



UNIVERSITY OF LEEDS

This is a repository copy of *Environmental health conditions in protracted displacement: A systematic scoping review*.

White Rose Research Online URL for this paper:
<http://eprints.whiterose.ac.uk/161368/>

Version: Accepted Version

Article:

Behnke, NL, Cronk, R, Shackelford, BB et al. (4 more authors) (2020) Environmental health conditions in protracted displacement: A systematic scoping review. *Science of The Total Environment*, 726. 138234. ISSN 0048-9697

<https://doi.org/10.1016/j.scitotenv.2020.138234>

© 2020 Elsevier B.V. All rights reserved. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Reuse

This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND) licence. This licence only allows you to download this work and share it with others as long as you credit the authors, but you can't change the article in any way or use it commercially. More information and the full terms of the licence here: <https://creativecommons.org/licenses/>

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.



eprints@whiterose.ac.uk
<https://eprints.whiterose.ac.uk/>

Environmental health conditions in protracted displacement: a systematic scoping review

Nikki L. Behnke^{1*}, Ryan Cronk¹, Brandie Banner Shackelford¹, Brittany Cooper¹, Raymond Tu¹, Leo Heller^{2,3}, and Jamie Bartram^{1,4}

¹ The Water Institute at UNC, Department of Environmental Sciences and Engineering, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, 135 Dauer Drive, CB#7431, Chapel Hill, North Carolina 27599, United States

² René Rachou Institute, Oswaldo Cruz Foundation, Av. Augusto de Lima, 1715, Belo Horizonte, Brazil

³ Office of the United Nations High Commissioner for Human Rights (OHCHR), Palais des Nations, CH-1211 Geneva 10, Switzerland

⁴ School of Civil Engineering, University of Leeds, Woodhouse Ln, Woodhouse, Leeds LS2 9DY, United Kingdom

* Corresponding author: Nikki Behnke

The Water Institute at UNC, Department of Environmental Sciences and Engineering, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, 135 Dauer Drive, CB#7431, Chapel Hill, North Carolina

Phone: (1) 919-768-2909; Email: Behnke@live.unc.edu

Adequate environmental health services are critical for human rights, health, and development, especially in the context of forced displacement. There are more than 70 million forcibly displaced persons worldwide, most in protracted situations, having been displaced for more than two years. Some live in camps or informal settlements, but most live in urban areas.

Environmental health services are important in the transition from emergency response to sustainable development in these settings, but evidence on environmental health in displaced populations is disparate and of variable quality. We conducted a systematic scoping review of environmental conditions, exposures, and outcomes in protracted displacement settings; obstacles to improvement in environmental health services; and recommendations made for improvement. We included 213 publications from peer-reviewed and grey literature databases. Data were extracted on environmental health topics including water, sanitation, hygiene, overcrowding, waste management, energy supply, vector control, menstrual hygiene, air quality, and food safety. Most studies present data from low- and lower-middle income countries. Northern Africa and Western Asia and Sub-Saharan Africa are the most-represented regions. There is substantial evidence on water, sanitation, and crowding, but few studies report findings on other environmental health topics. Water-related disease, parasites, and respiratory infections are frequently cited and studies report that services often fail to meet international standards for humanitarian response. The most frequent obstacles and recommendations are institutional, political, or implementation-related, but few studies provide concrete recommendations for improvement. Our review compiles and characterizes the research on environmental health in protracted displacement. We recommend including displaced populations in international environmental health policy and monitoring initiatives, and bridging from humanitarian response to sustainable development by preparing for long-term displacement from the early stages of a crisis.

Keywords: refugee; internally displaced person (IDP); humanitarian; post-emergency; migration; WaSH

1. Introduction

There are more than 70 million forcibly displaced persons¹ worldwide, many of whom live in low- and middle-income countries (UNHCR, 2019). Adequate environmental health services, including water, sanitation, and hygiene (WaSH), are critical to health, development, and human rights, and cannot be denied based on immigration or legal status (Heller, 2018). Environmental health services are especially important for forcibly displaced populations; overcrowded camps and poor environmental health conditions foster the spread of communicable diseases, and inadequate environmental health services have detrimental impacts on the health and wellbeing of displaced persons and host communities (UNHCR, 2011; Cronin et al., 2008). Environmental health services in humanitarian crises, especially in non-household settings, are poorly understood, and evidence is of variable quality (Blanchet et al., 2017; Cronk et al., 2015).

Although environmental health is often among the highest priorities in emergencies, long-term, sustainable services and their monitoring are challenging in camp settings as well as outside of camps, where 60% of displaced populations live (UNHCR, 2016a). Refugee and internally displaced person (IDP) settings are typically designed as short-term solutions, but forcible displacement usually outlasts the emergency stage; 80% of refugee crises last more than 10 years, and 40% persist past 20 years (Crawford et al., 2015). Protracted crises—defined by the United Nations High Commissioner for Refugees (UNHCR) as situations where populations are displaced for longer than two years—require different environmental health standards than acute emergencies (UNHCR, 2017a). This is reflected in the distinct principles outlined in the Sphere handbook—the international charter for humanitarian response—for protracted crises (Sphere Association, 2018).

¹ We defined “forcibly displaced” as displacement that is a result of anthropogenic threats (e.g. war, political violence, persecution) or natural disaster.

In order to compile and characterize the existing evidence on environmental health in protracted displacement, we conducted a systematic scoping review to answer the following research questions:

1. *What environmental health conditions, exposures, and outcomes are reported in protracted refugee or IDP settings?*
2. *What obstacles are reported to prevent improvements in environmental health in these settings?*
3. *What recommendations do studies give to improve environmental health in these settings?*

Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

guidelines, we analyzed data extracted from peer-reviewed publications and grey literature. Our results describe environmental health conditions, exposures, and outcomes related to: water, sanitation, and hygiene; overcrowding; waste management; energy supply; vector control; menstrual hygiene; food safety; and air quality. We also extracted information on obstacles to improvement that are reported in the studies included in our review, as well as their recommendations. Based on our findings, we make recommendations for policymakers, environmental health service providers, and researchers.

2. Methods

2.1 - Research questions and search strategy

This systematic review was designed according to the PRISMA methodology (Moher et al., 2009). We selected a scoping review as our methodology in order to map the key concepts of this emerging area of research, and structured the review to answer our research questions about environmental health conditions, exposures, and outcomes, obstacles to improvement, and recommendations. Scoping reviews determine what evidence is available on a given topic, and take a broader approach than systematic literature reviews (Peters et al., 2015). We designed a search strategy using terminology associated with environmental health and displaced

populations, based on other systematic reviews on related topics (Adair-Rohani et al., 2013; De Buck et al., 2015; Freeman et al., 2014; Moffa et al., 2019, 2018). Search terms included environmental health factors (water, sanitation, and hygiene; waste management; energy supply; vector control; air quality; food hygiene and safety; and cleanliness); and displaced populations terms (refugees; internally displaced persons (IDPs); and other displaced populations such as asylum seekers). Examples are included in **Table 1**, and the full search terms are available in *SI*.

Table 1 – Themes and examples of search terms for a systematic scoping review on environmental health in protracted displacement

Theme	Examples
Environmental health	
Water	“water”
Sanitation	“sanitation”; “plumbing”; “latrine”
Hygiene	“hygiene”; “soap”; “shower”; “menstrual hygiene”
Waste management	“waste management”; “landfill”; “wastewater”
Energy	“electricity”; “generator”; “lighting”
Vector control	“vector control”; “rodent”; “infestation”
Air pollution	“indoor air”; “ventilation”; “mold”
Food safety	“food safety”; “undercooked”; “foodborne”
Cleaning	“fomite”; “disinfect”; “cleanliness”
Other environmental health issues	“environmental health”; “environmental exposure”; “lead poisoning”; “overcrowding”
Displaced populations	
Refugees	“refugee”; “refugees”
Internally displaced persons	“internally displaced person”; “internally displaced people”
Other displaced populations	“immigrant”; “asylum seeker”

For peer-reviewed literature, PubMed, Web of Science, Scopus, and EBSCOhost Global Health were searched between September 23rd 2017 and October 12th 2017. Using Cochrane’s online systematic review software, Covidence, two screeners reviewed titles and abstracts of each publication. If necessary, a third reviewer resolved conflicts. The same process was used for

109 full text review.

110 For grey literature, the databases: DisasterLit; International Rescue Committee; United
 111 Nations Children’s Fund (UNICEF) WaSH; UNHCR; RAND; Centers for Disease Control and
 112 Prevention (CDC) WaSH; Water, Engineering and Development Centre (WEDC); International
 113 Committee of the Red Cross; World Bank Water were searched between December 23rd 2017
 114 and January 6th 2018. One of four screeners adapted the search terms for environmental health,
 115 displaced populations, or both, according to the search systems for each database (e.g. character
 116 limits, sector of focus), and documented search methods and number of results (S2). The results
 117 of each search were scanned for relevant publications, and screeners selected documents for full
 118 text review. Two screeners reviewed each document and included or excluded them using the
 119 criteria outlined in section 2.2, with a third screener resolving conflicts if needed.

120 2.2 – Study eligibility criteria

121 For peer-reviewed literature, studies were excluded if they had any of the characteristics
 122 outlined in **Table 2**:

123 **Table 2 – Exclusion criteria for peer-reviewed literature for a systematic scoping review on**
 124 **environmental health in protracted displacement**

Exclusion criteria	Explanation
Not focused on population of interest	Populations that have not been displaced; officially resettled displaced populations; Single patient or household; animal or epidemiological migration
Not forcibly displaced	Economically-driven or voluntary migration
Not focused on setting of interest	Analysis does not concern the setting in which displaced populations reside; setting is intended for permanent resettlement
Not environmental health	Not connected to environmental health or human health
Wrong study type	Documents that do not provide new data or analysis; news articles, letters to the editors, opinion pieces, newsletters
Published before 1945	We excluded articles that preceded the current “refugee regime”—the policies, institutions, and convention that

	continue to shape the international community's approach to mass displacement. ²
Not in English	N/A
Duplicate	Duplicate that was not removed by Covidence
Inaccessible	Research team and university library exhausted all reasonable resources, but could not locate a copy of the publication

For grey literature, we used the same criteria, and reviewers also excluded publications if they did not meet criteria established by the Accuracy, Authority, Coverage, Objectivity, Date, and Significance (AACODS) checklist (Tyndall, 2010).

2.3 – Data Extraction

After full text review, each publication was sorted into one of three phases of displacement as defined by UNHCR: emergency (0–6 months), medium-term (6 months – 2 years), or protracted (more than two years) (UNHCR, 2017a). This review analyzes publications that fell into the “protracted” category.

The following data were extracted from included publications: metadata (e.g. publication title, year of study, study type); contextual characteristics (e.g. study country/countries, stage of displacement at time of study); population characteristics (e.g. origin of refugee/IDP population, reason for displacement); setting characteristics (e.g. setting establishment date, total setting population, managing authority, funder(s)); environmental health conditions reported (e.g. water source(s); sanitation service(s); animal vector(s); crowding); environmental health exposures and hazards (e.g. toxins; pathogens; disease transmission route(s)); outcomes (e.g. health outcomes; livelihood outcomes); other relevant themes (e.g. climate/season/natural disaster; relevant country policies); and obstacles to improvement, knowledge gaps, and recommendations.

² Although the Convention of the Status on Refugees was not established until 1951, the negotiations that shaped this and other components of the current “refugee regime” began around 1945. The development of the “current expression” of this regime was prompted by the displacement of 30 million people during and after World War II (Barnett, 2002; Keely, 2001).

143 Simplified extraction tables are available in S3.

144 Each publication was assigned to a region (Sustainable Development Goals (SDG)
145 regional groupings (United Nations, 2017)) and income level (World Bank's list of economies
146 (World Bank, 2018)), according to the country or countries studied; if a publication reported on
147 more than one country or spanned more than one income level or region, it was counted in all
148 applicable categories.

149 3. Results

150 The search process for this study is outlined in **Figure 1**:

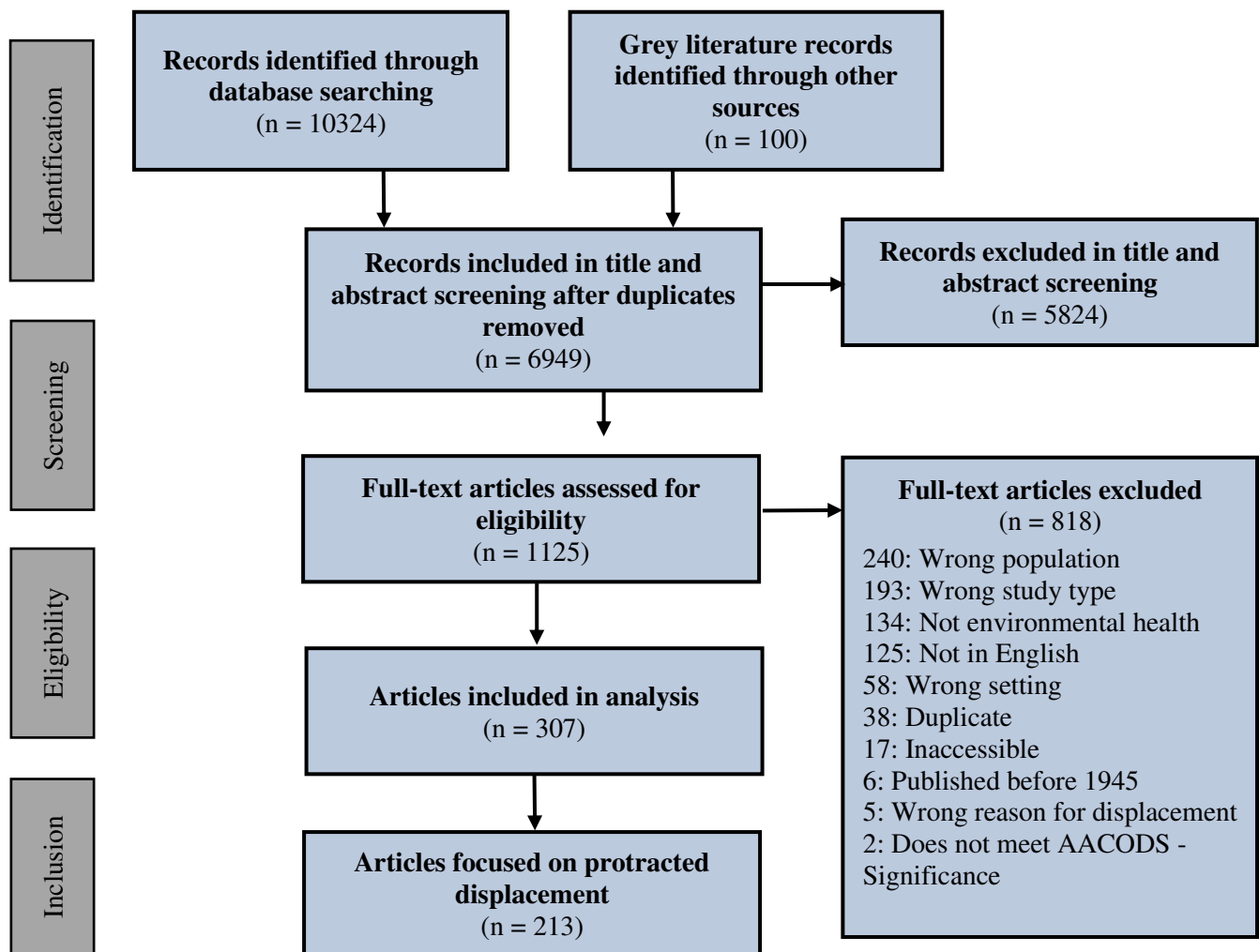


Figure 1 – Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram for a systematic scoping review on environmental health in protracted displacement

3.1 – Metadata

3.1.1 Study characteristics

Based on our search criteria, 307 publications were eligible for data extraction. Of these, 213 publications fell into the “protracted” stage of displacement and are thus included in this paper. Findings for the emergency stages are presented in a separate publication (Shackelford et al., 2020) and findings for the transitional phase will be presented in a forthcoming review.

Stage of displacement	Number of publications*
Emergency (0-6 months)	104
Mid-term/transitional (6 months – 2 years)	88
Protracted (more than 2 years)	213
*The total exceeds 307 because some publications fell into more than one category.	

shows the number of eligible publications that fell into each stage of displacement.

Table 3 – Publications by stage of displacement for a systematic scoping review of environmental health in displaced populations

Stage of displacement	Number of publications*
Emergency (0-6 months)	104
Mid-term/transitional (6 months – 2 years)	88
Protracted (more than 2 years)	213
*The total exceeds 307 because some publications fell into more than one category.	

Of the eligible publications, 213 presented data on environmental health services in displaced population that qualified as protracted – 198 peer-reviewed publications and 15 from grey literature.

Study characteristics are described in **Table 4**. Over half of the studies (n=113, 53%) were quantitative. Twenty-eight studies (13%) used approaches categorized as “other”; these included project and situation reports, threat assessments, guidance documents, and project evaluations, or did not state the study type.

Table 4 - Study characteristics for a systematic scoping review on environmental health in protracted displacement

Characteristic	Count	Percentage
Publication source		
Peer-reviewed database	198	93%
Grey literature	15	7%
Study type		
Quantitative	113*	53%
<i>Cross-sectional</i>	91	81%
<i>Case control</i>	11	10%
<i>Controlled trial</i>	5	4%
<i>Cohort</i>	4	4%
Literature review	37	17%
Mixed-methods	20	9%
Qualitative	10	5%
Case study	5	2%
Other	28	13%
*Some studies used more than one quantitative method, and others did not specify which quantitative methods were used, so the subgroups do not add up to 113. Percentages in italics are out of the 113 quantitative studies.		

The oldest publication included was published in 1946, and the most recent in 2017 (**Figure 2**).

With the exception of the oldest publication, there were no eligible publications from before 1979. Over half (n=112, 53%) were published after 2008.

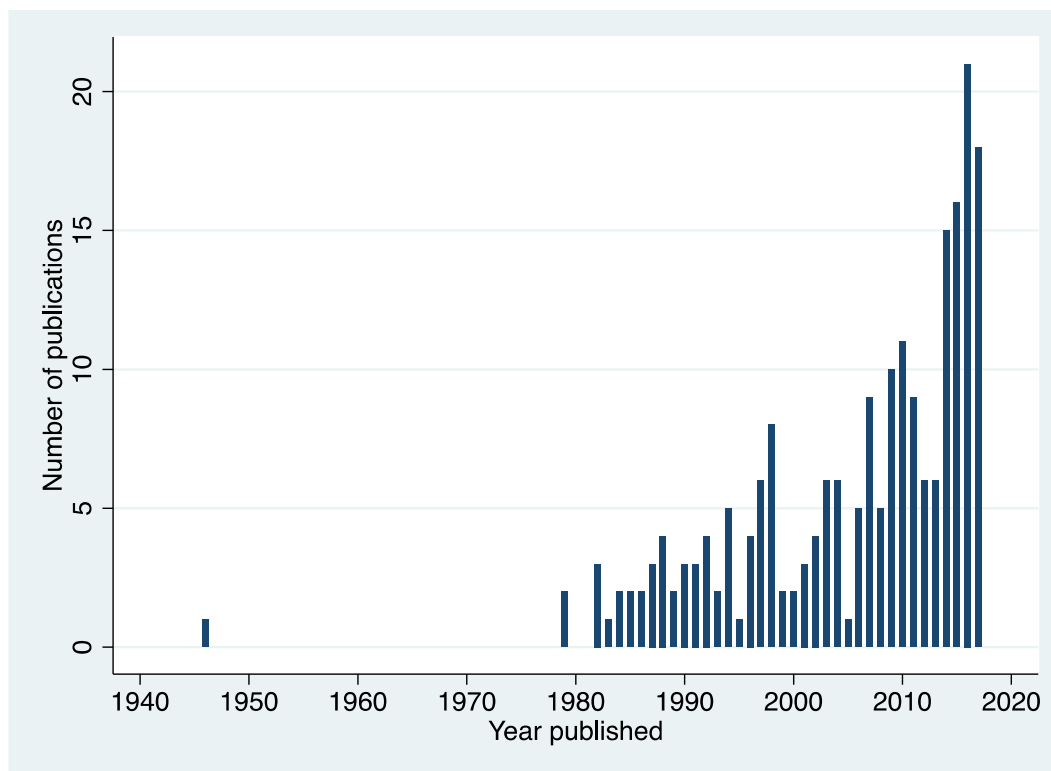


Figure 2 - Number of publications by year published included in a systematic scoping review on environmental health in protracted displacement

3.1.2 Setting characteristics

Publications present findings from 54 countries and from all SDG regions except Oceania (Error! Reference source not found.). A breakdown by region and by country is available in *S4*.

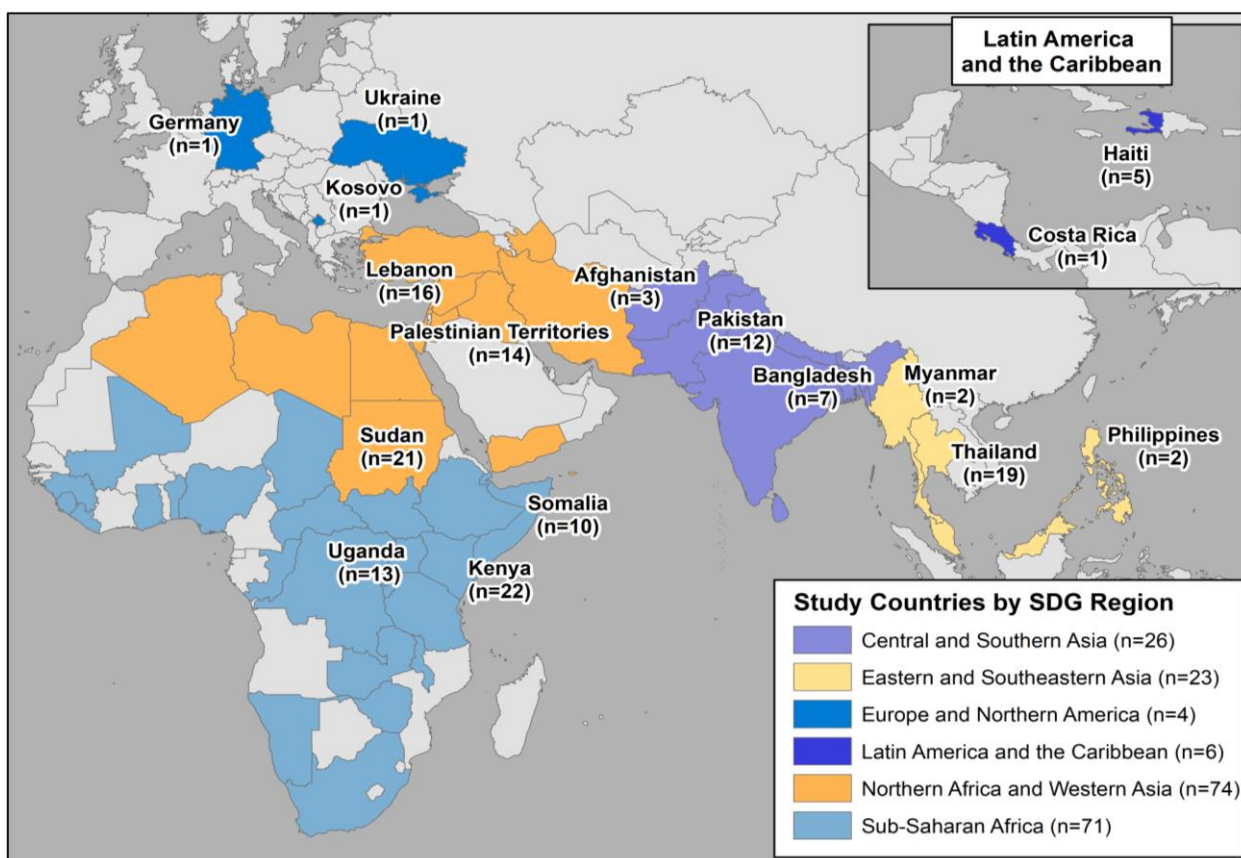


Figure 3 – Map of countries represented in a systematic scoping review on environmental health conditions in protracted displacement. Countries are color-coded by SDG region, with the three most represented countries in each region and their corresponding number of papers listed (except for Latin America and the Caribbean, where only two countries were represented).

One study (0.5%) presents findings on the European region in general, one presents findings on Africa in general, one presents findings on the Sahel region, and 18 publications (8%) do not specify the countries addressed.

Northern Africa and Western Asia is the most represented region (n=74, 35%), followed by Sub-Saharan Africa (n=71, 33%). This is nearly three times the number of publications as the next most represented regions: Central and Southern Asia (n=26, 12%) and Eastern and Southeastern Asia (n=23, 11%). The least represented regions are Latin America and the Caribbean (n=6, 3%) and Europe and Northern America (n=4, 2%). The most represented

country in the literature is Kenya with 22 publications (10%), followed by Sudan (n=21, 10%) and Thailand (n=19, 9%).

Income level	Count	Percentage*
Low-income	55	26%
Lower middle-income	87	41%
Upper middle-income	58	27%
High-income	1	0.5%
*The percentages do not add up to 100% because some publications reported data on more than one country or region.		

shows how many publications fall into each country income category. The majority of publications represent low-income countries (n=55, 26%) or lower middle-income countries (n=87, 41%).

Table 5 – Publications by World Bank income level for a systematic scoping review on environmental health in protracted displacement

Income level	Count	Percentage*
Low-income	55	26%
Lower middle-income	87	41%
Upper middle-income	58	27%
High-income	1	0.5%
*The percentages do not add up to 100% because some publications reported data on more than one country or region.		

The terminology used to describe the settings in which displaced populations live is shown in **Table 6**; 203 publications (95%) report this information. Terminology was separated into three categories based on the vocabulary used in the publications: Camp (n=184, 86%), settlement (n=19, 9%), and other (n=38, 18%).

Table 6 - Terminology used to describe settings in which displaced populations live, for a systematic scoping review on environmental health in protracted displacement

Setting	Count	Percentage*
Camp	184	86%
Settlement	19	9%

Other	38	18%
Urban	20	9%
Village	12	6%
Gathering	3	1%
Slum	3	1%
Holding center	2	1%
Community	1	0.5%
“Out of camp”	1	0.5%
“Colonia”	1	0.5%
*The percentages do not add up to 100% because some publications reported data on more than one country or region.		

3.1.3 – Population characteristics

Nearly three-quarters of the publications (n=155, 73%) report findings on refugees, and 58 (27%) report on IDPs. Other terms used to describe the population of interest are: displaced person/individual/people/community/population (n=6, 3%), asylum seekers (n=3, 1%), climate/environmental refugee/migrant (n=3, 1%), and displaced migrant (n=1, 0.5%). Some studies use more than one of these terms to describe displaced populations.

Of the 132 publications (62%) that specified reasons for population displacement, nearly all (n=124, 94% of 132) mention conflict. Other reasons include natural disaster (n=19, 14%) and famine (n=6, 5%). Cited natural disasters include droughts (n=12, 9%), earthquakes (n=6, 5%), floods (n=5, 4%), cyclones (n=3, 2%), river erosion (n=2, 2%), and tsunamis (n=1, 1%). Some publications (n=14, 11%) list more than one reason.

3.1.4 – Environmental health topics

The most frequently discussed environmental health topic is water, with findings reported in 149 studies (70%), followed by sanitation (n=107, 50%), and then crowding (n=79, 37%) (Table 7).

Table 7 - Prevalence of environmental health topics considered in publications included in a systematic scoping review on environmental health in protracted displacement

Topic	Count*	Percentage
Water	149	70%
Sanitation	107	50%
Crowding	79	37%
Vector control	60	28%
Energy	36	17%
Waste management	33	15%
Hand hygiene	31	15%
Food safety	24	11%
Menstrual hygiene	7	3%
*The percentages do not add up to 100% because some publications reported data on more than one topic.		

233 3.2 – Environmental health conditions, exposures, and outcomes

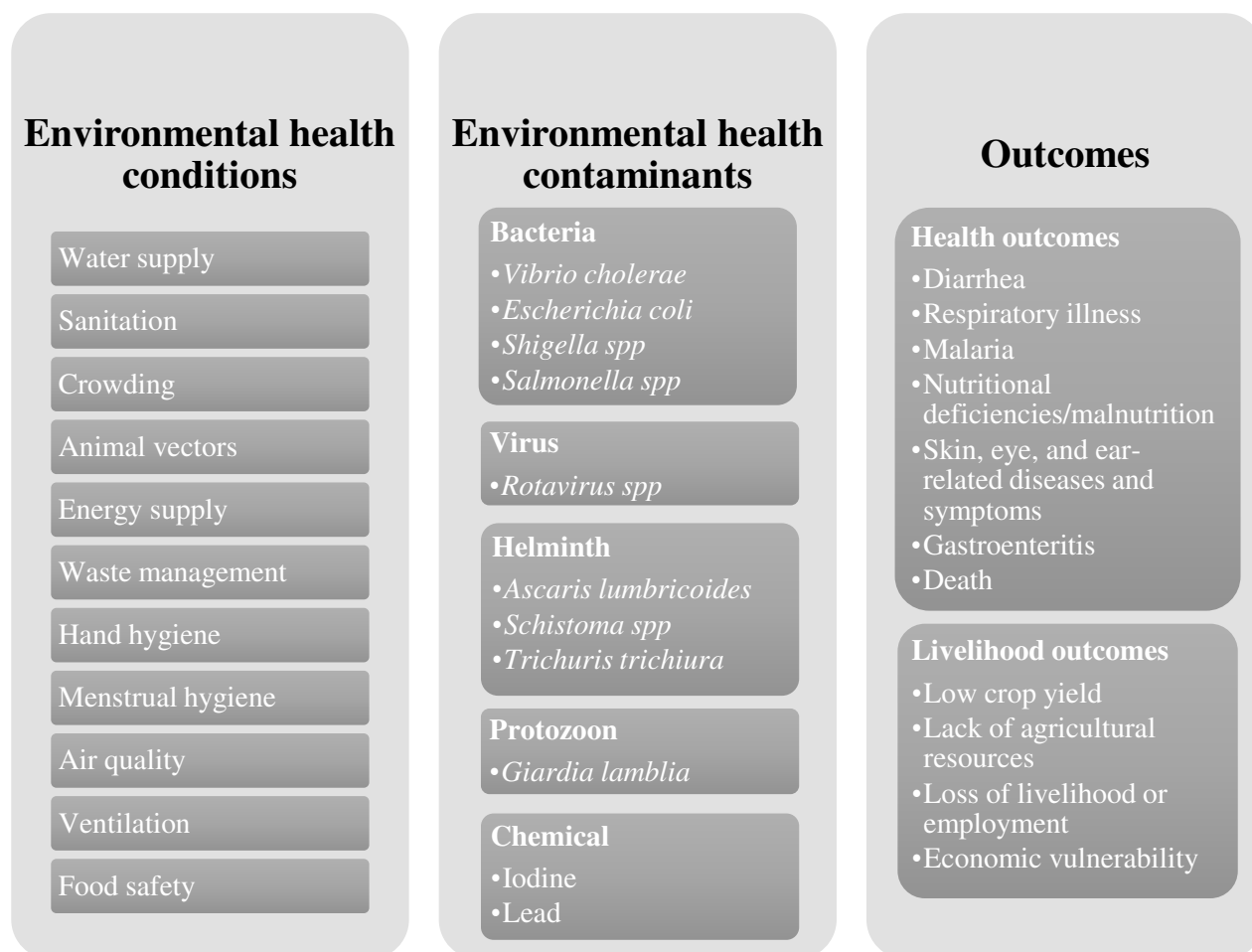


Figure 4 - Summary of environmental health conditions, contaminants, and outcomes reported in 213 publications included in a systematic scoping review on environmental health in protracted displacement

234 3.2.1 – Environmental health conditions

235 Themes for water supply conditions include water source(s); water collection; water
 236 distribution and access; water system reliability; water quantity; water quality; water treatment;
 237 water storage; water uses; cost of water; and water management. Reported water sources span
 238 unimproved source types (unprotected well; surface water; irrigation canal) and improved
 239 sources (borehole; protected spring; private well; protected well; piped water; rainwater
 240 collection; private vendor; bottled water) (WHO/UNICEF, 2018). Studies also present findings

on distance from water points, time spent collecting water, threats at the point of collection (drowning; snakes; crocodiles) (Apiyo, 2014), and arguments or fights over water collection (WFP et al., 2014). Distribution is reported to occur through trucking or pipelines (to communal taps or to individual households). Limited hours for water collection, water system breakdowns, and interruptions in water supply are reported.

Eighteen publications present findings on average water consumption per day, which ranged from one to 40 liters per capita per day (**Table 8**). One systematic review evaluates the minimum water allocation necessary in post-disaster situations, but did not present primary data (De Buck et al., 2015). Water quality is also addressed, with publications describing poor taste and chemical, bacterial, and helminth contamination as concerns. The use of both treated and untreated water is described, with treatment occurring from the municipal to the household level. Treatment methods include chlorine, filtration, boiling, and ultraviolet (UV) disinfection. Water tanks and buckets are reported for household level storage.

Table 8 – Summary of average water quantity data from publications included in a systematic scoping review on environmental health in protracted displacement

Publication	Country/countries	Population(s)	Setting(s)	Water quantity
CDC, 2003	Liberia	IDP	Settlement	1.8 liters/capita/day
Cronin, Shrestha, Spiegel, Gore, & Hering, 2009	Ethiopia; Kenya; Tanzania; Sierra Leone; Democratic Republic of the Congo (DRC); Republic of the Congo	Refugee	Camp	8-20 liters/capita/day
Crooks & Hailegiorgis, 2014	Kenya	Refugee	Camp	4-15 liters/capita/day
Davey & Maziliauskas, 2003	Lebanon	Refugee	Camp	Less than 50 liters/household/day
Fadul & Reed, 2010	Sudan	IDP; Refugee	Village	12 liters/capita/day

Herrera & Sataviriya, 1984	Thailand	Refugee	Camp; holding center	15-40 liters/capita/day
Milton et al., 2017	Bangladesh	Refugee; displaced individuals	Camp	16-18 liters/capita/day
Shultz et al., 2009	Kenya	Refugee	Camp	19 liters/capita/day
Singh et al., 2017	Kenya	IDP	Camp	20 liters/family/day
Toole & Waldman, 1990	Ethiopia ³	Refugee	Camp	6 liters/capita/day
van der Helm, Bhai, Coloni, Koning, & de Bakker, 2017	Jordan	Refugee	Camp	35 liters/capita/day
Vivar, Pichel, Fuentes, & Martínez, 2016	Algeria	Refugee	Camp	15-17 liters/capita/day
M. Toole & Malkki, 1992	Ethiopia; Kenya ⁴	Refugee	Camp	1-3 liters/capita/day
UNHCR, 2006	Sudan; Chad	IDP; Refugee	Camp; Village	19 liters/capita/day
UNHCR, 2008	Ghana; Kenya; Uganda	Refugee	Camp	40 (Ghana), 20.5 (Kenya), and 15.2 (Uganda) liters/capita/day
UNHCR, 2017b	DRC; Rwanda; Uganda; Tanzania	Refugee	Camp	17 liters/capita/day
UNHCR, 2016b	South Sudan	Refugee	Camp; settlement	9 liters/capita/day
Waters, 1984	Thailand	Refugee	Camp	12.5-40 liters/capita/day

Studies report water being used for drinking, bathing, washing, cooking, household cleaning, laundry, irrigation, flushing toilets, making tea, and making formula milk for babies. In some cases, water is reported to have been provided free of charge, but water tariffs and connection fees are also reported. Affordability, especially of water purchased from private

³ This publication presented data on IDPs and refugees in both Ethiopia and Sudan, but this quantity was presented in the context of a Somali refugee camp in Ethiopia

⁴ This publication presented data on many countries and contexts, but this quantity was presented in the context of Somali refugee camps in Ethiopia and Kenya

vendors, is reported to be of particular concern. Management mechanisms include water committees, with looting and lack of ownership mentioned as concerns. The use of UNHCR and Sphere standards is reported.

Studies report on sanitation technology and construction (including pit latrines, ventilated improved pit (VIP) latrines, communal latrines, household latrines, emergency latrines, and hanging latrines; toilets, pour-flush toilets, toilets with U-bends, aqua privies, container-based toilets, and public sewerage systems); and general considerations related to spacing, ventilation, and drainage. Open defecation is commonly reported. Wastewater is also frequently addressed (including references to cesspits, soak-aways, septic tanks, flood control, and desludging. Moreover, studies reference wastewater treatment through waste stabilization and oxidation ponds, and wastewater treatment plants).

Some of the poorest sanitation conditions reported are zero latrines for an IDP population in Somalia (Grunewald, F., 2012) and for a refugee population in the Central African Republic (UNHCR, 2016b), and defecation into plastic bags that were then thrown into a ravine in an IDP camp in Haiti (Schuller and Levey, 2014). Conversely, studies report that 100 per cent of households had their own latrines in a refugee camp in Jordan (van der Helm et al., 2017), universal availability of sanitation infrastructure in a refugee camp on the Thailand-Myanmar border (McCleery et al., 2015), and 97% of households being connected to a sewerage network in a refugee camp in Jerusalem (Issa et al., 2015). Of the 107 publications (50%) that report on sanitation conditions, 42 (20%) report coverage data, though measurement methods varied: 21 studies (10%) report household or population sanitation coverage, 15 (7%) measure average number of persons per latrine or toilet per person, six (3%) measure coverage of a specific sanitation technology (sewer connection, communal latrines, private latrines, etc.), five (2%)

report percentages of the population engaging in open defecation, five (2%) report the breakdown of the use of different sanitation technologies, two (1%) report on the average distance from shelters to latrines, two (1%) report on percentage of households engaging in proper child excreta disposal, and one (0.5%) reports on the percentage of households meeting UNHCR excreta disposal standards. Several studies use more than one indicator to assess sanitation conditions.

A few studies address sanitation concerns other than household toilet coverage. One mentions sanitary waste from health care facilities (UNHCR, 2008) and one reports on sanitation coverage in restaurants (Al-Khatib & Al-Mitwalli, 2007). Two publications address disposal of dead bodies in camps (Schuller and Levey, 2014; UNHCR, 2008). Publications reference the World Health Organization (WHO), UNICEF, and UNHCR standards and guidelines for sanitation; one study notes that refugees considered the UNICEF guideline of 14 persons per toilet to be insufficient due to conflicts that arise over toilet upkeep (Hydroconseil, 2017).

Overcrowding is the third-most discussed topic. Many publications mention “overcrowded conditions” without additional commentary. Studies use a variety of methods to present data on crowding, including the crowding index (individuals per room), average family size, acreage/average shelter size per family, population density, population growth, and persons per tent or shelter. Eight studies (4%) present data on the “crowding index” (Afon et al., 2010; Al-Khatib et al., 2003; Al-Khatib & Tabakhna, 2006; Dolan, CG., Tollman, SM., Nkuna, VG., & Gear, JS., Habib et al., 2014, 1997; Molla, Mollah, Fungladda, et al., 2014; Mourada, 2004; Rueff & Viaro, 2010). The highest crowding index reported was in a refugee camp in Nigeria, where nearly 30% of the population lived in shelters with seven or more persons per room (Afon et al., 2010). In addition to crowding within and between households, one study references

crowding in schools (Affolter and Allaf, 2014) and one references crowding in hospitals (Ekmekci, PE., 2016)

Many animal vectors of disease are discussed, including insects (mosquitos, cockroaches, flies, sandflies, lice, bed bugs, and fleas), mites, donkeys, dogs, coyotes, foxes, cats, rodents, birds, cows, goats, pigs, and freshwater snails. Reported reservoirs of and causes for vector breeding include: domestic water sources, surface water pools, standing water, inadequate or polluted water supplies, animal water supplies; poor sanitary practices, full latrines, wastewater ditches, poor drainage; dead animal carcasses, poor waste management practices (open dumping, accumulation of waste, standing water around uncollected trash, uncovered waste); forests or fields, food storage, food preparation, food sale, raw meat consumption; rotting roof mats; animals around the household; shrubs, firewood, rubble, and rat burrows. Vector control measures mentioned include bed nets, indoor and outdoor spraying, treated bed sheets, fumigation, corral use for animals, screening on latrine vents, building latrines away from food, effective drainage, covers on latrine holes, and sealing water containers. Other factors affecting vector control and vector-related disease transmission include season, cost of control measures, chloroquine resistance, and low immunity against vector-based diseases among displaced populations.

Reported energy coverage varies from no household access (Mahmoud, Sheikh, Domeika, & Mårdh, 1994; McCleery et al., 2015) to 95% or more of households having access (Rodriguez, SV., Santos Ocampo, PD., Ka, E., & Tescon, V., 1982). One study notes that camps near urban areas had better access to electricity (Boss, LP., Brink, EW., & Dondero, TJ., 1987). Reported energy sources include solar, fossil fuel, wood or charcoal, gas, and reused waste. One publication notes that energy was accessed informally through the grid (Yassin et al., 2016).

Publications report on the following energy uses: cooking or reheating food; pumping or purifying water; pumping or treating wastewater; refrigeration (for food or vaccines); lighting (for sanitation facilities and communal areas); heating; and non-governmental organization (NGO) needs (administration and telecommunications). Cost of energy service is also addressed; studies note that displaced persons sometimes did not receive energy services due to the cost (Grunewald, F., 2012), that energy costs for pumping water were high (Waters, 1984), and that only wealthier individuals had access to electricity (Krings, 1987).

Waste management involves household waste management, waste collection and transport, and waste disposal. Publications addressing household waste mention refuse pits, garbage around shelters, waste production per capita, and the use of garbage bins with lids. Multiple studies reference drains, soak-aways, streams, and latrines being clogged with trash. Two waste collection methods are reported: through trucking—managed by an NGO, municipality, or private contractor—or through a community-organized process involving residents serving as garbage collectors with wheelbarrows. Reported periodicity of waste collection varies, with the most frequent collection reported to be six days per week (Yassin et al., 2016). Waste disposal was reported to occur through dumping (open or semi-covered) or incineration. Incineration was reported to occur at both the household level and at dumpsites for the whole settlement, and one publication mentions incineration of solid waste at health care facilities (UNHCR, 2008). One study describes the use of waste as manure (WFP et al., 2014) and one mentions composting (Dolan, CG., Tollman, SM., Nkuna, VG., & Gear, JS., 1997).

Major themes for hand hygiene include the availability of water, the availability of soap or ash, hand hygiene behavior, distance to handwashing facilities from latrines, and hygiene education and promotion. Publications that address hand hygiene behavior mention handwashing

times (before eating, after eating, after using the latrine), adoption of handwashing, the use of drinking water cups for handwashing (WFP et al., 2014), and handwashing at schools and health posts (UNHCR, 2016b).

Publications that discuss menstrual hygiene addressed: access and distribution of menstrual hygiene materials (such as sanitary pads); disposal of menstrual hygiene materials; privacy for menstruating women; and facilities in schools. Sanitary pads are occasionally discussed in the context of distributing NFIs (non-food items). One publication discusses the cost and purchase of menstrual hygiene materials (UNHCR, 2016).

Environmental health topics discussed, others than those listed in **Table 7**, include: air quality and pollution; ventilation, mold, and dampness; and food safety and hygiene. Food safety and hygiene fell under the category of “other hygiene,” which we separated from “hand hygiene” and which also includes included laundry, bathing, washing, hygienic breastfeeding practices, washing dishes, hygiene kits, and other general hygiene-related conditions and factors.

3.2.2 Environmental hazards and exposures

Contaminants were categorized as “pathogens” or “chemicals”; 77 studies (36%) present findings on pathogens, and 23 studies (11%) present findings on chemicals. The most frequently discussed pathogen is *Vibrio cholerae* (n=26, 12%), followed by *E. coli* (n=13, 6%). The most commonly cited chemical is iodine (n=7, 3%), and all publications reporting this contaminant were conducted in the Tindouf province in Algeria. The ten most frequently addressed pathogens, and their environmental classifications based on their categorization in the Sphere handbook (Sphere Association, 2018), can be seen in **Table 9**.

Table 9 – Ten most frequently addressed pathogens in publications included in a systematic scoping review on environmental health in protracted displacement

Pathogen	Common name	Environmental classification	Count	Percentage
----------	-------------	------------------------------	-------	------------

<i>Vibrio cholerae</i>	Cholera	Fecal-oral (bacterial)	26	12%
<i>Escherichia coli</i>	<i>E. coli</i>	Fecal-oral (bacterial)	13	6%
<i>Shigella spp</i>	Dysentery	Fecal-oral (bacterial)	8	4%
<i>Ascaris lumbricoides</i>	Roundworm	Soil-transmitted helminth	7	3%
<i>Giardia lamblia</i>	Giardia	Fecal-oral (protozoon)	7	3%
<i>Schistoma spp</i>	Bilharzia	Water-based helminth	6	3%
<i>Trichuris trichiura</i>	Whipworm	Soil-transmitted helminth	6	3%
<i>Salmonella spp</i>	Salmonella	Fecal-oral (bacterial)	6	3%
<i>Rotavirus spp</i>	Rotavirus	Fecal-oral (virus)	6	3%
<i>Malaria spp</i>	Malaria	Vector-borne	6	3%

Some studies report a relationship between specific environmental health conditions and the presence or prevalence of contaminants.

Table 10 shows which environmental health conditions were linked to eight of the most frequently reported contaminants in at least one of the publications included in this review.

Table 10 – Reported associations between environmental health conditions and contaminants as reported in studies for a systematic scoping review of environmental health in protracted displacement

Water	Sanitation	Crowding	Energy	Waste management	Hand hygiene	Food hygiene
-------	------------	----------	--------	------------------	--------------	--------------

Cholera	x	x	x	x	x	x	x
E. coli	x	x				x	
Shigella	x	x				x	x
Giardia	x	x				x	x
Rotavirus	x	x				x	x
Malaria	x	x		x	x		
Iodine	x						
Lead	x						

3.2.3 Outcomes

Outcomes of environmental health conditions are reported in 136 studies (64%) and were categorized as health (n=133, 62%) or livelihood (n=10, 5%). Percentages below are out of the total of 213 publications.

Diarrhea is the most frequently reported health outcome (n=53, 25%), followed by respiratory illness (n=35, 16%) and malaria (n=34, 16%). Reported respiratory illnesses include acute respiratory infection, upper respiratory infection, lower respiratory infection, tuberculosis, pneumonia, bronchitis, asthma, whooping cough, emphysema, and other respiratory infections. Reported nutritional deficiencies and malnutrition outcomes include protein, micronutrient, and niacin deficiencies, anemia, and scurvy. Skin-related diseases and symptoms, including rashes, scabies, lesions, eye-related afflictions such as conjunctivitis and blindness, and ear infections are noted as health outcomes. Other outcomes reported to be associated with environmental health conditions include vomiting, cold-like symptoms, influenza and influenza-like illnesses, thyroid dysfunction (due to excessive iodine exposure), gastroenteritis, fever, measles, urinary tract infections, tonsillitis, abdominal pain, dehydration, stunting, and mental illness. Death is frequently listed as an outcome, or implied through discussions of morbidity and mortality.

Few publications report on livelihood outcomes. Those that do mostly relate to agriculture, referencing low crop yield (Muhammad et al., 2012) and a lack of funds for crop diversification, greenhouses, and efficient use of limited land (Singh et al., 2017). In one study, insufficient vegetation for animals and animal diseases are cited as outcomes for those who rear animals as part of their livelihoods (Gila et al., 2011). Three studies mention loss of livelihood (Ahsan et al., 2011; Barbieri et al., 2017; Caniato et al., 2017). Other outcomes include unemployment (De Buck et al., 2015), economic vulnerability and a lack of opportunity (Dolan et al., 1997), low income (Apiyo, 2014; Molla et al., 2014a; Singh et al., 2017), low market access (Apiyo, 2014), and lack of access to loans (Singh et al., 2017).

3.3 – Obstacles to improvement

Table 11 - Summary and examples of reported obstacles and recommendations in publications included in a systematic scoping review of environmental health in protracted displacement

Category	Obstacle	Example	Recommendation	Example
Institutional	Legal/policy environment	<i>Laws limiting expansion or development of camp infrastructure (Rueff and Viaro, 2010)</i>	More effective legal/policy structures	<i>Regulations establishing periodic food safety inspection and training (Kalipeni and Oppong, 1998)</i>
	Management challenges	<i>Balancing needs for rapid deployment of infrastructure and interventions in crises with the potential for integrated development in the future (Tota-Maharaj, 2016)</i>	Management improvements	<i>Centralize information on WaSH programs through development of a database system (Parpaleix and Pajak, 2016)</i>
	Lack of coordination	<i>Lack of coordination between WaSH NGO partners and across sectors</i>	Better camp planning	<i>Settling displaced populations near existing communities (Afon et al., 2010)</i>

		(Hydroconseil, 2017)		
Political	Conflict and instability	<i>Rival military force denying IDPs access to food and healthcare (Toole and Waldman, 1990)</i>	Increase transparency	<i>Avoid mistrust through increased transparency about use of community resources (Bönda, 2007a)</i>
	Resource scarcity	<i>Insufficient water supply infrastructure; 400 families relying upon a single borehole (Singh et al., 2017)</i>	Improve political agency of displaced populations	<i>Ensure that displaced populations are able to participate and exert influence in relevant forums (Aagaard-Hansen and Chaignat, 2010)</i>
	Financial concerns	<i>Cost of sanitation infrastructure construction (Taylor, 1979)</i>	Bolster fundraising efforts	<i>Seek additional funding from private philanthropic organizations and international agencies (Milton et al., 2017b)</i>
Implementation	Infrastructure	<i>Poor road infrastructure preventing delivery of WaSH supplies (Apiyo, 2014)</i>	Increase education and awareness	<i>Training refugees to provide basic health diagnostic and curative services (Dick and Simmonds, 1983)</i>
	Behavioral	<i>Theft of crockery from drying racks (Waterkeyn et al., 2005)</i>	Implement targeted interventions	<i>Temporary closure of markets during cholera outbreaks (Moren et al., 1991)</i>
	Monitoring and research	<i>Difficulty of tracking multiple source water use (Abouteir et al., 2011)</i>	Targeted adoption of technology	<i>Pilot mass cholera vaccinations in high-risk populations (Dorlencourt et al., 1999)</i>
			Fill research gaps	<i>Investigate timing of vaccination interventions at various stages of crises (Lam et al., 2015)</i>

Forty-three studies (20%) mention specific obstacles to improving environmental health conditions. Such obstacles are institutional, political, or implementation-related (**Table II**).

Reported institutional obstacles concern legal and policy environments and management. The lack of international humanitarian laws devoted to IDPs is cited as a concern (Aagaard-Hansen and Chaignat, 2010). National laws and policies are frequently described as obstacles; specifically, policies which require refugees to stay in camps prevent them from seeking government health services (Mohamed et al., 2014), and laws that prevent the expansion or development of permanent camp infrastructure limit potential improvements in environmental health conditions (Hydroconseil, 2017; Rueff & Viaro, 2010). Inadequate coordination among NGOs, governments, and the private sector, between sectors (for example, between water providers and energy providers), and across levels of management is described as an obstacle (Ahsan et al., 2011; Bönda, 2007b; Hydroconseil, 2017; Toole and Malkki, 1992; Waters, 1984). Moreover, the short duration of most projects, the high turnover of NGOs and employees providing services in camps, and frequent changes in camp location pose challenges to continuity and quality of services (Hydroconseil, 2017; M. Toole & Malkki, 1992). One study mentions balancing needs for rapid deployment of infrastructure and interventions in crises with the potential for integrated development in the future as a challenge (Tota-Maharaj, 2016).

Political challenges at multiple levels are mentioned in the literature—publications report on international, national, and community-level conflict; resource scarcity; and financial barriers. International conflict, a lack of international cooperation, and insecurity or violence are frequently-referenced obstacles. These are sometimes described as indirect obstacles, but in some cases created direct disruptions; one study notes a case where IDPs were denied access to food and healthcare by a rival military force (Toole and Waldman, 1990). At the national level, a

fear of government officials (Mohamed et al., 2014) and reluctance to participate in mass vaccination due to rumors of biological warfare (Grunewald, 2012) are cited as challenges. At the local level, publications note weak engagement of both displaced populations and host communities as a challenge; both populations are reported to have been left out of planning, decision-making, and management processes. Studies report resentment among host communities (Hydroconseil, 2017) and tensions between displaced populations and host communities (Bönda, 2007b) as consequences.

Studies frequently report scarcity of resources such as water, agricultural resources, and energy. In one case, a lack of agricultural resources is reported to have led to harvest failure (Juel-Jensen, 1985). Insufficient equipment, including tools, spare parts, containers for food storage (Bonner et al., 2007), and cement (Waterkeyn et al., 2005) are also listed as obstacles, and insufficient human resources and lack of funds are frequently cited. Financial obstacles at the local level include: high prices for soap and other essential commodities, price uncertainty, and low incomes.

Reported challenges in the implementation of interventions concern: infrastructure, behavioral, and monitoring and research. Infrastructure challenges include the breakdown of health services during conflict and disasters, poor road infrastructure, sewage system leaks, and unsuitable soil for latrines. More specific infrastructure challenges include: circular pits for latrines being difficult to dig (Bönda, 2007b); a lack of roofs on latrines leading to sun hitting and overheating the seats, dissuading refugees from using latrines (Nyoka et al., 2017); and the closure of a municipal waste dump that had been used by refugees, leading to a waste management crisis (Stel and van der Molen, 2015). Publications present a wide range of implementation challenges related to behavioral interventions. Some are broad and apply to

groups of displaced populations, such as negligence and a lack of awareness (Afon et al., 2010), a lack of community acceptance of latrines (Bönda, 2007b), and a lack of ownership among displaced populations (Hydroconseil, 2017). Individual behaviors that create obstacles for improvement include sabotage of water pumps by private vendors (Bönda, 2007a), theft of drying racks (Waterkeyn et al., 2005), vandalism (WFP et al., 2014), and embezzlement of water committee funds (Bönda, 2007a). Some publications mention monitoring and research challenges, including field staff safety, the difficulty of tracking water use when respondents use multiple sources (Abouteir et al., 2011), and a lack of researcher understanding of transmission dynamics of lymphatic filariasis (de Souza et al., 2014).

3.4 – Recommendations reported in included studies

Ninety-nine studies (46%) provide recommendations. Many of these recommendations are general; few studies provide tailored recommendations or insight about how to achieve them. Like obstacles (section 3.3), recommendations were categorized as institutional, political, and implementation-related (**Table 11**).

Like the institutional obstacles, institutional recommendations involve legal structures and management, but also include suggestions about camp planning and international, national, and camp level laws and regulations. Management recommendations generally involve the development of action plans, frameworks, or strategies for topics such as solid waste management (Al-Khatib et al., 2007) or housing (Al-Khatib et al., 2006) or through an integrated approach (Cronin et al., 2008a). Some studies recommend using existing guidelines and protocols, including one study (Abouteir et al., 2011) that advocates for the use of the WHO guidelines on management of infectious diarrhea (World Health Organization, 2005) and another (Cronin et al., 2008b) recommending the use of minimum standards for environmental health

services. Studies also discuss the importance of standardization and harmonization of indicators (Cronk et al., 2015), as well as the need to address displacement concurrently with other determinants of health (Aagaard-Hansen and Chaignat, 2010). One study recommends programmed inspections and maintenance as well as involving community leaders and displaced populations in decision-making (Bönda, 2007a). In terms of camp planning, studies recommend deliberate placement of camps. Studies suggest settling displaced populations near existing communities (Afon et al., 2010), near clean water sources (Toole and Waldman, 1997), and in community settings rather than in camps (Araya et al., 2011).

Political recommendations include curbing violence and conflict to remove barriers to improvement of environmental health conditions for displaced populations. More practically, studies recommend being transparent in the implementation of environmental health programs and improving the political agency of displaced populations. Studies also recommend bolstering fundraising efforts, improving coordination among stakeholders, and working with international contractors more frequently.

Most recommendations are implementation-related, and concerned: education and awareness; interventions; technology; infrastructure; and research. Many studies cite a need for improved awareness of environmental health among displaced populations, recommending health education programs, awareness sessions, posters and leaflets, and promotional events. A few studies provide more specific recommendations, such as targeting environmental health messaging during peak communicable disease transmission times (Ahmed et al., 2012) or training refugees to provide basic diagnostic and health services (Dick and Simmonds, 1983). Recommendations related to interventions vary widely. The most frequently discussed include vaccination, improving disease surveillance and health information systems, treating drinking

water, preventing environmental health-related disease, reducing crowding, supporting host communities in addition to displaced populations, and striving for early detection of communicable diseases. A few studies provide specific recommendations for interventions, such as prioritizing the treatment of acute respiratory infections (Ahmed et al., 2012), fortifying food with micronutrients (Jemal et al., 2017), temporarily closing markets during cholera outbreaks (Moren et al., 1991), and improving tuberculosis screening in HIV-positive populations (Kimbrough et al., 2012).

A few studies reference technology in their recommendations—including installation of microgrids to expand electricity access (Aste et al., 2017) and upgrading cooking technology in displaced persons' households (Barbieri et al., 2017).

Infrastructure recommendations include adequate well protection, improving cleanliness around shelters, and establishing guidelines for latrine construction. More specific recommendations include constructing demonstration latrines to show displaced populations how to construct their own (Paquet and Hanquet, 1998), modeling water systems after already functioning ones in the surrounding community (Waters, 1984), and phasing out water trucking (Waters, 1984).

In terms of research, studies recommend more field research, seeking user feedback on interventions, and more qualitative research (Rueff and Viaro, 2010). More specific recommendations include sharing research findings with donors and resource managers as well as other stakeholders (A. A. Cronin et al., 2008; UNHCR, 2016), conducting more research on the timing of interventions in crises (Lam et al., 2015), and investigation of the unintentional behavioral effects that research might have on displaced populations (Inci et al., 2015).

4. Discussion

4.1 – Overview

This systematic scoping review is the first to comprehensively document evidence about environmental health conditions in protracted displacement. Other reviews, such as De Buck et. al. (2015) distinguish between “disaster” and “post-disaster” phases of their review of the amount of water needed per day in emergencies, but did not focus on the protracted phase. Yates et. al. (2017) conducted a systematic review of WaSH interventions in emergency settings explicitly excluding protracted crises. Some other studies consider specific environmental health conditions, exposures, or outcomes in the context of forced displacement, such as cooking technologies (Barbieri et al., 2017), vaccine-preventable disease (Lam et al., 2015), tuberculosis (Kimbrough et al., 2012); however in this study we more comprehensively explore environmental health conditions, exposures, and outcomes in protracted displacement. We find that many aspects of environmental health in displaced populations are infrequently reported—energy, waste management, hand hygiene, menstrual hygiene, food safety, mold and ventilation, and air quality.

We identify three frequent themes that are particularly relevant to protracted crises: integration or separation of displaced populations and host communities; evolving funding for and management of environmental health services; and institutional and political challenges.

The issue of integration or separation of displaced populations and host communities—both socially and geographically—becomes more pertinent as crises extend into the protracted stage. Studies report resentment among host populations and conflict between displaced populations and host populations (Bönda, 2007b; Hydroconseil, 2017), suggesting that the relationship between these communities is a concern in long-term planning, including for environmental health service provision. Involving host communities and local leaders in

planning and decision-making may help to mitigate this kind of conflict (Bönda, 2007a). Moreover, **Table 6** shows that most of the included literature focused on camps (n=184, 86%) or settlements (n=19, 9%), which are often physically separated from host populations. However, approximately 60% of displaced persons live in urban areas (UNHCR, 2016a), whereas only 38 studies (18%) reported data from urban areas, slums, or similar, more integrated settings. This suggests a substantive overrepresentation of camp settings in the literature, which may lead to an inadequate understanding of environmental health conditions for the majority of displaced populations who live outside of camps.

Another common theme was long-term funding and management. Over time, responsibility for environmental health services in displaced populations becomes less clearly defined as funding dwindles and external actors withdraw their programming (Heller, 2018). Some decisions that could be taken in the early planning stage of a crisis may alleviate this; establishing camps near existing communities, for example, may facilitate the extension of municipal services later on (Afon et al., 2010).

Protracted crises also give rise to institutional and political challenges; governments, host communities, and displaced populations often struggle to accept the permanence of displacement. Some national policies, such as a law in Lebanon that forbids the construction of permanent infrastructure in refugee settlements (Hydroconseil, 2017), reflect this mindset. Such legal and political constraints limit the potential for development and expansion of sustainable environmental health services despite the need for long-term provision of these services.

4.2 – Recommendations for policy, monitoring, and practice

Two of the primary obstacles described in included publications are institutional: the exclusion of forcibly displaced populations in legal and policy environments, and a lack of

coordination between actors. The absence of forcibly displaced populations in international development policies and environmental health frameworks is partially due to the taboos attached to the social and political status of, and the lack of defined stakeholders and responsibility for, involuntarily displaced populations (Behnke et al., 2018). The inclusion of forcibly displaced populations in international policies is critical given that provision of environmental health services in long-term displacement also requires a difficult transition from emergency response to sustainable development. Such a transition requires coordination between humanitarian and development actors as well as governments, displaced communities, and host communities, which is not possible without appropriately framed policies to establish roles and responsibilities throughout the process (Heller, 2018).

Forcibly displaced populations are also often left out of research that measures progress on international policies and agreements related to environmental health. Specifically, insufficient information on the enjoyment of human rights by refugees, asylum seekers, undocumented migrants and internally displaced persons is collected in relation to the Sustainable Development Goals (SDGs). Global monitoring for Goal 6, which sets a target of “availability and sustainable management of water and sanitation for all” by 2030, does not include disaggregated data on access to those services by forcibly displaced persons (United Nations General Assembly, 2015). Without information on the extent to which forcibly displaced persons enjoy human rights, it is impossible to plan and strategize effective ways to realize these rights. Monitoring initiatives such as the WHO/UNICEF Joint Monitoring Programme (JMP) should disaggregate data and conduct targeted analysis to evaluate WaSH services in displaced populations, much like its recent additions of targeted analysis on WaSH in schools and health care facilities (UNICEF et al., 2019).

Environmental health of forcibly displaced populations is directly linked to the human right to water and sanitation, which was recognized by the UN General Assembly in 2010 (United Nations General Assembly, 2010). According to the human rights framework, the migratory status of a given population should not be grounds for discrimination; forcibly displaced persons have equal human rights to non-displaced populations (United Nations Secretary-General, 2016). Often, when relying on humanitarian assistance, people tend to be seen as “victims”, “beneficiaries” or “recipients” and not as rights holders, and this perception hinders the transition to long-term development (Heller, 2018). The human rights framework would require an “inclusive approach”; that is, involving forcibly displaced persons in national and local development planning and the improvement and expansion of local services. This approach promotes sustainability and resilience and ensures access to those services for forcibly displaced persons over time (Heller, 2018).

In addition to adopting a human rights approach to environmental health service provision in protracted forcible displacement, the international community must also shift its approach to the transition from emergency response to long-term sustainable development. Some have suggested that, in some contexts, incorporating development activities in the early stages of a crisis could be more effective; Mosel and Levine (2014), for example, suggest that there is a need for a new model that “would essentially not be about linking different kinds of aid, but about finding a different model of long-term engagement that can deal with protracted and recurrent crises as part of normality”. Some ways in which this could take place include early and frequent cooperation between humanitarian and international development actors, earlier engagement with governments, and the implementation of more flexible funding mechanisms

(Mason, N., Mosello, B., Shah, J. & Grieve, 2017). This would address some of the institutional and political obstacles described in section 3.3.

4.3 – Evidence gaps and future research needs

Due to the broad range of displaced populations and settings, there is a need for better documentation of vocabulary related to forcible displacement. Understanding what forcible displacement looks like in its many different contexts—from established refugee camps to unofficial slums in urban centers—is critical for the development of more targeted programming and policies. This review takes a first step towards documenting this vocabulary for displaced populations and the settings where they settle (see **Table 6**), but is limited to the literature included in this review, and a more comprehensive typology is needed.

There are some substantial gaps in evidence on environmental health in protracted displacement. One is geographical; there were only six studies that reported findings on Latin America and the Caribbean, and no studies on Oceania. Moreover, there were no studies on Small Island Developing States (SIDS), which are likely to face challenges related to displacement due to their vulnerability to the impacts of climate change (United Nations General Assembly, 2015). Although the included studies may partially reflect the reality of the geographic distribution of displaced populations, some countries and regions are underrepresented. For example, in 2018, there were eight million forcibly displaced Colombians, 98% of whom have been displaced within Colombia's borders for several years, making them the second-largest group of internally displaced persons after Syrians (UNHCR, 2019), yet our review retrieved no studies that reported data on Colombia.

There are also topical gaps, suggesting a need for broader coverage of environmental health by researchers working in these contexts. Specifically, menstrual hygiene, air quality, food

safety, and ventilation, and mold are relatively under-researched in the context of protracted displacement.

Although they were not the subject of this review, our findings are relevant to those who face protracted displacement for reasons other than conflict or natural disaster. Those who are displaced due to extreme poverty, for example, may face some of the same environmental health conditions, exposures, and outcomes as forcibly displaced populations. Further research is necessary on the conditions in which these populations live.

4.4 – Limitations, Data quality and generalizability

Given the breadth of this scoping review, some relevant terms or databases may have been omitted. Several researchers contributed to this review, and inter-researcher inconsistencies may have occurred in screening and data extraction. This review only included publications available in English, which may affect the geographic representation of the studies included. In some cases, it was not possible to determine when the displacement occurred; in these cases, we included the publications to avoid data loss, but some mis-categorization may have occurred.

The quality of evidence varied substantially. We did not evaluate the quality of studies included in the review, and instead compiled and reported aggregate results. Studies often failed to report study type or other metadata, and recommendations in particular were lacking in specificity.

Due to the scoping nature of this review, the results were heterogeneous. There is great diversity across contexts, settings, populations, managing authorities, and conditions faced by populations living in protracted displacement, and it is inappropriate to generalize findings across displaced populations. However, this review is the first step in documenting evidence

related to environmental health conditions in protracted displacement, and some of the common themes and lessons learned may be useful in responding to other crises.

5. Conclusion

This review is the first to analyze environmental health conditions in protracted displacement. The global population of forcibly displaced persons is growing rapidly, at a rate equivalent to 37,000 newly displaced persons per day (UNHCR, 2019). With global population growth and the impacts of climate change, forcible displacement is likely to become more frequent, and the likelihood of crises becoming protracted will remain high. Adequate environmental health services are critical for human health, dignity, and human rights, but we find that environmental health conditions in protracted displacement are often poor. Our results suggest that these conditions facilitate the spread of communicable disease, foster preventable environmental hazards, and lead to detrimental health and livelihood outcomes. Moreover, institutional, political, and implementation-related obstacles impede improvement of environmental health services in these contexts.

Research is rarely perceived as a priority in these settings, and the processes and institutions that could facilitate the sharing of findings, lessons learned, and steps forwards are underdeveloped. There is insufficient understanding of how NGOs, UN entities, donors, governments, displaced populations, host communities, and other stakeholders can best approach the complex challenge of long-term, sustainable environmental health service provision in relation to protracted forcible displacement. However, the number of publications that were identified in this review suggests that there is an opportunity to learn from existing evidence to minimize adverse impacts of poor environmental conditions and sustain the health and wellbeing of forcibly displaced populations.

Based on our findings, we make recommendations for policy, monitoring, and practice. First, displaced populations must be addressed in international environmental health policy so that stakeholders have a more nuanced understanding of the roles and responsibilities involved in providing adequate services to these populations. This also extends to monitoring for global development initiatives; research initiatives such as the UNICEF/WHO Joint Monitoring Programme must collect and analyze data on the state of environmental health services for forcibly displaced populations. The international community should also adopt a human rights approach to forcible displacement, and include displaced populations and host communities in planning for environmental health services in order to promote more inclusive development in protracted crises. Finally, since most displacement lasts beyond the emergency stage, all relevant stakeholders should work to shift their mindsets to longer-term planning and sustainable development rather than emergency response alone. If decision-making in the early stages of forcible displacement is carried out with the intention to prepare for potentially providing for displaced populations for several years, many of the obstacles reported in these studies could be precluded in future crises.

Acknowledgements

The authors would like to thank Mary White (UNC Health Sciences librarian), Michelle Moffa, and Wilson Guo for their assistance in developing a search strategy, as well as Mabel D'Souza for screening and extracting data from articles. Thank you to Emma Kelly for her assistance with mapping and editing.

This project was made possible by funding from the Foreign Language and Area Studies fellowship through the Carolina Center for the Study of the Middle East and Islamic Civilizations, World Vision International, the Sut and Fay Ahuja Fellowship, the UNC Department of Public Policy, the UNC Department of Environmental Sciences and Engineering, the UNC Environment, Ecology, and Energy Program, the Morehead-Cain scholarship, CVM LLC, Carolina Performing Arts, and the Jon Curtis Student Enrichment Fund.

Bibliography

- Aagaard-Hansen, J., Chaignat, C.L., 2010. Neglected tropical diseases: equity and social determinants, in: Blas, E and Kurup, A. (Ed.), *EQUITY, SOCIAL DETERMINANTS AND PUBLIC HEALTH PROGRAMMES*. pp. 135–157.
- Abouteir, A., Yaagoubi, F. El, Bioh-Johnson, I., Kamel, A., Godard, N., Cormerais, L., Robin, F., Lesens, O., 2011. Water access and attendance for diarrhea in primary health care centers, Gaza strip. *Trans. R. Soc. Trop. Med. Hyg.* 105, 555–560.
<https://doi.org/10.1016/j.trstmh.2011.07.002>
- Adair-Rohani, H., Zukor, K., Bonjour, S., Wilburn, S., Kuesel, A.C., Hebert, R., Fletcher, E.R., 2013. Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access, sources, and reliability. *Glob. Heal. Sci. Pract.* 1, 249–261. <https://doi.org/10.9745/GHSP-D-13-00037>
- Affolter, F.W., Allaf, C., 2014. Displaced sudanese voices on education, dignity, and humanitarian aid. *Refuge* 30, 5–14.
- Afon, A.O., Asani, M.A., Adeyinka, S.A., Hasan, A.Z., Jimah, M.S., Ilogho, T.U., Faborode, T.G., Faniran, G.B., Popoola, K.O., 2010. Linkages between responses to the available amenities and expressed environment-related health needs in international refugee camp, Oru-Ijebu, Nigeria. *WIT Trans. Ecol. Environ.* 142, 69–78.
<https://doi.org/10.2495/SW100071>
- Ahmed, J.A., Katz, M.A., Auko, E., Njenga, M.K., Weinberg, M., Kapella, B.K., Burke, H., Nyoka, R., Gichangi, A., Waiboci, L.W., Mahamud, A., Qassim, M., Swai, B., Wagacha, B., Mutonga, D., Nguhi, M., Breiman, R.F., Eidex, R.B., 2012. Epidemiology of respiratory viral infections in two long-term refugee camps in Kenya, 2007-2010. *BMC Infect. Dis.* 12. <https://doi.org/10.1186/1471-2334-12-7>
- Ahsan, R., Karuppannan, S., Kellett, J., 2011. Climate Migration and Urban Planning System: A Study of Bangladesh. *Environ. Justice* 4, 163–170. <https://doi.org/10.1089/env.2011.0005>
- Al-Khatib, I.A., Al-Mitwalli, S.M., 2007. Restaurant environment and its possible effects on food safety: Case study of restaurants in Palestinian Ramallah-Bireh District. *Jordan Med. J.* 41, 145–152.
- Al-Khatib, I.A., Arafat, H.A., Basheer, T., Shawahneh, H., Salahat, A., Eid, J., Ali, W., 2007. Trends and problems of solid waste management in developing countries: A case study in seven Palestinian districts. *WASTE Manag.* 27, 1910–1919.
<https://doi.org/10.1016/j.wasman.2006.11.006>
- Al-Khatib, I.A., Ju'ba, A., Kamal, N., Hamed, N., Hmeidan, N., Massad, S., 2003. Impact of housing conditions on the health of the people at al-Ama'ri refugee camp in the West Bank of Palestine. *Int. J. Environ. Health Res.* 13, 315–326.
<https://doi.org/10.1080/09603120310001616092>
- Al-Khatib, I.A., Tabakhna, H., IA., A.-K., H., T., 2006. Housing conditions and health in Jalazone Refugee Camp in Palestine. *East. Mediterr. Heal. J.* 12, 144–152.
- Apiyo, R.J., 2014. FINAL EVALUATION REPORT REGIONAL SUPPLY HUB MECHANISM AS A STRATEGY FOR WASH EMERGENCY RESPONSE IN SOMALIA.
- Araya, M., Chotai, J., Komproe, I.H., de Jong, J.T.V.M., 2011. Quality of life after postconflict displacement in Ethiopia: comparing placement in a community setting with that in shelters. *Soc. Psychiatry Psychiatr. Epidemiol.* 46, 585–593. <https://doi.org/10.1007/s00127-010->

0223-1

- Aste, N., Barbieri, J., Berizzi, A., Colombo, E., del Pero, C., Leonforte, F., Merlo, M., Riva, F., 2017. Innovative energy solutions for improving food preservation in humanitarian contexts: A case study from informal refugees settlements in Lebanon. *Sustain. ENERGY Technol. ASSESSMENTS* 22, 177–187. <https://doi.org/10.1016/j.seta.2017.02.009>
- Barbieri, J., Riva, F., Colombo, E., 2017. Cooking in refugee camps and informal settlements: A review of available technologies and impacts on the socio-economic and environmental perspective. *Sustain. ENERGY Technol. ASSESSMENTS* 22, 194–207. <https://doi.org/10.1016/j.seta.2017.02.007>
- Barnett, L., 2002. Global governance and the evolution of the international refugee regime (No. 54), *New Issues in Refugee Research*.
- Behnke, N., Cronk, R., Snel, M., Moffa, M., Tu, R., Banner, B., Folz, C., Anderson, D., Macintyre, A., Stowe, E., Bartram, J., 2018. Improving environmental conditions for involuntarily displaced populations: water, sanitation, and hygiene in orphanages, prisons, and refugee and IDP settlements. *J. Water, Sanit. Hyg. Dev.* 8, 1–8. <https://doi.org/10.2166/washdev.2018.019>
- Blanchet, K., Ramesh, A., Frison, S., Warren, E., Hossain, M., Smith, J., Knight, A., Post, N., Lewis, C., Woodward, A., Dahab, M., Ruby, A., Sistench, V., Pantuliano, S., Roberts, B., 2017. Evidence on public health interventions in humanitarian crises. *Lancet* 6736, 1–10. [https://doi.org/10.1016/S0140-6736\(16\)30768-1](https://doi.org/10.1016/S0140-6736(16)30768-1)
- Bönda, S.T., 2007a. Community management and sustainability of hand pumps in jebel aulia, Sudan, in: 2006 32nd WEDC International Conference: Sustainable Development of Water Resources, Water Supply and Environmental Sanitation. pp. 358–361.
- Bönda, S.T., 2007b. Emergency Sanitation solutions for war IDPs in West Darfur State, Sudan, in: 2006 32nd WEDC International Conference: Sustainable Development of Water Resources, Water Supply and Environmental Sanitation. pp. 489–492.
- Bonner, P.C., Schmidt, W.-P., Belmain, S.R., Oshin, B., Baglole, D., Borchert, M., 2007. Poor housing quality increases risk of rodent infestation and lassa fever in refugee camps of sierra leone. *Am. J. Trop. Med. Hyg.* 77, 169–175.
- Boss, L.P., Brink, E.W., Dondero, T.J., 1987. Infant mortality and childhood nutritional status among Afghan refugees in Pakistan. *Int. J. Epidemiol.* 16, 556–560.
- Byleveld, P.M., Deere, D., Davison, A., 2008. Water safety plans: Planning for adverse events and communicating with consumers. *J. Water Health* 6, 1–9. <https://doi.org/10.2166/wh.2007.019>
- Caniato, M., Carliez, D., Thulstrup, A., 2017. Challenges and opportunities of new energy schemes for food security in humanitarian contexts: A selective review. *Sustain. Energy Technol. Assessments* 22, 208–219. <https://doi.org/10.1016/j.seta.2017.02.006>
- CDC, 2003. Cholera epidemic after increased civil conflict--Monrovia, Liberia, June-September 2003. *MMWR. Morb. Mortal. Wkly. Rep.* 52, 1093–1095.
- Crawford, N., Cosgrave, J., Haysom, S., Walicki, N., 2015. Protracted displacement: uncertain paths to self-reliance in exile.
- Cronin, A.A., Shrestha, D., Cornier, N., Abdalla, F., Ezard, N., Aramburu, C., 2008a. A review of water and sanitation provision in refugee camps in association with selected health and nutrition indicators - The need for integrated service provision. *J. Water Health* 6, 1–13. <https://doi.org/10.2166/wh.2007.019>
- Cronin, A.A., Shrestha, D., Cornier, N., Abdalla, F., Ezard, N., Aramburu, C., 2008b. A review

- of water and sanitation provision in refugee camps in association with selected health and nutrition indicators – the need for integrated service provision. *J. Water Health* 6, 1. <https://doi.org/10.2166/wh.2007.019>
- Cronin, A.A., Shrestha, D., Spiegel, P., Gore, F., Hering, H., 2009. Quantifying the burden of disease associated with inadequate provision of water and sanitation in selected sub-Saharan refugee camps. *J. Water Health* 7, 557–568. <https://doi.org/10.2166/wh.2009.089>
- Cronk, R., Slaymaker, T., Bartram, J., 2015. Monitoring Drinking Water, Sanitation, and Hygiene in Non-Household Settings: Priorities for Policy and Practice. *Int. J. Hyg. Environ. Health*. <https://doi.org/10.1016/j.ijheh.2015.03.003>
- Crooks, A.T., Hailegiorgis, A.B., 2014. An agent-based modeling approach applied to the spread of cholera. *Environ. Model. Softw.* 62, 164–177. <https://doi.org/10.1016/j.envsoft.2014.08.027>
- Davey, J.C., Maziliauskas, J., 2003. Water, sewerage and drainage infrastructure for Palestinian refugee camps in Lebanon. *J. Chart. Inst. WATER Environ. Manag.* 17, 1–7.
- De Buck, E., Borra, V., De Weerd, E., Veegaete, A. Vande, Vandekerckhove, P., 2015. A Systematic Review of the Amount of Water per Person per Day Needed to Prevent Morbidity and Mortality in (Post-)Disaster Settings. *PLoS One* 10. <https://doi.org/10.1371/journal.pone.0126395>
- de Souza, D.K., Sesay, S., Moore, M.G., Ansumana, R., Narh, C.A., Kollie, K., Rebollo, M.P., Koudou, B.G., Koroma, J.B., Bolay, F.K., Boakye, D.A., Bockarie, M.J., 2014. No Evidence for Lymphatic Filariasis Transmission in Big Cities Affected by Conflict Related Rural-Urban Migration in Sierra Leone and Liberia. *PLoS Negl. Trop. Dis.* 8. <https://doi.org/10.1371/journal.pntd.0002700>
- Dick, B., Simmonds, S., 1983. Refugee health care: Similar but different? *Disasters* 7, 291–303. <https://doi.org/10.1111/j.1467-7717.1983.tb00837.x>
- Dolan, C.G., Tollman, S.M., Nkuna, V.G., Gear, J.S., 1997. The Links between Legal Status and Environmental Health: A Case Study of Mozambican Refugees and Their Hosts in the Mpumalanga (Eastern Transvaal) Lowveld, South Africa. *Health Hum. Rights* 2, 62–84.
- Dorlencourt, F., Legros, D., Paquet, C., Neira, M., Ivanoff, B., Le Saout, E., 1999. Effectiveness of mass vaccination with WC/rBS cholera vaccine during an epidemic in Adjumani district, Uganda. *Bull. World Health Organ.* 77, 949–950.
- Ekmekci, P., 2016. Syrian Refugees, Health and Migration Legislation in Turkey. *J. Immigr. Minor. Heal.* <https://doi.org/10.1007/s10903-016-0405-3>
- Evans, G.W., Kantrowitz, E., 2002. Socioeconomic Status and Health: The Potential Role of Environmental Risk Exposure. *Annu. Rev. Public Health* 23, 303–331. <https://doi.org/10.1146/annurev.publhealth.23.112001.112349>
- Fadul, E., Reed, B., 2010. Domestic water supply options in Gezira irrigation scheme. *Waterlines* 29, 108–123. <https://doi.org/10.3362/1756-3488.2010.012>
- Freeman, M.C., Grimes, J.E.T., Croll, D., Harrison, W.E., Templeton, M.R., 2014. The Relationship between Water, Sanitation and Schistosomiasis: A Systematic Review and Meta-analysis 8. <https://doi.org/10.1371/journal.pntd.0003296>
- Gila, O.A., Ugalde Zaratiegui, A., Lopez De Maturana Dieguez, V., 2011. Western Sahara: Migration, Exile and Environment. *Int. Migr.* 49, e146–e163. <https://doi.org/10.1111/j.1468-2435.2010.00665.x>
- Grünewald, F., 2012. Aid in a city at war: the case of Mogadishu, Somalia. *Disasters* 36 Suppl 1, S105–25. <https://doi.org/10.1111/j.1467-7717.2012.01287.x>

- Habib, R.R., Hojeij, S., Elzein, K., Chaaban, J., Seyfert, K., 2014. Associations between life conditions and multi-morbidity in marginalized populations: the case of Palestinian refugees. *Eur. J. Public Health* 24, 727–733. <https://doi.org/10.1093/eurpub/cku089>
- Heller, L., 2018. A/HRC/39/55: Report of the Special Rapporteur on the human rights to safe drinking water and sanitation.
- Herrera, C.E., Sataviriya, S., 1984. Refugee camp water and sanitation. pp. 180–183.
- Hydroconseil, 2017. Evaluation of the Water, Sanitation and Hygiene (WASH) Programme within the UNICEF Country Programme in Lebanon (2013-2016).
- Inci, R., Ozturk, P., Mulayim, M.K., Ozyurt, K., Alatas, E.T., Inci, M.F., 2015. Effect of the Syrian Civil War on Prevalence of Cutaneous Leishmaniasis in Southeastern Anatolia, Turkey. *Med. Sci. Monit.* 21. <https://doi.org/10.12659/MSM.893977>
- Issa, M., McHenry, M., Issa, A.A., Blackwood, R.A., 2015. Access to safe water and personal hygiene practices in the kulandia refugee camp (Jerusalem). *Infect. Dis. Rep.* 7, 6040. <https://doi.org/10.4081/idr.2015.6040>
- Jemal, Y., Haidar, J., Makau, W.K., 2017. The magnitude and determinants of anaemia among refugee preschool children from the Kebribeyah refugee camp, Somali region, Ethiopia. *SOUTH AFRICAN J. Clin. Nutr.* 30, 1–6. <https://doi.org/10.1080/16070658.2017.1237446>
- Juel-Jensen, B., 1985. Personal experiences of medical problems among Ethiopian refugees in the Ethio-Sudanese borderland. *J. Infect.* 11, 221–223.
- Kalipeni, E., Oppong, J., 1998. The Refugee Crisis in Africa and Implications for Health and Disease: A political ecology approach. *Soc. Sci. Med., Pregnancy and Infants-Medical Psychological and Social Issues* 46, 1636–1953. <https://doi.org/10.1016/j.jen.2005.01.008>
- Keely, C.B., 2001. The International Refugee Regime (s): The End of the Cold War Matters. *Int. Migr. Rev.* 35, 303–314.
- Kimbrough, W., Saliba, V., Dahab, M., Haskew, C., Checchi, F., 2012. The burden of tuberculosis in crisis-affected populations: a systematic review. *Lancet. Infect. Dis.* 12, 950–965. [https://doi.org/10.1016/S1473-3099\(12\)70225-6](https://doi.org/10.1016/S1473-3099(12)70225-6)
- Krings, T., 1987. Surviving in the periphery of the town - the living conditions of sahelian drought refugees in Mopti (Republic of Mali). *GeoJournal* 14, 63–70. <https://doi.org/10.1007/BF02484698>
- Lam, E., McCarthy, A., Brennan, M., E., L., A., M., M., B., 2015. Vaccine-preventable diseases in humanitarian emergencies among refugee and internally-displaced populations. *Hum. Vaccin. Immunother.* 11, 2627–2636. <https://doi.org/10.1080/21645515.2015.1096457>
- Mahmoud, E.A., Sheikh, A.H., Domeika, M.A., Mårdh, P.A., 1994. Prevalence of trachoma among displaced persons in the Sudan: A clinical and sero-epidemiological study. *Eye* 8, 130–133. <https://doi.org/10.1038/eye.1994.26>
- Mason, N., Mosello, B., Shah, J. & Grieve, T., 2017. Improving the fit between development and humanitarian WASH in protracted crises. 40th WEDC Int. Conf. all.
- McCleery, E.J., Patchanee, P., Pongsopawijit, P., Chailangkarn, S., Tiwananthagorn, S., Jongchansittoe, P., Dantrakool, A., Morakote, N., Phyu, H., Wilkins, P.P., Noh, J.C., Phares, C., O’Neal, S., Porse, C.C., 2015. Taeniasis among Refugees Living on Thailand-Myanmar Border, 2012. *Emerg. Infect. Dis.* 21, 1824–1829. <https://doi.org/10.3201/eid2110.141657>
- Milton, A.H., Rahman, M., Hussain, S., Jindal, C., Choudhury, S., Akter, S., Ferdousi, S., Mouly, T.A., Hall, J., Efird, J.T., 2017a. Trapped in Statelessness: Rohingya Refugees in Bangladesh. *Int. J. Environ. Res. Public Health* 14. <https://doi.org/10.3390/ijerph14080942>

- 907 Milton, A.H., Rahman, M., Hussain, S., Jindal, C., Choudhury, S., Akter, S., Ferdousi, S.,
 908 Mouly, T.A., Hall, J., Efird, J.T., AH., M., M., R., S., H., C., J., S., C., S., A., S., F., TA.,
 909 M., J., H., JT., E., Milton, A.H., Rahman, M., Hussain, S., Jindal, C., Choudhury, S., Akter,
 910 S., Ferdousi, S., Mouly, T.A., Hall, J., Efird, J.T., 2017b. Trapped in Statelessness:
 911 Rohingya Refugees in Bangladesh. *Int. J. Environ. Res. Public Health* 14.
 912 <https://doi.org/10.3390/ijerph14080942>
- 913 Moffa, M., Cronk, R., Fejfar, D., Dancausse, S., Padilla, L.A., Bartram, J., 2019. A systematic
 914 scoping review of hygiene behaviors and environmental health conditions in institutional
 915 care settings for orphaned and abandoned children. *Sci. Total Environ.* 658, 1161–1174.
 916 <https://doi.org/10.1016/j.scitotenv.2018.12.286>
- 917 Moffa, M., Cronk, R., Fejfar, D., Dancausse, S., Padilla, L.A., Bartram, J., 2018. A systematic
 918 scoping review of environmental health conditions and hygiene behaviors in homeless
 919 shelters. *Int. J. Hyg. Environ. Health* 0–1. <https://doi.org/10.1016/j.ijheh.2018.12.004>
- 920 Mohamed, A.H., Dalal, W., Nyoka, R., Burke, H., Ahmed, J., Auko, E., Shihaji, W., Ndege, I.,
 921 Breiman, R.F., Eidex, R.B., 2014. Health care utilization for acute illnesses in an urban
 922 setting with a refugee population in Nairobi, Kenya: a cross-sectional survey. *BMC Health*
 923 *Serv. Res.* 14. <https://doi.org/10.1186/1472-6963-14-200>
- 924 Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., 2009. Preferred reporting items for systematic
 925 reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 6, e1000097.
 926 <https://doi.org/10.1371/journal.pmed.1000097>
- 927 Molla, N.A., Mollah, K.A., Ali, G., Fungladda, W., Shipin, O. V, Wongwit, W., Tomomi, H.,
 928 2014a. Quantifying disease burden among climate refugees using multidisciplinary
 929 approach: A case of Dhaka, Bangladesh. *Urban Clim.* 8, 126–137.
 930 <https://doi.org/10.1016/j.uclim.2014.02.003>
- 931 Molla, N.A., Mollah, K.A., Fungladda, W., Ramasoota, P., 2014b. Multidisciplinary household
 932 environmental factors: Influence on DALYs lost in climate refugees community. *Environ.*
 933 *Dev.* 9, 1–11. <https://doi.org/10.1016/j.envdev.2013.09.006>
- 934 Moren, A., Stefanaggi, S., Antona, D., Bitar, D., Gastellu Etchegorry, M., Tchatchioka, M.,
 935 Lungu, G., 1991. Practical field epidemiology to investigate a cholera outbreak in a
 936 Mozambican refugee camp in Malawi, 1988. *J. Trop. Med. Hyg.* 94, 1–7.
- 937 Mosel, I., Levine, S., 2014. Supporting resilience in difficult places: a critical look at applying
 938 the 'resilience concept in countries where crises are the norm. *HPG Comm. Rep.* 31.
- 939 Mourada, T.A.A., 2004. Palestinian refugee conditions associated with intestinal parasites and
 940 diarrhoea: Nuseirat refugee camp as a case study. *Public Health* 118, 131–142.
 941 <https://doi.org/10.1016/J.PUHE.2003.09.002>
- 942 Muhammad, N., Bangush, M., Khan, T.A., 2012. Microbial Contamination in Well Water of
 943 Temporary Arranged Camps: A Health Risk in Northern Pakistan. *WATER Qual. Expo.*
 944 *Heal.* 4, 209–215. <https://doi.org/10.1007/s12403-012-0080-0>
- 945 Nyoka, R., Foote, A.D., Woods, E., Lokey, H., O'Reilly, C.E., Magumba, F., Okello, P., Mintz,
 946 E.D., Marano, N., Morris, J.F., 2017. Sanitation practices and perceptions in Kakuma
 947 refugee camp, Kenya: Comparing the status quo with a novel service-based approach. *PLoS*
 948 *One* 12. <https://doi.org/10.1371/journal.pone.0180864>
- 949 Paquet, C., Hanquet, G., 1998. Control of infectious diseases in refugee and displaced
 950 populations in developing countries. *Bull. L Inst. PASTEUR* 96, 3–14.
 951 [https://doi.org/10.1016/S0020-2452\(98\)80024-9](https://doi.org/10.1016/S0020-2452(98)80024-9)
- 952 Parpaleix, L.A., Pająk, J., 2016. Sanitation management and information technology in Za'atari

- refugee camp , Jordan 1–6.
- Peters, M.D.J., Godfrey, C.M., Khalil, H., McInerney, P., Parker, D., Soares, C.B., 2015. Guidance for conducting systematic scoping reviews. *Int. J. Evid. Based. Healthc.* 13, 141–146. <https://doi.org/10.1097/XEB.0000000000000050>
- Rodriguez, S. V., Santos Ocampo, R., Ka, E.K., Tecson, L. V., 1982. Diarrhoea among Vietnamese refugees in the Philippines. *Southeast Asian J. Trop. Med. Public Health* 13, 366–372.
- Rueff, H., Viaro, A., 2010. Palestinian refugee camps: From shelter to habitat. *Refug. Surv. Q.* 28, 339–359. <https://doi.org/10.1093/rsq/hdp041>
- Schuller, M., Levey, T., 2014. Kabrit ki gen twop met: understanding gaps in WASH services in Haiti's IDP camps. *Disasters* 38, S1–S24. <https://doi.org/10.1111/disa.12053>
- Shackelford, B.B., Cronk, R., Behnke, N., Cooper, B., Tu, R., D'Souza, M., Bartram, J., Schweitzer, R., Jaff, D., 2020. Environmental health in forced displacement: A systematic scoping review of the emergency phase. *Sci. Total Environ.* 714, 136553. <https://doi.org/10.1016/j.scitotenv.2020.136553>
- Shultz, A., Omollo, J.O., Burke, H., Qassim, M., Ochieng, J.B., Weinberg, M., Feikin, D.R., Breiman, R.F., 2009. Cholera Outbreak in Kenyan Refugee Camp: Risk Factors for Illness and Importance of Sanitation. *Am. J. Trop. Med. Hyg.* 80, 640–645.
- Singh, K.P., Hasan, Z., Bhoopathy, S. V, Worth, H., Seale, H., Richmond, R.L., 2017. A qualitative assessment of food security in an internally displaced persons camp in Kenya. *African J. Food, Agric. Nutr. Dev.* 17.
- Sphere Association, 2018. *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*, 4th ed.
- Stel, N., van der Molen, I., 2015. Environmental vulnerability as a legacy of violent conflict: a case study of the 2012 waste crisis in the Palestinian gathering of Shabriha, South Lebanon. *Conflict, Secur. Dev.* 15, 387–414. <https://doi.org/10.1080/14678802.2015.1070486>
- Taylor, A.J., 1979. Emergency Sanitation for Refugees: Experiences in the Bangladesh Refugee Relief Camps, India, 1971–1972. *Disasters* 3, 435–442. <https://doi.org/10.1111/j.1467-7717.1979.tb00182.x>
- Toole, M., Malkki, R., 1992. Famine-affected, refugee, and displaced populations: recommendations for public health issues. *MMWR. Recomm. Rep.* 41, 1–76. <https://doi.org/10.1249/MSS.0000000000001020>
- Toole, M.J., Waldman, R.J., 1997. The public health aspects of complex emergencies and refugee situations. *Annu. Rev. Public Health* 18, 283–312. <https://doi.org/10.1146/annurev.publhealth.18.1.283>
- Toole, M.J., Waldman, R.J., 1990. Prevention of excess mortality in refugee and displaced populations in developing countries. *JAMA* 263, 3296–3302.
- Tota-Maharaj, K., 2016. *WASH in Emergencies Problem Exploration Report: Surface Water Drainage*.
- Tyndall, J., 2010. *The AACODS checklist*. Flinders Univ.
- UNHCR, 2019. *Global Trends: Forced Displacement in 2018*.
- UNHCR, 2017a. *UNHCR WASH manual; Practical Guidance for Refugee Settings*.
- UNHCR, 2017b. *Burundi: Regional refugee response plan mid year revision*.
- UNHCR, 2016a. *Global Trends: Forced Displacement in 2016*. *Glob. Trends* 2016 50.
- UNHCR, 2016b. *SOUTH SUDAN REGIONAL REFUGEE RESPONSE PLAN*.
- UNHCR, 2011. *Epidemic Preparedness and Response in Refugee Camp Settings: Guidance for*

- 999 Public Health Officers.
- 1000 UNHCR, 2008. A GUIDANCE FOR UNHCR FIELD OPERATIONS ON WATER AND
 1001 SANITATION SERVICES 6–30.
- 1002 UNHCR, 2006. SUDAN/CHAD SITUATION UPDATE 62.
- 1003 UNHCR, n.d. Cash Based Interventions for WASH Programmes in Refugee Settings.
- 1004 UNICEF, WHO, JMP, 2019. Progress on household drinking water, sanitation and hygiene
 1005 2000-2017, Unicef/Who.
- 1006 United Nations, 2017. SDG Indicators: Regional groupings used in 2017 Report and Statistical
 1007 Annex.
- 1008 United Nations General Assembly, 2015. Transforming our world: the 2030 Agenda for
 1009 Sustainable Development.
- 1010 United Nations General Assembly, 2010. The Human Right to Water and Sanitation.
 1011 <https://doi.org/10.4324/9781315471532-2>
- 1012 United Nations Secretary General, 2016. A-71-353: Report on the Outcome of the World
 1013 Humanitarian Summit 12603.
- 1014 van der Helm, A.W.C., Bhai, A., Coloni, F., Koning, W.J.G., de Bakker, P.T., 2017. Developing
 1015 water and sanitation services in refugee settings from emergency to sustainability ? the case
 1016 of Zaatari Camp in Jordan. *J. Water Sanit. Hyg. Dev.* washdev2017107.
 1017 <https://doi.org/10.2166/washdev.2017.107>
- 1018 Vivar, M., Pichel, N., Fuentes, M., Martínez, F., 2016. An insight into the drinking-water access
 1019 in the health institutions at the Saharawi refugee camps in Tindouf (Algeria) after 40 years
 1020 of conflict. *Sci. Total Environ.* 550, 534–546.
 1021 <https://doi.org/10.1016/j.scitotenv.2016.01.113>
- 1022 Waterkeyn, J., Okot, P., Kwame, V., 2005. Rapid sanitation uptake in the internally displaced
 1023 people camps of Northern Uganda through community health clubs, in: 31st WEDC
 1024 International Conference Maximizing the Benefits from Water and Environmental
 1025 Sanitation. p. 4.
- 1026 Waters, T., 1984. Reports from the Field: A comparative analysis of water provision in four Thai
 1027 refugee camps. <https://doi.org/10.1111/j.1467-7717.1984.tb00871.x>
- 1028 WFP, UNHCR, Government of Malawi, 2014. Joint Assessment Mission Report: Dzaleka
 1029 Refugee Camp, Malawi.
- 1030 WHO/UNICEF, 2018. JMP Methodology: 2017 Update & SDG baselines 1–23.
- 1031 World Bank, 2018. World Bank list of economies (June 2018). Office 0–12.
 1032 <https://doi.org/10.4135/9781446217221>
- 1033 World Health Organization, 2005. Diarrhoea treatment guidelines including new
 1034 recommendations for the use of ORS and zinc supplementation for clinic-based healthcare
 1035 workers., Who.
- 1036 Yassin, N., Stel, N., Rassi, R., 2016. Organized chaos: Informal institution building among
 1037 Palestinian refugees in the Maashouk gathering in south Lebanon. *J. Refug. Stud.* 29, 341–
 1038 362. <https://doi.org/10.1093/jrs/few016>
- 1039 Yates, T., Allen, J., Joseph, M.L., Lantagne, D., 2017. Short-term WASH interventions in
 1040 emergency response: A systematic review 291 pp.
- 1041
- 1042