



A Scoping Review of Factors Associated with HIV Acquisition in the Context of Humanitarian Crises

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Abstract

Humanitarian crises—natural or human-made events that can threaten communities' health, safety, security, and well-being—may affect the HIV epidemic dynamics. Common aspects of humanitarian crises such as poverty, powerlessness, disruptions to the health systems, and social instability can contribute to a person's vulnerability to HIV infection through increased risk behaviors and limited access to health services. Guided by the Joanna Briggs Institute methodology for scoping reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) reporting guidelines, we conducted a scoping review of literature published in English between January 1990 and March 2022 to characterize the global evidence of modifiable and non-modifiable factors for HIV acquisition in the context of humanitarian crises. We systematically searched, screened, and synthesized literature from MEDLINE, Embase, Global Health (all accessed via Ovid), and Scopus, and also grey literature through websites of humanitarian agencies and relevant non-government organizations, the International AIDS Society's abstract databases, and Google Scholar. We considered studies presenting empirical data on HIV prevalence, incidence, or risk factors in humanitarian crises-affected populations, including refugees, asylum seekers, and internally displaced persons. Forty-nine studies met the inclusion criteria. The majority of studies were quantitative ($n = 43$, 87.8%) and cross-sectional ($n = 37$, 75.5%) in design. Most were single-country studies ($n = 43$, 87.8%) and conducted in Sub-Saharan Africa ($n = 31$, 63.3%). We identified 5 non-modifiable factors for HIV acquisition (i.e., age, gender, location, place of birth or origin, and ethnicity) and 60 modifiable factors that we further classified into five categories, namely 18 policy and structural, 9 sociocultural, 11 health and mental health, 16 sexual practice, and 6 humanitarian crisis-related traumatic event factors. Within the modifiable categories, factors that were most often investigated were education level, marital status, sexually transmitted infection diagnosis, condom use, and experience of rape or sexual trauma, respectively. Informed by the findings, we applied the social-ecological model to map the identified multidimensional factors associated with HIV acquisition at the levels of individual, social and sexual networks, community, public policy, and the context of humanitarian crises. The current review provides a comprehensive, global analysis of the available evidence on HIV prevalence, incidence, and risk factors in humanitarian crises and implications for potential programs and research. Future research is warranted to further understand the directionality of the non-modifiable and modifiable factors affecting HIV acquisition, and the multilevel barriers and facilitators to the uptake of HIV prevention strategies in the context of humanitarian crises. Such research can generate actionable evidence to inform the development of ethical, trauma-informed, and culturally appropriate HIV prevention interventions in humanitarian settings.

Keywords HIV · Risk factors · Armed conflicts · Natural disasters · Review

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Resumen

Las crisis humanitarias (eventos naturales o provocados por el hombre que pueden amenazar la salud, la seguridad y el bienestar de las comunidades) pueden afectar la dinámica de la epidemia del VIH. Los aspectos comunes de las crisis humanitarias como la pobreza, la impotencia, las perturbaciones de los sistemas de salud y la inestabilidad social pueden contribuir a la vulnerabilidad de una persona a la infección por VIH a través del aumento de comportamientos de riesgo y el acceso limitado a los servicios de salud. Guiados por la metodología del Instituto Joanna Briggs para las revisiones de alcance y la extensión de las directrices para la presentación de elementos de informe preferidos para revisiones sistemáticas y metaanálisis para revisiones de alcance (PRISMA-ScR), llevamos a cabo una revisión de alcance de la literatura publicada en inglés entre enero de 1990 y marzo de 2022 para caracterizar la evidencia global de factores modificables y no modificables para la adquisición del VIH en el contexto de crisis humanitarias. Buscamos, seleccionamos y sintetizamos sistemáticamente literatura de MEDLINE, Embase, Global Health (todas accedidas a través de Ovid) y Scopus y literatura gris a través de sitios web de agencias humanitarias y organizaciones no gubernamentales relevantes, las bases de datos de resúmenes de la Sociedad Internacional del SIDA y Google Académico. Consideramos estudios que presentaban datos empíricos sobre la prevalencia, incidencia o factores de riesgo del VIH en poblaciones afectadas por crisis humanitarias, incluyendo las personas refugiadas, solicitantes de asilo y desplazadas internamente. Cuarenta y nueve estudios cumplieron los criterios de inclusión. La mayoría de los estudios fueron de diseño cuantitativo ($n=43$, 87.8%) y transversal ($n=37$, 75.5%). La mayoría fueron estudios de un solo país ($n=43$, 87.8%) y realizados en África subsahariana ($n=31$, 63.3%). Identificamos cinco factores no modificables para la adquisición del VIH (es decir, edad, género, ubicación geográfica, lugar de nacimiento u origen y grupo étnico) y 60 factores modificables que clasificamos en cinco categorías, a saber 18 políticos y estructurales, 9 socioculturales, 11 factores de salud y salud mental, 16 de práctica sexual y 6 de eventos traumáticos relacionados con crisis humanitarias. Dentro de las categorías modificables, los factores que se investigaron con mayor frecuencia fueron el nivel educativo, el estado civil, el diagnóstico de infecciones de transmisión sexual, el uso de condón y la experiencia de violación o trauma sexual, respectivamente. Informados por los hallazgos, aplicamos el modelo socioecológico para asignar los factores multidimensionales asociados con la adquisición del VIH identificados a los niveles individual, de redes sociales y sexuales, comunidad, políticas públicas y contexto de crisis humanitaria. La revisión presente proporciona un análisis integral y global de la evidencia disponible sobre la prevalencia, la incidencia y los factores de riesgo del VIH en crisis humanitarias y sus implicaciones para posibles programas e investigaciones. Se necesitan más investigaciones para comprender mejor la direccionalidad de los factores modificables y no modificables que afectan la adquisición de VIH, y las barreras y facilitadores multinivel para el uso de estrategias para la prevención del VIH en el contexto de las crisis humanitarias. Dicha investigación puede generar evidencia accionable para informar el desarrollo de intervenciones para la prevención del VIH que sean éticas, informadas sobre el trauma, y culturalmente apropiadas en entornos humanitarios.

Introduction

The global crisis of people affected by humanitarian crises caused by conflict, violence, climate change, and natural disasters has reached unprecedented levels. By the end of 2023, the number of individuals worldwide displaced by humanitarian crises exceeded 117.3 million, the highest level seen since World War II [1]. The United Nations (UN) defines humanitarian crisis as “an event or series of events that represents a critical threat to the health, safety, security, or well-being of a community or other large group of people usually over a wider area” [2]. Recent examples of humanitarian crises caused by conflict and violence that led to mass displacement include the Israel-Gaza conflict, the Russia-Ukraine war, the Syrian civil war, the Haiti political crisis, the military and ethnic conflict in Myanmar, and the South Sudan civil war [1]. Climate change and natural disasters such as the droughts in Ethiopia and Afghanistan and the large-scale floods in Nigeria and Ecuador may also lead to temporary or permanent displacement [3, 4]. Globally, weather-related

and geophysical disasters internally displaced 26.4 million people in 2023 [4]. A situation analysis of the Israel-Gaza conflict describes the breadth of public health issues caused by the conflict and forced displacement, including acute malnutrition, increased non-communicable disease burden due to interrupted treatment, poor birth outcomes, and mental health problems [5]. Ultimately, humanitarian crises have multiple adverse health impacts that significantly increase mortality and morbidity rates in the affected regions [6, 7].

Poverty, powerlessness, political and economic instability, disruptions to the health systems, and loss of social networks are common aspects of humanitarian crises and can contribute to a person’s vulnerability to human immunodeficiency virus (HIV) infection [8–11]. In conflict- and disaster-affected settings, health-seeking behaviors such as testing for HIV among those at risk for infection and maintaining adherence to antiretroviral therapy (ART) among persons with HIV (PWH) may assume lower priority than securing more urgent and basic needs such as food and shelter [12, 13]. Limited access to money and other resources may

lead individuals affected by humanitarian crises to exchange sex for money or nonmonetary items as a means of survival [14, 15]. The use of alcohol and/or drugs as coping strategies may further increase the risk of HIV infection [16]. Nevertheless, evidence on the direction and scale to which humanitarian crises affect the epidemiology of HIV/AIDS can be difficult to elucidate and is often context-specific [10, 17–19]. For instance, the prevalence of HIV might fluctuate before, during, and after times of conflict, with prevalence data remaining stable during conflict [18, 20, 21]. Prior research suggests the flow of humanitarian aid, forced displacement, and limited population mobility for the duration of the conflict may slow the spread of HIV [18, 20]. On the other hand, factors such as exposure to conflict-related traumatic events (e.g., sexual violence) and low HIV knowledge can increase HIV risk at the individual level during all stages of conflict [8, 18].

Individuals affected by humanitarian crises may present with a range of risk factors for HIV acquisition and transmission. Yet, there remains limited evidence on how these factors interact with the challenges of living in a conflict or disaster setting and influence the risk of HIV acquisition. Previous approaches to identifying individual risk factors of HIV have shifted towards characterizing multiple levels of HIV risk and risk contexts. One example of such approaches is the social-ecological model, which posits the complex interaction between an individual at risk for HIV (e.g., a person who injects drugs) and their social network, community, public policy, and the stage of HIV epidemic in determining their ability to protect themselves and others from acquiring HIV [22]. Researchers have also examined modifiable and non-modifiable determinants of HIV infection in the context of mobility, to understand the routes through which labor migration might exacerbate the spread of HIV and to inform potential HIV prevention interventions [23]. A study exploring how climate change may influence the HIV/AIDS epidemic identified four contextual pathways including food insecurity, erosion of public health infrastructure, human migration, and the prevalence of other infectious diseases [15]. These frameworks can serve as important guides for assessing factors affecting vulnerability to HIV in diverse settings and communities [22, 23], facilitating implementation of evidence-based HIV prevention programs [24], and informing effective strategies to advance actionable health research in humanitarian settings [25, 26].

Given the increasing number of people affected by humanitarian crises worldwide [1], the goal of reducing new HIV infections by 90% by 2030 [27], and the complexity of addressing HIV in humanitarian settings [10, 19], we conducted a scoping review [28, 29] to explore the evidence and identify key concepts concerning HIV acquisition in humanitarian settings. Reviews undertaken on this topic have focused on the associations between mental health and

HIV acquisition and disease progression in conflict settings [30] and on HIV, reproductive, and sexual health services in emergency settings for specific populations such as adolescent girls and young women [31] and sex workers [32]. To our knowledge, there is no rigorous literature review on factors associated with HIV acquisition in the context of humanitarian crises. This scoping review, therefore, is guided by the following research question: “What is the global evidence on factors associated with HIV acquisition among individuals affected by humanitarian crises?” The review seeks to summarize research on HIV risk factors among people affected by humanitarian crises and identify recommendations for future research and practice.

Methods

We followed the Joanna Briggs Institute (JBI) methodology for scoping reviews [33] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) reporting guidelines [34]. The review protocol was previously published [35]. A completed PRISMA-ScR checklist is included as Supplementary Table 1. Our multidisciplinary research team included individuals who have taken part in conducting HIV-related research and published peer-reviewed literature in the HIV/AIDS, humanitarian, and health sciences fields.

Eligibility Criteria

We included articles that met the following criteria: 1) involving participants affected by humanitarian crises (see below *definition of terms*); 2) including empirical data on HIV serostatus or risk factors of HIV acquisition as a main or substantial focus of the article; 3) were conducted in the context of humanitarian crises including natural and human-caused disasters [2]; and 4) were published in English between January 1990 through March 2022. The search was limited to 1990 onwards which reflects the period when the demographic data on refugees and displaced persons first became available in many host countries [36]. We excluded studies that 1) did not include humanitarian settings or participants; 2) did not report original data (e.g., reviews or opinion pieces); 3) did not address HIV (e.g., focused on sexually transmitted infections (STI) excluding HIV); and 4) studies without full-text available. All quantitative, qualitative, and mixed methods designs were included. Modeling studies reporting empirical data were included.

Definition of Terms

We recognized the use of different terms in existing literature to describe the concepts and contexts concerning HIV

acquisition and humanitarian crises. Informed by relevant review papers and guidance documents published by organizations providing humanitarian assistance, the definitions of the key concepts used in this scoping review are detailed as follows.

We defined *factors associated with HIV acquisition* as a broad range of determinants that may increase or decrease an individual's risk of HIV acquisition, and contribute to HIV prevalence or incidence [37]. Examples of these determinants include biological risk factors (e.g., other STI) [37], behavioral risk factors (e.g., alcohol or substance use) [38], protective behaviors (e.g., condom use, male circumcision) [37], and structural variables (e.g., access to health care) [39]. *People affected by humanitarian crises* include refugees, asylum seekers, internally displaced persons (IDP), and other individuals in need of protection and/or assistance based on humanitarian grounds as described by the United Nations High Commissioner for Refugees (UNHCR) [1, 40]. *Humanitarian crises* as defined by the UN [2] include i) *natural disasters or environmental events* that cause considerable morbidity and mortality, such as droughts, floods, storms, and earthquakes [41], and ii) *complex emergencies* associated with fragile states or areas of conflict, in which a total or considerable breakdown of authority has occurred and requires a large-scale or international response, and often includes large numbers of affected and displaced civilian populations [42, 43].

Data Sources and Search Strategy

The study team (KK, DH, HP, KN) identified initial keywords for the search strategy from previous HIV- and humanitarian-related research [37, 44–46] and refined them collaboratively. The search strategy was developed by a public health librarian (KN) and peer-reviewed by a second librarian not participating in the study. The search strategy in the current scoping review included terms for **participant** (e.g., refugee, asylum seeker, internally displaced person), **concept** (e.g., HIV infection or transmission, HIV incidence or prevalence, risk factor, sexual behavior), and **context** (e.g., disaster, war, humanitarian). Full search terms (including controlled vocabulary) tailored to individual databases are listed in Supplementary Tables 2, 3, 4, and 5.

Studies were identified through searches on several electronic databases including MEDLINE, Embase, Global Health (all accessed via Ovid), and Scopus. We identified additional studies by forward citation chaining using the “cited by” function on Google Scholar for relevant review papers. Additionally, we searched for relevant grey literature by reviewing websites of organizations involved in humanitarian assistance and development work (e.g., UN agencies), relevant non-government organizations (e.g., Elrha), research networks (e.g., Refugee Research Network), and the

International AIDS Society's conference abstract databases and abstract books (2006–2021) (Supplementary Table 6). For unpublished studies (e.g., conference abstracts, repositories), we contacted study authors to request additional data. A search on Google Scholar was conducted until 10 consecutive results unrelated to the topic were displayed in the search results. Searches were conducted between October 2021 through March 2022.

Study Selection

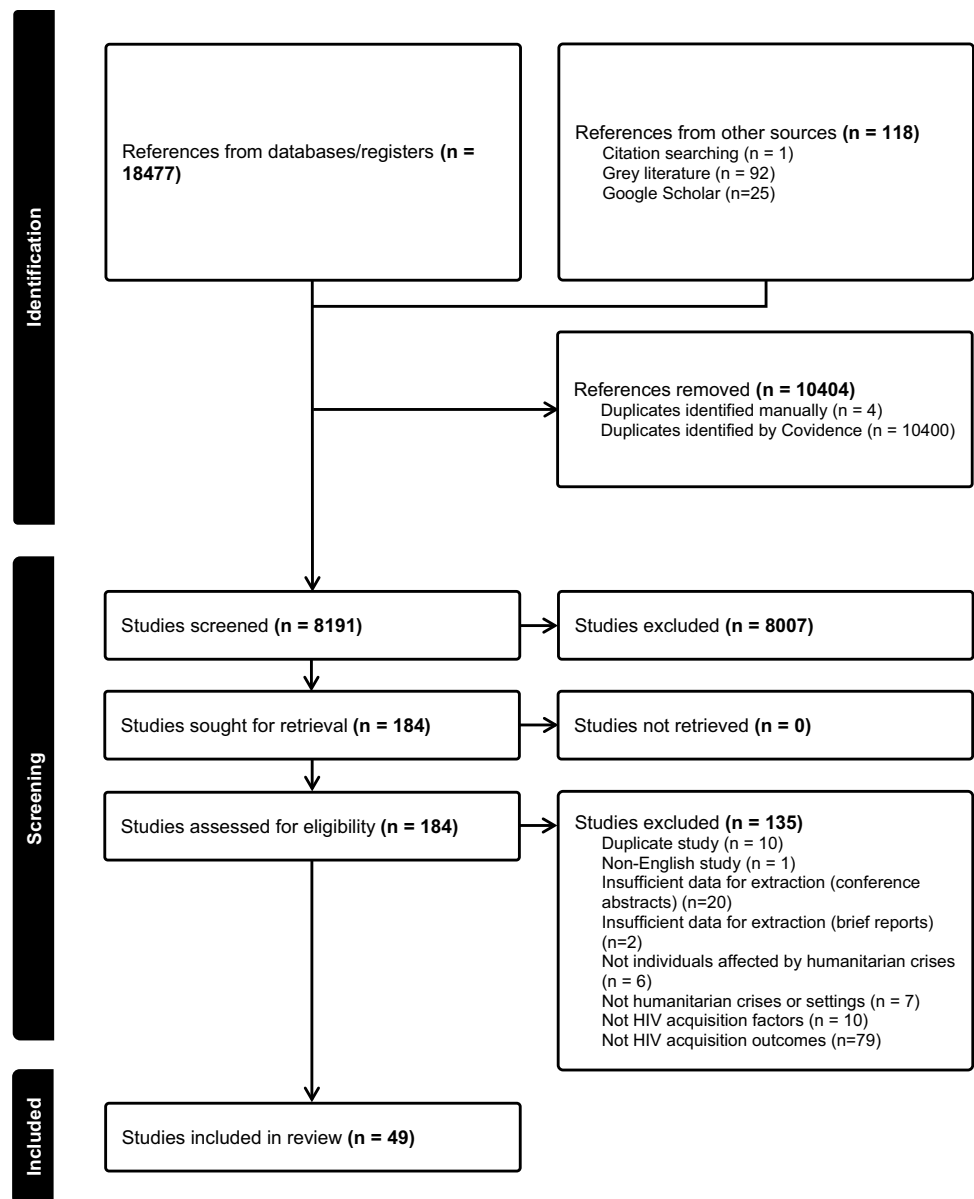
Following the search, all identified citations were uploaded to Covidence (Veritas Health Innovation, Melbourne, Australia), a web-based platform to manage and streamline systematic review process including deduplication, citation screening, full-text review, and data extraction. Two reviewers (DH and HP) independently screened titles and abstracts and excluded articles that did not meet the inclusion criteria for this review. A full-text assessment of the remaining articles was conducted by three reviewers (SA, DH, HP). Disagreements during the screening and full-text assessment processes were resolved by consensus, with additional input from a team member (KK).

Data Extraction

Four reviewers (SA, DH, HP, DG) extracted data into Covidence using a data extraction tool that included author, publication date, type of publication, citation, sample size, type of participants, inclusion and exclusion criteria, participant characteristics (gender, age), country/location of study, context of humanitarian crisis, study aims, study design, outcomes (i.e., HIV prevalence or incidence, modifiable factors and non-modifiable factors for HIV acquisition), and implications for future practice and research reported in the study. Two reviewers (SA and DH) verified the completed extraction forms and subsequently exported them from Covidence into a Microsoft Excel spreadsheet for analysis.

Data Synthesis

Two authors (SA and DH) categorized modifiable and non-modifiable factors of HIV acquisition through discussion and informed by the work of Weine and Kashuba on HIV risk among labor migrants [23]. We generated a list of *non-modifiable factors* that included age, gender, ethnicity, location (e.g., rural or urban), and place of birth or origin. *Modifiable factors*, defined for the purpose of our analysis as any factors that are not biologically or socially determined and can potentially be modified through policy or intervention [47, 48], were categorized into five broad categories: i) policy and structural (e.g., access to HIV prevention and care, mobility status); ii) sociocultural (e.g., religious

Fig. 1 PRISMA-ScR flow diagram

beliefs, marital status); iii) health and mental health (e.g., substance use, STI other than HIV, post-traumatic stress disorder (PTSD), depression); iv) sexual practice (e.g., exchanging sex for money or nonmonetary items, multiple sex partners); and v) exposure to traumatic events related to humanitarian crisis (e.g., sexual violence, abduction or kidnapping). Unless specified by the study authors as refugees, asylum seekers, IDP, or other specific groups (e.g., military personnel), we used the term *persons affected by conflict* or *persons affected by natural disasters* to describe the study populations. We presented descriptive characteristics of the included studies, a narrative summary relevant to the research question, and implications for future programs and research reported in the studies. We created a world map with MapChart to visualize the geographical locations of

the included studies and generated a figure with Microsoft PowerPoint (Microsoft, Redmond, WA, USA) to illustrate the range of factors affecting HIV acquisition in humanitarian settings.

Results

The search yielded 18,595 potentially relevant citations (18,477 from databases, 118 from grey literature). After removing 10,404 duplicates, we screened titles and abstracts of 8,191 citations. We excluded 8,007 citations and retained 184 articles for a full-text review (Fig. 1). These 184 were screened at the full-text level; 135 were excluded, mostly (102)

due to lack of relevance to the research question. A total of 49 articles were included in the final analysis (Fig. 1).

Study Characteristics

Table 1 presents information of the included studies by author name and year, study location (country), study aims, population, design and methodology, context of humanitarian crises, and non-modifiable and modifiable factors. All studies were published in peer-reviewed journals between 1991 and 2022, with nearly three-fourths published from 2010 onward ($n=35$, 71%). Studies were primarily conducted in complex emergencies ($n=40$, 81.6%) [20, 49–87], complex emergencies and natural disasters ($n=4$, 8.2%) [88–91], natural disasters ($n=3$, 6.1%) [92–94], and not specified ($n=2$, 4.1%) [95, 96]. In terms of geographical settings, most were single-country studies ($n=43$, 87.8%) (Fig. 2). Not shown in the figure were four studies involving multiple countries in Sub-Saharan Africa (SSA) ($n=4$, 8.2%) and two global analyses of 69 and 177 countries, respectively ($n=2$, 4.1%). Among the single-country studies ($n=43$), the majority were conducted in SSA ($n=31$, 72.1%) specifically in Uganda ($n=13$). Other single-country studies were conducted in Asia ($n=4$, 9.3%), North America ($n=3$, 7%), Europe ($n=2$, 4.7%), South/Latin America ($n=2$, 4.7%), and the Middle East ($n=1$, 2.3%).

The main study objectives, as reported by the authors, were to determine the prevalence or incidence of HIV and risk behavior correlates of HIV infection ($n=27$, 55.1%) [49, 51, 54–58, 60, 63, 68–72, 74–77, 79, 81, 84, 86, 87, 91, 92, 94, 96], the prevalence or incidence and correlates of HIV and other infectious diseases ($n=12$, 24.5%) [50, 53, 61, 62, 64–66, 73, 80, 83, 88, 95], the potential impact of complex emergencies and natural disasters on HIV prevalence or incidence through mathematical modeling ($n=8$, 16.3%) [20, 52, 78, 82, 85, 89, 90, 93], and the prevalence and correlates of mental health problems and HIV ($n=2$, 4.1%) [59, 67]. Among the 49 included studies, 43 (87.8%) were quantitative, 4 (8.2%) were qualitative, and 2 (4.1%) were mixed methods studies. Most were cross-sectional in design ($n=37$, 75.5%), and the remaining were modeling studies ($n=8$, 16.3%), prospective cohort studies ($n=2$, 4.1%), and case-control studies ($n=2$, 4.1%). Of the 49 studies, only one (2%) was an intervention study in the form of an HIV screening program.

Evidence of Non-modifiable Factors for HIV Acquisition in Humanitarian Settings

Of the 49 included studies, 36 (73.5%) reported information on the effects of five non-modifiable factors on HIV prevalence, incidence, or serostatus in the context of

humanitarian crises, namely age ($n=28$), gender ($n=24$), location ($n=16$), place of birth or origin ($n=8$), and ethnicity ($n=4$). A list of factors and corresponding frequencies are presented in Table 2.

Age

The effect of age on HIV acquisition was referenced in 28 studies [49–51, 53, 55–57, 60–66, 68–73, 76, 77, 80, 84, 88, 90, 94, 95] with varying results. Twenty-two studies reported HIV prevalence and correlates in different age groups [50, 51, 53, 55–57, 60–62, 64–66, 68, 69, 71, 72, 76, 77, 80, 84, 90, 94]; 5 examined factors related to HIV serostatus [49, 70, 73, 88, 95]; and 1 measured HIV incidence rate [63]. Several studies reported that the prevalence of HIV was higher among older individuals in humanitarian settings [50, 55, 57, 60, 66, 69, 76, 80, 90]. In a large sample of refugees and asylum seekers in Germany ($n=15,317$), increased age was a significant predictor of HIV infection (Odds Ratio (OR) 1.09 [CI not reported]; $p<0.001$) [50]. Similarly, among 970 male and female refugee participants in Cameroon, age > 40 years was identified as a risk factor for HIV infection (OR 3.3 [CI 1.3 to 8.9]; $p=0.01$) [66]. In a survey study of 605 conflict-affected women aged 13–49 in Northeastern Uganda, increased age was associated with reporting HIV-positive serostatus in two of the three districts included in the study [70]. Conversely, younger age was associated with higher prevalence of HIV in several studies [56, 62, 68, 72, 94]. For example, in a study examining HIV prevalence and associated factors in conflict-affected sex workers in Uganda, newly diagnosed women were younger compared to women with a previous HIV diagnosis (median age: 24 (Inter-Quartile Range (IQR): 20–26) vs. 25 (IQR: 23–28), $p=0.07$) [56]. In a Pakistani study of IDP, the HIV positivity rate was higher among individuals aged 18–30 years (0.7%) compared to individuals aged 31–40 years (0.3%) [73]. In a cross-sectional study of HIV prevalence and correlates among displaced pregnant women in Mozambique [53], participants who were HIV-positive reported a slightly younger mean age compared to those without HIV (24.3 vs. 25.5); however, the difference was not statistically significant.

Gender

The role of gender in HIV acquisition in humanitarian settings were examined in 24 studies [50, 51, 61–64, 66–69, 71–77, 79, 82, 88, 90, 93–95]. Nineteen studies reported on HIV prevalence and correlates [50, 51, 61, 62, 64, 66, 68, 69, 71, 72, 74–77, 79, 82, 90, 93, 94], 4 studies on determinants of HIV serostatus [67, 73, 88, 95], and 1 study on HIV incidence [63]. The prevalence of HIV appeared to be higher among females than males, as observed in multiple studies conducted among conflict-affected individuals and refugees

Table 1 Characteristics of included studies (n = 49)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Quantitative studies (n = 43)							
Adedimeji [49]	Rwanda 2005	To describe the associations between HIV infection and factors influencing current sexual practices and risk behavior of women who experienced sexual violence in and outside the Rwandan 1994 genocide	Persons affected by conflict; female adults and children n = 928 Age range: 15 and older	Cross-sectional study; interviewer-administered survey, physical and gynecological examination, HIV serological testing, collection of blood, urine, and gynecological specimens	Complex emergency	Age	Income level (monthly), living with someone else, living with husband/partner, number of people living with, STI diagnosis (past), depression symptoms, PTSD symptoms, sex in last 6 months, number sex partners last 6 months, condom use \geq 50% last 6 months, exchanging sex for money or nonmonetary items, experience of non-genocidal sexual trauma, experience of genocidal rape
Alberer [50]	Germany November 2014– October 2016	To identify risk factors for notifiable infectious diseases and other infectious diseases relevant in the setting of a communal accommodation	Refugees and asylum seekers; female and male adults and children n = 811 Median age (range): 23 (2–76)	Cross-sectional study; health records review	Complex emergency	Age, gender, place of birth/origin	N/A
Aliyu [51]	Nigeria July– December 2018	To ascertain the burden and distribution of HIV disease, assess the coverage and impact of HIV services at the population level, and measure HIV-related risk behaviors	Persons affected by conflict; female and male adults and children n = 186,405 Age range: 15–64	Cross-sectional interviewer-administered survey, HIV, hepatitis B, and hepatitis C serological testing	Complex emergency	Age, gender, location (urban or rural; conflict or non-conflict zones)	Income level (household)

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Anema [52]	Burundi, Sierra Leone, Rwanda, Democratic Republic of the Congo, Liberia, Sudan, Uganda Secondary data reported in 2006, accessed in 2007	To analyze the impact of varying scenarios of widespread rape on HIV prevalence in 7 SSA countries affected by conflict	Persons affected by conflict; female adults and children n = 2,782,000 (United States Census Bureau's International Data Base annual population estimates of HIV/AIDS) n = 60,064,924 (UNAIDS/WHO's national HIV prevalence estimates for women aged 5–49 years) Age range: 5–49	Modeling study; secondary data analysis	Complex emergency	N/A	Widespread rape during armed conflicts
Beckwith [95]	United States 2000–2006	To perform a retrospective case-control analysis to characterize HIV acquisition, disease comorbidities, HIV stage upon establishment of care, ART utilization, enrollment in clinical studies, and adherence with appointments	Refugees and non-refugees; female and male adults n = 104 (52 refugees, 52 matched non-refugees) Mean age (SD) of refugees: 34.2 (21–56) Mean age (SD) of non-refugees: 35.3 (22–58)	Retrospective case-control study; health records review	Not reported	Age, gender	Marital status, mobility status (refugee, non-refugee), active TB disease, latent TB infection, hepatitis A infection, hepatitis B infection, hepatitis C infection, STI diagnosis (current), low albumin, leukopenia, thrombocytopenia, anemia, alcohol use (current), injecting drug use (current), heterosexual, MSM

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Bennett [20]	Angola, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe	To quantify the association between violent conflict and the HIV/AIDS incidence rates in 36 SSA countries, and to determine the temporal patterns of HIV incidence in relation to violent conflict	Persons affected by conflict; female and male adults and children n = not reported Age range: 15–49	Modeling study; secondary data analysis	Complex emergency	N/A	Conflict intensity (<25 deaths, 25–1000 deaths, > 1000 deaths), conflict time period (no conflict, pre-conflict, during conflict, post-conflict), number of refugees, income level (country), conflict type (extra-systemic, interstate, internal, international war), number of battle-related deaths
	Secondary data reported in 1990–2012, accessed in 2014						

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Berndt [93]	69 countries identified within the lower three quartiles of the World Bank income classification Secondary data reported in 2008–2012, accessed in 2018	To examine HIV burden among women experiencing droughts	Persons affected by drought; female adults and children n = not reported Age range: 15–49	Modeling study; secondary data analysis	Natural disaster or environmental event	Gender, place of birth/origin	Average % affected by droughts, GDP per capita, health expenditures as % of GDP, percentage of population living in urban areas, democracy measure, external debt stocks as % of GDP, education level (secondary or higher), number of trained health workers, religious beliefs (percent Muslim population), female contraceptive use

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Cossa [53]	Mozambique September 1992–February 1993	To determine the prevalence and correlates of HIV infection and syphilis, and to characterize the impact of war-related migration on STI acquisition	IDP; female adults and children n = 1728 Mean age (range): 25.5 (14–45)	Cross-sectional study; interviewer-administered survey, HIV and syphilis serological testing, physical examination	Complex emergency	Age	Education level (≥ 1 year of school), marital status, history of blood transfusion (past 10 years), genital ulcers (current), vaginal discharge (current), warts (current), STI diagnosis (current, past), number of sexual partners, exchanging sex for money or nonmonetary items, partner's circumcision status, partner ever used a condom, ever used vaginal herbs before coitus, ever practiced anal sex, ever practiced vaginal douching, ever practiced oral sex, recent contraception use, duration of displacement (months), mobility status (IDP, externally displaced), with husband during displacement, experience of rape, experience of sexual abuse during displacement
Courtney [54]	South Sudan July–August 2010 and April–May 2012	To estimate the prevalence and correlates of HIV infection	Military personnel; female and male adults n = 1149 Mean age: 34.8	Cross-sectional study; computer-assisted survey, HIV serological testing	Complex emergency	N/A	HIV knowledge, stigma (HIV), alcohol use (current), depression symptoms, PTSD symptoms, HIV knowledge, multiple sex partners, condom use at last sex

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Crawshaw [88]	United Kingdom March 2013–August 2017	To analyze and describe data on the prevalence of all infectious diseases among refugees who underwent comprehensive pre-entry health assessments as part of the UK resettlement program	Refugees; female and male adults and children n = 17,729 Median age (IQR): 18 (7–33)	Cross-sectional study; health records review, secondary data analysis, hepatitis B, hepatitis C, HIV, other STI, and TB serological testing	Complex emergency and natural disaster or environmental event	Age, gender, place of birth/origin	WHO region of examination, years of examination, STI diagnosis (past), history of blood transfusion, experience of torture, history of being displaced, illicit drug use (past), history of surgical intervention, history of tattoos, alcohol use (past)
Fabiani [55]	Uganda June–December 2005	To estimate the prevalence and identify sociodemographic factors associated with HIV infection	Persons affected by conflict and IDP; female adults and children n = 3051 Mean age (SD): 24.8 (6)	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, location (district; inside or outside of protected camps for IDP)	Education level (primary or lower, secondary or higher), employment and occupation status (modern, traditional), employment and occupation status of partner, marital status, age of partner, lifetime pregnancies

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Goldenberg [57]	Uganda May 2011-January 2012	To determine the HIV burden and associations with structural factors	Persons affected by conflict; FSW n = 400 Median age (range): 21 (19–25)	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, ethnicity, place of birth/origin	Education level (primary or lower), mobility status (migrant, non-migrant), having lived in an IDP camp, criminal justice involvement, having children, age at first sex work, duration in sex industry, income level (weekly from sex work), having an intimate partner, having a manager for sex work, experience of abduction into the Lord's Resistance Army, rushed client negotiations due to police presence, client physical or sexual violence, verbal/physical sexual violence by partner, verbal/physical/sexual violence by police/soldiers, average weekly client volume, inconsistent condom use, working under the influence of alcohol/drugs, having all/most clients intoxicated on dates, sex work solicitation venue, access to HIV information and education, access to HIV prevention and care

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Goldenberg [55, 56]	Uganda May 2011-January 2012	To examine factors associated with new HIV diagnoses and ART utilization	Persons affected by conflict; FSW n = 400 Age range: 14 and older	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age	Housing status, education level (primary or lower), mobility status (migrant, non-migrant), police harassment without arrest, drug/alcohol use (past 6 months), drug/alcohol use with clients (past 6 months), lifetime pregnancies, inconsistent condom use with clients, access to HIV information and education, client sexual/physical violence, intimate partner violence, STI diagnosis (past), access to HIV prevention and care, received a pap smear, weekly client volume, income level (weekly from sex work), places of solicitation, places of service
Harbertson [59]	Rwanda October 2008-November 2010	To assess the prevalence of depression and PTSD and identify associations with sexual risk behavior, STI, HIV, and alcohol use	Military personnel; male adults n = 1307 Mean age (SD): 30.9 (5.6)	Cross-sectional study; self-administered survey, HIV serological testing	Complex emergency	N/A	Depression symptoms, PTSD symptoms

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Heimer [60]	Lebanon October 2014-February 2015	To assess HIV prevalence and identify HIV risk behaviors and psychological factors	Persons affected by conflict; male adults, MSM n = 292 Mean age (SD): 27.1 (8.1)	Cross-sectional study; interviewer-administered survey	Complex emergency	Age, place of birth/origin	Income level (monthly), experience of housing discrimination, experience of physical assault, multiple sex partners, condomless sex past year, exchanging sex for money or nonmonetary items past year, sex while intoxicated or high on drugs past year
Kaiser [62]	Sudan November 2002 and April 2003	To determine the prevalence and correlates of HIV, syphilis, and herpes simplex virus 2	Persons affected by conflict; female and male adults n = 2731 Age range: 15–49	Cross-sectional study; interviewer-administered survey, herpes simplex virus 2, HIV, and syphilis serological testing	Complex emergency	Age, gender, location (district)	Marital status, genital ulcers (past year), abnormal urethral discharge (past year), herpes simplex infection (current), STI diagnosis (current), mobility status (IDP, refugee, local resident), condom use with non-regular partner in past 12 months

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Katamba [63]	Uganda November 2011– March 2015	To determine the HIV incidence and identify vulnerabilities associated with HIV infection	Persons affected by conflict; female and male adults and children n = 1920 Median age of female participants (IQR): 25 (19–33) Median age of male participants (IQR): 23 (17–32)	Prospective cohort study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, gender, ethnicity	Education level (none, primary, secondary or higher, others), female-headed household, depression symptoms, suicide ideation, STI diagnosis (current), sex with genital ulcers in past year, ill health without medical care, marital status, age of sexual debut (< 16 vs ≥ 16), first sex partner ≥ 10 years older, coerced sexual debut, condom use at sexual debut, number of sex partners past year, inconsistent condom use with last 3 partners, experience of abduction, sexual assault in context of war, ≥ 12 traumatic events
Kerridge [89]	WHO Member States (n = 177) Secondary data reported in 2002–2010, accessed in 2013–2014	To develop and test a longitudinal explanatory model linking armed conflict occurring between 2002 and 2008 and its longer-term impact on HIV morbidity and mortality in 2010	Persons affected by conflict and natural disasters Sample size, gender, and age not reported	Modeling study; secondary data analysis	Complex emergency and natural disaster or environmental event	Ethnicity	Number of refugees, total HIV spending, number of people on ART, per capita alcohol consumption, prevalence of illicit drug use (cannabis, opiates, cocaine), prevalence of injecting drug use, natural disaster measure, ethnic heterogeneity (racial, linguistic, religious), baseline HIV prevalence

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Khanani [64]	Pakistan Not stated	To investigate the prevalence of HIV, hepatitis B, and hepatitis C	Refugees; female and male adults and children n=556 Age range: 10 and older	Cross-sectional study; interviewer-administered survey, hepatitis B, hepatitis C, and HIV serological testing	Complex emergency	Age, gender, location (district)	Employment and occupation status, history of travel out of country, marital status, drug use (past), drug use (current), multiple sex partners, MSM
Kim 2009[65]	Democratic Republic of Congo February-April 2005	To investigate the prevalence and correlates of HIV and syphilis	IDP and refugees; female adults and children n = 1288 Age range: 15–49	Cross-sectional study; interviewer-administered survey, HIV and syphilis serological testing	Complex emergency	Age	Mobility status (local resident, repatriated refugee, IDP), STI diagnosis (current, past), age of sexual debut, numbers of partners past 12 months, experience of sexual violence (during conflict)
Kowo [66]	Cameroon 2019	To assess risk factors and the prevalence of hepatitis B, hepatitis C, and HIV	Refugees; female and male adults and children n=970 Median age (range): 29 (2–87)	Cross-sectional study; interviewer-administered survey, hepatitis B, hepatitis C, and HIV serological testing	Complex emergency	Age, gender	Employment and occupation status, marital status, history of abortion, history of dental procedure, history of surgery, history of hospitalization, STI diagnosis (past), history of blood transfusion, history of scarifications, history of tattoos, family viral infection, injecting drug use (past), multiple sex partners

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Loevinsohn [90]	Malawi Secondary data reported in 1999, 2002, 2003, 2004, 2005, accessed year not reported	To assess the 2001–03 famine in Malawi as a country-scale natural experiment on the effect of hunger on the dynamics of HIV	Persons affected by famine; female and male adults and children n = 1128 households (prevalence of rural hunger derived from a country-wide humanitarian survey in 2002) n = 10,777 households (prevalence of migration derived from a country-wide survey in 2004 and early 2005, age range 15–49) n = 14,142 women attending ANC (prevalence of HIV derived from the ANC surveillance), age range 15–44	Modeling study; secondary data analysis	Complex emergency and natural disaster or environmental event	Age, gender, location (rural, urban, or semi-urban) recategorized in analysis as rural or non-rural)	Employment and occupation status (farmer, non-farmer), education level
Low [94]	Lesotho November 2016–May 2017	To assess the association between drought, HIV prevalence, and risk behaviors	Persons affected by drought; female and male adults and children n = 12,887 Age range: 15–59	Cross-sectional study; interviewer-administered survey, HIV serological testing	Natural disaster or environmental event	Age, gender, location (rural or urban)	Income level, food insecurity, history of travel out of country, education level, marital status, intergenerational sex (i.e., sexual partner ≥ 10 years older) in past year, exchanging sex for money or nonmonetary items, condom use at last sex

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Luo [67]	Uganda November 2011-July 2022	To estimate the prevalence of probable PTSD and depression in post-conflict setting and examine socio-structural, war-related, and sexual vulnerability factors associated with mental health	Persons affected by conflict; female and male adults and children n = 2458 Median age (IQR): 25 (18–32) Age range: 13–49	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Gender, location (district)	Marital status, depression, PTSD, ill health without medical care, coerced sexual debut, forced sex by partner past year, mobility status (permanent, transient, displaced), perceived safety in community, number of camps lived in, ≥ 10 traumatic events, experience of war-related rape or sexual abuse

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Malamba [68]	Uganda November 2011–July 2012	To determine the HIV prevalence and associated risk factors	Persons affected by conflict; female and male adults and children n = 2449 Median age (IQR): 25 (18–32) Age range: 13–49	Cross-sectional study; interviewer-administered survey, HIV and syphilis serological testing	Complex emergency	Age, gender, location (district)	Education level, marital status, religious beliefs, child-headed household, female-headed household, depression symptoms, PTSD symptoms, suicide ideation (past 2 weeks), ill health without medical care, genital ulcers (past year), STI diagnosis (current), lifetime number of sexual partners, buying/purchasing sex past 12 months, circumcision status (men only), condom use with last 3 partners in past 12 months, experience of rape or sexual abuse, ≥ 12 traumatic events, war trauma experiences, mobility status (permanent, transient, displaced), experience of abduction
Mansson [69]	Guinea-Bissau February 1990–31 December 2007 (data collection paused from June 1998 through end of 2002 due to civil war)	To examine the prevalence and incidence of HIV-1 and HIV-2 between 1990 and 2007 and examine the impact of the 1998–1999 civil war	Police officers; female and male adults and children Median age (IQR) of female participants: 30 (25–38) Median age (IQR) of male participants: 36 (28–45) Age range: 17 and older	Prospective cohort study; interviewer-administered survey, HIV and syphilis serological testing	Complex emergency	Age, gender	History of genital ulcer disease, history of urethral discharge and/or genital ulcer disease, STI diagnosis (current), number of sexual partners or extramarital relations past month, buying/purchasing sex (male only), inconsistent condom use

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Moorz [70]	Uganda January–May 2016	To examine the mediating effect of transactional sex work on the observed relationship between exposure to armed conflict and reporting a HIV-positive serostatus	Persons affected by conflict; female n = 605 Mean age (SD): 29.88 (8.89)	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, location (district)	Exchanging sex for money or nonmonetary items, exposure to armed conflict
Mulanga [71]	Democratic Republic of the Congo March–May 2002	To report the impact of conflict on the stability of HIV prevalence compared with previous study results (Mulanga-Kabeya 1998)	Persons affected by conflict; female and male adults n = 3090 Gender and age not reported	Cross-sectional study; HIV serological testing	Complex emergency	Age, gender, location (district)	STI diagnosis (current), exchanging sex for money or nonmonetary items, mobility status (local resident, IDP)

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Mulanga-Kabeya [72]	Democratic Republic of the Congo February-April 1997	To determine current data on HIV infection and document changes and trends of HIV seroprevalence in selected populations over time	Persons affected by conflict; female and male adults, FSW n = 1970 Mean age (SD) of pregnant women: 25.2 (6.3) Hospitalized TB patients; mean age (SD) of female patients: 29.8 (12.6), mean age (SD) of male patients: 32.1 (2.7) Mean age (SD) of FSW: 24.9 (5.8) People attending STI clinics; mean age (SD) of female patients: 28.3 (7.8), mean age (SD) of male patients: 32.6 (12.7) Blood donors (gender and age not reported) Male clients of FSW (age not reported)	Cross-sectional study; self-administered survey, HIV serological testing	Complex emergency	Age, gender, location (district)	History of travel outside of country, marital status, exchanging sex for money or nonmonetary items, buying/purchasing sex
Najib [73]	Pakistan Data collection period not reported	To investigate the burden of hepatitis B, hepatitis C and HIV and explore route of transmission	IDP; female and male adults n = 300 Age range: 18 and older	Cross-sectional study; self-administered survey, HIV serological testing	Complex emergency	Age, gender	History of travel outside of country, history of dental procedure, drug use (past)

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
O'Laughlin [74]	Uganda March 2013-November 2014	To evaluate the correlation of HIV infection of those tested during a clinic-based HIV screening intervention study	Refugees and non-refugees; female and male adults n = 7766 Median age (IQR): 32 (25–43) Age range: 18 and older	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Gender, location (district), place of birth/origin	Mobility status (refugee, non-refugee), education level (none, some primary, completed primary, higher than primary), access to health care, marital status, previous HIV testing, HIV knowledge
Patel [75]	Uganda May-December 2010	To determine the effects of abduction and living in the bush on the prevalence of HIV and HIV-related risk behaviors	Persons affected by conflict; female and male adults and children n = 384 Median age (IQR): 20 (15–29) Age range: 15–29	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Gender	Experience of abduction

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Patel [76]	Uganda May-December 2010	To assess the prevalence and correlates of HIV infection among young people living in post-conflict transition	Persons affected by conflict; female and male adults and children n = 384 Median age (IQR): 20 (15–29) Age range: 15–29	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, gender, location (district)	Food and water insecurity, had enough food to eat past 12 months, education level (ever in school, currently in school, dropped out), marital status, alcohol use (past), STI diagnosis (past), experience of rape, sexual assault perpetrator \geq 10 years older, physical/sexual/verbal abuse by sexual partner, coerced sexual debut, first sex partner \geq 10 years older, ever practiced dry sex, number of HIV tests in lifetime, knowing partner's HIV status, perceived ability to protect oneself from HIV/STI, experience of night-commuting during the war, age of sexual debut, alcohol use before sex (past), alcohol use before last sex, exchanging sex for money or nonmonetary items, ever used a condom, condom use during last sex, able to say no to sex, experience of abduction, lived in IDP camps \geq 10 years

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Patel [77]	Uganda September-December 2010	To analyze sex-disaggregated data to assess the strongest correlates of HIV infection in relation to gender and risk behaviors among young people living in transit camps	Persons affected by conflict; female and male adults and children n = 384 Median age (range): 20 (15–29)	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Age, gender, location (district)	Education level (currently in school), food and water insecurity, had enough food to eat past 12 months, marital status, age at first marriage, ever pregnant, age at first pregnancy, experience of rape, age at rape, sexual assault perpetrator \geq 10 years older, STI diagnosis (past), previous HIV testing, lifetime number of HIV tests, experience of physical/sexual/verbal abuse, age of sexual debut, first sex partner \geq 10 years older, ever practiced dry sex, coerced sexual debut, alcohol before sex (past), ever used a condom, inconsistent condom use, condom used last sex, knowing partner's HIV status, able to say no to sex, perceived ability to protect oneself from HIV/STI, exchanging sex for money or nonmonetary items, experience of night-commuting, experience of abduction, lived in IDP camps \geq 10 years

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Smallman-Raynor [78]	Uganda Secondary data reported in 1989, accessed in February 1990	To assess the impact of military-associated factors on geographical distribution of reported AIDS cases	Persons affected by conflict n = 12,444 Gender and age not reported	Modeling study; secondary data analysis	Complex emergency	N/A	Urbanization, migrant labor, district accessibility to the main highways, military recruitment

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Spittal [79]	Uganda November 2011-July 2012	To assess the HIV prevalence and vulnerabilities stratified by gender in post-conflict setting	Persons affected by conflict; female and male children and adults n = 2008 Age range: 13–49	Cross-sectional study; interviewer-administered survey, HIV and syphilis serological testing	Complex emergency	Gender	Female-headed household, child-headed household, marital status, religious beliefs, depression symptoms, PTSD symptoms, suicide ideation, ill health without medical care, genital ulcers (past year), STI diagnosis (current), first sex partner ≥ 10 years older, condom use at sexual debut, number of sexual partners in past year, condom use with last 3 partners past year, exchanging sex for money or nonmonetary item, age of sexual debut (< 18 or ≥ 18), coerced sexual debut, most recent partner's circumcision status, circumcision status (male only), mobility status (permanent, transient, displaced), sexual assault in context of war, ≥ 12 traumatic events, experience of abduction, access to health care

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Strand [81]	Angola February–March 2000	To determine the HIV prevalence and the relationship between armed conflict and HIV prevalence	Persons affected by conflict; female n = 1035 Mean age (SD): 26.3 (not reported)	Cross-sectional study; interviewer administered survey, HIV and syphilis serological testing	Complex emergency	N/A	Employment status, monogamous relationship status, marital status, mean age of sexual debut, level of arm conflicts
Supervie [82]	Burundi, Democratic Republic of Congo, Rwanda, Sierra Leone, Somalia, Sudan ^a , Uganda Data collection period not reported	To quantify the potential impact of mass rape on HIV incidence in conflict-afflicted countries	Persons affected by conflict; female n = not reported Age range: 5–49	Modeling study; secondary data analysis	Complex emergency	Gender, place of birth/origin	Widespread rape during armed conflicts
Todd [83]	Afghanistan June 2007–December 2009	To estimate the incidence of hepatitis C and HIV and modifying factors	Persons affected by conflict; male n = 483 Median age (IQR): 28 (24–35)	Cross-sectional study; interviewer administered survey, hepatitis C and HIV serological testing	Complex emergency	N/A	Duration of injecting drug use, sharing of syringes/needles, sharing of injecting supplies, use of NSP (past 3 months, current, discontinued), changed from injecting to smoking, exposure to conflicts
Wanigaratne [96]	Canada Secondary data reported in 2002–2011, accessed year not reported	To compare severe maternal morbidity (SMM) and SMM subtypes, including HIV	Refugees, non-refugee immigrants, and non-immigrants; female adults and children n = 1,154,421 Age range: 15 and older	Retrospective case-control study; secondary data analysis	Not reported	N/A	Mobility status (refugee, immigrant, nonimmigrant)

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Wanigaratne [84]	Canada Secondary data reported in 2002–2014, accessed year not reported	To examine the relationship between refugee status and HIV prevalence modified by secondary migration status (i.e., movement of migrants to a transition country prior to moving to the current location)	Refugees and non-refugees; female adults and children n = 141,775 Age range: 15–50	Cross-sectional study; interviewer-administered survey, HIV and syphilis serological testing	Complex emergency	Age, place of birth/origin	Mobility status (refugee, immigrant), refugee with secondary migration status (residing in a transition country prior to resettling in another country), refugee sponsorship status (UNHCR-sponsored refugee, non-sponsored refugee)
Watts [85]	Burundi, Cote d'Ivoire, Democratic Republic of the Congo, Liberia, Rwanda, Uganda Secondary data reported in 1997, 2004, 2007, 2008, 2009, accessed year not reported	To present published evidence on sexual violence in different conflict affected settings in SSA, and use mathematical modelling to explore whether sexual violence increases individual HIV risk and community HIV incidence	Persons affected by conflict; female adults, female children, and male adults Sample size, gender, and age not reported	Modeling study; secondary data analysis	Complex emergency	N/A	Experience of sexual violence or rape, history of genital injury, perpetrators' HIV-positive serostatus, community HIV incidence
Wollants [86]	El Salvador July 1988–December 1993	To evaluate reported cases of HIV-1/AIDS and determine routes of transmission and risk behavior factors	Military personnel; female and male adults n = 33,000 Age range: 18–38	Cross-sectional study; interviewer-administered survey, HIV serological testing	Complex emergency	Location (rural or urban)	Blood donor, time in the military, marital status, sexual contact as route of transmission, multiple heterosexual partners in year prior to diagnosis, buying/purchasing sex

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Qualitative studies (n = 4)							
Anthoni [92]	Namibia March–May 2012	To understand the impact of flooding on PWH and HIV service providers	Persons affected by flood; female and male adults n = 7 (PWH) n = 21 (stakeholders) n = not reported (stakeholder feedback meeting) Age not reported	Cross-sectional qualitative study; individual semi-structured interviews, focus groups, stakeholder feedback meeting	Natural disaster or environmental event	N/A	Access to health care, access to HIV information and education, access to HIV prevention and care, safety and camp conditions, stigma (HIV), lack of livelihood assets, family separation, social support, alcohol use in community, sexual violence in community, outbreak of other diseases, immune system impairment, exchanging sex for money or nonmonetary items, unprotected sex

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Haffejee [58]	South Africa Data collection period not reported	To provide an in-depth understanding of HIV risk factors among refugee women	Refugees; female adults n = 12 Age range: 20 and older	Cross-sectional qualitative study; individual semi-structured interviews	Complex emergency	N/A	Access to HIV prevention and care, income level, employment and occupation status, marital status, sexual/physical/verbal abuse by partner, abuse by partner's sexual partner, regular HIV testing, not knowing partner/husband's HIV status, partner infidelity, exchanging sex for money or nonmonetary items, perceived sexual power to negotiate safe sexual practices, religious beliefs, partner/husband's having multiple sexual partners, partner/husband refusing HIV testing, forced sex by partner/husband

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Zea [91]	Colombia 2008–2009	To explore the life trajectories of displaced gay, bisexual and transgender individuals to understand the effect of forced internal displacement on HIV risk	IDP and key informants; male, female and transgender adults n = 61 (42 IDP, 19 key informants) Age range: 18–48	Cross-sectional qualitative study; individual in-depth interviews, life history interviews, self-report HIV status	Complex emergency and natural disaster or environmental event	N/A	Migration, poverty, widespread fumigation of coca fields causing contamination, employment and occupation status, education level (primary or less, middle school, some high school, finished high school, some college, finished college), access to health care, access to HIV prevention and care, access to HIV information and education, family separation (due to sexual identity and HIV-positive status), social support, social norms (family rejection/acceptance), stigma (gender non-conformity, HIV, homosexuality), experience of rape or sexual violence, experience of anti-gay violence, exchanging sex for money or nonmonetary items, STI diagnosis (past) Experience of sexual violence or rape
Zihindula [87]	Democratic Republic of Congo Data collection period not reported	To explore the perceptions and experiences of the risk of sexual violence	Persons affected by conflict; female adults and children n = 19 Age range: 13–50	Cross-sectional qualitative study; individual in-depth interviews, self-report HIV status	Complex emergency	N/A	

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Mixed methods studies (n = 2)							
Holt [61]	Ethiopia June and October 1992	To investigate knowledge, attitudes, risk behaviors, and HIV and STI prevalence	Refugees and non-refugees; female and male adults and children, FSW 28 refugee women participating in focus group, age range: 18–45 49 refugee women attending ANC participating in a survey, age not reported 469 persons participating in serological testing (211 male refugees, median age (range): 20 (15–50); 209 FSW, median age (range): 19 (15–35); 94 ANC attendees median age (range): 24 (16–36))	Cross-sectional study; interviewer administered survey, focus groups, herpes simplex virus 2, HIV, and syphilis serological testing	Complex emergency	Age, gender	Herpes simplex infection, STI diagnosis (past), vaginal discharge-genital ulcers-inguinal swelling (past), penile discharge-genital ulcers-inguinal swelling (past), buying/purchasing sex

Table 1 (continued)

First author, year published	Study location, year of data collection	Study aims/ objectives	Study population, sample size, age (mean, median, or age range in years)	Study design and methodology	Context of humanitarian crisis	Non-modifiable factors	Modifiable factors
Plewes [80]	Thailand 1997 and 2005	To determine the prevalence of HIV and syphilis, and assess knowledge, attitudes, beliefs and behaviors surrounding HIV and STI	Refugees and migrant women; female adults and children attending ANC 500 pregnant women tested for HIV in 1997 and 2005, respectively; 404 and 234 pregnant women tested for syphilis in 1997 and 2005, respectively; 109 pregnant women participating in focus group in 2005; 2 counselors participating in interviews in 2005 Median age (range) of pregnant women with HIV participating in focus group: 25 (15–43) Median age (range) of pregnant women without HIV participating in focus group: 33 (22–41)	Cross-sectional study; interviewer administered survey, individual semi-structured interviews, focus groups, HIV and syphilis serological testing	Complex emergency	Age, location (district), ethnicity	Education level (none, 1–5 years, 6–8 years, 9–12 years), history of travel outside camp, number of marriages, number of husband's marriages, multiple sex partners, lifetime pregnancies, history of tattoos, husband's history of tattoos, STI diagnosis (past), injecting drug use (past), husband's injecting drug use (past), history of (past), history of blood transfusion, husband's history of blood transfusion, HIV knowledge level, husband's buying/purchasing sex, exchanging sex for money or nonmonetary items

ANC antenatal clinics, ART antiretroviral therapy, FSW female sex workers, GDP gross domestic product, IDP internally displaced persons, IQR interquartile range, MSM men who have sex with men, NSP needle and syringe program, PTSD post-traumatic stress disorder, PWH persons with HIV, PWID persons who inject drugs, SSA Sub-Saharan Africa, STI sexually transmitted infections, TB tuberculosis, UNAIDS Joint United Nations Programme on HIV/AIDS, UNHCR United Nations High Commissioner for Refugees, WHO World Health Organization

^aSouthern Sudan was part of Sudan during the study. South Sudan declared independence in 2011



Fig. 2 Countries of included studies ($n=43$, single-country study), excluding 4 studies involving multiple Sub-Saharan African countries and 2 global analyses of 69 and 177 countries. The geographical locations of the 43 studies were Afghanistan (1), Angola (1), Cameroon (1), Canada (2), Colombia (1), Democratic Republic of Congo (4), El

Salvador (1), Ethiopia (1), Germany (1), Guinea-Bissau (1), Lebanon (1), Lesotho (1), Malawi (1), Mozambique (1), Namibia (1), Nigeria (1), Pakistan (2), Rwanda (2), South Africa (1), South Sudan (1), Sudan (1), Thailand (1), Uganda (13), the United Kingdom (1), and the United States (1)

in Uganda [68, 74, 76, 79], the Democratic Republic of Congo (DRC) [72], Sudan [62], and Lesotho [94]. Being female aged 15–19 years living in drought-affected areas in Lesotho was associated with a higher HIV prevalence compared to their male counterparts in rural areas without drought (OR 2.77 [CI 1.19 to 6.47]; $p=0.02$), although this association was not significant for females of older age groups in the study (20–59 years) [94]. These findings were in line with research showing that female refugees and asylum seekers in the UK and Germany had increased odds of reporting HIV infection [50, 88]. In a large modeling study of 65 countries, being impacted by drought significantly increased the proportion of HIV burden among women relative to men [93]. In contrast, studies in Pakistan involving IDP [73] and refugees [64], respectively, indicated a higher prevalence of HIV among males compared to females. Similarly, in Nigeria, adult females affected by conflicts had a 43% lower likelihood of testing HIV-positive than adult males [51].

Location

Sixteen studies examined the impact of location on HIV acquisition by considering factors such as urban or rural settings [51, 86, 90, 94], specific districts [55, 62, 64, 67, 68,

70–72, 74, 76, 77, 80], conflict or non-conflict areas [51], and residing inside or outside protected IDP camps [55]. Fourteen studies focused on HIV prevalence and correlates [51, 55, 62, 64, 68, 71, 72, 74, 76, 77, 80, 86, 90, 94] and 2 studies on associated factors of HIV-positive serostatus [67, 70]. A study conducted in Nigeria found that the prevalence of HIV was significantly higher in conflict than non-conflict areas (1.75% vs. 1.0%; $p<0.01$) [51]. Regarding correlates of HIV serostatus, rural dwellers in Malawi were found to be less likely to test HIV-positive than urban dwellers (OR 0.72 [CI 0.53 to 0.98]; $p<0.05$) [51]. The same study also found that individuals living in conflict zones were nearly three times as likely to test positive for HIV (OR 2.80 [CI 2.08 to 3.60]; p -value not reported). In a nationally representative sample in Lesotho, females aged 15–19 years old living in a rural area affected by severe drought had almost threefold higher odds of HIV infection (OR 2.77 [CI 1.19 to 6.47]; $p=0.02$) compared to their counterparts in rural areas without drought [94]. In Northern Uganda, a study among conflict-affected women revealed that residing in protected camps for IDP was associated with a higher risk of HIV infection among women who had higher education (Adjusted OR (AOR) 2.29 [CI 1.30 to 4.04]; $p=0.004$) and women whose occupations (AOR 3.62 [CI 1.32 to 9.91]; $p=0.01$) or partners' occupations (AOR 2.38 [CI 1.60

Table 2 Non-modifiable and modifiable factors for HIV acquisition in humanitarian crises assessed in the included studies (n = 49)

Factors for HIV acquisition in humanitarian settings	N (%)
Non-modifiable	36 (73.5)
Age	28 (57.1)
Gender	24 (49)
Location (i.e., rural or urban; district; conflict or non-conflict zones; inside or outside protected camps of IDP)	16 (32.7)
Place of birth or origin	8 (16.3)
Ethnicity	4 (8.2)
Modifiable	47 (95.9)
Policy and structural	35 (71.4)
Education level (e.g., school attendance, level of completion)	14 (28.6)
Mobility status (e.g., refugee or non-refugee; permanent, transient, displaced)	13 (26.5)
Access to health care (e.g., access to health facilities, distance to clinic)	8 (16.3)
Employment and occupation status	7 (14.3)
Income level (i.e., individual-, household-, country-level)	7 (14.3)
Access to HIV prevention and care	6 (12.2)
History of travel (e.g., out of country, outside of camp)	5 (10.2)
Food and/or water insecurity	5 (10.2)
Stigma (towards HIV, gender non-conformity, homosexuality)	2 (4.1)
Access to HIV information and education	2 (4.1)
HIV knowledge level	2 (4.1)
Housing status (i.e., unstable)	2 (4.1)
Country-level health expenditures (e.g., HIV spending)	2 (4.1)
Number of trained health workers	1 (2)
Conflict time period (i.e., pre-conflict, during conflict, post-conflict)	1 (2)
Conflict intensity (i.e., <25 deaths, 25–1000 deaths, > 1000 deaths)	1 (2)
Conflict type (i.e., extra-systemic, interstate, internal, international war)	1 (2)
Criminal justice involvement	1 (2)
Sociocultural	24 (49)
Marital status	18 (36.7)
Religious beliefs	4 (8.2)
Female-headed household	3 (6.1)
Family separation (due to sexual identity and HIV-positive status)	2 (4.1)
Disruption of social networks	2 (4.1)
Child-headed household	2 (4.1)
Number of marriages	1 (2)
Living with someone else and not in own house	1 (2)
Number of other household members	1 (2)
Health and mental health	29 (59.2)
STI (non-HIV) diagnosis (e.g., syphilis, genital ulcers)	18 (36.7)
Substance use (e.g., illicit drug use, injecting drug use)	11 (22.4)
Alcohol use	7 (14.3)
Mental health conditions (e.g., PTSD, depression, suicide ideation)	7 (14.3)
Blood transfusion or donor	7 (14.3)
Other diseases (e.g., malaria, hepatitis A, tuberculosis)	4 (8.2)
Lifetime pregnancies	3 (6.1)
History of tattoos	3 (6.1)
Dental procedure	2 (4.1)
History of abortion	1 (2)
Surgery and hospitalizations	1 (2)

Table 2 (continued)

Factors for HIV acquisition in humanitarian settings	N (%)
Sexual practices	29 (59.2)
Condom use	14 (28.6)
Exchanging sex for money or nonmonetary items	14 (28.6)
Number of sex partners	14 (28.6)
Age of sexual debut (e.g., < 18 or ≥ 18 years)	6 (12.2)
Buying or purchasing sex	6 (12.2)
Coerced sexual debut	5 (10.2)
First sexual partner ≥ 10 years older	4 (8.2)
Circumcision status (i.e., self-reported by men, male partner's reported by women)	3 (6.1)
Perceived ability to protect oneself from HIV/STI	3 (6.1)
Knowing sexual partner's HIV status	3 (6.1)
Men who have sex with men	2 (4.1)
Practice of dry sex (i.e., sexual intercourse when the vagina is dry upon penetration)	2 (4.1)
Sex while intoxicated or high on drugs	1 (2)
Intergenerational sex (i.e., sexual partner ≥ 10 years older)	1 (2)
Female contraceptive use	1 (2)
Partner infidelity	1 (2)
Exposure to humanitarian crisis-related traumatic events	19 (38.8)
Experience of rape, sexual violence, or other sexual trauma	14 (28.6)
Experience of abduction or kidnapping	7 (14.3)
Experience of traumatic events (e.g., ≥ 12 traumatic events)	4 (8.2)
Night-commuting (i.e., movement at night to sleep elsewhere than family home for security and privacy)	2 (4.1)
Experience of torture	1 (2)
Military recruitment	1 (2)

IDP internally displaced persons, *STI* sexually transmitted infections, *PTSD* post-traumatic stress disorder

to 3.53]; $p < 0.001$) were considered modern (i.e., not an agricultural worker or a housewife) [55]. According to the authors, both higher education and non-traditional occupation were likely to be associated with increased mobility that may heighten the exposure to HIV among women living inside the camps [55].

Place of Birth or Origin

Eight studies examined the effect of place of birth or origin on HIV acquisition [50, 57, 60, 74, 82, 84, 93]; with 7 studies identifying HIV prevalence and correlates [50, 57, 60, 74, 82, 84, 88, 93] and 1 study reporting factors associated with HIV-positive serostatus [88]. Two infectious disease testing studies conducted in large cohorts of refugees and asylum seekers in Germany and the United Kingdom found that individuals of SSA origins represented the highest number of HIV cases, reflecting the higher HIV prevalence in the region [50, 88]. In Germany, HIV prevalence was mainly observed among refugees and asylum seekers of Nigerian origin (14.7% of 15,137 individuals) [50]. In the United Kingdom, refugees with a SSA nationality had significantly higher odds of being HIV positive (AOR 51.72 [CI 20.67 to 129.39]; $p < 0.001$) compared to those with different nationalities [88]. In a single-site study among men who have sex with men (MSM) in Lebanon, individuals who were Lebanese-born were more likely to test HIV-positive than MSM born in in Syria and other countries (AOR 0.14 [CI 0.04 to

0.51]; $p < 0.05$) [60]. Similarly in a Ugandan HIV testing study [74], refugees were less likely to be diagnosed with HIV compared to Ugandan nationals (AOR 0.27 [CI 0.21 to 0.34]; $p < 0.001$) that may indicate a lower HIV prevalence in the refugees' countries of origin compared to Uganda.

Ethnicity

The relation between ethnicity and HIV acquisition was examined in 2 studies on HIV prevalence and correlates [57, 80], 1 study on HIV incidence [63], and another study on risk factors for HIV-positive serostatus [89]. Two studies in Uganda considered ethnicity as a correlate of HIV infection and incidence among conflict-affected female sex workers (FSW) and persons, respectively [57, 63]. One study suggested that FSW of the Acholi ethnic group might have a lower likelihood of HIV infection compared to other tribes although it was not statistically significant (OR 0.51 [CI 0.25 to 1.08]; $p = 0.08$) [57], and the other study did not report an association [63]. In a study examining the impact of armed conflict across the 177 member states of the World Health Organization (WHO), the authors found that ethnic heterogeneity (i.e., racial, linguistic, and religious characteristics) directly increased longer-term HIV morbidity and mortality, suggesting inequitable access to HIV prevention and treatment due to discrimination and political power among minorities [89].

Evidence of Modifiable Factors for HIV Acquisition in Humanitarian Settings

Of the 49 studies included in the analysis, 47 (95.9%) presented information on the effects of modifiable factors on HIV prevalence, incidence, or serostatus in the context of humanitarian crises (Table 2). These factors were further classified into five categories including policy and structural (18 factors), sociocultural (9 factors), health and mental health (11 factors), sexual practice (16 factors), and exposure to humanitarian crisis-related traumatic events (6 factors).

Policy and Structural Factors

Thirty-five studies examined 18 policy and structural factors affecting HIV acquisition in humanitarian settings, including education level [53, 55–57, 63, 68, 74, 76, 77, 80, 90, 91, 93, 94], employment and occupation status [55, 58, 64, 66, 81, 90, 91], income level [20, 49, 51, 56, 57, 60, 94], food and/or water insecurity [76, 77, 90, 92, 94], mobility status [53, 56, 57, 62, 65, 67, 68, 71, 74, 79, 84, 95, 96], history of travel (e.g., out of country, outside of camp) [64, 72, 73, 80, 94], access to health care (e.g., access to health facilities, distance to clinic) [63, 67, 68, 74, 79, 91, 92], access to HIV prevention and care [56–58, 80, 91, 92], access to HIV information and education [91, 92], HIV knowledge level [54, 80], housing status [56, 60], stigma [54, 91, 92], country-level health expenditures [89, 93], number of trained health workers [93], conflict time period (i.e., pre-conflict, during conflict, post conflict) [20], conflict intensity (i.e., < 25 deaths, 25–1000 deaths, > 1000 deaths) [20], conflict type (i.e., extra-systemic, interstate, internal, international war) [20], and criminal justice involvement [57].

At the individual-level, policy and structural factors were found to have effects on HIV prevalence or incidence, or various degrees of association with HIV serostatus in humanitarian settings. Two Ugandan studies examining the impact of war on HIV prevalence in the same samples of 400 FSW reported that around one-third of participants (33.8%, $n = 135$) were HIV positive; of whom 45 (33.3%) women were newly diagnosed or previously undiagnosed with HIV [56, 57]. The researchers noted that FSW diagnosed with HIV infection were significantly more likely to have been *incarcerated* (33.3% vs. 23%, OR: 1.67 [CI: 1.06 to 2.64]; $p = 0.03$) [57], and that those with new HIV diagnosis had higher odds of reporting recent *unstable housing* (AOR: 2.48 [CI: 1.05 to 5.85]; $p < 0.05$) [56]. With respect to *education*, 8 out of 14 studies presented evidence on the significant effect of school attendance or

completion on HIV prevalence, incidence, or serostatus. A study of 12,877 drought-affected individuals in Lesotho reported that attending secondary or higher education was protective against HIV infection among male and female youths aged 15–24 years (AOR 0.66 [CI 0.47 to 0.92]; $p = 0.02$) and 25–29 years (AOR 0.54 [CI 0.46 to 0.62]; $p < 0.001$) [94]. Similarly, among 384 conflict-affected youths living in transit camps in Northern Uganda where the HIV prevalence rate was 12.8%, HIV-positive individuals were significantly less likely than HIV-negative participants to currently be in school (12.2% vs. 26.9%, $p = 0.03$) [76]. Moreover, a modeling study of the effects of famine on HIV prevalence in Malawi suggested that a woman who worked as a farmer, was under 25 years of age, and had less than a primary education, had a 9.9% probability of being HIV positive [90]. In terms of *income*, four studies measured income by individual level (i.e., monthly [49, 60] and weekly [56, 57]), two studies by household level [51, 94], and one study by country level as defined by the World Bank [20]. At the individual level, among 292 MSM including Syrian refugees in Lebanon with an estimated HIV prevalence ranging from 13% to 14.9%, earning higher income was associated with HIV-positive status in bivariate analysis (OR 2.33, $p = 0.03$) [60]. This association did not remain significant in the adjusted regression model [60]. Among 928 conflict-affected Rwandan women of whom 75.9% were HIV positive, earning between 10,000 and 35,000 Rwandan Francs monthly was significantly associated with HIV-positive status compared to lower or higher income (81.5% vs 72.9% vs 75.2%, respectively) [49]. Lastly, in a modeling study estimating the effect of conflict periods on country-level HIV incidence in 36 SSA countries, low-income/lower-middle income nations had significantly positive associations with increased HIV incidence compared to upper-middle/upper income countries [20]. The estimates suggested an increase of 8.0 infections per 1000 people in HIV incidence on average per year in low-income countries (95% CI 5.19, 10.86), and an increase of 7.3 new infections per 1000 people per year in lower-middle income countries (95% CI 4.96, 9.56) [20].

Mobility status, an indicator to describe human movement due to livelihood, displacement, voluntary migration, or other factors [97], was measured in different ways in 13 studies. For example, three studies categorized mobility status by temporality (i.e., permanent, transient, displaced) [67, 68, 79] while others considered mobility according to legal status (e.g., IDP, refugee, local resident) [53, 62, 65, 71, 74, 84, 96]. Findings from a Canadian study of 15,269 refugee women and 126,506 non-refugee women estimated a higher HIV prevalence among refugees who initially sought asylum in a transition country before coming to Canada (i.e., secondary migration) (1.47%) than refugees with primary

migration who directly arrived in Canada (0.82%) [84]. The study also reported that refugees with secondary migration were 68% more likely to have HIV compared to refugees with primary migration (AOR 1.68 [CI 1.04 to 2.71]; $p < 0.05$) [84]. In two studies conducted in conflict-affected areas in the DRC, HIV prevalence was significantly higher among IDP when compared to the local population [65, 71]. A study of adult females living in an IDP camp and host communities near the Congo River found that while HIV prevalence among the river populations was similar to the national estimates at 3.1% (95% CI 2.1, 4.1), prevalence was higher in the IDP population at 7.6% (95% CI 4.1, 11) [65]. In other studies involving conflict-affected individuals in Mozambique [53], Uganda [56, 57, 67, 68, 79], and Sudan [62], no effect was found between mobility status and HIV prevalence, incidence, or serostatus. Relevant to mobility status, one modeling study of multi-country data investigated the potential impact of conflict on HIV incidence rate by considering *conflict intensity* (i.e., < 25 deaths, 25–1000 deaths, > 1000 deaths), *conflict time period* (i.e., no conflict, pre-conflict, during conflict, post-conflict), and *conflict type* (i.e., extra-systemic, interstate, internal, international war) [20]. The study reported that HIV incidence was significantly higher in the 5 years prior to conflict with an increase of 2.1 per 1000 infections per year, with no significant increase during and immediately following periods of conflict [20]. The authors surmised that their findings support prior evidence on stabilized HIV infection rates during times of conflict that were likely due to limited access to HIV testing and reporting [20].

At the community level, access to health care facilities and programs were found to affect HIV correlates of HIV-positive serostatus in humanitarian settings. Studies have examined the role of *access to healthcare* including distance to health facilities [74], *access to HIV prevention and care* [20], and *access to HIV information and education* [56]. A study conducted in a Ugandan refugee settlement of 7766 individuals of whom 330 (4%) tested HIV-positive revealed that residing more than one hour from the clinic was associated with increased likelihood of HIV infection (Adjusted Relative Risk 1.39 [CI 1.11 to 1.74], $p = 0.003$) [74]. Two studies of conflict-affected FSW in Uganda examined the association of having access to HIV education programs, such as condom demonstrations, with HIV serostatus [56, 57]. One study reported that receiving a condom demonstration was negatively associated with new HIV diagnosis among conflict-affected FSW (AOR 0.39 [CI 0.15 to 0.97]; $p < 0.05$) [56], but no difference was found when comparing between individuals with and without HIV serostatus in the same samples [57]. In a qualitative study in Namibia, IDP and key stakeholder participants conveyed that lack of access to family planning, condoms, and HIV testing due to flooding could increase the risk of HIV acquisition

among affected individuals [92]. Similar observations were described in an interview study of Colombian IDP and stakeholders working with displaced MSM [91]. Furthermore, *stigma* concerning PWH, gender non-conformity, and homosexuality was perceived as a factor affecting HIV acquisition that could cause further isolation of internally displaced individuals of sexual minorities [54, 91, 92]. Studies also reported the link of *food and water insecurity* with HIV prevalence and correlates in humanitarian settings. In a modeling study of HIV prevalence in famine-affected Malawi, increased HIV prevalence was positively associated with hunger in rural areas, attributing to hunger-induced exchanging sex for food or money and the impact of hunger on immune function [90]. In two studies of conflict-affected young men and women in Uganda of which the overall HIV prevalence rate was estimated at 12.8%, HIV-positive individuals were significantly more likely than HIV-negative participants to indicate lacking food and/or water (57.1% vs. 37.3%, $p = 0008$) [76, 77].

At the country level, a modeling study analyzing the impact of drought on HIV burden in 69 countries revealed that *health expenditures* were not associated with women's proportion of HIV cases; however, countries with a larger number of *trained health workers* were more likely to have a lower proportion of women with HIV and lower rates of HIV prevalence [93]. In another modeling study that examined the association between armed conflict and HIV morbidity and mortality in 177 countries [89], the researchers considered total HIV spending, number of refugees, asylum seekers, and IDP, and number of persons on ART as factors representing a conflict-associated vulnerability construct. The findings suggest that the conflict and HIV association was moderated by these factors, highlighting the need of HIV prevention and care among the displaced populations to reduce longer-term morbidity and mortality [89].

Sociocultural Factors

Twenty-four studies investigated 9 sociocultural factors and their influence on HIV prevalence, incidence, and HIV-positive serostatus in humanitarian settings. These factors include marital status [53, 55, 58, 62–64, 66–68, 72, 74, 76, 77, 79, 81, 86, 94, 95], number of marriages [80], religious beliefs [58, 68, 79, 93], staying in a child-headed household [68, 79], having a female household head [79], family separation due to sexual identity and HIV-positive status [91, 92], disruption of social networks [91, 92], living with someone else and not in their own house [49], and number of other household members [49]. Regarding *marital status* as a correlate of HIV infection, there was evidence that the risk of acquiring HIV was higher among individuals who were divorced, separated, widowed, or single (i.e., never married) [55, 62, 74, 86]. In a Sudanese study, conflict-affected

women who were separated, divorced, or widowed had a higher likelihood of HIV infection compared to women in married and monogamous relationships (AOR 7.7 [CI 2.3 to 25.4]; $p < 0.001$) [62]. In contrast, some studies reported a higher HIV seropositivity rate among individuals who were married compared to those who were not married [64, 68, 76, 77, 94]; such as in a Ugandan cohort study where compared to individuals who never married, those who were married (AOR 4.69 [CI 3.25 to 6.76]; $p < 0.001$), separated or divorced (AOR 9.17 [CI 5.60 to 15.00]; $p < 0.001$), or widowed (AOR 20.35 [CI 10.27 to 40.34]; $p < 0.001$) were significantly more likely to be HIV-positive [68]. Additionally, among women living in a refugee camp in Thailand, women with HIV were more likely to report having had a greater number of marriage partners than HIV-negative women (OR 1.4 [CI 1.1 to 1.8]; $p < 0.001$) [80].

Two studies in Uganda of conflict-affected individuals reported higher HIV prevalence among women than men (14.6% vs. 8.5%, $p < 0.001$ and 17.2% vs. 10.6%, $p < 0.001$, respectively) [68, 79]. The authors reported that individuals who lived in a *female-headed household* had increased odds of HIV infection, although no association was found between staying in a *child-headed household* and HIV-positive serostatus [68, 79]. In two qualitative studies involving persons affected by flood in Namibia [92] and IDP in Colombia [91], participants expressed that *family separation* and *disruption of social networks* could increase the risk of HIV acquisition due to loss of social support. Lastly, regarding *religious beliefs*, higher percentage of Muslim population was a predictor of a lower HIV prevalence in drought-affected populations in 69 countries that may be attributable to the emphasis of conservative sexual norms, such as promoting abstinence before marriage [93]. On the other hand, female refugees who were interviewed in a South African qualitative study believed that their religious beliefs prohibited condom use and thus, may increase the women's risk of acquiring HIV [58].

Health and Mental Health Factors

Eleven health and mental health factors impacting HIV prevalence, incidence, and serostatus were reported in 29 studies. The factors identified were current or past STI (non-HIV) diagnosis [49, 53, 56, 61–63, 65, 66, 68, 69, 71, 76, 77, 79, 80, 88, 91, 95], substance use (including illicit drug use, injecting drug use, needle sharing) [56, 59, 64, 66, 73, 76, 80, 83, 88, 89, 95], alcohol use [54, 56, 76, 88, 89, 92, 95], mental health conditions (e.g., PTSD, depression, suicide ideation) [49, 54, 59, 63, 67, 68, 79], blood transfusion or donor [53, 66, 71, 72, 80, 86, 88], other diseases (e.g., malaria, hepatitis A, tuberculosis) [71, 72, 92, 95], lifetime pregnancies [55, 56, 80], history of tattoos [66, 80, 88], dental procedure [66, 73], history of abortion [66], and surgery

and hospitalizations [66]. Several studies conducted in humanitarian settings reported evidence of linkage between *diagnosis of other STI* (e.g., syphilis, herpes simplex virus (HSV)-2, genital ulcers) and HIV infection, as indicated by serological testing and/or self-report [49, 53, 61–63, 65, 68, 69, 76, 77, 79, 88, 91]. In a mixed methods study of conflict-affected persons in Ethiopia, FSW with HSV-2 infection were more likely to have an HIV diagnosis compared to those without (48% vs 27%, Risk Ratio (RR) 1.8 [CI 1.2 to 2.8]; $p < 0.005$) [61]. Other studies also reported a link between a previous STI diagnosis and the likelihood of having HIV-positive diagnosis among conflict-affected individuals [49, 53, 65, 76, 77]. The effect of *alcohol and substance use* on HIV acquisition in humanitarian settings was also examined in several studies. In a modeling study of 177 WHO member states, alcohol consumption, illicit drug use, and injection drug use moderated the relationship between conflict and HIV prevalence, suggesting HIV-related risk behaviors in conflict situations and in the presence of high substance use would increase the population's risk of HIV infection [89]. Furthermore, in a Ugandan study of conflict-affected FSW, women newly diagnosed with HIV were more likely to report heavy drug or alcohol use (AOR 5.73 [CI 2.22 to 14.78]; $p < 0.05$) [56]. Studies have also reported *mental health conditions* including probable depression, PTSD, and suicide ideation to be significantly associated with HIV infection among different conflict-affected groups including military personnel in South Sudan [54] and Rwanda [59], men and women in Uganda [63, 67, 68, 79], and women in Rwanda [49]. In a study of male military personnel in conflict-affected Rwanda, HIV prevalence was higher among those who screened positive for either PTSD (3.9% vs. 2.7%) or depression (3.6% vs. 2.4%); however, the difference was not statistically significant [59]. In a Ugandan study of conflict-affected men and women, women who tested positive for HIV had 90% increased odds of probable depression (AOR 1.90 [CI 1.29 to 2.80]; $p = 0.001$), although no such association was found among male participants [67].

Sexual Practice Factors

Twenty-nine studies documented the impact of 16 sexual practice-related factors on HIV acquisition in humanitarian settings, namely condom use [49, 53, 54, 56, 57, 60, 62, 63, 68, 69, 76, 77, 79, 94], number of sex partners [49, 53, 54, 58, 60, 63–66, 68, 69, 79, 80, 86], exchanging sex for money or nonmonetary items [49, 53, 58, 60, 70–72, 76, 77, 79, 80, 91, 92, 94], buying or purchasing sex [61, 68, 69, 72, 80, 86], age of sexual debut [63, 65, 76, 77, 79, 81], coerced sexual debut [63, 67, 75, 76, 79], first sexual partner ≥ 10 years older [63, 75, 76, 79], circumcision status [53, 68, 79], perceived ability to protect oneself from HIV/STI [76, 77, 79], knowing sexual partner's HIV status [76, 77, 79], MSM [64,

95], practice of dry sex (i.e., sexual intercourse when the vagina is dry upon penetration) [76, 77], having sex while intoxicated or high on drugs [60], intergenerational sex (i.e., sexual relationships with a partner ≥ 10 years older) [94], female contraceptive use [93], and partner infidelity [58].

Condom use measurements were reported in various dimensions across studies; for example, by considering a specific timeframe (e.g., last sex, past 6 months, ever), type of sexual partner (e.g., regular or non-regular partner, last 3 partners, sexual debut), and consistency (e.g., inconsistent condom use coded as a dichotomous yes or no response). Some studies, such as two Ugandan studies assessing the correlates of HIV infection among conflict-affected young people, employed multiple condom use measures including ever use of condom (yes or no), condom use during last sex (yes or no), and condom use consistency (always vs. sometimes or never) [76, 77]. None of the condom use measures were significantly associated with HIV infection in bivariate analysis; except among young men who were HIV-negative and more likely to report using a condom during last sex compared to men who tested HIV-positive (37.8% vs. 16.7%, $p=0.05$) [77]. The association was not statistically significant in a multivariable model [77]. Among Rwandan conflict-affected women, those indicating not using condom at least half the time ($\sim 50\%$) in the last 6 months were more likely to report an HIV diagnosis than women reporting more frequent condom use (66.1% vs 33.9%, $p<0.001$) [49]. The authors also found that HIV-positive serostatus was an independent factor of condom use at least half the time in the last 6 months among sexually active women in the study ($p<0.001$) [49]. A study among refugees in Cameroon found that individuals who reported *multiple sex partners* had higher odds of HIV infection than their peers who did not (OR 4.3 [CI 1.5 to 11.8]; $p=0.01$) [66]. A study among 2008 conflict-affected persons in Uganda examined several correlates of HIV infection [79]. Among conflict-affected women, sexual practice-related factors associated with HIV infection included *age younger than 18 at sexual debut* (AOR 2.00 [CI 0.91 to 4.38]; $p=0.08$), *first sexual partner ≥ 10 years older* (AOR: 1.69 [CI 1.07 to 2.67]; $p=0.03$), reporting 2 (AOR: 2.54 [CI 1.23 to 5.23]; $p=0.02$) or 3+ (AOR: 4.65 [CI 2.65 to 8.18]; $p<0.001$) sexual partners in the past year, inconsistent condom use with last 3 partners in the past 12 months (AOR: 0.40 [CI 0.29 to 0.57]; $p<0.001$), and *exchanging sex for money or other items* in the past year (AOR: 5.51 [1.76 to 17.31]; $p=0.01$) [79]. Among conflict-affected men, not using a condom at sexual debut was significantly associated with HIV infection as a sexual practice factor (AOR: 1.92 [CI 1.30 to 2.83]; $p=0.006$) [79]. *Use of female contraceptives*, such as oral contraceptives, was found to be significantly protective against HIV acquisition in a modeling study of 65 countries experiencing drought [93]. In a qualitative study of female

refugees in South Africa, participants noted factors that could increase their susceptibility for HIV infection including *partner infidelity* and *low perceived ability to protect oneself from HIV/STI* [58]. In Lesotho, reporting *intergenerational sex* with a partner ≥ 10 years older was found to be significantly associated with HIV infection among drought-affected persons aged 15–24 years (AOR 1.54 [CI 0.97 to 2.44]; $p<0.001$) and 25–29 years (AOR 1.37 [CI 1.10 to 1.71]; $p=0.007$), respectively [94]. In a study involving conflict-affected MSM in Lebanon, reporting multiple sex partners ($p=0.02$), condomless sex ($p=0.008$), exchanging sex for money or other items ($p=0.01$), and *having sex while intoxicated or high* ($p=0.02$) in the past year were identified as factors associated with HIV infection [60]. Notably, a study among conflict-affected female adults in Uganda did not find exchanging sex for money or other items to be associated with HIV positive serostatus [70]. In two Ugandan studies involving the same sample of 384 conflict-affected youths aged 15–29, the *practice of dry sex* was a factor independently associated with HIV infection (AOR 2.31 [CI 1.04 to 5.13]; $p<0.05$) [76] and specifically among young women (AOR 7.62 [CI 1.56 to 16.95]; $p<0.05$) [77]. Further, both studies found that HIV-positive participants were significantly less likely than those who were HIV-negative to *know their partner's HIV status* (AOR 0.50 [CI 0.22 to 1.12]; $p<0.05$) [76] and when analyzed by gender, i.e., young men (AOR 0.40 [CI 0.08 to 1.41]; $p<0.05$) and young women (AOR 0.57 [CI 0.19 to 1.77]; $p<0.05$) [77].

Exposure to Humanitarian Crisis-Related Traumatic Events

Nineteen studies reported 6 factors concerning humanitarian crisis-related traumatic events that affect HIV acquisition such as experience of rape, sexual violence, or other sexual trauma during conflict or displacement [49, 52, 53, 65, 67, 68, 76, 77, 79, 82, 85, 87, 91, 92], experience of abduction or kidnapping [57, 63, 68, 75–77, 79], experience of traumatic events [63, 67, 68, 79], night commuting (i.e., traveling at night to sleep elsewhere than family home for security and privacy reasons) [76, 77], experience of torture [88], and military recruitment [78]. Several modeling studies examined the impact of widespread *rape or sexual violence* in conflict-affected SSA countries on HIV prevalence and/or incidence [52, 82, 85]; such as a modeling study of six countries with a recent period of armed conflict that estimates increased HIV incidence by 10% after accounting for a high prevalence of rape, the effect of genital injury on HIV transmission, the perpetrator's HIV serostatus, and underlying HIV incidence [85]. Findings from these studies suggest that while widespread rape did not seem to have significant impact on HIV prevalence [52, 82, 85], it might contribute to increased HIV incidence at a community level when the

underlying HIV incidence was low and where systematic or mass rape had occurred during conflict [82, 85]. Additionally, reporting experience of rape or sexual violence was significantly associated with HIV infection among the IDP in the DRC [65], young people living in post-conflict transition camps in Uganda [76, 77], and conflict-affected persons in Uganda [79]. Experience of rape was also described in qualitative studies involving persons affected by flood in Namibia [92], displaced gay, bisexual, and transgender persons in Colombia [91], and conflict-affected women in the DRC [87], citing an increased risk of acquiring HIV during flooding and armed conflict when unstable situations occurred resulting in rape and violence.

According to a study on HIV incidence and correlates in Uganda where the overall HIV incidence rate was 10.1 (95% CI 7.2, 13.8) per 1000 person years, individuals who had *experienced abduction* during conflict had a significantly higher odds of HIV infection, with a 3.2 times greater likelihood compared to those who did not experience abduction (Hazard Ratio (HR) 3.23 [CI 1.64 to 6.34]; $p < 0.001$) [63]. In another Ugandan study among 384 conflict-affected persons, a significantly larger proportion of former abductees compared to non-abductees reported sexual practices that could increase their risk of HIV infection such as experiencing non-consensual sexual debut (30.5% vs. 11.2%, $p < 0.001$), having a first sexual relationship with a partner ≥ 10 years older (26.3% vs. 12.6%, $p < 0.001$), having a greater median number of sex partners in the previous six months (2 vs. 1, $p = 0.02$), and ever use of condom (63.6% vs. 50.5%, $p = 0.02$) [75]. In several studies, conflict-affected individuals in Uganda who had undergone ≥ 12 *traumatic events* related to war were more than twice as likely to have HIV diagnosis as those who did not report traumatic events [63, 68, 79].

Implications for Future Programs

In order to effectively address HIV acquisition in humanitarian settings, evidence from ten studies highlighted the importance of systematic screenings, prevention, and treatment for HIV and other infectious diseases among people affected by complex emergencies or experiencing mobility, and recognizing the differences between the groups (e.g., refugees, asylum seekers, IDP, and migrants) and their specific health needs and experiences [50, 53, 62, 64, 66, 74, 80, 84, 88, 95]. An HIV screening intervention study in a refugee settlement in Uganda found that Ugandan nationals were more likely to be HIV-positive than refugees [74]. Similar findings were observed in an epidemiologic study of HIV and hepatitis B and C infections among refugees in Cameroon [66] and an HIV prevalence study of Lebanese and Syrian-born MSM in Lebanon [60]. Studies conducted

in countries that have resettlement programs for refugees such as Germany, Canada, the US, and the UK highlight that prevalence of HIV varies among refugees based on individual-level risk factors and prevalence in the country of origin [50, 84, 88, 95]. Authors of these studies emphasized the importance of tailoring HIV screening and prevention programs for different groups and needs, and training providers to create culturally relevant healthcare approaches, particularly when addressing behaviors considered as illegal or stigmatized in the country of origin such as illicit drug use, sex work, or same-sex sexual relationships [88, 95].

Six studies in the present review examined the impact of widespread rape and sexual violence in conflict settings on HIV prevalence and incidence [20, 49, 52, 82, 85, 87]. Evidence from a modeling study involving seven countries in SSA showed that widespread sexual violence might not have a direct population-level impact on HIV prevalence in conflict-affected settings [52]. Nevertheless, the authors underlined that consequences of sexual violence such as physical and psychological trauma could not be understated. Improved surveillance for sexual violence and identifying its drivers in conflict settings were recommended to understand the impact on HIV and STI epidemiology at the population- and individual-levels [52, 85]. Researchers in Rwanda endorsed interventions that address the specific needs of women with a history of sexual violence in conflict settings, including implications for long-term reproductive health and susceptibility to high-risk sexual behaviors [49]. Others suggested integrating HIV prevention services and psychosocial support interventions that provide access to emergency contraception and HIV post-exposure prophylaxis to prevent unwanted pregnancies and HIV transmission [82, 87], support the needs of young people (aged 15–29) who survived sexual violence and abduction [75–77], and promote women's empowerment [49, 85].

Findings from five studies indicated associations between reporting depression and PTSD symptoms with HIV diagnosis [49, 59, 67, 68, 79], highlighting the need for evidence-based strategies to enhance mental health screening and treatment for people affected by conflicts. HIV prevention and treatment interventions also need to address war trauma experiences among this population and provide a gender-sensitive programming and trauma-informed care to foster resilience and facilitate healing at the individual, family, and community levels [67, 68, 79]. Strategies to screen and treat alcohol and other substance use are also needed to reduce HIV acquisition risk, in particular among military communities [54, 59] and people who inject drugs [83] in conflict settings.

Informed by findings from a qualitative study involving PWH, service providers, and other stakeholders, an HIV and flooding framework was developed to demonstrate health-related vulnerabilities in the context of flooding in Namibia

[92]. The framework represents the interlinkages between the livelihood loss caused by flooding (e.g., destruction of agriculture, lack of shelter), the emergence of flood-related diseases (e.g., malaria, cholera, malnutrition), the limited accessibility of health services including HIV prevention and treatment (e.g., condoms, ART), and the increased risk of HIV acquisition due to contributing factors (e.g., violence, alcohol use, stigma, displacement). The researchers endorsed adapting and applying the framework in other disaster conditions to assess capacity and vulnerability in emergency response plans and potentially reduce HIV risk acquisition and disease progression [92].

Implications for Future Research

Recommendations for future research were proposed in several studies [20, 51, 52, 54–57, 59, 60, 65, 70, 71, 76, 78, 82, 84, 87, 93–96]. Regarding methodology, studies using structural equation modeling could refine the existing theoretical models of HIV acquisition in humanitarian settings and identify the role of multiple risk factors for HIV morbidity and mortality [89]. Modeling studies could also be useful to facilitate rigorous hypothesis testing to examine the relationship between humanitarian crises and HIV cross-nationally, adjusting for economic, social, political and cultural factors [20, 93]. The use of qualitative and mixed methods studies was recommended to provide insights into the lived experiences and perceptions related to HIV acquisition in humanitarian settings [57, 76, 87, 93]. A modeling study investigating the impact of drought in multiple SSA countries recommended employing qualitative research to further understand the relationship between drought and HIV vulnerability among women by considering multiplicity of experiences according to poverty, race, religion, and disability [93]. Longitudinal and mixed methods studies could also be useful to understand the potential causal pathways between criminal justice system involvement with HIV risks, and to inform the development of HIV and sexual reproductive health interventions that promote health and human rights [57]. Additionally, studies recommended standardization of definitions (e.g., transactional sex work), measurements of risk behaviors, and surveillance methodologies to ensure precision and reproducibility [52, 70].

Nine studies suggested further research on the impact of complex emergencies on HIV prevalence [54, 55, 65, 71, 76, 78, 82, 84, 96], specifically by identifying individual- and community-level factors associated with HIV acquisition [54, 76, 82, 84, 96], engaging displaced populations and host communities [55, 71], and determining national-level HIV prevalence [71, 78] both during and after the conflict period [65]. Lastly, two studies recommended exploring the effects of complex emergencies on HIV care cascade

including linkage to care, ART adherence, resistance, and toxicity [56, 95].

Discussion

This scoping review provides a comprehensive summary of a range of factors associated with HIV acquisition in the context of humanitarian crises caused by natural disasters and complex emergencies resulting from conflict. We identified a total of 49 relevant studies, primarily conducted in SSA, with a notable concentration in Uganda. The amount of published evidence on HIV acquisition in humanitarian settings based on geographical locations gave the general impression that such data were abundant in the African region, and less so in Asia and Europe where humanitarian crises also occurred. The fact that the HIV epidemic has had the greatest impact on SSA [98] and the majority of individuals experiencing displacement reside in SSA [1] might explain the high number of studies conducted in this region. It is important to note that the UNHCR acknowledged the rising number of refugees in European countries due to the ongoing Russia-Ukraine war that has created the fastest and one of the largest displacement crises, from 7 million displaced people at the end of 2021 to 12.4 million at the end of 2022 [1]. In the current review that is inclusive of literature published between January 1990 and March 2022, the lack of published research on HIV acquisition in the context of Russia-Ukraine war can be attributable to the complexity in conducting research amid an ongoing humanitarian crisis where the conditions are often unstable and can present risks to both researchers and research participants [99].

Across the 49 studies included, the majority employed a quantitative approach and a cross-sectional design. Around half of the studies were designed to investigate the prevalence or incidence of HIV and risk behavior correlates of HIV infection in humanitarian crises. Regarding the types of humanitarian crises, complex emergencies were the most reported setting in over 80% of the studies, followed by natural disasters, and crises that were considered both complex emergencies and natural disasters. The review identified five salient non-modifiable factors associated with HIV acquisition in humanitarian settings across 36 studies, including age, gender, location, place of birth or origin, and ethnicity. Both older and younger age groups were associated with an increased risk of HIV infection in humanitarian settings. As for gender, the prevalence of HIV appeared to be higher among females than males. Residing in some locations, such as rural areas affected by crises, was associated with HIV-positive serostatus. Regarding place of birth or origin, there was some evidence of a higher HIV prevalence among refugees and asylum seekers with SSA origins. Lastly, the four

studies investigating the role of ethnicity in HIV acquisition reported varying results.

The present review also identified 60 factors linked with HIV acquisition that could potentially be modified through policy or intervention. These factors were examined in 47 out of 49 studies and categorized into five domains, including policy and structural, sociocultural, health and mental health, sexual practice, and exposure to humanitarian crisis-related traumatic events. The policy and structural factor most often examined in the included studies was education level, with evidence of being in school or completing school was associated with lower odds of HIV infection among persons affected by humanitarian crises. The sociocultural factor most often associated with HIV acquisition was marital status, suggesting that individuals who were married had a lower risk of HIV infection compared to those who were divorced, separated, or widowed. The health factor most associated with HIV infection was current or past STI diagnosis, while substance use was identified as a mental health factor predicting a higher risk of HIV infection. Sexual practice factors most often associated with HIV infection were inconsistent condom use, exchanging sex for money or nonmonetary items, and reporting a higher number of sex partners, respectively. Lastly, experience of rape or sexual violence during conflict or displacement was most frequently identified as correlate of HIV infection in the included studies.

Our analysis of the studies highlights various multi-level factors that contribute to the risk of acquiring HIV in humanitarian settings. Understanding the interlinkages of these factors can help researchers, service providers, and others to identify the needs of the population affected by humanitarian crises related to HIV prevention; develop priority research questions and methodological approaches that are ethical, appropriate, and adaptable for humanitarian crises; and adapt evidence-based HIV prevention interventions developed in non-crisis settings to implement in humanitarian settings [25]. Building on the findings of the present review and informed by relevant HIV literature [22, 30], we applied the social-ecological model to map the identified multidimensional factors associated with HIV acquisition in the context of humanitarian setting at the levels of individual, social and sexual networks, community, public policy, and the context of humanitarian crises (Fig. 3). Each dimension in the model presents a range of modifiable and non-modifiable factors that were most often investigated in the published studies to date. We also highlighted recommendations for programming and opportunities for research. The framework can guide data collection to further understanding of different factors contributing to HIV acquisition in humanitarian crises and the development of tailored interventions to reduce HIV prevalence and incidence in these settings by considering different contexts, for example,

social and cultural norms that may influence sexual practices and acceptability of HIV prevention strategies.

From a methodological perspective, the reviewed studies had several common limitations. We found that the sampling approaches in some studies were not clearly described, raising the possibility of selection bias. The reliance on self-reported data to document HIV risk factors might expose these studies to social desirability bias, with potential effects such as underreporting of sensitive behaviors (e.g., sexual practices) and experiences (e.g., sexual violence). With only two studies employing prospective cohort designs [63, 69], the predominance of cross-sectional designs in the included studies limits inferences about causality between risk factors and HIV infection. Our review also showed a noticeable lack of intervention studies, with only one study reporting an HIV screening program in a refugee settlement in Uganda [74]. Our findings highlight the need for researchers, practitioners, policymakers, and other stakeholders to identify and use standardized measures and screening tools of underlying factors that affect HIV vulnerability in humanitarian settings. Routine HIV surveillance efforts are critical for documenting the impact of humanitarian crises on the HIV epidemic and informing resource allocation, as well as prospective studies with a community-based participatory approach to develop meaningful HIV prevention and care interventions that are ethical, trauma-informed, and culturally relevant. Establishing HIV prevention and care plans for individuals who are most at risk for HIV and those diagnosed with HIV should consider the lived experiences of people affected by humanitarian crises and their perceived needs. Future efforts that examine the directionality of social determinants of health affecting HIV acquisition in this population are warranted. The lack of studies from South America and Asia, regions with a high HIV burden that have experienced humanitarian crises, highlights the need for more research to generate evidence on the impact of crises on HIV acquisition in these settings.

The present scoping review has several important strengths. First, our review provides a thorough synopsis of the global evidence on modifiable and non-modifiable factors associated with HIV acquisition among people affected by humanitarian crises caused by natural disasters and human-made complex emergencies. Second, we considered all research using any type of study designs and methodologies that were published in both peer-reviewed journals and grey literature. Third, our multidisciplinary review team members are trained as infectious disease epidemiologists or public health professionals or research librarians. Record screening, full-text review, and data extraction approaches were piloted for reliability and conducted by multiple reviewers who had independently completed each step and resolved disagreements through consensus. Fourth, we used a systematic, iterative, and reproducible approach to

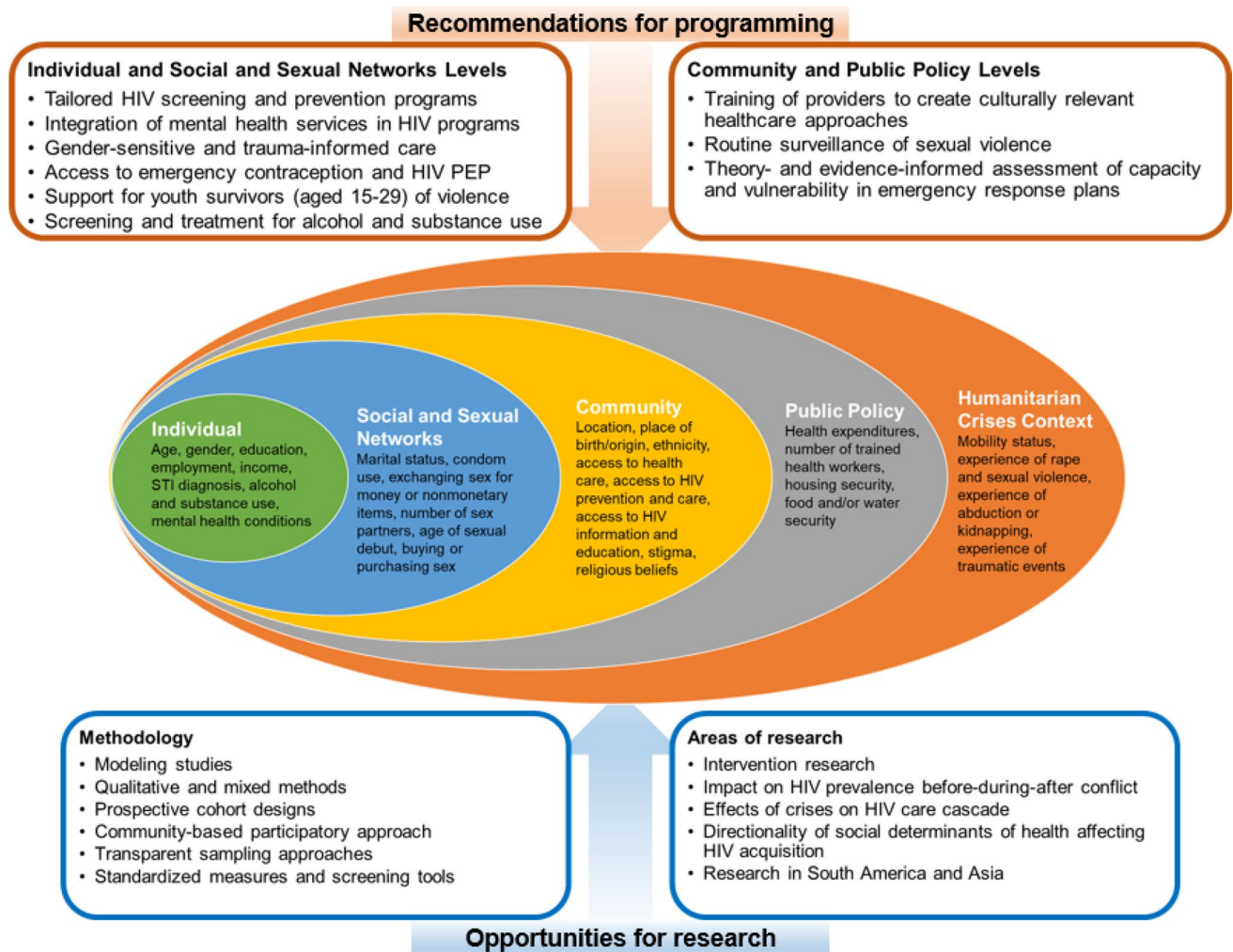


Fig. 3 Social-ecological model of the identified multidimensional factors associated with HIV acquisition at the levels of individual, social and sexual networks, community, public policy, and the context of humanitarian crises. This figure illustrates a range of modifiable and non-modifiable factors that were most often investigated in the published studies to date, with the adapted social-ecological model at

the center. The outside boxes at the top (orange) present recommendations for future programming in line with the levels of the social-ecological model. The outside boxes at the bottom (blue) present opportunities for research including methodological approaches and topic areas (Color figure online)

map the extent of the literature, determine knowledge gaps, and suggest implications for future practice and research. This review also has some limitations. First, non-English language articles were excluded due to time and human resource constraints. Second, while we reported on the individual study designs, we did not assess the quality of the included publications. Third, we did not characterize sources of funding or the role of funders in the included studies.

Conclusion

In conclusion, this scoping review systematically summarizes the current evidence and understanding of factors related to HIV acquisition in humanitarian settings,

emphasizing the multidimensional risks and vulnerabilities faced by the affected populations. Existing literature demonstrates that non-modifiable and modifiable factors were found to be associated in varying degrees with HIV acquisition in humanitarian settings. Moving forward, investigations are warranted to further examine the directionality of the modifiable and non-modifiable factors affecting HIV acquisition and consider the multilevel barriers and facilitators to the uptake of HIV prevention strategies in the context of humanitarian crises. Intervention research aimed at promoting HIV prevention strategies should consider individual, social, community, and structural levels of risk factors and contexts and tailor to the needs of the affected populations in these settings.

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Data Availability All relevant data are presented in the manuscript and supplementary materials. Additional details can be obtained by contacting the corresponding author.

Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

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Consent to Participate Not applicable.

References

1. United Nations High Commissioner for Refugees. Global trends: forced displacement in 2023 [Internet]. Copenhagen: United Nations High Commissioner for Refugees; 2024 [cited 2024 July 11]. Available from: <https://www.unhcr.org/global-trends-report-2023>
2. Jeong BG, Yeo J. United Nations and crisis management: Springer Cham; 2017 [cited 2023 July 31]. Available from: https://link.springer.com/referenceworkentry/https://doi.org/10.1007/978-3-319-31816-5_850-1
3. International Rescue Committee. 2024 emergency watchlist [Internet]: International Rescue Committee; 2023 [cited 2023 December 22]. Available from: https://www.rescue.org/sites/default/files/2023-12/CS2401_Report_Watchlist_Final_30MB_0.pdf
4. Internal Displacement Monitoring Centre. Global report on internal displacement (GRID 2024) [Internet]. Geneva: Internal Displacement Monitoring Centre; 2024 [cited 2024 July 11]. Available from: <https://www.internal-displacement.org/global-report/grid2024/>
5. Checchi F, Jamaluddine Z, Campbell O. Public health situation analysis: war in the Gaza Strip: London school of hygiene & tropical medicine; 2023 [cited 2023 December 22]. Available from: <https://www.lshtm.ac.uk/media/75901>
6. Kohrt BA, Carruth L. Syndemic effects in complex humanitarian emergencies: a framework for understanding political violence and improving multi-morbidity health outcomes. *Soc Sci Med*. 2022;295:113378. <https://doi.org/10.1016/j.socscimed.2020.113378>.
7. Sheehan MC. 2021 Climate and health review—uncharted territory: extreme weather events and morbidity. *Int J Health Serv*. 2022;52(2):189–200. <https://doi.org/10.1177/00207314221082452>.
8. Hankins CA, Friedman SR, Zafar T, Strathdee SA. Transmission and prevention of HIV and sexually transmitted infections in war settings: implications for current and future armed conflicts. *AIDS*. 2002;16(17):2245–52. <https://doi.org/10.1097/00002030-200211220-00003>.
9. Friedman SR, Smyrnov P, Vasylyeva TI. Will the Russian war in Ukraine unleash larger epidemics of HIV, TB and associated conditions and diseases in Ukraine? *Harm Reduct J*. 2023;20(1):119. <https://doi.org/10.1186/s12954-023-00855-1>.
10. Joint United Nations Programme on HIV/AIDS (UNAIDS). The Gap report [Internet]. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS); 2014 [cited 2023 July 31]. Available from: https://www.unaids.org/sites/default/files/media_asset/UNAIDS_Gap_report_en.pdf
11. Joint United Nations Programme on HIV/AIDS (UNAIDS). UNAIDS Global AIDS update 2023 [Internet]. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS); 2023 [cited 2023 September 6]. Available from: https://thepath.unaids.org/wp-content/themes/unaids2023/assets/files/2023_report.pdf
12. Munezero E, Manoukian S. The social determinants of health and health seeking behaviour in populations affected by armed conflict: a qualitative systematic review. *Med Confl Surviv*. 2021;37(4):293–318. <https://doi.org/10.1080/13623699.2021.1971824>.
13. Orievulu KS, Ayeb-Karlsson S, Ngema S, Baisley K, Tanser F, Ngwenya N, et al. Exploring linkages between drought and HIV treatment adherence in Africa: a systematic review. *Lancet Planet Health*. 2022;6(4):e359–70. [https://doi.org/10.1016/S2542-5196\(22\)00016-X](https://doi.org/10.1016/S2542-5196(22)00016-X).
14. Tanaka Y, Kunii O, Hatano T, Wakai S. Knowledge, attitude, and practice (KAP) of HIV prevention and HIV infection risks among congolese refugees in Tanzania. *Health Place*. 2008;14(3):434–52. <https://doi.org/10.1016/j.healthplace.2007.07.005>.
15. Lieber M, Chin-Hong P, Whittle HJ, Hogg R, Weiser SD. The synergistic relationship between climate change and the HIV/AIDS epidemic: a conceptual framework. *AIDS Behav*. 2021;25(7):2266–77. <https://doi.org/10.1007/s10461-020-03155-y>.
16. Seguin M, Roberts B. Coping strategies among conflict-affected adults in low- and middle-income countries: a systematic literature review. *Glob Public Health*. 2017;12(7):811–29. <https://doi.org/10.1080/17441692.2015.1107117>.
17. Mishra D, O’Laughlin K, Spiegel P. A systematic review evaluating HIV prevalence among conflict-affected populations, 2005–2020. *AIDS Rev*. 2021;23(3):143–52. <https://doi.org/10.24875/AIDSRev.200001311>.
18. Mock NB, Duale S, Brown LF, Mathys E, O’Maonaigh HC, Abul-Husn NK, et al. Conflict and HIV: a framework for risk assessment to prevent HIV in conflict-affected settings in Africa. *Emerg Themes Epidemiol*. 2004;1(1):6. <https://doi.org/10.1186/1742-7622-1-6>.
19. Vasylyeva TI, Horyniak D, Bojorquez I, Pham MD. Left behind on the path to 90–90–90: understanding and responding to HIV among displaced people. *J Int AIDS Soc*. 2022;25(11):e26031. <https://doi.org/10.1002/jia2.26031>.
20. Bennett BW, Marshall BD, Gjelsvik A, McGarvey ST, Lurie MN. HIV incidence prior to, during, and after violent conflict in 36

- sub-saharan African Nations, 1990–2012: an ecological study. *PLoS ONE*. 2015;10(11):e0142343. <https://doi.org/10.1371/journal.pone.0142343>.
21. Spiegel PB, Bennedsen AR, Claass J, Bruns L, Patterson N, Yiweza D, et al. Prevalence of HIV infection in conflict-affected and displaced people in seven sub-Saharan African countries: a systematic review. *Lancet*. 2007;369(9580):2187–95. [https://doi.org/10.1016/S0140-6736\(07\)61015-0](https://doi.org/10.1016/S0140-6736(07)61015-0).
 22. Baral S, Logie CH, Grosso A, Wirtz AL, Beyrer C. Modified social ecological model: a tool to guide the assessment of the risks and risk contexts of HIV epidemics. *BMC Public Health*. 2013;13:482. <https://doi.org/10.1186/1471-2458-13-482>.
 23. Weine SM, Kashuba AB. Labor migration and HIV risk: a systematic review of the literature. *AIDS Behav*. 2012;16(6):1605–21. <https://doi.org/10.1007/s10461-012-0183-4>.
 24. Wang Y, Mitchell JW, Zhang C, Liu Y. Evidence and implication of interventions across various socioecological levels to address pre-exposure prophylaxis uptake and adherence among men who have sex with men in the United States: a systematic review. *AIDS Res Ther*. 2022;19(1):28. <https://doi.org/10.1186/s12981-022-00456-1>.
 25. Kohrt BA, Mistry AS, Anand N, Beecroft B, Nuwayhid I. Health research in humanitarian crises: an urgent global imperative. *BMJ Glob Health*. 2019;4(6):e001870. <https://doi.org/10.1136/bmjgh-2019-001870>.
 26. Leresche E, Hossain M, De Rubeis ML, Hermans V, Burtscher D, Rossi R, et al. How is the implementation of empirical research results documented in conflict-affected settings? Findings from a scoping review of peer-reviewed literature. *Confl Health*. 2023;17(1):39. <https://doi.org/10.1186/s13031-023-00534-9>.
 27. United Nations. Political declaration on HIV and AIDS: ending inequalities and getting on track to end AIDS by 2030 [Internet]. New York: United Nations General Assembly; 2021 [cited 2023 September 9]. Available from: https://www.unaids.org/sites/default/files/media_asset/2021_political-declaration-on-hiv-and-aids_en.pdf
 28. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1):19–32. <https://doi.org/10.1080/1364557032000119616>.
 29. Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. *JBIM Evid Synth*. 2020;18(10):2119–26. <https://doi.org/10.11124/JBIES-20-00167>.
 30. Koegler E, Kennedy CE. A scoping review of the associations between mental health and factors related to HIV acquisition and disease progression in conflict-affected populations. *Confl Health*. 2018;12:20. <https://doi.org/10.1186/s13031-018-0156-y>.
 31. Roxo U, Mobula ML, Walker D, Ficht A, Yeiser S. Prioritizing the sexual and reproductive health and rights of adolescent girls and young women within HIV treatment and care services in emergency settings: a girl-centered agenda. *Reprod Health*. 2019;16(Suppl 1):57. <https://doi.org/10.1186/s12978-019-0710-0>.
 32. Ferguson A, Shannon K, Butler J, Goldenberg SM. A comprehensive review of HIV/STI prevention and sexual and reproductive health services among sex workers in conflict-affected settings: call for an evidence- and rights-based approach in the humanitarian response. *Confl Health*. 2017;11:25. <https://doi.org/10.1186/s13031-017-0124-y>.
 33. Peters M, Godfrey C, McInerney P, Munn Z, Tricco A, Khalil H. Chapter 11: Scoping reviews [Internet]: JBI; 2020 [cited 2023 July 31]. Available from: <https://jbi-global-wiki.refined.space/MANUAL/4687342/Chapter+11%3A+Scoping+reviews>
 34. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169(7):467–73. <https://doi.org/10.7326/M18-0850>.
 35. Harsono D, Peterson H, Nyhan K, Khoshnood K. Factors associated with HIV acquisition in the context of humanitarian crises: a scoping review protocol. *JBIM Evid Synth*. 2022;20(7):1852–60. <https://doi.org/10.11124/JBIES-21-00135>.
 36. United Nations High Commissioner for Refugees. Refugee data finder: methodology Geneva: United Nations High Commissioner for Refugees; [updated 2023; cited 2023 July 31]. Available from: <https://www.unhcr.org/refugee-statistics/methodology/>
 37. Patel P, Borkowf CB, Brooks JT, Lasry A, Lansky A, Mermin J. Estimating per-act HIV transmission risk: a systematic review. *AIDS*. 2014;28(10):1509–19. <https://doi.org/10.1097/QAD.0000000000000298>.
 38. Kanny D, Broz D, Finlayson T, Lee K, Sionean C, Wejnert C, et al. A key comprehensive system for biobehavioral surveillance of populations disproportionately affected by HIV (National HIV Behavioral Surveillance): cross-sectional Survey Study. *JMIR Public Health Surveill*. 2022;8(11):e39053. <https://doi.org/10.2196/39053>.
 39. Levy ME, Wilton L, Phillips G 2nd, Glick SN, Kuo I, Brewer RA, et al. Understanding structural barriers to accessing HIV testing and prevention services among black men who have sex with men (BMSM) in the United States. *AIDS Behav*. 2014;18(5):972–96. <https://doi.org/10.1007/s10461-014-0719-x>.
 40. United Nations High Commissioner for Refugees. Refugee data finder: definition Geneva: United Nations High Commissioner for Refugees; [updated 2023; cited 2023 July 31]. Available from: <https://www.unhcr.org/refugee-statistics/methodology/definition/>
 41. Prasad AS, Francescutti LH. Natural disasters. In: *International encyclopedia of public health*. Amsterdam: Elsevier; 2017. p. 215–22.
 42. United Nations High Commissioner for Refugees. Coordination in complex emergencies Geneva: United Nations High Commissioner for Refugees; [updated 2001; cited 2023 July 31]. Available from: <https://www.unhcr.org/us/publications/coordination-complex-emergencies>
 43. Boyd AT, Cookson ST, Anderson M, Bilukha OO, Brennan M, Handzel T, et al. Centers for disease control and prevention public health response to humanitarian emergencies, 2007–2016. *Emerg Infect Dis*. 2017;23(13):S196–202. <https://doi.org/10.3201/eid2313.170473>.
 44. Jordan K, Lewis TP, Roberts B. Quality in crisis: a systematic review of the quality of health systems in humanitarian settings. *Confl Health*. 2021;15(1):7. <https://doi.org/10.1186/s13031-021-00342-z>.
 45. Purgato M, Gastaldon C, Papola D, van Ommeren M, Barbui C, Tol WA. Psychological therapies for the treatment of mental disorders in low- and middle-income countries affected by humanitarian crises. *Cochrane Database Syst Rev*. 2018;7(7):CD011849. <https://doi.org/10.1002/14651858.CD011849.pub2>.
 46. Uphoff E, Robertson L, Cabieses B, Villalon FJ, Purgato M, Churchill R, et al. An overview of systematic reviews on mental health promotion, prevention, and treatment of common mental disorders for refugees, asylum seekers, and internally displaced persons. *Cochrane Database Syst Rev*. 2020;9(9):CD013458. <https://doi.org/10.1002/14651858.CD013458.pub2>.
 47. Adebayo OW, Gonzalez-Guarda RM. Factors associated with HIV testing in youth in the United States: an integrative review. *J Assoc Nurses AIDS Care*. 2017;28(3):342–62. <https://doi.org/10.1016/j.jana.2016.11.006>.
 48. Ramjee G, Moonsamy S, Abbai NS, Wand H. Individual and population level impact of key HIV risk factors on HIV incidence rates in Durban, South Africa. *PLoS ONE*. 2016;11(4):e0153969. <https://doi.org/10.1371/journal.pone.0153969>.


49. Adedimeji AA, Hoover DR, Shi Q, Gard T, Mutimura E, Sinayobye J, et al. Sexual behavior and risk practices of HIV positive and HIV negative Rwandan women. *AIDS Behav.* 2015;19(7):1366–78. <https://doi.org/10.1007/s10461-014-0964-z>.
50. Alberer M, Malinowski S, Sanftenberg L, Schelling J. Notifiable infectious diseases in refugees and asylum seekers: experience from a major reception center in Munich Germany. *Infection.* 2018;46(3):375–83. <https://doi.org/10.1007/s15010-018-1134-4>.
51. Aliyu GG, Aliyu SH, Ehoche A, Dongarwar D, Yusuf RA, Aliyu MH, et al. The burden of HIV, hepatitis B and hepatitis C by armed conflict setting: the Nigeria AIDS indicator and impact survey, 2018. *Ann Glob Health.* 2021;87(1):53. <https://doi.org/10.5334/aogh.3226>.
52. Anema A, Joffres MR, Mills E, Spiegel PB. Widespread rape does not directly appear to increase the overall HIV prevalence in conflict-affected countries: so now what? *Emerg Themes Epidemiol.* 2008;5:11. <https://doi.org/10.1186/1742-7622-5-11>.
53. Cossa HA, Gloyd S, Vaz RG, Folgosa E, Simbine E, Diniz M, et al. Syphilis and HIV infection among displaced pregnant women in rural Mozambique. *Int J STD AIDS.* 1994;5(2):117–23. <https://doi.org/10.1177/095646249400500208>.
54. Courtney LP, Goco N, Waja J, Farris T, Cummiskey C, Smith E, et al. HIV prevalence and behavioral risk factors in the Sudan People's liberation army: data from South Sudan. *PLoS ONE.* 2017;12(11):e0187689. <https://doi.org/10.1371/journal.pone.0187689>.
55. Fabiani M, Nattabi B, Pierotti C, Ciantia F, Opio AA, Musinguzi J, et al. HIV-1 prevalence and factors associated with infection in the conflict-affected region of North Uganda. *Confl Health.* 2007;1:3. <https://doi.org/10.1186/1752-1505-1-3>.
56. Goldenberg SM, Muzaaya G, Akello M, Braschel M, Birungi J, Shannon K. High burden of previously undiagnosed HIV infections and gaps in HIV care cascade for conflict-affected female sex workers in northern Uganda. *Int J STD AIDS.* 2019;30(3):275–83. <https://doi.org/10.1177/0956462418804658>.
57. Goldenberg SM, Muzaaya G, Akello M, Nguyen P, Birungi J, Shannon K. War-related abduction and history of incarceration linked to high burden of HIV among female sex workers in conflict-affected Northern Uganda. *J Acquir Immune Defic Syndr.* 2016;73(1):109–16. <https://doi.org/10.1097/QAI.0000000000001030>.
58. Haffeejee F, Maksudi K. Understanding the risk factors for HIV acquisition among refugee women in South Africa. *AIDS Care.* 2020;32(1):37–42. <https://doi.org/10.1080/09540121.2019.1687833>.
59. Harbertson J, Grillo M, Zimulinda E, Murego C, Cronan T, May S, et al. Prevalence of PTSD and depression, and associated sexual risk factors, among male Rwanda defense forces military personnel. *Trop Med Int Health.* 2013;18(8):925–33. <https://doi.org/10.1111/tmi.12129>.
60. Heimer R, Barbour R, Khouri D, Crawford FW, Shebl F, Aaraj E, et al. HIV risk, prevalence, and access to care among men who have sex with men in Lebanon. *AIDS Res Hum Retrovir.* 2017;33(11):1149–54. <https://doi.org/10.1089/AID.2016.0326>.
61. Holt BY, Effler P, Brady W, Friday J, Belay E, Parker K, et al. Planning STI/HIV prevention among refugees and mobile populations: situation assessment of Sudanese refugees. *Disasters.* 2003;27(1):1–15. <https://doi.org/10.1111/1467-7717.00216>.
62. Kaiser R, Kedamo T, Lane J, Kessia G, Downing R, Handzel T, et al. HIV, syphilis, herpes simplex virus 2, and behavioral surveillance among conflict-affected populations in Yei and Rumbek, southern Sudan. *AIDS.* 2006;20(6):942–4. <https://doi.org/10.1097/01.aids.0000218564.20521.51>.
63. Katamba A, Ogwang MD, Zamar DS, Muyinda H, Oneka A, Atim S, et al. Cango Lye (healing the elephant): HIV incidence in post-conflict Northern Uganda. *EclinicalMedicine.* 2020;23:100408. <https://doi.org/10.1016/j.eclinm.2020.100408>.
64. Khanani MR, Ansari AS, Khan S, Somani M, Kazmi SU, Ali SH. Concentrated epidemics of HIV, HCV, and HBV among Afghan refugees. *J Infect.* 2010;61(5):434–7. <https://doi.org/10.1016/j.jinf.2010.08.009>.
65. Kim AA, Malele F, Kaiser R, Mama N, Kinkela T, Mantshumba JC, et al. HIV infection among internally displaced women and women residing in river populations along the Congo River. *Democr Repub Congo AIDS Behav.* 2009;13(5):914–20. <https://doi.org/10.1007/s10461-009-9536-z>.
66. Kowo MP, Frungwa CN, Njonnou SRS, Andoulo FA, Ndam AWN, Yemeli LD, et al. Epidemiologic patterns of HIV, hepatitis B and C virus infections among refugees of the Mbile Camp in the east region of Cameroon (hepatitis and HIV among refugees). *J Gastroenterol Hepatol Res.* 2021;10(3):3524–30. <https://doi.org/10.17554/j.issn.2224-3992.2021.10.989>.
67. Luo J, Zamar DS, Ogwang MD, Muyinda H, Malamba SS, Katamba A, et al. Cango Lye (healing the elephant): probable post-traumatic stress disorder (PTSD) and depression in Northern Uganda five years after a violent conflict. *J Migr Health.* 2022;6:100125. <https://doi.org/10.1016/j.jmh.2022.100125>.
68. Malamba SS, Muyinda H, Spittal PM, Ekwaru JP, Kiwanuka N, Ogwang MD, et al. “The Cango Lye Project - Healing the Elephant”: HIV related vulnerabilities of post-conflict affected populations aged 13–49 years living in three Mid-Northern Uganda districts. *BMC Infect Dis.* 2016;16(1):690. <https://doi.org/10.1186/s12879-016-2030-0>.
69. Mansson F, Biague A, da Silva ZJ, Dias F, Nilsson LA, Andersson S, et al. Prevalence and incidence of HIV-1 and HIV-2 before, during and after a civil war in an occupational cohort in Guinea-Bissau, West Africa. *AIDS.* 2009;23(12):1575–82. <https://doi.org/10.1097/QAD.0b013e32832cedfb>.
70. Mootz JJ, Odejimi OA, Bhattacharya A, Kann B, Ettelbrick J, Mello M, et al. Transactional sex work and HIV among women in conflict-affected Northeastern Uganda: a population-based study. *Confl Health.* 2022;16(1):8. <https://doi.org/10.1186/s13031-022-00441-5>.
71. Mulanga C, Bazepeo SE, Mwamba JK, Butel C, Tshimpaka JW, Kashi M, et al. Political and socioeconomic instability: how does it affect HIV? A case study in the Democratic Republic of Congo. *AIDS.* 2004;18(5):832–4. <https://doi.org/10.1097/00002030-200403260-00024>.
72. Mulanga-Kabeya C, Nzilambi N, Edidi B, Minlangu M, Tshimpaka T, Kambembo L, et al. Evidence of stable HIV seroprevalences in selected populations in the Democratic Republic of the Congo. *AIDS.* 1998;12(8):905–10. <https://doi.org/10.1097/00002030-199808000-00013>.
73. Najib R, Mumtaz S, Ahmed J, Muhammad H, Ahmed N, Qureshi MSH. Frequency of hepatitis B, hepatitis C and human immunodeficiency viruses in internally displaced persons of south Waziristan, Pakistan. *J Postgrad Med Inst.* 2017;31(1):82–7.
74. O'Laughlin KN, Rabideau DJ, Kasozi J, Parker RA, Bustamante ND, Faustin ZM, et al. Predictors of HIV infection: a prospective HIV screening study in a Ugandan refugee settlement. *BMC Infect Dis.* 2016;16(1):695. <https://doi.org/10.1186/s12879-016-2021-1>.
75. Patel S, Schechter MT, Sewankambo NK, Atim S, Oboya C, Kiwanuka N, et al. Comparison of HIV-related vulnerabilities between former child soldiers and children never abducted by the LRA in northern Uganda. *Confl Health.* 2013;7(1):17. <https://doi.org/10.1186/1752-1505-7-17>.
76. Patel S, Schechter MT, Sewankambo NK, Atim S, Kiwanuka N, Spittal PM. Lost in transition: HIV prevalence and correlates of infection among young people living in post-emergency phase transit camps in Gulu District, Northern Uganda. *PLoS ONE.* 2014;9(2):e89786. <https://doi.org/10.1371/journal.pone.0089786>.

77. Patel S, Schechter MT, Sewankambo NK, Atim S, Lakor S, Kiwanuka N, et al. War and HIV: sex and gender differences in risk behaviour among young men and women in post-conflict Gulu District, Northern Uganda. *Glob Public Health*. 2014;9(3):325–41. <https://doi.org/10.1080/17441692.2014.887136>.
78. Smallman-Raynor MR, Cliff AD. Civil war and the spread of AIDS in Central Africa. *Epidemiol Infect*. 1991;107(1):69–80. <https://doi.org/10.1017/s095026880004869x>.
79. Spittal PM, Malamba SS, Ogwang MD, Musisi S, Ekwaru JP, Sewankambo NK, et al. Cango Lye (healing the elephant): gender differences in HIV infection in post-conflict Northern Uganda. *J Acquir Immune Defic Syndr*. 2018;78(3):257–68. <https://doi.org/10.1097/QAI.0000000000001671>.
80. Plewes K, Lee T, Kajecheva L, Thwin MM, Lee SJ, Carrara VI, et al. Low seroprevalence of HIV and syphilis in pregnant women in refugee camps on the Thai–Burma border. *Int J STD AIDS*. 2008;19(12):833–7. <https://doi.org/10.1258/ijsa.2008.008034>.
81. Strand RT, Fernandes Dias L, Bergström S, Andersson S. Unexpected low prevalence of HIV among fertile women in Luanda, Angola. Does war prevent the spread of HIV? *Int J STD AIDS*. 2007;18(7):467–71. <https://doi.org/10.1258/095646207781147300>.
82. Supervie V, Halima Y, Blower S. Assessing the impact of mass rape on the incidence of HIV in conflict-affected countries. *AIDS*. 2010;24(18):2841–7. <https://doi.org/10.1097/QAD.0b013e32833fed78>.
83. Todd CS, Nasir A, Stanekzai MR, Fiekert K, Sipsma HL, Vlahov D, et al. Hepatitis C and HIV incidence and harm reduction program use in a conflict setting: an observational cohort of injecting drug users in Kabul, Afghanistan. *Harm Reduct J*. 2015;12:22. <https://doi.org/10.1186/s12954-015-0056-z>.
84. Wanigaratne S, Rashid M, Gagnon A, Cole DC, Shakya Y, Moineddin R, et al. Refugee mothers, migration pathways and HIV: a population-based cohort study. *AIDS Care*. 2020;32(1):30–6. <https://doi.org/10.1080/09540121.2019.1612009>.
85. Watts CH, Foss AM, Hossain M, Zimmerman C, von Simson R, Klot J. Sexual violence and conflict in Africa: prevalence and potential impact on HIV incidence. *Sex Transm Infect*. 2010;86(Suppl 3):iii93–9. <https://doi.org/10.1136/sti.2010.044610>.
86. Wollants E, Schoenenberg M, Figueroa C, Shor-Posner G, Klaskala W, Baum MK. Risk factors and patterns of HIV-1 transmission in the El Salvador military during war time. *AIDS*. 1995;9(11):1291–2. <https://doi.org/10.1097/00002030-19951000-00017>.
87. Zihindula G, Maharaj P. Risk of sexual violence: perspectives and experiences of women in a hospital in the Democratic Republic of Congo. *J Community Health*. 2015;40(4):736–43. <https://doi.org/10.1007/s10900-015-9992-5>.
88. Crawshaw AF, Pareek M, Were J, Schillinger S, Gorbacheva O, Wickramage KP, et al. Infectious disease testing of UK-bound refugees: a population-based, cross-sectional study. *BMC Med*. 2018;16(1):143. <https://doi.org/10.1186/s12916-018-1125-4>.
89. Kerridge BT, Saha TD, Hasin DS. Armed conflict, substance use and HIV: a global analysis. *AIDS Behav*. 2016;20(3):473–83. <https://doi.org/10.1007/s10461-015-1161-4>.
90. Loevinsohn M. The 2001–03 famine and the dynamics of HIV in Malawi: a natural experiment. *PLoS ONE*. 2015;10(9):e0135108. <https://doi.org/10.1371/journal.pone.0135108>.
91. Zea MC, Reisen CA, Bianchi FT, Gonzales FA, Betancourt F, Aguilar M, et al. Armed conflict, homonegativity and forced internal displacement: implications for HIV among Colombian gay, bisexual and transgender individuals. *Cult Health Sex*. 2013;15(7):788–803. <https://doi.org/10.1080/13691058.2013.779028>.
92. Anthonj C, Nkongolo OT, Schmitz P, Hango JN, Kistemann T. The impact of flooding on people living with HIV: a case study from the Ohangwena Region, Namibia. *Glob Health Action*. 2015;8:26441. <https://doi.org/10.3402/gha.v8.26441>.
93. Berndt VK, Austin KF. Drought and disproportionate disease: an investigation of gendered vulnerabilities to HIV/AIDS in less-developed nations. *Popul Environ*. 2021;42(3):379–405. <https://doi.org/10.1007/s11111-020-00367-1>.
94. Low AJ, Frederix K, McCracken S, Manyu S, Gummerson E, Radin E, et al. Association between severe drought and HIV prevention and care behaviors in Lesotho: a population-based survey 2016–2017. *PLoS Med*. 2019;16(1):e1002727. <https://doi.org/10.1371/journal.pmed.1002727>.
95. Beckwith CG, DeLong AK, Desjardins SF, Gillani F, Bazerman L, Mitty JA, et al. HIV infection in refugees: a case-control analysis of refugees in Rhode Island. *Int J Infect Dis*. 2009;13(2):186–92. <https://doi.org/10.1016/j.ijid.2008.06.004>.
96. Wanigaratne S, Cole DC, Bassil K, Hyman I, Moineddin R, Urquia ML. Contribution of HIV to maternal morbidity among refugee women in Canada. *Am J Public Health*. 2015;105(12):2449–56. <https://doi.org/10.2105/AJPH.2015.302886>.
97. Thorp M, Ayieko J, Hoffman RM, Balakasi K, Camlin CS, Dovel K. Mobility and HIV care engagement: a research agenda. *J Int AIDS Soc*. 2023;26(3):e26058. <https://doi.org/10.1002/jia2.26058>.
98. World Health Organization. Fact sheet: HIV statistics, globally and by WHO region 2023 [cited 2023 December 1]. Available from: <https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/j0294-who-hiv-epi-factsheet-v7.pdf>
99. Guha-Sapir D, Scales SE. Challenges in public health and epidemiology research in humanitarian settings: experiences from the field. *BMC Public Health*. 2020;20(1):1761. <https://doi.org/10.1186/s12889-020-09851-7>.

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