" (refugee young man, age 21).

This KI quote also speaks of the vulnerability of the current road infrastructure to heavy rain. One young man also described food distribution as stopping entirely during heavy rain, contributing to food insecurity and hunger:

> In the process of receiving food, when it is raining, the distribution of food will be stopped. When it is raining, from morning to evening, you will not receive food . . . So, it will be very difficult for you to get food and eat. So that day, you end up sleeping without eating. (young man, age 20, ID 030202)

In addition to the interruption of food distribution services, agricultural destruction due to excessive rain also contributes to food insecurity and hunger. One young woman explained, "Too much rain destroys our crops . . . You know, our houses are temporary so when the rain is too much, with a lot of wind, it destroys the house and spoils our food" (young woman, age 17, ID 030108). This quote also notes that precarious building infrastructure is vulnerable to heavy rains, leading to the loss of food resources. Another participant also spoke to the destruction of agriculture contributing to community hunger: "when the flood finds seeds in the garden, the seeds will be thrown out by this flooding, and also it will cause hunger in the community" (young man, age 19, ID 030208).

Flooding and heavy rain increase water and sanitation insecurity that contribute to water-borne diseases

Many youth participants brought interviewers to sanitation facilities during their walk-along interviews, as shown in Figure 3 and Figure 4. Participants described how these facilities were vulnerable to overflow or collapse during periods of heavy rain and flooding, contributing to water contamination and contraction of water-borne diseases. One young man highlighted the link between flooded latrines and disease: "if there is flooding, the latrines get filled up with water and faeces start coming out and floats with water which brings diseases to us," (young man, age 19, ID 030208).

Figure 3. "If there is flooding the latrines get filled up with water and faeces starts coming out and floats with water, which brings diseases to us," (refugee young man, age 19).

Figure 4. "You find most construct these toilets and the washrooms with unburnt bricks, so when there is too much rain . . . some of them are collapsing" (women key informant in sexual and reproductive health).

Collapsing sanitation facilities were commonly cited during the rainy season. A KI described how collapsing sanitation facilities resulted in more people relieving themselves outdoors, further contributing to disease spread.

> You find most construct these toilets and washrooms with unburnt bricks, so when there is too much rain, like [for] three weeks it has been raining here, some of them are collapsing and in the facilities. Our fear is how is the health at home? Won't we get cholera if people start easing themselves out (urinating/defecating outdoors) in this current season? (woman, KI-8, refugee sexual and reproductive health [SRH] sector)

Defaecation outdoors creates increased health risks during the rainy season because heavy rains and floods may draw faeces into water sources. One young woman explained, "when it rains too much here, the streams floods, and the running water also brings dirty things in the stream which contaminates the water we are fetching . . . like rubbish, faeces, used condoms, polythene bags." (young woman, age 22; ID 030102).

Despite the contamination of water sources during the rainy season, community members may have no choice but to collect unimproved water sources because of the unavailability of water from other sources. One participant described how boreholes were contaminated by rust during the rainy season, driving people to collect water from unclean streams:

> In the rainy season sometimes, the borehole will be fine, but [there is] the issue of rusting. You find that the water will come with yellow particles. And people may end up going for [open water] streams. And also, these streams, sometimes our kids when they go and fetch water, they end up urinating and defecating on the sides of streams. Which is also affecting our health. And you may find people suffering from this stomach pain. (young man, age 18, ID 030206)

Another participant explained that heavy rain and floods may also destroy water infrastructure: "When it's rainy season, since the pipes are going underground, you find sometimes rain will wash out the pipes, so it will be very hard for communities to access water" (woman, KI-7, refugee sector).

The destruction and contamination of other water sources drive community members to collect unclean water from streams. The health issues from drinking unimproved sources of water are compounded during the rainy season because of the challenge of acquiring dry firewood needed to boil the water:

> In the rainy [season], if there is no water at the tap, we go to the streams, although that water is not clean—but we can use it for cooking, bathing. But I know some families here in the settlement who also drink that water. They told me they cannot waste firewood to boil water for drinking, yet they have to cook food; that becomes expensive, so they have to save firewood for cooking food and then just drink this water as it is". (young man, age 24, ID 030204)

The outcome of consuming contaminated water included contracting water-borne diseases such as cholera, typhoid, and diarrhoeal disease. A young man highlighted this problem.

> During rainy season, there are a lot of diseases that are affecting people. During flooding and also during rainy season, when people are defecating outside, you know, other diseases will affect people more, especially our people who are fetching water from the stream. They will be affected by the diseases. They will also get cholera, typhoid, and even diarrhea during that time of rain. (young man, age 19, ID 030208)

Infrastructure collapsing due to flooding and heavy rains creates injury risks

Participants described how the sudden collapse of infrastructure, such as buildings, especially sanitation facilities, during flooding and heavy rains posed a risk of injury. One young woman explained, "When there are floods, at times the houses leak, they collapse. The bathing shelter and even the latrine, they collapse due to too much rain and wind" (young woman, age 24, ID 030101). The fragile structure of latrines makes them particularly vulnerable to collapse. One young man described an instance where a woman was inside a latrine when it collapsed:

> It was raining, and the rain took two to three hours, and this neighbor of mine went to the latrine. . . The moment she stepped one leg out, the latrine collapsed down. That one was very bad, very bad really. The latrine collapsed completely down. (young man, age 24, ID 040203)

Another participant echoed the risk of injury owing to collapsing structures, recalling a situation where a house collapsed with a family inside:

> You find most of the homes are in water . . . concerning floods and because of the heavy rains . . . the houses, the wall falls, then immediately the person runs outside. And even there is one, that house falls on her when she is inside the house . . . They were three in that house, so people rescued her, but she was hurt, and the daughter also was hurt somewhere, plus that grandchild. (women, KI-7, refugee sector)

Participants described how falling objects caused injury and even the risk of death. Another young man described, "When it rains consecutively and carries big winds that blow off the roofs of the houses . . . that tree fell down and destroyed the house, it almost killed a young baby inside there" (young man, age 18, ID 040208).

Theme 2. Drought

Participants described how drought resulted in crop failure, extreme heat and dry conditions, and lack of clean water, winds, dust, and bush-burning fires. These factors were perceived as contributing to sanitation, water, food, and economic insecurity. Stemming from these resource insecurities, participants described increases in hygiene-related infections, water-borne diseases, hunger and malnourishment, dehydration and heat exhaustion, and the risk of bodily harm due to fires.

Drought-related sanitation insecurity contributes to increases in hygiene-related infections

Water shortages during drought resulted in a decreased ability to maintain hygiene practices, which increased infections, including urinary tract infections (UTIs) and skin infections. One participant spoke of the potential for hygiene-related infections due to the inability to maintain handwashing practices.

> The health conditions at every home are broken down. Like, if in the toilet, there is no water, at home there is no water, there is even no container where if you visit the toilet you can wash your hands . . . all of them are suffering from water-borne, air-borne related sickness, because when you don't maintain those [hygiene] things, well definitely the population is going to suffer from health issues like bilharzia, hookworms, and cholera. (man KI-1, community development sector)

Another KI spoke of the increase in UTIs resulting from inadequate WASH. She reported, "we have the UTIs, urinary tract infection, because hygiene is not enough. That is the most common, due to an improper way of cleaning" (woman, KI-8, refugee SRH sector). The inability to maintain hygiene during drought poses health risks to women during menstruation. One KI explained, "Because there is no water so you cannot bathe as required, definitely you will get sick. And if you are using the recyclable pads that even makes it worse, because you can't wash, because you don't have sufficient water" (man, KI-12, refugee sector). One young woman developed a skin infection when unable to bathe during menstruation.

> At times, my private parts will have some wounds maybe due to that remaining blood. If I don't bathe like for two days, wounds will develop in my private parts . . . If it is wounded, I will go to the health centre, I will go and explain to them. If there is medicines, they will give me. If there is no medicine, I will come and try other means, like moving far distances in search for water. (young woman, age 23, ID 030103)

This participant's description also speaks to the converging challenges of the inability to bathe during menstruation, needing to travel far while feeling unwell, and medication stockouts at humanitarian health clinics.

Drought-related water and sanitation insecurity contributes to increases in water-borne disease and other infections

Many participants stated that water sources were either not functioning or produced only low-quality water during drought, leading to the increased use of contaminated water from unimproved sources. One walk-along interview participant showed their interviewer a borehole where the community collected the water (Figure 5). She described, "during dry season, the water will not be there. Like this borehole, the water will come, but it will be very dirty, sometimes with soil particles and other black particles. Sometimes the water can be like yellowish in color." (young woman, age 19, ID 040105)

The lack of available clean water sometimes leads community members to consume water from unimproved sources, thereby contributing to water-borne illnesses. One young man explained,

> But there is no water, there is no water, there is nothing that you can drink. The only thing you will just drink this water like that. So, this one will cause germs sometimes. It will lead to disease and sickness. (young man, age 20, ID 030202)

Figure 5. "The water will come, but it will be very dirty, sometimes with soil particles and other black particles. Sometimes the water can be like yellowish in colour." (refugee young woman, age 19).

One coping strategy the participants described was collecting water from streams because of unavailability at taps and other water sources. However, participants recognized that such unimproved water sources also carry the risk of water-borne diseases and skin infections. One young woman was admitted to the hospital after consuming unclean water.

> Due to shortages of water in this place, this is where we come and fetch water, and it is the nearest water source where we can get water easily . . . . Sometimes, the water may be dirty, so we first boil it to make it clean. If you don't boil it, it can make you get diseases. The diseases that we get from water, when you use this water, it can affect your skin, it makes your skin itchy; and when you continue scratching your skin, you end up developing wounds on your body, and also in your private parts . . . This is what we experience in this place. Even me myself, I was admitted in the hospital for the last two weeks that have passed due to using this water, because of headache, and skin disease. (young woman, age 22, ID 040103)

Drought-related food and economic insecurity contribute to malnourishment

The participants explained that the lack of water during extended droughts affected their ability to farm. One young woman described famine as an outcome of the food shortage.

> When there is no water, sometimes it's hard, because, for instance, we use the water for watering our crops, and now if the drought comes then the water dries off, then it will lead to food shortage, because our crops will dry off which lead to famine. (young woman, age 19, ID 040107)

Another participant highlighted that low crop yields in drought exacerbate poverty:

> In drought you may find that there is a lot of challenges, there is no food. People are sleeping without eating. Because in the wet season, you can plant your small thing and get something to eat, like vegetables. But in the dry season, there is no place to get water, maybe to water the vegetables, that you can be able to sell and get some money to buy other home needs or requirements. But there is not enough water where you plant your vegetable, that's the shortage. (young man, age 24, ID 030204)

As described by KI, a combination of crop failure and economic insecurity contribute to malnourishment.

> During the dry season the [food] access being a little bit reduced because they don't produce from their garden enough, like now the vegetables. That is why we have a lot of malnourished children. That is why some other partners have to involve this particular section of the people, and not only the children, but also the adults, the elderly people, the youths, [and provide] some kind of food, they easily lack [food] because of the nature of the environment. (man, KI-6, community development sector)

As described above, malnourishment and hunger are potential outcomes of drought-related food insecurity. Another KI reported:

> So if you have prolonged drought, definitely you can't produce enough food. And it will increase your food insecurity. It will increase stress within the refugee operations in terms of feeding. It will result into malnutrition in children. (man, KI-12, refugee sector)

Extreme heat and drought lead to dehydration and heat exhaustion

The unavailability of improved drinking water sources exacerbates the risks of dehydration and heat exhaustion during the dry season. One participant described both expending energy on collecting water and being unable to remain hydrated.

> Humans also struggle to move distances to get water, let me say, over 3 km to go and get water. But the water you get will not be enough. You find yourself carrying one jerrycan; you are already tired. So, at the end of the day, you say this water is better for cooking, let bathing wait. Let drinking wait, let washing wait, because there is nothing to do. And you forego drinking water and just use it for cooking. (young man, age 19, ID 030205)

Multiple participants described instances in which people collapsed or experienced heat exhaustion symptoms while waiting in food distribution lines. One participant described an instance where someone collapsed and was taken to the hospital after standing in direct sunlight for too long:

> For the dry season, the trees that we used to get shade from are all dry without leaves. If they shed off their leaves, then there will be no chance of hiding away from the direct sun heat, so we just stand in line. I think it was in February, the sun heat was too much as we were in the line; there is one sister of mine who collapsed here because the sun heat was too much. She fainted from here, but the good thing she was taken to hospital. That was in February, then in March we thought they are going to improve, at least organize a tent for us to help us with shade and maybe also lining up, but we have waited for long and now they tell us they cannot put [one up]. (young man, age 18, ID 040208)

This quote also speaks of the perceived lack of action in putting up a tent/infrastructure to prevent similar extreme heat-related issues. Another walk-along interview participant showed the interviewer an open space where they waited for food (Figure 6). She described how waiting in lines was particularly challenging for mothers: "during the dry season, we experience too much sun heat. Our mothers are really suffering. When you come with a baby and they delay to give you food, you will stay in the sun heat, and this affects the baby' (young woman, age 23, ID 030104). Another participant described physical symptoms associated with prolonged sun exposure.

> Dry season … the bad thing is when you stand in the sunshine; it heats you badly that you feel like you have malaria and also, there are many mosquitoes around. And during the process, some people end up collapsing, so they will be taken to the health centre for treatment. (young man, age 24, ID 040203)

Wind, dust, and bush-burning fires during the dry season create risks of bodily harm and respiratory infection

Multiple KIs discussed increased dust and wind during the dry season, which contribute to respiratory illness. One KI explained, "in the dry season we normally have a lot of issues with cough, then a lot of flu because of the dust all these are coming up" (man, KI-6, community development sector). Flu, cough, and other respiratory infections are the outcomes that were cited by participants: "during the dry season … when

Figure 6. "During the dry season, we experience too much sun heat … when you come with a baby and they delay to give you food, you will stay in the sun heat, and this affects the baby." (refuge young woman, age 23).

there is a lot of dust it comes also with some respiratory infections, the likes of flu and cough become rampant" (man, KI-5, food insecurity sector).

Winds during the dry season also pose a health risk owing to the burning of bush fires. KI explained that youth engage in bush-burning as a means of hunting to obtain food during the dry season:

> When it's a dry season, we find the youth, they engage in fruit gathering and hunting. And in the process, you find when you are hunting for rats and some animals in the bush, you need to use fire, and you find this fire can go and rampage and destroy houses and people's crops. That has been a negative impact, during the dry season. It's engaged by the youths, but it affects the entire community—sometimes including the host community. (man, KI-1, community development sector)

Bush-burning fires emerge during the dry season as a response to food and economic insecurity. However, the dry and windy conditions during drought contribute to uncontrolled bush-burning fires, contributing to the risk of bodily harm for all in the community. One participant shared how bush-burning fires destroyed people's homes.

> Another thing we talk of is the bush burning. It can either be refugees or host [Ugandans], some are for hunting purposes, some are just to clear the place. So that mostly when they set this bush [on fire] it ends up even affecting the gardens and you know once you have your gardens, and it has been burnt off, you know how it terrifies. At times there are houses affected by the bush burning, because as it burns some particles of fire also keep flying to people's houses, so many people have also lost their houses as a result of bush burning. That has also affected their physical well-being. (man, KI-2, refugee sector)

Another KI described an extreme example in which a pregnant woman was killed by a bush-burning fire:

> Like last year we even lost a woman to those bush fires. Someone setting ablaze the bush, then she was in the garden because sometimes they ask for land from those landlords from the [Ugandan] nationals. She had her *tukul* (traditional South Sudanese home) there, she was sleeping, fire came and caught the whole house and she was pregnant. So in the morning when the nationals came they found the refugee had died and so it was really a bad situation for them. So for the dry season, I would say what is affecting them so much, is that they put their lives at risk trying to make ends meet, using fire to burn charcoal, looking for hunting places. (woman, KI-9 community development sector)

Discussion

Our findings provide insight into the complex pathways through which EWE shape refugee youths' physical health in this Northern Ugandan refugee settlement. Flooding and drought exacerbate multiple interlinked resource insecurities (food, water, and sanitation) (Workman et al., 2022), which contribute to the risks of bodily harm, water-borne diseases, and malnourishment (Figure 1). While flooding and heavy rain were uniquely associated with vector-borne infections, drought was associated with hygiene-related respiratory infections, dehydration, and heat exhaustion. Walk-along methods produced rich visual and narrative insights into the role of place to better understand refugee youths' resource access in the context of EWE, and findings can inform place-based, youth-led, and climate-tailored health promotion.

Our findings offer unique insights into the convergence of environmental factors and human practices that can result in bodily harm in humanitarian settings. For instance, during flooding and heavy rain, bush overgrowth increases youths' chances of being bitten/attacked by animals and insects while collecting resources. There are also indirect pathways to harm; for instance, due to the impact of drought on rain-fed agriculture and subsequent food insecurity, youths may hunt animals through bush-burning practices. Drought-related extreme heat and dry winds can result in bush-burning leading to air pollution and housing destruction. Our findings expand upon the existing literature on direct connections between climate-related EWE and bodily harm (e.g., drowning (Walika et al., 2023), infrastructure collapse) (Chekuri et al., 2024) to identify other direct risks via animals and insects, as well as indirect pathways via sociocultural practices (i.e., bush-burning) (Helldén et al., 2021; Schuster et al., 2024).

Participant narratives highlight several ways that drought impacts health. Drought contributes to travelling further distances to fetch water, which impacts well-being. Exacerbated household water scarcity during drought also compromises WASH access, which in turn increases the risk of infection, dehydration, and malnourishment. Heat exhaustion is exacerbated by environmental (e.g., leafless trees) and structural (e.g., food distribution tents) factors. This corroborates research on physical

harm from longer distances to fetch water in Northern Ugandan non-refugee settings, where water fetching during drought takes 6–8 hours/day (Amondo et al., 2022). Youth discussed unspecified skin infections related to hygiene concerns; this requires investigation, but could be linked with scabies, as documented in Ethiopia's drought (Enbiale & Ayalew, 2018). Young women participants noted UTI and genital infections, corroborating research in other contexts on water insecurity-related hygiene-related infections (Andersen & Dowdell, 2019; Graham et al., 2021; Sarkar et al., 2024). As Ugandan refugee settlements experience greater exposure to high temperatures during drought (Fransen et al., 2024), and related increased water and food scarcity (Nuwagira & Yasin, 2022; Sunday et al., 2023), our findings highlight the need for urgent action to address WASH access during drought.

Our findings expand research regarding the linkages between floods and physical health in Uganda. Participants noted that flooding-related pooling of water and overgrown vegetation contributed to increased mosquito breeding and malaria, corroborating prior research (Semenza et al., 2022). Furthermore, participants explained that flooding caused latrines to collapse and overflow, resulting in drinking water contamination and increased waterborne infections (e.g., cholera, typhoid). Our findings align with prior research documenting flood-related water-borne infections attributed to damage to infrastructure, sewage overflow, and latrine collapse that contaminate drinking water sources (Suhr & Steinert, 2022; Walika et al., 2023).

These findings signal the utility of the resource scarcity framework (Wutich & Brewis, 2014) to understand how ecologic (e.g., drought), socio-economic (e.g., agricultural disruption), socio-political (e.g., food distribution systems), and socio-cultural (e.g., bush burning) factors shape experiences of multiple, co-occurring resource insecurities (e.g., food, water, sanitation) (Workman et al., 2022), and subsequently harm refugee youth health. We expand on the focus of resource scarcity on ecological, social, and socio-economic factors to reveal the importance of socio-political humanitarian practices (e.g., food distribution infrastructure, WASH access) and socio-cultural survival strategies (e.g., hunting). Practices in this refugee settlement to mitigate climate-related impacts on food insecurity (e.g., food distribution tents and bush burning) also have unintended social consequences (e.g., heatstroke and fires). Our findings emphasize the importance of examining interactions between climate change and broader socio-political contexts of insufficient humanitarian assistance in LMIC humanitarian settings (Adotu et al., 2024; Norwegian Refugee Council, 2023; Rédaction Africanews & Redden, 2024; World Food Programme, 2020)

Study limitations include non-random purposive sampling, which may have overrepresented youth connected with the collaborating refugee agency programs. While all key informants had at least one year of experience working with refugee youth and in Bidi Bidi, the majority had been doing so for five years or less. Walk-along interviews may have constrained the discussion of physical health in public spaces, yet the interviewers attempted to mitigate these limitations by conducting interviews in private places. Further research can include parent and family perspectives to enrich understanding about household-level solutions. Study strengths include a focus on multiple EWEs, perspectives from youth and KI, and multiple qualitative methods, whereby photos and their descriptions add contextual richness and insight (O'Reilly et al., 2021). Data collectors reported that the walk-along interview method was enjoyable for the youth, and tablet-based photos were of high quality.

Conclusion

Refugee youth in Northern Uganda are at the nexus of refugee camps' disproportionate exposure to EWE (Fransen et al., 2024), insufficient humanitarian aid (Adotu et al., 2024; Norwegian Refugee Council, 2023; Rédaction Africanews; Rédaction Africanews & Redden, 2024; World Food Programme, 2020), and inadequate WASH infrastructure (UNHCR & Martinez, 2019) (UNHCR, 2025b). Our findings can inform future research on diagnosing and treating physical health concerns, developing community-based strategies to mitigate resource insecurity, and informing structural-level changes. Climate research can meaningfully engage refugee youth in advancing climate resilience, health, and rights.

Acknowledgments

We acknowledge all the peer navigators and participants, as well as collaborating agencies: Uganda Refugee Disaster and Management Council (URDMC), Ugandan Ministry of Health, Office of the Prime Minister, and Most At Risk Populations Initiative (MARPI).

Author contributions

CRediT: **Carmen H. Logie:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **Rachel Leggett:** Formal analysis, Validation, Writing – original draft, Writing – review & editing; **Ofir Sivan:** Formal analysis, Validation, Writing – original draft, Writing – review & editing; **Frannie MacKenzie:** Investigation, Project administration, Supervision, Writing – review & editing; **Moses Okumu:** Conceptualization, Data curation, Funding acquisition, Writing – review & editing; **Miranda Loutet:** Data curation, Investigation, Project administration, Supervision, Writing – review & editing; **Simon Odong Lukone:** Conceptualization, Data curation, Funding acquisition, Investigation, Project administration, Validation, Writing – review & editing; **Nelson Kisubi:** Investigation, Project administration, Supervision, Validation, Writing – review & editing; **Lesley Gittings:** Methodology, Validation, Writing – review & editing; **Lawrence Otika:** Data curation, Validation, Writing – review & editing; **Moses Lukwago:** Investigation, Validation, Writing – review & editing; **Caetano Dorea:** Funding acquisition, Validation, Writing – review & editing; **Perry Hystad:** Funding acquisition, Validation, Writing – review & editing; **Peter Kyambadde:** Funding acquisition, Methodology, Validation, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was funded by the Social Sciences and Humanities Research Council of Canada (Insight Grant). Logie was also supported by Canada Research Chairs (CRC 2-SSHRC). The funders had no role in the study design.

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Data availability statement

The data underlying this article cannot be shared publicly because of the ethical need to protect the privacy of the youth who participated in the study and current ethical approval. Therefore, the data cannot be publicly shared with the DOI/URL. The data will be shared upon reasonable request with the corresponding author.

Ethics approval was obtained from three research boards:

(1) the University of Toronto Research Ethics Board (41103), (2) Mildmay Uganda Research Ethics Committee (MUREC) (MUREC-2021–85), and (3) the Uganda National Council for Science and Technology (SS1315ES). It is standard in global research to obtain ethics approval from academic institutions such as University of Toronto as well as a local ethics organization, and MUREC is a local Ugandan ethics organization that is used by academic and non-academic organizations such as our partners at the Ministry of Health. We obtained ethical approval for 16 and 17 year old participants to provide their own consent from these 3 research ethics boards.

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