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Gaps and opportunities in the climate change, migration and health nexus: Insights from a questionnaire based study of practitioners and researchers

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ABSTRACT

Background: : While climate change and migration are separately recognised as public health challenges, the combination of the two – climate change-induced migration which is predicted to increase through this century – requires further research to ensure population health needs are met. As such, this paper aims to identify initial gaps and opportunities in the nexus of climate change, migration and health research.
Methods: : We conducted a questionnaire based study of academics and practitioners working in the fields of climate change, migration and health. Open-ended responses were thematically analysed.
Results: : Responses from 72 practitioners collected in October 2021 were categorised into a thematic framework encompassing i) gaps and opportunities: across health care and outcomes, impact pathways between climate change and migration, most at risk groups (specific actors) and regions, and longitudinal perspectives on migrant journeys; alongside ii) methodological challenges; iii) ethical challenges, and iv) advancing research with better funding and collaboration. Broadly, findings suggested that research must clarify the interlinkages and drivers between climate change, migration, health (systems), and intersecting factors including the broader determinants of health. Study of the dynamics of migration needs to extend beyond the current focus of rural-urban migration and international migration into high income countries, to include internal displacement and immobile/ trapped populations. Research could better include considerations of vulnerable groups currently underrepresented, people with specific health needs, and focus more on most at-risk regions. Research methodology could be strengthened through better data and definitions, clear ethical guidelines, and increased funding and collaboration.
Conclusion: : This study describes gaps, challenges and needs within research on the nexus of climate change, migration and health, in acknowledgement of the complexity of studying across multiple intersecting factors. Working with complexity can be supported by using the framework and findings to support researchers grappling with these intersecting themes.

1. Introduction

While much of the discourse concerning climate-induced migration cites future projections, the impacts of climate-change on migration are already tangible, with climate-related disasters displacing at least 7 million people within country borders in 2020 (IDMC, 2021). Both climate change and migration, separately and together, impact health in a number of ways. Climate change directly affects health, such as through morbidity (physical and/or psychological) and mortality from extreme weather events, and indirectly through a number of health-enabling systems, including freshwater availability, quality food production and access, and political, social and economic consequences (Watts et al., 2019).

Migration and health are interlinked along bidirectional pathways. The process of migrating can impact health and wellbeing – often negatively, particularly where migration is unplanned and disorderly;

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and can have implications for health systems in a migrants' place of origin, whilst in transit, and once settled in host communities (Watts et al., 2019; Scheerens et al., 2021). Health status and access to healthcare can separately act as push or pull factors of migrating: as a strategy of last resort, or as an adaptive health-seeking response.

Understanding the dynamics and interactions between climate change, migration, and health has proven challenging: due to nonlinear relationships with multiple and heterogeneous drivers, dependant on differential exposure, vulnerability, and adaptive capacity, and mediated by various social, economic, political, and demographic factors (Schwerdtle et al., 2020 (i)). This complexity is exemplified by the wide range and non-specific projections for climate-related migration, ranging between 4400 and 1.2 billion displaced people by 2050 (Kelman, 2019; Watts et al., 2018; IEP, 2020).

Whilst the fields of climate-health, migration-health, and climate-migration are somewhat established, research on the nexus of climate change, migration and health together (hereafter named 'the nexus`) is relatively emergent (Schwerdtle et al., 2020(i)), and an agenda guiding the research direction and priorities in this field does not exist. Findings to date suggest that exploring these pathways is "a complex challenge", requiring transdisciplinarity and a systems approach to respond to the threat of climate change on global health gains and equity, particularly for migrants with added vulnerability (Schwerdtle et al., 2020(i)).

Garnering insights from those working within a field can be a useful practice to better understand knowledge gaps and opportunities in the absence of adequate data (Sutherland W, 2006), as is the case for the nexus where a cohesive research strategy is currently lacking. As such, this paper aims to describe the initial orientations of research gaps and opportunities in this emerging field by: i) surveying practitioners and researchers working in the fields of climate change, migration and/or health; and ii) analysing their responses in parallel with the existing literature on the nexus.

2. Methods

2.1. Questionnaire design

An open-ended two-section questionnaire gathered responses from participants over a 3-week period in October 2021. The questionnaire was hosted on, and responses gathered via, the software Opinio (Opinio, 2022). Participants were asked to read an information sheet and consent to participation. The questionnaire first gathered non-identifiable demographic information (subject area, academic expertise if relevant, and geographic location, of i) residence, and ii) work focus). The questionnaire then asked four open questions [Appendix 1] to help ascertain perceived research gaps, priorities and challenges in climate change, migration and health research. The questionnaire design was tested amongst the authors prior to dissemination. Responses were accepted in any language.

2.2. Sampling and recruitment

Participants were recruited amongst practitioners working in the fields of climate change and/or migration and/or health praxis and/or research. Purposive and convenience sampling of participants was facilitated through their membership in the CliMigHealth International Thematic Network, an interdisciplinary network of researchers working across these themes. The questionnaire was also snowballed through other research networks [Appendix 2] via email and twitter lists. The email invitation [Appendix 3] invited participants to share the questionnaire through their networks.

2.3. Data analysis

Participant responses were analysed by two researchers in an excel spreadsheet. The open-ended responses were analysed using thematic analysis. Though this method is typically used for interview data, it can also be applied to text analysis when questions are open-ended (Warner and Griffiths 2006; Zhang and Walton 2018; Vaismoradi et al., 2013). The analysis was conducted per Braun and Clark as described in Vaismoradi et al. (2013). In the first stage, the researchers read the open-ended responses to become familiar with the data and initial ideas were noted down. On second reading, interesting features of the whole dataset were coded, and subsequently grouped into emergent themes [Fig. 1]. These themes were checked to see if they worked in relation to the coded extracts and the entire dataset; under each theme codes were re-grouped to identify further sub-themes which were labelled only when a finding did not fit under an existing theme. In our process, a subsequent second round of analysis was conducted where the themes were re-generated by analysing the open-ended response of each question in isolation and coded sections re-grouped as per the new thematic map [Fig. 2]. As we used exploratory-descriptive methodology, the focus of analysis was to describe rather than conceptualise or interpret, with an aim of supporting hypothesis generation for further studies (Hunter and Howes 2019).

2.4. Research ethics

Ethics approval was granted by the University College London Research Ethics Committee (reference 20849/001).

2.5. Reflexivity

All qualitative data is subject to influence by the researcher. The authors are all active within the fields of climate change, migration and health research; as such, both researchers and respondents may exhibit inadvertent bias or trends towards certain 'expected' responses. The authors continuously monitored their expectations of the data throughout, noting the ways in which the responses may have influenced the analysis through a collective reflective process.

3. Results

3.1. Demographic information and categories of the study respondents

In total, 72 individuals completed the questionnaire. Responses were in English, aside from two respondents who submitted open-ended answers in Spanish, translated for analysis. The majority of respondents were academics ($n = 47$, 65%; of which 2 MSc students, 5 PhD students, 6 post-doctoral researchers, 11 professors and 22 holding non-specified research roles), with non-governmental organisations ($n = 12$, 17%), government ($n = 6$, 8%) and 'other' sectors (healthcare, education) also represented. 10 respondents' (14%) work focused on all three aspects of the climate, migration and health nexus; 22 (31%) respondents worked on climate change and health, and 19 (26%) on migration and health. 15 (20%) of respondents worked solely on one of the three themes. Respondents resided in 19 different locations: Europe ($n = 19$), UK ($n = 18$), Africa ($n = 12$), Asia ($n = 8$), South America ($n = 6$), North America ($n = 6$) and Australia ($n = 3$). Of those residing in high-income settings ($n = 52$, 72%) who reported a geographical focus for their work, 74% ($n = 36$) primarily focused on low- and middle-income settings either fully or partially, with the remaining 27% ($n = 13$) focused on high-income settings. For those based in low- and middle-income settings ($n = 20$, 28%), all but one focused their work on low- and middle-income settings. Demographic information is summarised in Table 1.

3.2. Thematic findings

An initial thematic framework [Fig. 1] was developed based on participant responses broadly categorising coded research gaps, themes and priorities into i) *what* should be researched; ii) *who* should be researched, *when*; and *where;* iii) the processes that facilitate *how*

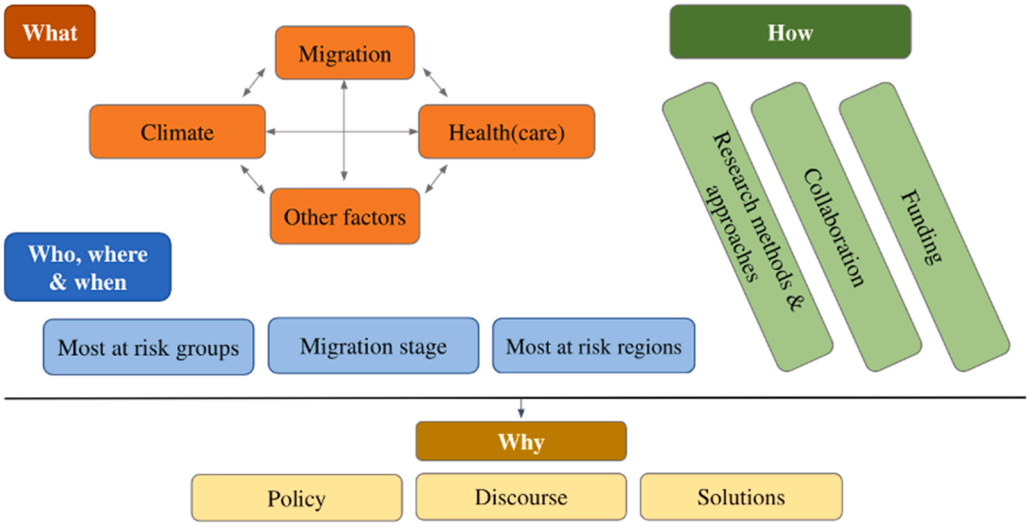

Fig. 1. First thematic framework.

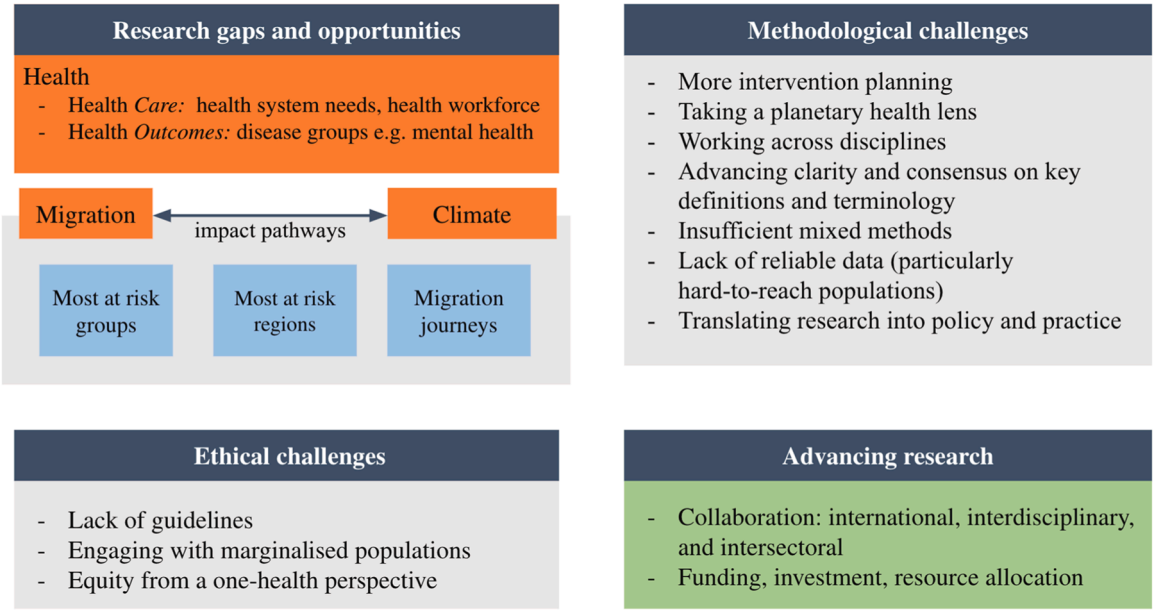

Fig. 2. Iterated thematic framework.

research is conducted, and iv) *why* research should be conducted (the desired outputs).

The quotes and themes were subsequently re-analysed per open-ended question and iterated into a second, more granular thematic framework [Fig. 2], which highlighted (i) research gaps and opportunities, (ii) methodological challenges, (iii) ethical challenges and (iv) issues related to advancing research on the nexus. Each of these is further described in the following sections.

3.2.1. Gaps and opportunities within the research nexus of health, climate change, and migration

3.2.1.1. Health system needs (health care). Research gaps and opportunities were delineated through broad systems: health(care), climate change, migration, and other factors that intersect and interact with these. Health was broadly categorised into i) health care, namely health workforce and health system needs, and ii) health outcomes, including disease groups such as mental health and sexual reproductive health. Several respondents identified the health workforce as a priority group that would benefit from input to upskill in the face of climate change and migration, as there was a need to *"prepare health workers in developing countries to deal with the extra challenges climate change and migration will bring" [Academic, Germany]*. This could occur through health worker education and preparedness, alongside increasing health-worker literacy, supporting behaviour change education, and sustainability with regards to health worker migration *"driving migration from south to north" [Academic, Uganda]*. Respondents asserted that health care systems must be better at identifying specific patient vulnerabilities and should be more adaptive to vulnerabilities and needs, especially in transit locations and settling locations for migrants. This applied to health care provision, including access to care and medicines. One respondent highlighted the need for research into financing of health care for migrants. Regarding climate change in this context, more understanding regarding the knowns and the unknowns of climate change as it interacts with health was called for, such as the unintended consequences of climate change associated with adaptation actions. More

Table 1
Demographic data of respondents.

Work Theme	Respondents	%
Climate change and health	22	31%
Climate change and migration	3	4%
Migration and health	19	26%
Climate change, migration and health	10	14%
Either climate change, or migration, or health	15	21%
Other	3	4%
Work Sector		
Academic	47	65%
Governmental	6	8%
Non-governmental organisation	12	17%
Other	7	10%
Residence		
Europe	19	26%
UK	18	25%
Africa	12	17%
Asia	8	11%
South America	6	8%
North America	6	8%
Australia	3	4%
Geographical focus of work		
HIC focussed on LMIC only	20	28%
HIC focussed on HIC only	13	18%
LMIC focussed on LMIC only	19	26%
LMIC focussed on HIC only	0	0%
HIC focussed on LMIC and HIC	16	22%
LMIC focussed on LMIC and HIC	1	1%
Other	3	4%

Abbreviations: UK: United Kingdom; HIC: High-income country; LMIC: low- and middle-income country. *column percentages.

localised understanding of how health systems respond to climate change was suggested, as stated by an NGO employee in Uganda: "*there are gaps when it comes to intersecting climate and health… not much research has been done in regards to this specifically in Uganda, which has led to a lack of action when it comes to the health impacts arising out of the climate crisis"*.

3.2.1.2. Disease groups (health outcomes). Respondents acknowledged gaps in health outcomes, particularly for mental health (including trauma, depression, anxiety and "*transgenerational consequences"*), non-communicable diseases (including access to medicines), infectious diseases (including antimicrobial resistance), sexual and reproductive health (including Gender Based Violence), and the social determinants of health. Several respondents reported the necessity to better understand the health impacts of climate change. Others reported the need to better understand the health impacts of migration, and the health impacts faced by climate migrants. One participant indicated, for instance, that "*internal migration and health is under-researched and both the above can be influenced greatly by climate change. Especially in a setting like Kerala, the last two years' adverse climate events have resulted in flash floods and have affected migrants' jobs and health. The effects of such natural disaster on migrants remain underresearched.*" [Academic, India].

3.2.1.3. Impact pathways between climate change and migration. The drivers of migration, and how climate interacts with migration pathways, needs to be better understood and modelled. Many respondents identified a need to map drivers and causality in order to better understand which migration factors were or might be climate-related, whether now or in the future: *"there is a need for clear understanding of the impact pathway (drivers, pressures, vulnerabilities, etc.) and interlinkages, with climate services appropriate to address the different aspects in the pathway." [Academic, South Africa]*. Synergies and interactions of other themes related to the nexus were also identified: nutrition and health, food security, access to water, wastewater, pesticide and chemical use, work and employment, income diversification as an adaptation strategy to environmental change, women's leadership, human rights, and culture.

3.2.1.4. Most at risk groups. Respondents identified research gaps addressing the needs of specific migrant groups, especially women: "there are few studies on international gendered mobility, little focus on women […] and the literature mostly focused on spouses, daughters, and dependents of male principals, despite the fact that women are migrating increasingly autonomously" [international organisation, South Africa]. Furthermore, the same respondent pointed to "a lack of gender and age-disaggregated migration data, as well as a lack of understanding of the role of female migrants' rights and legal protection." Other at-risk groups identified included children, adolescents and "youth migrating autonomously", refugees, trapped populations, forced migrants, and those with specific health issues.

3.2.1.5. More emphasis on regions that are most at risk of climate change and migration. Several respondents identified a research dearth in certain regions, particularly "*for the most impacted countries and communities" [Non-profit employee, the Philippines]*. These were mainly low- and middle-income settings, with South America (Chile, Peru, Argentina), Southern Africa, Uganda, and Kerala (India) specifically mentioned. Several respondents also referenced the broader need for more research conducted in, and led by, low- and middle-income settings and fragile settings, and the importance of where research is conducted. For example, one respondent commented on how the majority of literature on African migrants is approached from the context of African migrants in destination countries outside of Africa.

3.2.1.6. Migration journeys. The longitudinal migratory journey could be better studied, particularly the drivers of migration (including the role of economic factors and health worker migration), trapped populations, migratory flows, reverse flows, the linkages between internal and international migration, and migrant integration: *"Causal claims are difficult to check, as they depend a lot on the direction of moves. Too much focus has been given to rural-urban and South-North flows, not enough on reverse flows and on relationships between internal and international flows" [Academic, Belgium]*. Gaps identified included approaches to prevention or mitigation of climate-induced migration, such as employment, or resilience factors that may affect the health of migrants during their journey, as well as issues in transit such as specific health concerns, access to health care, and safety.

3.2.2. Methodological challenges

3.2.2.7. More intervention planning needed. Respondents identified challenges and needs specific to research methods and approaches when studying the nexus. Firstly, changing the research mindset was suggested, including a "*shift in thinking about the purposes of research*" *[Academic, Netherlands],* given the urgency to cope with climate change and migration. Instead of feeding into merely academic outputs, respondents suggested more focus might be put to collaborate with intervention planning (with behavioural interventions, programmes or policy) within a holistic approach, alongside a suggestion to prioritise solutions, with gaps about how to protect and support migrants, constructive policy making, and preparedness for the impacts of migration.

3.2.2.8. Taking a planetary health lens and working across disciplines. There was also a need to apply "*a planetary health lens as a requirement for all research*" *[Academic, United Kingdom]*. This could help to recognise and manage silo-thinking and silo-acting by engaging pragmatically in inter- and transdisciplinary approaches. Research could better bridge across themes, embrace complexity and build upon transdisciplinary capacities, facilitated by research capacity building including overcoming practical shortcomings including a lack of research supervisors, logistical support and time.

3.2.2.9. Advancing clarity and consensus on key definitions and terminology. To advance the research agenda on the nexus, respondents called for clearer and universally agreed definitions and terminology (of climate migration) as a "*lack of globally agreed upon definitions and terminology around migration and environmental changes risk that researchers using similar research questions get different outcomes" [international organisation, South Africa]*, a better theoretical framework and better identification of the priority areas through climate risk and vulnerability assessment.

3.2.2.10. More mixed methodology needed. Participants mentioned multiple barriers to applying methods, including too much emphasis on "*rhetoric and unscientific assumptions*", and an absence of understanding of basic concepts and prior work. Several respondents noted that appropriate methods to analyse the complexity of the nexus do not exist, leading to difficulties in identifying answerable research questions, as well as to evidence that is difficult to interpret. Likewise, a lack of expertise in using mixed methods - which was deemed crucial for this research topic – appeared to be an obstacle. Mixed methods could consist of a combination of certain qualitative methods (such as "*Shifting toward more participatory and advocacy-based research, potentially including methods within the family of participatory action research, that locates data collection, analysis, and future response initiatives within communities [Academic, Netherlands],* alongside action research), and certain quantitative methods ("*longitudinal studies, migrant surveys, comparative studies and cost-benefit analyses*").

3.2.2.11. Lack of reliable data (particularly for hard-to-reach populations). Topic-related methodological issues were raised. Respondents mentioned the challenge to measure inequalities in healthcare access for migrants, difficulties when working with nomadic groups, to draw correlation between migration and sexual reproductive health and gender-based violence, and to create estimates with available data. There was a cited need for better and more reliable data (including age-disaggregated, and integrated into national systems). This could be achieved via data sharing and the promotion of comparable, regular and representative migration surveys, as well as via "*building baseline data repositories across disciplines and sectors" [Research Institute, South Africa]*. Eventually, this may enable more targeted socio-economic and socio-ecological research on affected populations as well as longitudinal and comparative studies, focusing on health analysis, transnational care, formal and informal care.

3.2.2.12. Translating research into policy and practice. Evidence-based policy making was identified as a gap by a number of respondents, as research and policy analysis could be better used to inform advocacy efforts and develop policies that respond to the nexus. Such translational research could increase "*prioritisation by policy makers… Other areas are deemed more important… It is a long-term commitment, and quick fixes are easier and within reach" [Academic, Belgium]*. Ad hoc priorities like the COVID-19 pandemic, for instance, drew away valuable resources from research on the nexus. Yet, it was also suggested that the COVID-19 pandemic, and the political and research focus the pandemic has received, could act as an opportunity to better engage policy makers on the nexus.

Political timelines, low awareness about the nexus amongst politicians, a lack of political interest and support, lack of trust in politicians, and populism were all cited as challenges to address the identified research gaps, both in terms of conducting research, and translating research to policy. Respondents noted too much focus on the topic of immigration, with a lack of focus on migrant wellbeing, limited political support for integration of refugees, and the impact of "*geopolitical and geostrategic influences"* on research *[Researcher, Uganda]*. One respondent noted that solutions should begin by '*de-problematising*' migration.

Capacity building was a stated priority for some, such as through better health information systems, or implementing greener hospitals which are sustainable and resilient. It was felt that better education on the nexus, especially amongst politicians and clinicians, might accommodate better political involvement and discourse. Strong leadership at the highest levels was expressed as a requirement to "*set the vision, commitment and direction" [Non profit worker, United Kingdom]* for future research and practice.

3.2.3. Ethical challenges

3.2.3.13. Lack of guidelines. Ethical concerns might form obstacles to research, particularly in the context of working with marginalised people, climate-impacted people, and applying a 'one health' perspective (considering the needs of the more-than human world such as animals and plants); with one academic from Germany who stated a need for "*ethical guidelines for researchers who are interested in conducting research about migration and health."*

3.2.4. How to advance research in the nexus

3.2.4.14. Funding. A large number of respondents indicated a lack of funding as a major challenge in research. There was a stated need for more financial support for researchers - particularly in low- and middle-income countries – as well as policy experts and advocates. One academic from the Netherlands stated, *"The biggest challenge seems to be financing long-term data collection initiatives, particularly in subject domains that are inherently trans-disciplinary and cross-cutting"*. An NGO employee from Uganda explained that *"One of the challenges would be funding this research. If it is not funded, then digging deeper into these research gaps would not be sufficient…."*, with another academic from the Netherlands adding that "*the financing issue is certainly a big challenge, but part of why it seems to be such a problem is because there is limited institutional commitment to these subject areas, or limited capacity of institutions to provide continuity of support for research that could span longer periods of time*."

3.2.4.15. Collaboration. The majority of respondents indicated a need for more – primarily transdisciplinary, intersectoral and international – collaboration, not only amongst academics, but with local stakeholders and decision makers, as well as local experts in vulnerable communities: "*Collaboration with external researchers in particular those that are familiar with the landscape and communities. This will ensure inclusivity and more holistic results" [NGO, Uganda]*. Within collaboration, "*agreement on outcomes of mutual benefit to different stakeholders*" *[Academic, South Africa]* is a key need for research on the nexus, which could be met through more co-production and transdisciplinary work across multiple settings.

There was a plea for more capacity and inclusion of local partners from the Global South and from low- and middle-income countries as project leaders in research projects. Many cited a lack of global frameworks enabling collaboration, while the process of initiating international collaboration was recognised to be reflective of political challenges.

4. Discussion

4.1. Key findings

The questionnaire responses identified key areas for research in the nexus across the four thematic dimensions. Gaps and opportunities included health care and outcomes, impact pathways between climate change and migration, most at risk groups (specific actors) and regions, and longitudinal perspectives on migrant journeys. The nexus might benefit from better understanding of the interlinkages and drivers between climate change, migration, health(systems) - including health workforce, and certain disease groups - and intersecting factors. Our understanding of the dynamics of migration could move beyond the

current research focus centred on rural to urban migration, and international migration into high income countries, to include internal displacement and trapped populations; and more attention to most-at-risk people - including women, children and adolescents, and people with specific health needs, and in most-at-risk regions. Methodological challenges concerned the purposes of research with a call for more intervention planning and a need to take a planetary health lens. Definitions in the nexus could be better clarified. Methods could be supported by working across disciplines and better mixed methodology and data. There was a strong call for better translating of research into policy and practice. Ethical challenges encompassed a lack of ethical guidelines and challenges working with marginalised groups and ensuring equity. Research on the nexus could be advanced with better funding, and through collaboration which is international, interdisciplinary and intersectoral.

Further research may be directed by utilising the building blocks of the first thematic framework depicted in Fig. 1, by selecting elements of 'what' topic will be covered (with inclusion from across climate, migration, health(care) and other factors), focusing in detail on 'who, where and when' (such as one 'at risk' group, at a particular migratory stage, in a particular 'at risk' region), and considering why and how research is conducted (to feed into policy, discourse, and/or solutions).

4.2. Questionnaire responses in the context of the existing academic literature

The questionnaire responses and thematic framework in many ways reflect the research gaps identified in the - albeit limited - academic literature on the nexus. Where our questionnaire respondents highlighted the need for more research on health outcomes, the literature also identifies gaps in responding to certain disease groups. For example, within the mental health impacts of climate related events, the literature (Cianconi et al., 2020; Schwerdtle et al., 2020(i)) cites exploring the connection between drought and suicide, as well as the psychosocial impacts from rising temperature and resulting disrupted livelihoods and climate-related migration, in particular for children and young adolescents (Clemens et al., 2022). Furthermore, as per our questionnaire findings, the syndemic of climate change, obesity, and undernutrition as it interacts with non-communicable disease management and migration is a highlighted gap (Schwerdtle et al., 2020(i)), especially for women, young people, refugees and asylum seekers. In addition to the at-risk groups identified in the questionnaire (women, young people, refugees and asylum seekers), the literature additionally cites the under-addressed needs of ethnic minorities and people with disabilities (Aleksandrova, 2019).

Health systems research gaps identified in the literature outline the need for "human health (to) be protected and promoted in the context of new patterns of human mobility as the climate crisis accelerates" (Schwerdtle et al., 2020(i)) including better understanding of health system resilience and preparedness for climate change and climate migration, and access to health services for climate displaced peoples (Ridde et al., 2019). Mapping the causal factors and network of factors in the nexus was a key gap and need highlighted by many questionnaire respondents; reflective of the literature which calls for research that more clearly unpacks the associations between climate change and climate vulnerability (Harper, 2011; Grecequet et al., 2017), population movements (Harper, 2011; Foresight, 2011), and subsequent health impacts (Ridde et al., 2019), with framework development "to connect the three issues'' so that research agendas do not "expand in different directions and policy responses develop in an inconsistent fashion" (Schütte et al., 2018).

Our results also call for a better understanding of and response to the needs of migrants, as per the existing literature, which states that research could better understand the *"entire migration ecosystem"* (Schwerdtle et al., 2020 (ii)), focusing not only on the health conditions of migrants, but also on those of immobile populations - including trapped populations (Schwerdtle et al., 2020(i)); McMichael, 2020). Research could orientate towards both sending and host communities, with an explicit call for research to also focus on destination areas (Schwerdtle et al., 2020 (ii)), including urban areas, rural populations, and sites of climate vulnerability (Harper, 2011; Foresight, 2011; Aleksandrova, 2019; McMichael, 2020); and to consider managed migration, for example: "moving persons and infrastructure out of 'harm's way' of drought" (Paterson et al., 2018). Painting this wider picture might allow researchers to better understand how migration influences vulnerability and resilience in the face of environmental change more broadly, leading to more relevant and applicable policy responses (Harper, 2011; Foresight, 2011).

Research (and the process of conducting research) could be better supported, as revealed in our findings and supported by the literature. Firstly, the concept of "climate migrant" needs to be clearly defined (Ridde et al., 2019). Secondly, there is a need for more and better data on migration and population displacement as well as the health indicators for migrants, the immobile, host and home communities (Mazhin et al., 2020). Furthermore, climate data could be integrated in climate change-related public health research (Schwerdtle et al., 2020). High quality (retrospective and prospective) longitudinal data on migration could help research move "beyond generalised statements to detailed understanding" (Harper, 2011; Foresight, 2011), as could population-level data on movement behaviours, which "could be investigated as a leading indicator of future health or migration due to climate change" (Turrisi et al., 2021). Developing ethical guidelines for conducting research about migration and health might help close the gap in research. In terms of how and why research is conducted, our questionnaire identified shortcomings in health and climate adaptation at the policy level (Godsmark et al., 2019), with little evaluation or identification on which policies are best for improving health outcomes (Mazhin et al., 2020). The questionnaire findings make tentative suggestion through which research could better engage with policy, including evidence-based policy analysis, political education, and leadership. This is underpinned by a need for collaboration, where "scholarly communities working on climate change, migration, and health have not yet coalesced to bring together their data, methods, and expertise" (Schütte et al., 2018), and "planetary health demands new coalitions and partnerships across many different disciplines to meet the pervasive knowledge failures'' (Schütte et al., 2018). However, there are many interested and engaged actors across academia, policy, NGOs and civil society moving to action on these challenges, including the CliMigHealth International Thematic Network (Ghent University, 2022) - a research network uniting scholars working on the nexus, and commitments made by organisations including WHO, IOM and The Lancet at events like COP26 (WHO, 2021), to facilitate better networking and collaboration across these siloed themes.

Given the complexity of determining factors and the importance of the local-specific context related to the nexus, "traditional" research methods that focus on measuring outcomes may not be the best fit for this research field. Future research might hence benefit from exploring non-traditional approaches and methods that may be better suited for this research field, which are also more likely to render valuable results for policy and practice implementation. One framework that could be applied to the nexus with the intention of increased multisectoral and transdisciplinary collaboration is the One Health approach. One Health works at local, regional, national, and global levels with the goal of achieving optimal health outcomes, recognising the interconnection between people, animals, plants, and their shared environment. Complexity Theory also provides numerous concepts which can be applied alongside different existing theoretical frameworks to view complex phenomena in different ways (Eppel, 2017; Tenbesel, 2015, 2015). The Complex Adaptive Systems (CAS) approach, for instance, goes beyond the identification of simple cause and effect, and sees systems as composed of multiple interconnected components with agents whose interactions and processes are dynamic, simultaneously affecting

and shaping the system. So far, only Kniveton et al. (Kniveton et al., 2012) has used a CAS approach to study the climate change-migration nexus in dryland Africa. Such approaches facilitate a transdisciplinary approach to research, allowing different bodies of knowledge to be combined to provide a wider understanding of complex problems (Gear et al., 2018).

4.3. Strengths

As far as we are aware, this is the first questionnaire attempting to ascertain research gaps and priorities within this thematic nexus. Drawing on the pre-existing network of the authors, including their coordinator positions within the CliMigHealth network on this theme, opinion from researchers and practitioners was canvassed through purposive and convenience sampling, with a decent number of responses on six continents. The format of the questionnaire, anonymised and using open-ended questions, allowed for total flexibility in the responses and theme generation, removing the risk of 'suggestion' which may arise where example themes or topics are offered (e.g. through a multiple-choice survey). Open thematic analysis allowed for the generation of a new thematic framework, and for the inclusion of specific language generated by respondents.

4.4. Limitations

However, there were several limitations to our study. Firstly, while there was a good geographic spread of respondents, there is a strong Eurocentric focus, and underrepresentation from some geographical areas, particularly those most at risk. The questionnaire was at risk of responder bias, where those who are less busy, or with less clarity in their work, may have responded. The process of the research itself - of very few researchers working on the triple nexus, and many respondents working on bidirectional themes - could bias the responses towards the respondents fields of inference. Whilst the questionnaire was distributed within networks through email chains, it was also shared on twitter, and as the questionnaire responses were anonymised, there was no certainty in assuring the expertise of respondents. The level of expertise was also not garnered from the respondents; while we gathered data for their educational or work level, we did not ask how long they had been active in this particular research field. The questionnaire methodology, while beneficial due to being rapid and able to reach good geographic spread, was somewhat limited in terms of the depth of responses; as such, the findings were descriptive with the purpose of generating further hypotheses and cannot be guaranteed to sufficiently map the research gaps nor build a substantive research agenda. Finally, the analysis could have been improved by stratifying the responses per geographical region and level of expertise, to see if certain themes and gaps were more prevalent or pertinent for specific 'groups' of experts.

5. Conclusions

Research on the nexus between climate change, migration and health can be challenging. Within any nexus, there is additional complexity when the themes move beyond a bidirectional relationship (such as climate change and health, or climate and migration) to incorporate a third or fourth variable. Researchers can embrace this complexity whilst recognising that it is rarely possible to capture the whole system, and that both methodologies and results might not be 'exact'. While this is not necessarily straightforward, going beyond siloes is undoubtedly rewarding and meaningful, allowing for cross-pollination of processes, methodologies, theories and outputs, with the potential to support novel approaches for tackling complex inter-related challenges. Complexity can both be embraced - for example, applying methods from complexity theory and systems thinking, or simplified for the purpose of applicable outputs. The thematic frameworks and thematic analysis described in this text can support researchers by contributing to hypothesis generation for further study of this pertinent and timely field.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. RI, AS, IR and CS are active with CliMigHealth (www.climighealth.com): an international, transdisciplinary network, integrating diverse expertise and better representing the Global South in the themes of Climate Change, Migration and Health, through strengthening research, educational and knowledge translation capacity. IR is the director, CS the coordinator, and RI the co-lead for health.

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Appendix 1. Questionnaire

Baseline questions

1. Which areas do you work across? Mark all that apply
   1. Climate Change
   2. Migration
   3. Health
2. What is your level of experience?
   1. Undergraduate student
   2. MSc student
   3. Doctoral
   4. Post-Doctoral
   5. Other
3. What is your job role?
4. Where are you based? *(geographical region)*

Research Questions

1. What do you think are the research gaps in climate change, migration and health research?
2. What is the most important priority area in climate change, migration and health research?
3. What are the methodological challenges of this research?
4. What are the ethical challenges of this research?
5. What would help to advance research in this area?

Appendix 2. Research networks approached via. email mailing lists

- Planetary Health Alliance
- Climate & Health Information
- CliMigHealth network
- HYCRISTAL

Appendix 3. Email invitation

Dear XXXXX

We are conducting a short survey of members to ascertain research gaps and priorities for the nexus of climate change, migration and health. The outcomes of this survey and literature review will be written into an academic paper aiming for publication, in collaboration with the CliMigHealth network.

The survey will take 5–10 min of your time and responses are anonymous and confidential. You can access the survey by following the

link here.

If you have any questions, queries or clarifications, or would like to be involved in any other aspect of the project, please feel free to email me on rita.issa@ucl.ac.uk.

Key project details are outlined

- Project Title: Mapping research priorities in the nexus of climate change, migration and health
- PI contact details: Dr Rita Issa, rita.issa@ucl.ac.uk; UCL Institute for Global Health
- This research project has received UCL REC approval (20849/001)

Sincerely,

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